

## RL78/G23

RENESAS MCU

R01DS0395EJ0130

Rev.1.30

Jan 31, 2024

True low-power platform, 41-μA/MHz operating current, 210-nA data retention current for 4 KB of RAM, up to 768-KB code flash memory and 48-KB RAM, capacitive sensing unit, from 30 to 128 pins, 1.6-5.5 V

## 1. Outline

### 1.1 Features

Ultra-low power consumption technology

- VDD = single power supply voltage of 1.6 to 5.5 V
- HALT mode
- STOP mode
  - High-speed wakeup from the STOP mode is possible.
- SNOOZE mode

RL78 CPU core

- CISC architecture with 3-stage pipeline
- Minimum instruction execution time:
  - Can be changed from high speed (0.03125 μs @ 32 MHz operation with the high-speed on-chip oscillator clock) to ultra-low speed (30.5 μs @ 32.768 kHz operation with the subsystem clock)
- Multiply/divide/multiply & accumulate instructions are supported.
- Address space: 1 MB
- General-purpose registers:
  - (8-bit register × 8) × 4 banks
- On-chip RAM: 12 to 48 KB

Code flash memory

- Code flash memory: 96 to 768 KB
- Block size: 2 KB
- Prohibition of block erase and rewriting (security function)
- On-chip debugging
- Self-programming (with boot swapping and flash shield window)

Data flash memory

- Data flash memory: 8 KB
- Background operation (BGO):
  - Instructions can be executed from the program memory while rewriting the data flash memory.
- Number of rewrites: 1,000,000 times (typ.)

High-speed on-chip oscillator

- Select from 32 MHz, 24 MHz, 16 MHz, 12 MHz, 8 MHz, 6 MHz, 4 MHz, 3 MHz, 2 MHz, or 1 MHz
- High accuracy: ±1.0%
  - (VDD = 1.8 to 5.5 V, TA = -20 to +85°C)

Middle-speed on-chip oscillator

- Select from 4 MHz, 2 MHz, or 1 MHz (with adjustability)

Low-speed on-chip oscillator

- 32.768 kHz (typ.) (with adjustability)

Operating ambient temperature

- TA = -40 to +85°C (2D: Consumer applications)
- TA = -40 to +105°C (3C: Industrial applications)

Power management and reset function

- On-chip power-on-reset (POR) circuit
- On-chip voltage detectors (LVD0 and LVD1)

Data transfer controller (DTC)

- Transfer modes:
  - Normal transfer mode, repeat transfer mode, block transfer mode
- Activation sources: Activated by interrupt sources.
- Chain transfer function

SNOOZE mode sequencer (SMS)

- Calculations and comparison of values by the commands for use in processing by the sequencer can realize intermittent operations where the RL78/G23 does not have to return to normal operation.
- Sequentially handling a total of 32 processes with the use of desired commands from among 21 different ones
- The SNOOZE mode sequencer offers operation with low power consumption without using the CPU, flash memory, and RAM.

## Logic and event link controller (ELCL)

- Event signals can be set up between specified peripheral functions.
- The signals can be generated by the input of multiple event signals to the logic circuit.
- Flip-flop circuits are incorporated to handle setting and resetting functions.

## Serial interface

- Simplified SPI (CSI<sup>Note 1</sup>): 3 to 8 channels
- UART/UART (LIN-bus supported)/UARTA: 3 to 6 channels
- I<sup>2</sup>C/Simplified I<sup>2</sup>C: 4 to 10 channels

## Remote control signal receiver

- 1 channel
- Matching of 4 waveform patterns (header, data 0, data 1, and special data)

## Timers

- 16-bit timer: 8 to 16 channels
- 32-bit interval timer:
  - 1 channel in 32-bit counter mode
  - 2 channels in 16-bit counter mode
  - 4 channels in 8-bit counter mode
- Realtime clock: 1 channel (counting of one second to 99 years, alarm interrupt, and clock correction)
- Watchdog timer: 1 channel (operates with the dedicated low-speed on-chip oscillator clock)

## A/D converter

- 8-/10-/12-bit resolution A/D converter
- Analog input: 8 to 26 channels
- Internal reference voltage (1.48 V) and temperature sensor

## D/A converter

- 8-bit resolution D/A converter
- Analog output: 2 channels
- Output voltage: 0 V to V<sub>DD</sub>
- Realtime output function

## Comparator

- 2 channels
- Operating modes:
  - Comparator high-speed mode and comparator low-speed mode
- The external reference voltage and the internal reference voltage or D/A converter output are selectable as the reference voltage.

## Capacitive sensing unit

- CTSU2L operating voltage condition: V<sub>DD</sub> = 1.8 to 5.5 V
- Self-capacitance method:
  - A single pin configures a single key, supporting up to 32 keys
- Mutual capacitance method:
  - Matrix configuration with 8 × 8 pins, supporting up to 64 keys

## Input/output port pins

- Number of port pins: 26 to 120
  - (N-ch open drain I/O [withstand voltage of 6 V]: 2 to 4, N-ch open drain I/O [V<sub>DD</sub> withstand voltage <sup>Note 2</sup>/EV<sub>DD</sub> withstand voltage<sup>Note 3</sup>]: 10 to 33, output current control pins: 6 to 8)
- Can be set to N-ch open drain or TTL input buffer, and use of an on-chip pull-up resistor can be specified.
- Connectable to a device with different voltage (1.8, 2.5, or 3 V)

## Others

- Key interrupt input
- Clock output/buzzer output controller
- BCD (binary-coded decimal) correction circuit

**Note 1.** Although the CSI function is generally called SPI, it is also called CSI in this product, so it is referred to as such in this manual.

**Note 2.** This applies to the 30- to 52-pin products.

**Note 3.** This applies to the 64- to 128-pin products.

**Remark** The functions mounted depend on the product. See **1.6 Outline of Functions**.

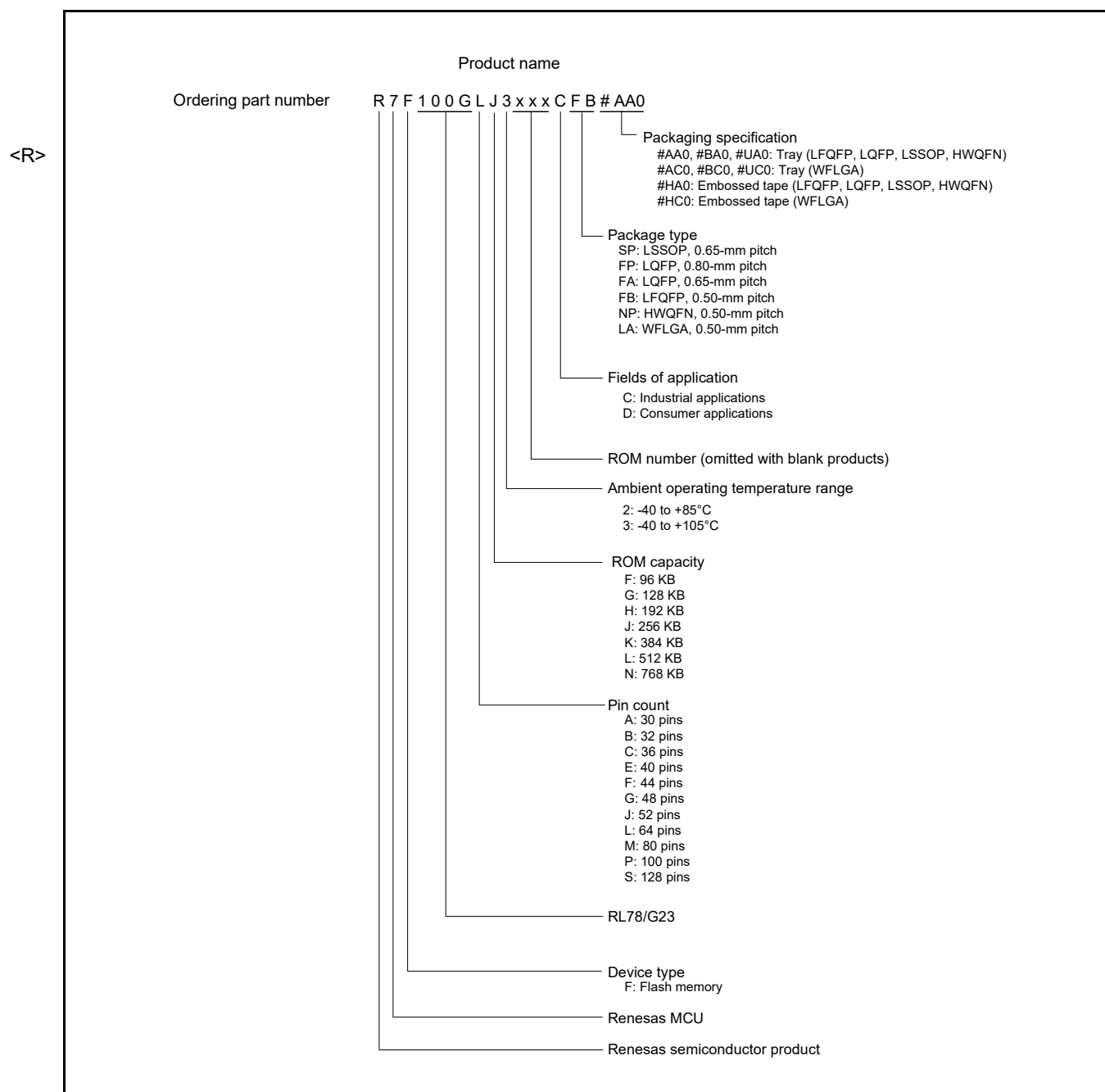
## O ROM, RAM capacities

| Flash ROM | Data flash | RAM   | RL78/G23  |           |           |           |           |           |
|-----------|------------|-------|-----------|-----------|-----------|-----------|-----------|-----------|
|           |            |       | 30 pins   | 32 pins   | 36 pins   | 40 pins   | 44 pins   | 48 pins   |
| 768 KB    | 8 KB       | 48 KB | —         | —         | —         | —         | R7F100GFN | R7F100GGN |
| 512 KB    | 8 KB       | 48 KB | —         | —         | —         | —         | R7F100GFL | R7F100GGL |
| 384 KB    | 8 KB       | 32 KB | —         | —         | —         | —         | R7F100GFK | R7F100GGK |
| 256 KB    | 8 KB       | 24 KB | R7F100GAJ | R7F100GBJ | R7F100GCJ | R7F100GEJ | R7F100GFJ | R7F100GGJ |
| 192 KB    | 8 KB       | 20 KB | R7F100GAH | R7F100GBH | R7F100GCH | R7F100GEH | R7F100GFH | R7F100GGH |
| 128 KB    | 8 KB       | 16 KB | R7F100GAG | R7F100GBG | R7F100GCG | R7F100GEG | R7F100GFG | R7F100GGG |
| 96 KB     | 8 KB       | 12 KB | R7F100GAF | R7F100GBF | R7F100GCF | R7F100GEF | R7F100GFF | R7F100GGF |

| Flash ROM | Data flash | RAM   | RL78/G23  |           |           |           |           |
|-----------|------------|-------|-----------|-----------|-----------|-----------|-----------|
|           |            |       | 52 pins   | 64 pins   | 80 pins   | 100 pins  | 128 pins  |
| 768 KB    | 8 KB       | 48 KB | R7F100GJN | R7F100GLN | R7F100GMN | R7F100GPN | R7F100GSN |
| 512 KB    | 8 KB       | 48 KB | R7F100GJL | R7F100GLL | R7F100GML | R7F100GPL | R7F100GSL |
| 384 KB    | 8 KB       | 32 KB | R7F100GJK | R7F100GLK | R7F100GMK | R7F100GPK | R7F100GSK |
| 256 KB    | 8 KB       | 24 KB | R7F100GJJ | R7F100GLJ | R7F100GMJ | R7F100GPJ | R7F100GSJ |
| 192 KB    | 8 KB       | 20 KB | R7F100GJH | R7F100GLH | R7F100GMH | R7F100GPH | —         |
| 128 KB    | 8 KB       | 16 KB | R7F100GJG | R7F100GLG | R7F100GMG | R7F100GPG | —         |
| 96 KB     | 8 KB       | 12 KB | R7F100GJF | R7F100GLF | —         | —         | —         |

## 1.2 List of Part Numbers

Figure 1 - 1 Part Number, Memory Size, and Package of RL78/G23



&lt;R&gt; Table 1 - 1 List of Ordering Part Numbers (1/3)

| Pin count | Package                                                | Fields of Application<br>Note | Ordering Part Number                                                                                             |                           | Renesas Code                  |
|-----------|--------------------------------------------------------|-------------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------|-------------------------------|
|           |                                                        |                               | Product Name                                                                                                     | Packaging Specification   |                               |
| 30        | 30-pin plastic LSSOP<br>(7.62 mm (300), 0.65-mm pitch) | C                             | R7F100GAF3CSP, R7F100GAG3CSP,<br>R7F100GAH3CSP, R7F100GAJ3CSP                                                    | #AA0, #BA0,<br>#UA0, #HA0 | PLSP0030JB-B                  |
|           |                                                        | D                             | R7F100GAF2DSP, R7F100GAG2DSP,<br>R7F100GAH2DSP, R7F100GAJ2DSP                                                    |                           |                               |
| 32        | 32-pin plastic HWQFN<br>(5 × 5 mm, 0.5-mm pitch)       | C                             | R7F100GBF3CNP, R7F100GBG3CNP,<br>R7F100GBH3CNP, R7F100GBJ3CNP                                                    | #AA0, #BA0,<br>#UA0, #HA0 | PWQN0032KE-A                  |
|           |                                                        | D                             | R7F100GBF2DNP, R7F100GBG2DNP,<br>R7F100GBH2DNP, R7F100GBJ2DNP                                                    |                           |                               |
|           | 32-pin plastic LQFP<br>(7 × 7 mm, 0.80-mm pitch)       | C                             | R7F100GBF3CFP, R7F100GBG3CFP,<br>R7F100GBH3CFP, R7F100GBJ3CFP                                                    | #AA0, #BA0,<br>#UA0, #HA0 | PLQP0032GB-A,<br>PLQP0032GE-A |
|           |                                                        | D                             | R7F100GBF2DFP, R7F100GBG2DFP,<br>R7F100GBH2DFP, R7F100GBJ2DFP                                                    |                           |                               |
| 36        | 36-pin plastic WFLGA<br>(4 × 4 mm, 0.50-mm pitch)      | C                             | R7F100GCF3CLA, R7F100GCG3CLA,<br>R7F100GCH3CLA, R7F100GCJ3CLA                                                    | #AC0, #BC0,<br>#UC0, #HC0 | PWL0036KB-A                   |
|           |                                                        | D                             | R7F100GCF2DLA, R7F100GCG2DLA,<br>R7F100GCH2DLA, R7F100GCJ2DLA                                                    |                           |                               |
| 40        | 40-pin plastic HWQFN<br>(6 × 6 mm, 0.50-mm pitch)      | C                             | R7F100GEF3CNP, R7F100GEG3CNP,<br>R7F100GEH3CNP, R7F100GEJ3CNP                                                    | #AA0, #BA0,<br>#UA0, #HA0 | PWQN0040KD-A                  |
|           |                                                        | D                             | R7F100GEF2DNP, R7F100GEG2DNP,<br>R7F100GEH2DNP, R7F100GEJ2DNP                                                    |                           |                               |
| 44        | 44-pin plastic LQFP<br>(10 × 10 mm, 0.80-mm pitch)     | C                             | R7F100GFF3CFP, R7F100GFG3CFP,<br>R7F100GFH3CFP, R7F100GFJ3CFP,<br>R7F100GFK3CFP, R7F100GFL3CFP,<br>R7F100GFN3CFP | #AA0, #BA0,<br>#UA0, #HA0 | PLQP0044GC-A,<br>PLQP0044GE-A |
|           |                                                        | D                             | R7F100GFF2DFP, R7F100GFG2DFP,<br>R7F100GFH2DFP, R7F100GFJ2DFP,<br>R7F100GFK2DFP, R7F100GFL2DFP,<br>R7F100GFN2DFP |                           |                               |
| 48        | 48-pin plastic LFQFP<br>(7 × 7 mm, 0.50-mm pitch)      | C                             | R7F100GGF3CFB, R7F100GGG3CFB,<br>R7F100GGH3CFB, R7F100GGJ3CFB,<br>R7F100GGK3CFB, R7F100GGL3CFB,<br>R7F100GGN3CFB | #AA0, #BA0,<br>#UA0, #HA0 | PLQP0048KB-B,<br>PLQP0048KL-A |
|           |                                                        | D                             | R7F100GGF2DFB, R7F100GGG2DFB,<br>R7F100GGH2DFB, R7F100GGJ2DFB,<br>R7F100GGK2DFB, R7F100GGL2DFB,<br>R7F100GGN2DFB |                           |                               |
|           | 48-pin plastic HWQFN<br>(7 × 7 mm, 0.50-mm pitch)      | C                             | R7F100GGF3CNP, R7F100GGG3CNP,<br>R7F100GGH3CNP, R7F100GGJ3CNP,<br>R7F100GGK3CNP, R7F100GGL3CNP,<br>R7F100GGN3CNP | #AA0, #BA0,<br>#UA0, #HA0 | PWQN0048KC-A                  |
|           |                                                        | D                             | R7F100GGF2DNP, R7F100GGG2DNP,<br>R7F100GGH2DNP, R7F100GGJ2DNP,<br>R7F100GGK2DNP, R7F100GGL2DNP,<br>R7F100GGN2DNP |                           |                               |

&lt;R&gt; Table 1 - 1 List of Ordering Part Numbers (2/3)

| Pin count | Package                                             | Fields of Application<br>Note | Ordering Part Number                                                                                             |                           | Renesas Code                  |
|-----------|-----------------------------------------------------|-------------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------|-------------------------------|
|           |                                                     |                               | Product Name                                                                                                     | Packaging Specification   |                               |
| 52        | 52-pin plastic LQFP<br>(10 × 10 mm, 0.65-mm pitch)  | C                             | R7F100GJF3CFA, R7F100GJG3CFA,<br>R7F100GJH3CFA, R7F100GJJ3CFA,<br>R7F100GJK3CFA, R7F100GJL3CFA,<br>R7F100GJN3CFA | #AA0, #BA0,<br>#UA0, #HA0 | PLQP0052JA-A                  |
|           |                                                     | D                             | R7F100GJF2DFA, R7F100GJG2DFA,<br>R7F100GJH2DFA, R7F100GJJ2DFA,<br>R7F100GJK2DFA, R7F100GJL2DFA,<br>R7F100GJN2DFA |                           |                               |
| 64        | 64-pin plastic LQFP<br>(12 × 12 mm, 0.65-mm pitch)  | C                             | R7F100GLF3CFA, R7F100GLG3CFA,<br>R7F100GLH3CFA, R7F100GLJ3CFA,<br>R7F100GLK3CFA, R7F100GLL3CFA,<br>R7F100GLN3CFA | #AA0, #BA0,<br>#UA0, #HA0 | PLQP0064JA-A                  |
|           |                                                     | D                             | R7F100GLF2DFA, R7F100GLG2DFA,<br>R7F100GLH2DFA, R7F100GLJ2DFA,<br>R7F100GLK2DFA, R7F100GLL2DFA,<br>R7F100GLN2DFA |                           |                               |
|           | 64-pin plastic LFQFP<br>(10 × 10 mm, 0.50-mm pitch) | C                             | R7F100GLF3CFB, R7F100GLG3CFB,<br>R7F100GLH3CFB, R7F100GLJ3CFB,<br>R7F100GLK3CFB, R7F100GLL3CFB,<br>R7F100GLN3CFB | #AA0, #BA0,<br>#UA0, #HA0 | PLQP0064KB-C,<br>PLQP0064KL-A |
|           |                                                     | D                             | R7F100GLF2DFB, R7F100GLG2DFB,<br>R7F100GLH2DFB, R7F100GLJ2DFB,<br>R7F100GLK2DFB, R7F100GLL2DFB,<br>R7F100GLN2DFB |                           |                               |
|           | 64-pin plastic WFLGA<br>(5 × 5 mm, 0.50-mm pitch)   | C                             | R7F100GLF3CLA, R7F100GLG3CLA,<br>R7F100GLH3CLA, R7F100GLJ3CLA,<br>R7F100GLK3CLA, R7F100GLL3CLA,<br>R7F100GLN3CLA | #AC0, #BC0,<br>#UC0, #HC0 | PWL00064KB-A                  |
|           |                                                     | D                             | R7F100GLF2DLA, R7F100GLG2DLA,<br>R7F100GLH2DLA, R7F100GLJ2DLA,<br>R7F100GLK2DLA, R7F100GLL2DLA,<br>R7F100GLN2DLA |                           |                               |
| 80        | 80-pin plastic LQFP<br>(14 × 14 mm, 0.65-mm pitch)  | C                             | R7F100GMG3CFA, R7F100GMH3CFA,<br>R7F100GMJ3CFA, R7F100GMK3CFA,<br>R7F100GML3CFA, R7F100GMN3CFA                   | #AA0, #BA0,<br>#UA0, #HA0 | PLQP0080JA-B                  |
|           |                                                     | D                             | R7F100GMG2DFA, R7F100GMH2DFA,<br>R7F100GMJ2DFA, R7F100GMK2DFA,<br>R7F100GML2DFA, R7F100GMN2DFA                   |                           |                               |
|           | 80-pin plastic LFQFP<br>(12 × 12 mm, 0.50-mm pitch) | C                             | R7F100GMG3CFB, R7F100GMH3CFB,<br>R7F100GMJ3CFB, R7F100GMK3CFB,<br>R7F100GML3CFB, R7F100GMN3CFB                   | #AA0, #BA0,<br>#UA0, #HA0 | PLQP0080KB-B                  |
|           |                                                     | D                             | R7F100GMG2DFB, R7F100GMH2DFB,<br>R7F100GMJ2DFB, R7F100GMK2DFB,<br>R7F100GML2DFB, R7F100GMN2DFB                   |                           |                               |

&lt;R&gt; Table 1 - 1 List of Ordering Part Numbers (3/3)

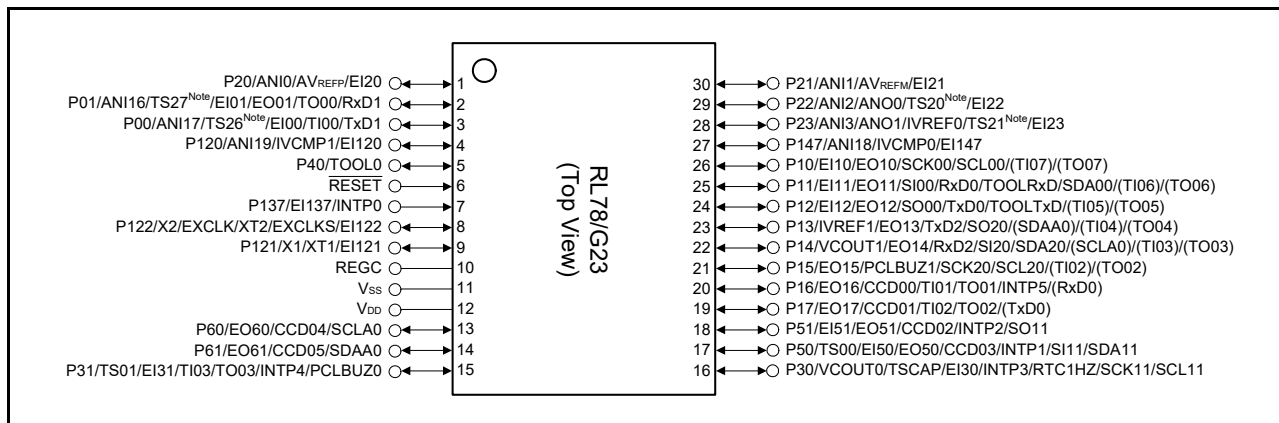
| Pin count | Package                                              | Fields of Application<br>Note | Ordering Part Number                                                                           |                           | Renesas Code |
|-----------|------------------------------------------------------|-------------------------------|------------------------------------------------------------------------------------------------|---------------------------|--------------|
|           |                                                      |                               | Product Name                                                                                   | Packaging Specification   |              |
| 100       | 100-pin plastic LFQFP<br>(14 × 14 mm, 0.50-mm pitch) | C                             | R7F100GPG3CFB, R7F100GPH3CFB,<br>R7F100GPJ3CFB, R7F100GPK3CFB,<br>R7F100GPL3CFB, R7F100GPN3CFB | #AA0, #BA0,<br>#UA0, #HA0 | PLQP0100KB-B |
|           |                                                      | D                             | R7F100GPG2DFB, R7F100GPH2DFB,<br>R7F100GPJ2DFB, R7F100GPK2DFB,<br>R7F100GPL2DFB, R7F100GPN2DFB |                           |              |
|           | 100-pin plastic LQFP<br>(14 × 20 mm, 0.65-mm pitch)  | C                             | R7F100GPG3CFA, R7F100GPH3CFA,<br>R7F100GPJ3CFA, R7F100GPK3CFA,<br>R7F100GPL3CFA, R7F100GPN3CFA | #AA0, #BA0,<br>#UA0, #HA0 | PLQP0100JC-A |
|           |                                                      | D                             | R7F100GPG2DFA, R7F100GPH2DFA,<br>R7F100GPJ2DFA, R7F100GPK2DFA,<br>R7F100GPL2DFA, R7F100GPN2DFA |                           |              |
| 128       | 128-pin plastic LFQFP<br>(14 × 20 mm, 0.50-mm pitch) | C                             | R7F100GSJ3CFB, R7F100GSK3CFB,<br>R7F100GSL3CFB, R7F100GSN3CFB                                  | #AA0, #BA0,<br>#UA0, #HA0 | PLQP0128KD-A |
|           |                                                      | D                             | R7F100GSJ2DFB, R7F100GSK2DFB,<br>R7F100GSL2DFB, R7F100GSN2DFB                                  |                           |              |

**Note** For the fields of application, see **Figure 1 - 1 Part Number, Memory Size, and Package of RL78/G23**.

## 1.3 Pin Configuration (Top View)

### 1.3.1 30-pin products

- 30-pin plastic LSSOP (7.62 mm (300), 0.65-mm pitch)



**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

**Caution** Connect the REGC pin to V<sub>SS</sub> via a capacitor (0.47 to 1  $\mu$ F).

**Remark 1.** For pin identification, see 1.4 Pin Identification.

**Remark 2.** Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to **Figure 4 - 10 Format of Peripheral I/O Redirection Register (PIOR)** in the RL78/G23 User's Manual.

Table 1 - 2 Multiplexed Pin Functions of the 30-pin Products (1/2)

| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI              |                  |                    | Timers                           |                        | Communications Interfaces |                         |                              |                                |                                       |
|------------|---------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | 30LSSOP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTS02L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 1          | P20     | —            | EI20                        | —                                         | ANI0/<br>AVREFP        | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 2          | P01     | —            | EI01/<br>EO01               | —                                         | ANI16                  | —                   | —                   | —                | —                | TS27<br>Note       | TO00                             | —                      | RxD1                      | —                       | —                            | —                              | —                                     |
| 3          | P00     | —            | EI00                        | —                                         | ANI17                  | —                   | —                   | —                | —                | TS26<br>Note       | TI00                             | —                      | TxD1                      | —                       | —                            | —                              | —                                     |
| 4          | P120    | —            | EI120                       | —                                         | ANI19                  | —                   | IVCMP1              | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 5          | P40     | —            | —                           | TOOL0                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 6          | —       | —            | —                           | RESET                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 7          | P137    | —            | EI137                       | —                                         | —                      | —                   | —                   | INTP0            | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 8          | P122    | —            | EI122                       | X2/XT2/<br>EXCLK/<br>EXCLKS               | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 9          | P121    | —            | EI121                       | X1/XT1                                    | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 10         | —       | —            | —                           | REGC                                      | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 11         | —       | —            | —                           | Vss                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 12         | —       | —            | —                           | VDD                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 13         | P60     | CCD04        | EO60                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | SCLA0                   | —                            | —                              | —                                     |
| 14         | P61     | CCD05        | EO61                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | SDAA0                   | —                            | —                              | —                                     |
| 15         | P31     | —            | EI31                        | PCLBUZ0                                   | —                      | —                   | —                   | INTP4            | —                | TS01               | TI03/<br>TO03                    | —                      | —                         | —                       | —                            | —                              | —                                     |
| 16         | P30     | —            | EI30                        | —                                         | —                      | —                   | VCOUT0              | INTP3            | —                | TSCAP              | —                                | RTC1HZ                 | SCK11/<br>SCL11           | —                       | —                            | —                              | —                                     |
| 17         | P50     | CCD03        | EI50/<br>EO50               | —                                         | —                      | —                   | —                   | INTP1            | —                | TS00               | —                                | —                      | SI11/<br>SDA11            | —                       | —                            | —                              | —                                     |
| 18         | P51     | CCD02        | EI51/<br>EO51               | —                                         | —                      | —                   | —                   | INTP2            | —                | —                  | —                                | —                      | SO11                      | —                       | —                            | —                              | —                                     |
| 19         | P17     | CCD01        | EO17                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI02/<br>TO02                    | —                      | (TxD0)                    | —                       | —                            | —                              | —                                     |
| 20         | P16     | CCD00        | EO16                        | —                                         | —                      | —                   | —                   | INTP5            | —                | —                  | TI01/<br>TO01                    | —                      | (RxD0)                    | —                       | —                            | —                              | —                                     |
| 21         | P15     | —            | EO15                        | PCLBUZ1                                   | —                      | —                   | —                   | —                | —                | —                  | (TI02)/<br>(TO02)                | —                      | SCK20/<br>SCL20           | —                       | —                            | —                              | —                                     |
| 22         | P14     | —            | EO14                        | —                                         | —                      | —                   | VCOUT1              | —                | —                | —                  | (TI03)/<br>(TO03)                | —                      | SI20/<br>RxD2/<br>SDA20   | (SCLA0)                 | —                            | —                              | —                                     |
| 23         | P13     | —            | EO13                        | —                                         | —                      | —                   | IVREF1              | —                | —                | —                  | (TI04)/<br>(TO04)                | —                      | SO20/<br>TxD2             | (SDAA0)                 | —                            | —                              | —                                     |
| 24         | P12     | —            | EI12/<br>EO12               | TOOLTxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI05)/<br>(TO05)                | —                      | SO00/<br>TxD0             | —                       | —                            | —                              | —                                     |
| 25         | P11     | —            | EI11/<br>EO11               | TOOLRxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI06)/(<br>TO06)                | —                      | SI00/<br>RxD0/<br>SDA00   | —                       | —                            | —                              | —                                     |
| 26         | P10     | —            | EI10/<br>EO10               | —                                         | —                      | —                   | —                   | —                | —                | —                  | (TI07)/<br>(TO07)                | —                      | SCK00/<br>SCL00           | —                       | —                            | —                              | —                                     |
| 27         | P147    | —            | EI147                       | —                                         | ANI18                  | —                   | IVCMP0              | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |

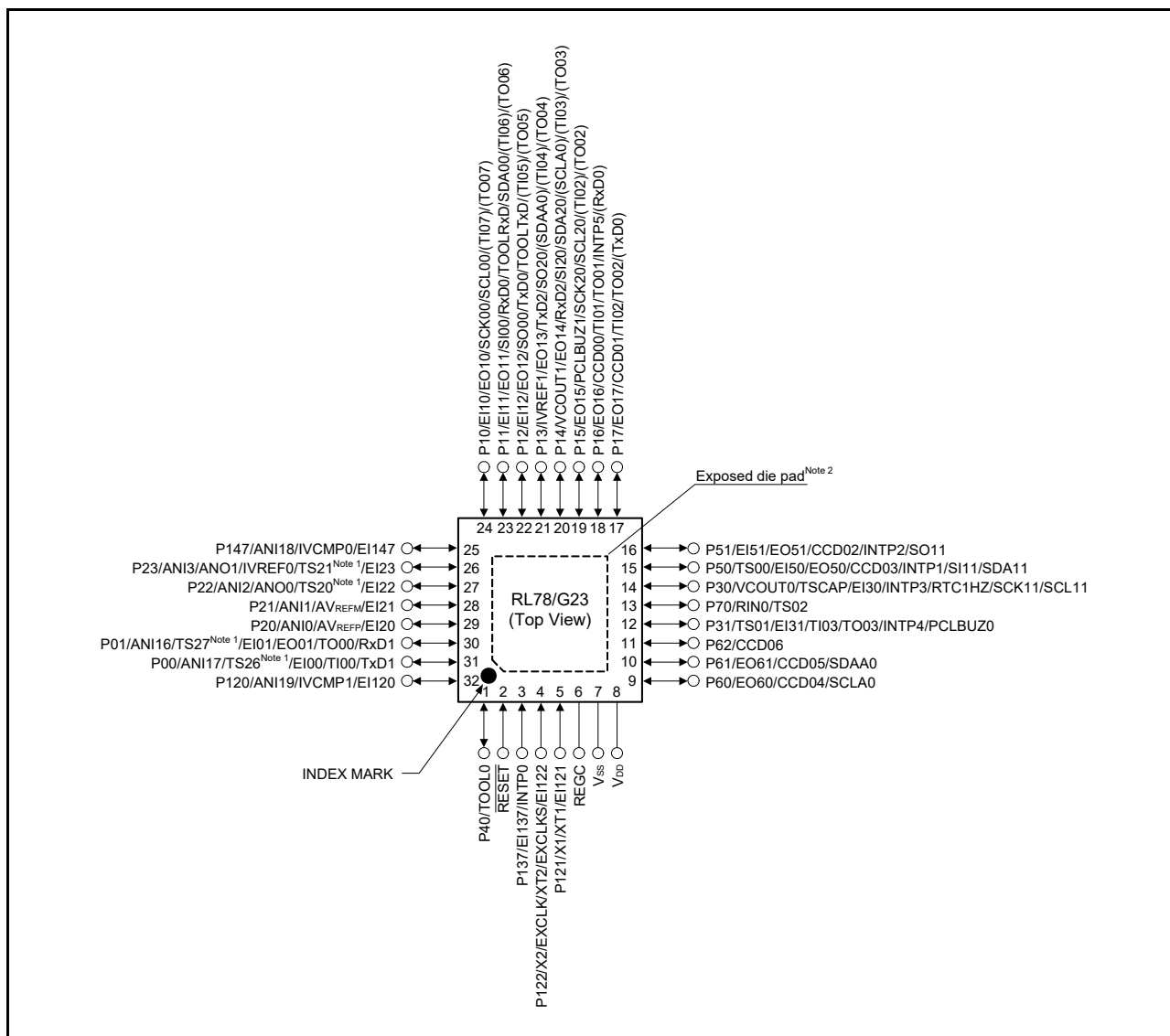
Table 1 - 2 Multiplexed Pin Functions of the 30-pin Products (2/2)

| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMIs             |                  |                    | Timers                          |                        | Communications Interfaces |                         |                              |                                |
|------------|---------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|---------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|
|            | 30LSSOP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUL) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) |
| 28         | P23     | —            | EI23                        | —                                         | ANI3                   | ANO1                | IVREF0              | —                | —                | TS21<br>Note       | —                               | —                      | —                         | —                       | —                            | —                              |
| 29         | P22     | —            | EI22                        | —                                         | ANI2                   | ANO0                | —                   | —                | —                | TS20<br>Note       | —                               | —                      | —                         | —                       | —                            | —                              |
| 30         | P21     | —            | EI21                        | —                                         | ANI1/<br>AVREFM        | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              |

**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

### 1.3.2 32-pin products

- 32-pin plastic HWQFN (5 × 5 mm, 0.50-mm pitch)
- 32-pin plastic LQFP (7 × 7 mm, 0.80-mm pitch)



**Note 1.** Not present in products with 128 or fewer Kbytes of code flash memory.

**Note 2.** The 32-pin plastic LQFP (7 × 7 mm, 0.80-mm pitch) products do not have an exposed die pad.

**Caution** Connect the REGC pin to V<sub>SS</sub> via a capacitor (0.47 to 1 μF).

**Remark 1.** For pin identification, see **1.4 Pin Identification**.

**Remark 2.** Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to **Figure 4 - 10 Format of Peripheral I/O Redirection Register (PIOR)** in the RL78/G23 User's Manual.

**Remark 3.** It is recommended to connect an exposed die pad to V<sub>SS</sub>.

Table 1 - 3 Multiplexed Pin Functions of the 32-pin Products (1/2)

| Pin Number | I/O             |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI              |                  |                    | Timers                            |                        | Communications Interfaces |                         |                              |                                |                                       |
|------------|-----------------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|-----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | 32HWQFN, 32LQFP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUL2L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 1          | P40             | —            | —                           | TOOL0                                     | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 2          | —               | —            | —                           | RESET                                     | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 3          | P137            | —            | EI137                       | —                                         | —                      | —                   | —                   | INTP0            | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 4          | P122            | —            | EI122                       | X2/XT2/EXCLK/EXCLKS                       | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 5          | P121            | —            | EI121                       | X1/XT1                                    | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 6          | —               | —            | —                           | REGC                                      | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 7          | —               | —            | —                           | Vss                                       | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 8          | —               | —            | —                           | VDD                                       | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 9          | P60             | CCD04        | EO60                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | SCLA0                        | —                              | —                                     |
| 10         | P61             | CCD05        | EO61                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | SDAA0                        | —                              | —                                     |
| 11         | P62             | CCD06        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 12         | P31             | —            | EI31                        | PCLBUZ0                                   | —                      | —                   | —                   | INTP4            | —                | TS01               | TI03/TO03                         | —                      | —                         | —                       | —                            | —                              | —                                     |
| 13         | P70             | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS02               | —                                 | —                      | —                         | —                       | —                            | —                              | RINO                                  |
| 14         | P30             | —            | EI30                        | —                                         | —                      | —                   | VCOUT0              | INTP3            | —                | TSCAP              | —                                 | RTC1HZ                 | SCK11/SCL11               | —                       | —                            | —                              | —                                     |
| 15         | P50             | CCD03        | EI50/EO50                   | —                                         | —                      | —                   | —                   | INTP1            | —                | TS00               | —                                 | —                      | SI11/SDA11                | —                       | —                            | —                              | —                                     |
| 16         | P51             | CCD02        | EI51/EO51                   | —                                         | —                      | —                   | —                   | INTP2            | —                | —                  | —                                 | —                      | SO11                      | —                       | —                            | —                              | —                                     |
| 17         | P17             | CCD01        | EO17                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI02/TO02                         | —                      | (TxD0)                    | —                       | —                            | —                              | —                                     |
| 18         | P16             | CCD00        | EO16                        | —                                         | —                      | —                   | —                   | INTP5            | —                | —                  | TI01/TO01                         | —                      | (RxD0)                    | —                       | —                            | —                              | —                                     |
| 19         | P15             | —            | EO15                        | PCLBUZ1                                   | —                      | —                   | —                   | —                | —                | —                  | (TI02)/(TO02)                     | —                      | SCK20/SCL20               | —                       | —                            | —                              | —                                     |
| 20         | P14             | —            | EO14                        | —                                         | —                      | —                   | VCOUT1              | —                | —                | —                  | (TI03)/(TO03)                     | —                      | SI20/RxD2/SDA20           | (SCLA0)                 | —                            | —                              | —                                     |
| 21         | P13             | —            | EO13                        | —                                         | —                      | —                   | IVREF1              | —                | —                | —                  | (TI04)/(TO04)                     | —                      | SO20/TxD2                 | (SDAA0)                 | —                            | —                              | —                                     |
| 22         | P12             | —            | EI12/EO12                   | TOOLTxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI05)/(TO05)                     | —                      | SO00/TxD0                 | —                       | —                            | —                              | —                                     |
| 23         | P11             | —            | EI11/EO11                   | TOOLRxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI06)/(TO06)                     | —                      | SI00/RxD0/SDA00           | —                       | —                            | —                              | —                                     |
| 24         | P10             | —            | EI10/EO10                   | —                                         | —                      | —                   | —                   | —                | —                | —                  | (TI07)/(TO07)                     | —                      | SCK00/SCL00               | —                       | —                            | —                              | —                                     |
| 25         | P147            | —            | —                           | —                                         | ANI18                  | —                   | IVCMP0              | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 26         | P23             | —            | EI23                        | —                                         | ANI3                   | ANO1                | IVREF0              | —                | —                | TS21<br>Note       | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 27         | P22             | —            | EI22                        | —                                         | ANI2                   | ANO0                | —                   | —                | —                | TS20<br>Note       | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |

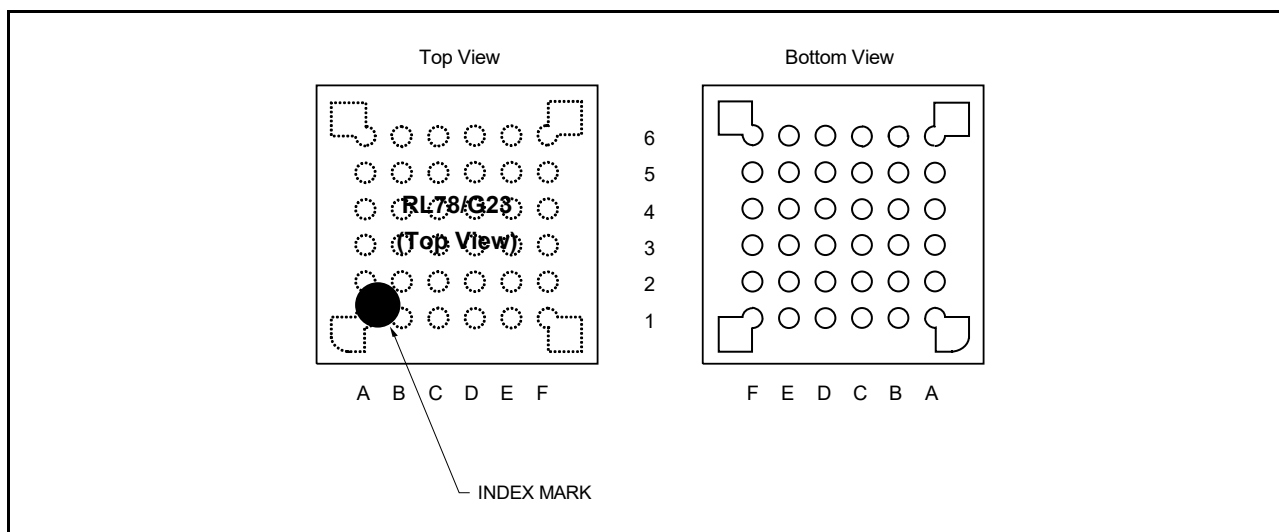
Table 1 - 3 Multiplexed Pin Functions of the 32-pin Products (2/2)

| Pin Number | I/O          |                             |                        | Power supply, system clock, and debugging | Analog Circuits     |                     |                  | HMI              |                    |                                 | Timers                 |                      | Communications Interfaces |                              |                                |                                        |
|------------|--------------|-----------------------------|------------------------|-------------------------------------------|---------------------|---------------------|------------------|------------------|--------------------|---------------------------------|------------------------|----------------------|---------------------------|------------------------------|--------------------------------|----------------------------------------|
|            | Digital port | Output current control port | ELCL input/output port |                                           | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUL) | Timer array unit (TAU) | Realtime Clock (RTC) | Serial array unit (SAU)   | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMIC) |
| 28         | P21          | —                           | EI21                   | —                                         | ANI1/<br>AVREFM     | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                      |
| 29         | P20          | —                           | EI20                   | —                                         | ANI0/<br>AVREFP     | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                      |
| 30         | P01          | —                           | EI01/<br>EO01          | —                                         | ANI16               | —                   | —                | —                | —                  | TS27<br>Note                    | TO00                   | —                    | RxD1                      | —                            | —                              | —                                      |
| 31         | P00          | —                           | EI00                   | —                                         | ANI17               | —                   | —                | —                | —                  | TS26<br>Note                    | TI00                   | —                    | TxD1                      | —                            | —                              | —                                      |
| 32         | P120         | —                           | EI120                  | —                                         | ANI19               | —                   | IVCMP1           | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                      |

**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

### 1.3.3 36-pin products

- 36-pin plastic WFLGA (4 × 4 mm, 0.50-mm pitch)



|   | A                                                      | B                                             | C                                                                 | D                                                           | E                                            | F                                                       |
|---|--------------------------------------------------------|-----------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------|----------------------------------------------|---------------------------------------------------------|
| 6 | P60/EO60/CCD04/<br>SCLA0                               | VDD                                           | P121/X1/XT1/EI121                                                 | P122/X2/EXCLK/XT2/<br>EXCLKS/EI122                          | P137/EI137/INTP0                             | P40/TOOL0                                               |
| 5 | P62/CCD06                                              | P61/EO61/CCD05/<br>SDAA0                      | VSS                                                               | REGC                                                        | $\overline{\text{RESET}}$                    | P120/ANI19/IVCMP1/<br>EI120                             |
| 4 | P72/TS04/SO21/<br>TxDA0                                | P71/TS03/SI21/<br>SDA21/RxDA0                 | P14/VCOUT1/EO14/<br>RxD2/SI20/SDA20/<br>(SCLA0)/(TI03)/<br>(TO03) | P31/TS01/EI31/TI03/<br>TO03/INTP4/<br>PCLBUZ0               | P00/TS26 <sup>Note</sup> /EI00/<br>TI00/TxD1 | P01/TS27 <sup>Note</sup> /EI01/<br>EO01/TO00/RxD1       |
| 3 | P50/TS00/EI50/EO50/<br>CCD03/INTP1/SI11/<br>SDA11      | P70/TS02/RIN0/<br>SCK21/SCL21                 | P15/EO15/PCLBUZ1/<br>SCK20/SCL20/<br>(TI02)/(TO02)                | P22/ANI2/ANO0/<br>TS20 <sup>Note</sup> /EI22                | P20/ANI0/AVREFP/<br>EI20                     | P21/ANI1/AVREFM/<br>EI21                                |
| 2 | P30/VCOUT0/TSCAP/<br>EI30/INTP3/RTC1HZ/<br>SCK11/SCL11 | P16/EO16/CCD00/<br>TI01/TO01/INTP5/<br>(RxD0) | P12/EI12/EO12/SO00/<br>TxD0/TOOLTxD/<br>(TI05)/(TO05)             | P11/EI11/EO11/SI00/<br>RxD0/TOOLRxD/<br>SDA00/(TI06)/(TO06) | P24/ANI4/TS22 <sup>Note</sup>                | P23/ANI3/ANO1/<br>IVREF0/TS21 <sup>Note</sup> /<br>EI23 |
| 1 | P51/EI51/EO51/<br>CCD02/INTP2/<br>SO11                 | P17/EO17/CCD01/<br>TI02/TO02(TxD0)            | P13/IVREF1/EO13/<br>TxD2/SO20/(SDAA0)/<br>(TI04)/(TO04)           | P10/EI10/EO10/<br>SCK00/SCL00/<br>(TI07)/(TO07)             | P147/ANI18/IVCMP0/<br>EI147                  | P25/ANI5/TS23 <sup>Note</sup>                           |

**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

**Caution** Connect the REGC pin to Vss via a capacitor (0.47 to 1  $\mu$ F).

**Remark 1.** For pin identification, see 1.4 Pin Identification.

**Remark 2.** Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to **Figure 4 - 10 Format of Peripheral I/O Redirection Register (PIOR)** in the RL78/G23 User's Manual.

Table 1 - 4 Multiplexed Pin Functions of the 36-pin Products (1/2)

| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI's            |                  |                    | Timers                           |                        | Communications Interfaces |                         |                              |                                |
|------------|---------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|
|            | 36WFLGA | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSU2L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) |
| A1         | P51     | CCD02        | EI51/EO51                   | —                                         | —                      | —                   | —                   | INTP2            | —                | —                  | —                                | —                      | SO11                      | —                       | —                            | —                              |
| A2         | P30     | —            | EI30                        | —                                         | —                      | —                   | VCOUT0              | INTP3            | —                | TSCAP              | —                                | RTC1HZ                 | SCK11/SCL11               | —                       | —                            | —                              |
| A3         | P50     | CCD03        | EI50/EO50                   | —                                         | —                      | —                   | —                   | INTP1            | —                | TS00               | —                                | —                      | SI11/SDA11                | —                       | —                            | —                              |
| A4         | P72     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS04               | —                                | —                      | SO21                      | —                       | TxDA0                        | —                              |
| A5         | P62     | CCD06        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| A6         | P60     | CCD04        | EO60                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | SCLA0                   | —                            | —                              |
| B1         | P17     | CCD01        | EO17                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI02/TO02                        | —                      | (TxD0)                    | —                       | —                            | —                              |
| B2         | P16     | CCD00        | EO16                        | —                                         | —                      | —                   | —                   | INTP5            | —                | —                  | TI01/TO01                        | —                      | (RxD0)                    | —                       | —                            | —                              |
| B3         | P70     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS02               | —                                | —                      | SCK21/SCL21               | —                       | —                            | RIN0                           |
| B4         | P71     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS03               | —                                | —                      | SI21/SDA21                | —                       | RxDA0                        | —                              |
| B5         | P61     | CCD05        | EO61                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | SDAA0                   | —                            | —                              |
| B6         | —       | —            | —                           | VDD                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| C1         | P13     | —            | EO13                        | —                                         | —                      | —                   | IVREF1              | —                | —                | —                  | (TI04)/TO04                      | —                      | SO20/TxD2                 | (SDAA0)                 | —                            | —                              |
| C2         | P12     | —            | EI12/EO12                   | TOOLTxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI05)/TO05                      | —                      | SO00/TxD0                 | —                       | —                            | —                              |
| C3         | P15     | —            | EO15                        | PCLBUZ1                                   | —                      | —                   | —                   | —                | —                | —                  | (TI02)/TO02                      | —                      | SCK20/SCL20               | —                       | —                            | —                              |
| C4         | P14     | —            | EO14                        | —                                         | —                      | —                   | VCOUT1              | —                | —                | —                  | (TI03)/TO03                      | —                      | SI20/RxD2/SDA20           | (SCLA0)                 | —                            | —                              |
| C5         | —       | —            | —                           | VSS                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| C6         | P121    | —            | EI121                       | X1/XT1                                    | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| D1         | P10     | —            | EI10/EO10                   | —                                         | —                      | —                   | —                   | —                | —                | —                  | (TI07)/TO07                      | —                      | SCK00/SCL00               | —                       | —                            | —                              |
| D2         | P11     | —            | EI11/EO11                   | TOOLRxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI06)/TO06                      | —                      | SI00/RxD0/SDA00           | —                       | —                            | —                              |
| D3         | P22     | —            | EI22                        | —                                         | ANI2                   | ANO0                | —                   | —                | —                | TS20<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| D4         | P31     | —            | EI31                        | PCLBUZ0                                   | —                      | —                   | —                   | INTP4            | —                | TS01               | TI03/TO03                        | —                      | —                         | —                       | —                            | —                              |
| D5         | —       | —            | —                           | REGC                                      | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| D6         | P122    | —            | EI122                       | X2/XT2/EXCLK/EXCLKS                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| E1         | P147    | —            | EI147                       | —                                         | ANI18                  | —                   | IVCMP0              | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| E2         | P24     | —            | —                           | —                                         | ANI4                   | —                   | —                   | —                | —                | TS22<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |

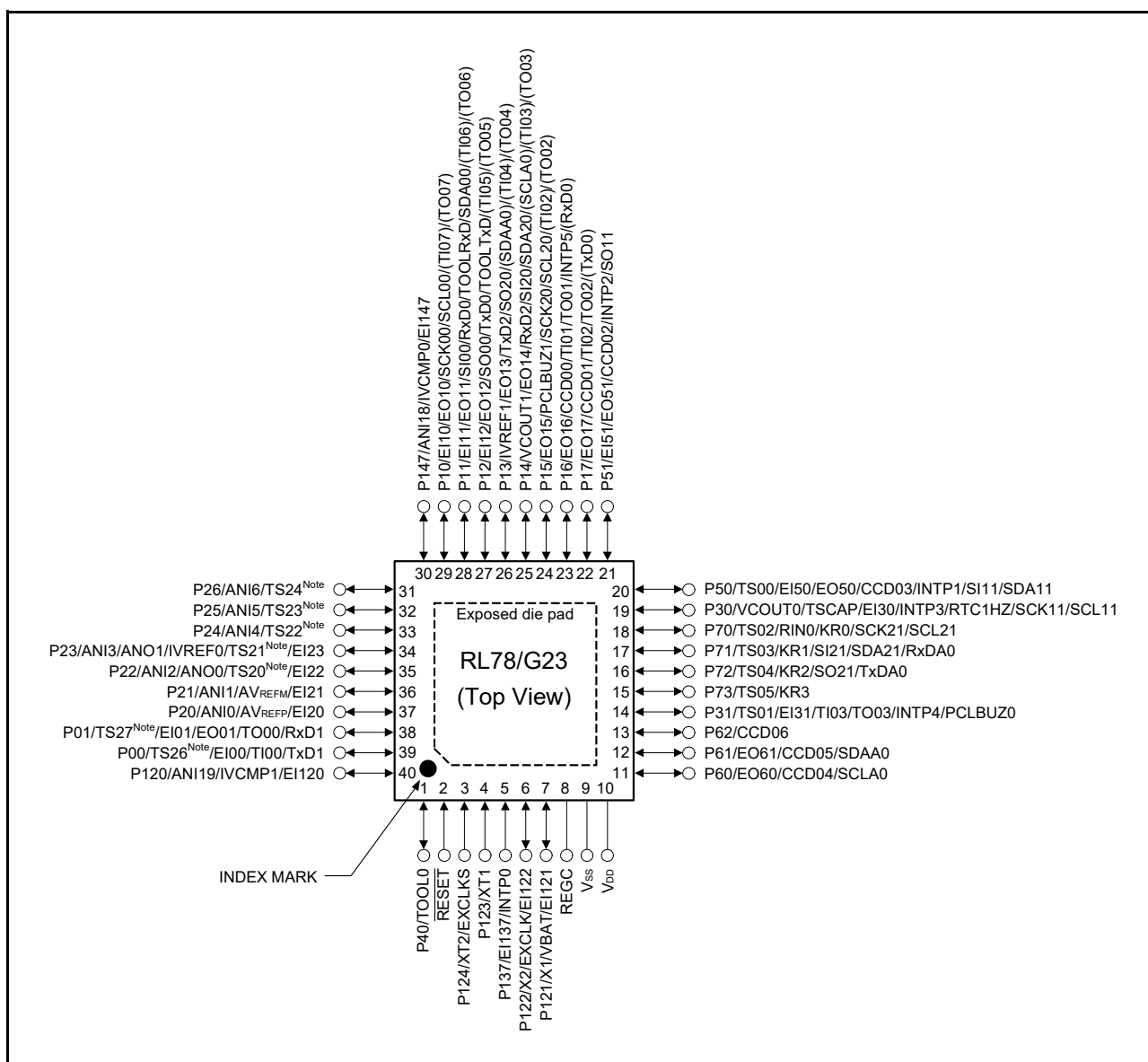
Table 1 - 4 Multiplexed Pin Functions of the 36-pin Products (2/2)

| Pin Number | I/O          |                             |                        | Power supply, system clock, and debugging | Analog Circuits     |                     |                  | HMIs             |                    |                                 | Timers                 |                      | Communications Interfaces |                              |                                |                                       |
|------------|--------------|-----------------------------|------------------------|-------------------------------------------|---------------------|---------------------|------------------|------------------|--------------------|---------------------------------|------------------------|----------------------|---------------------------|------------------------------|--------------------------------|---------------------------------------|
| 36WFLGA    | Digital port | Output current control port | ELCL input/output port |                                           | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUL) | Timer array unit (TAU) | Realtime Clock (RTC) | Serial array unit (SAU)   | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| E3         | P20          | —                           | EI20                   | —                                         | ANI0/<br>AVREFP     | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| E4         | P00          | —                           | EI00                   | —                                         | —                   | —                   | —                | —                | —                  | TS26<br>Note                    | TI00                   | —                    | TxD1                      | —                            | —                              | —                                     |
| E5         | —            | —                           | —                      | RESET                                     | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| E6         | P137         | —                           | EI137                  | —                                         | —                   | —                   | —                | INTP0            | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| F1         | P25          | —                           | —                      | —                                         | ANI5                | —                   | —                | —                | —                  | TS23<br>Note                    | —                      | —                    | —                         | —                            | —                              | —                                     |
| F2         | P23          | —                           | EI23                   | —                                         | ANI3                | ANO1                | IVREF0           | —                | —                  | TS21<br>Note                    | —                      | —                    | —                         | —                            | —                              | —                                     |
| F3         | P21          | —                           | EI21                   | —                                         | ANI1/<br>AVREFM     | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| F4         | P01          | —                           | EI01/<br>EO01          | —                                         | —                   | —                   | —                | —                | —                  | TS27<br>Note                    | TO00                   | —                    | RxD1                      | —                            | —                              | —                                     |
| F5         | P120         | —                           | EI120                  | —                                         | ANI19               | —                   | IVCMP1           | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| F6         | P40          | —                           | —                      | TOOL0                                     | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |

**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

## 1.3.4 40-pin products

- 40-pin plastic HWQFN (6 × 6 mm, 0.50-mm pitch)



**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

**Caution** Connect the REGC pin to V<sub>SS</sub> via a capacitor (0.47 to 1 μF).

**Remark 1.** For pin identification, see 1.4 Pin Identification.

**Remark 2.** Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to **Figure 4 - 10 Format of Peripheral I/O Redirection Register (PIOR)** in the RL78/G23 User's Manual.

**Remark 3.** It is recommended to connect an exposed die pad to V<sub>SS</sub>.

Table 1 - 5 Multiplexed Pin Functions of the 40-pin Products (1/2)

| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI              |                  |                    | Timers                           |                        | Communications Interfaces |                         |                              |                                |                                       |
|------------|---------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | 40HWQFN | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTS02L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 1          | P40     | —            | —                           | TOOL0                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 2          | —       | —            | —                           | RESET                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 3          | P124    | —            | —                           | XT2/EXCLKS                                | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 4          | P123    | —            | —                           | XT1                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 5          | P137    | —            | EI137                       | —                                         | —                      | —                   | —                   | INTP0            | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 6          | P122    | —            | EI122                       | X2/EXCLK                                  | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 7          | P121    | —            | EI121                       | X1/VBAT                                   | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 8          | —       | —            | —                           | REGC                                      | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 9          | —       | —            | —                           | Vss                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 10         | —       | —            | —                           | VDD                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 11         | P60     | CCD04        | EO60                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | SCLA0                        | —                              | —                                     |
| 12         | P61     | CCD05        | EO61                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | SDAA0                        | —                              | —                                     |
| 13         | P62     | CCD06        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 14         | P31     | —            | EI31                        | PCLBUZ0                                   | —                      | —                   | —                   | INTP4            | —                | TS01               | TI03/TO03                        | —                      | —                         | —                       | —                            | —                              | —                                     |
| 15         | P73     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR3              | TS05               | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 16         | P72     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR2              | TS04               | —                                | —                      | —                         | SO21                    | —                            | TxDA0                          | —                                     |
| 17         | P71     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR1              | TS03               | —                                | —                      | —                         | SI21/SDA21              | —                            | RxDA0                          | —                                     |
| 18         | P70     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR0              | TS02               | —                                | —                      | —                         | SCK21/SCL21             | —                            | —                              | RIN0                                  |
| 19         | P30     | —            | EI30                        | —                                         | —                      | —                   | VCOUT0              | INTP3            | —                | TSCAP              | —                                | RTC1HZ                 | —                         | SCK11/SCL11             | —                            | —                              | —                                     |
| 20         | P50     | CCD03        | EI50/EO50                   | —                                         | —                      | —                   | —                   | INTP1            | —                | TS00               | —                                | —                      | —                         | SI11/SDA11              | —                            | —                              | —                                     |
| 21         | P51     | CCD02        | EI51/EO51                   | —                                         | —                      | —                   | —                   | INTP2            | —                | —                  | —                                | —                      | —                         | SO11                    | —                            | —                              | —                                     |
| 22         | P17     | CCD01        | EO17                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI02/TO02                        | —                      | —                         | (TxD0)                  | —                            | —                              | —                                     |
| 23         | P16     | CCD00        | EO16                        | —                                         | —                      | —                   | —                   | INTP5            | —                | —                  | TI01/TO01                        | —                      | —                         | (RxD0)                  | —                            | —                              | —                                     |
| 24         | P15     | —            | EO15                        | PCLBUZ1                                   | —                      | —                   | —                   | —                | —                | —                  | (TI02)/TO02                      | —                      | —                         | SCK20/SCL20             | —                            | —                              | —                                     |
| 25         | P14     | —            | EO14                        | —                                         | —                      | —                   | VCOUT1              | —                | —                | —                  | (TI03)/TO03                      | —                      | —                         | SI20/xD2/SDA20          | (SCLA0)                      | —                              | —                                     |
| 26         | P13     | —            | EO13                        | —                                         | —                      | —                   | IVREF1              | —                | —                | —                  | (TI04)/TO04                      | —                      | —                         | SO20/TxD2               | (SDAA0)                      | —                              | —                                     |
| 27         | P12     | —            | EI12/EO12                   | TOOLTxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI05)/TO05                      | —                      | —                         | SO00/TxD0               | —                            | —                              | —                                     |
| 28         | P11     | —            | EI11/EO11                   | TOOLRxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI06)/TO06                      | —                      | —                         | SI00/RxD0/SDA00         | —                            | —                              | —                                     |

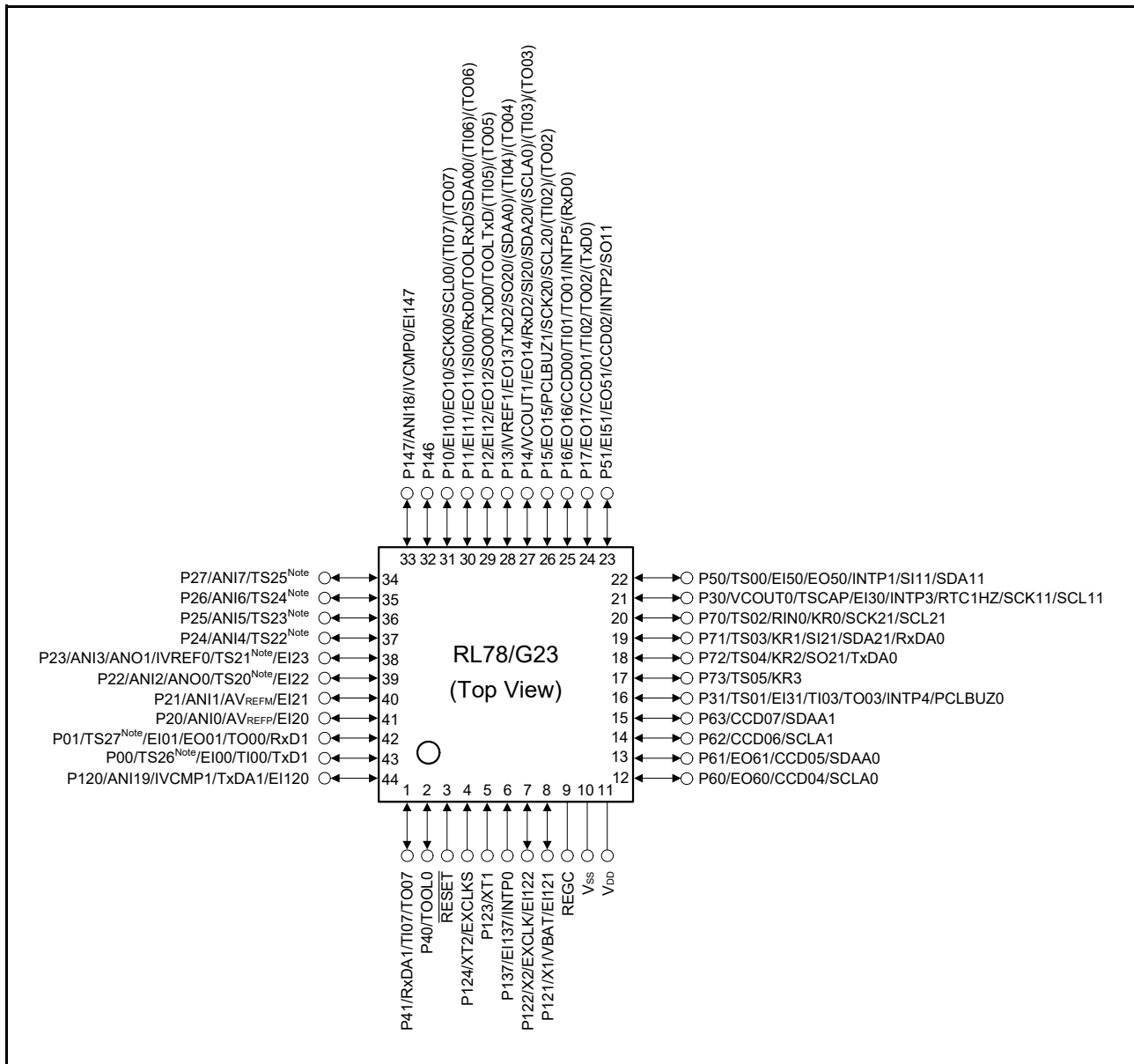
Table 1 - 5 Multiplexed Pin Functions of the 40-pin Products (2/2)

| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMIs             |                  |                    | Timers                          |                        | Communications Interfaces |                         |                              |                                |
|------------|---------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|---------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|
|            | 40HWQFN | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTS2L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) |
| 29         | P10     | —            | EI10/EO10                   | —                                         | —                      | —                   | —                   | —                | —                | —                  | (TI07)/(TO07)                   | —                      | SCK00/SCL00               | —                       | —                            | —                              |
| 30         | P147    | —            | EI147                       | —                                         | ANI18                  | —                   | IVCMP0              | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              |
| 31         | P26     | —            | —                           | —                                         | ANI6                   | —                   | —                   | —                | —                | TS24<br>Note       | —                               | —                      | —                         | —                       | —                            | —                              |
| 32         | P25     | —            | —                           | —                                         | ANI5                   | —                   | —                   | —                | —                | TS23<br>Note       | —                               | —                      | —                         | —                       | —                            | —                              |
| 33         | P24     | —            | —                           | —                                         | ANI4                   | —                   | —                   | —                | —                | TS22<br>Note       | —                               | —                      | —                         | —                       | —                            | —                              |
| 34         | P23     | —            | EI23                        | —                                         | ANI3                   | ANO1                | IVREF0              | —                | —                | TS21<br>Note       | —                               | —                      | —                         | —                       | —                            | —                              |
| 35         | P22     | —            | EI22                        | —                                         | ANI2                   | ANO0                | —                   | —                | —                | TS20<br>Note       | —                               | —                      | —                         | —                       | —                            | —                              |
| 36         | P21     | —            | EI21                        | —                                         | ANI1/<br>AVREFM        | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              |
| 37         | P20     | —            | EI20                        | —                                         | ANI0/<br>AVREFP        | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              |
| 38         | P01     | —            | EI01/EO01                   | —                                         | —                      | —                   | —                   | —                | —                | TS27<br>Note       | TO00                            | —                      | RxD1                      | —                       | —                            | —                              |
| 39         | P00     | —            | EI00                        | —                                         | —                      | —                   | —                   | —                | —                | TS26<br>Note       | TI00                            | —                      | TxD1                      | —                       | —                            | —                              |
| 40         | P120    | —            | EI120                       | —                                         | ANI19                  | —                   | IVCMP1              | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              |

**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

### 1.3.5 44-pin products

- 44-pin plastic LQFP (10 × 10 mm, 0.80-mm pitch)



**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

**Caution** Connect the REGC pin to V<sub>ss</sub> via a capacitor (0.47 to 1 μF).

**Remark 1.** For pin identification, see 1.4 Pin Identification.

**Remark 2.** Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to **Figure 4 - 10 Format of Peripheral I/O Redirection Register (PIOR)** in the RL78/G23 User's Manual.

Table 1 - 6 Multiplexed Pin Functions of the 44-pin Products (1/2)

| Pin Number | I/O    |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI              |                  |                    | Timers                          |                        | Communications Interfaces |                         |                              |                                |
|------------|--------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|---------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|
|            | 44LQFP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUL) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) |
| 1          | P41    | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI07/TO07                       | —                      | —                         | —                       | RxDA1                        | —                              |
| 2          | P40    | —            | —                           | TOOL0                                     | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              |
| 3          | —      | —            | —                           | RESET                                     | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              |
| 4          | P124   | —            | —                           | XT2/EXCLKS                                | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              |
| 5          | P123   | —            | —                           | XT1                                       | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              |
| 6          | P137   | —            | EI137                       | —                                         | —                      | —                   | —                   | INTP0            | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              |
| 7          | P122   | —            | EI122                       | X2/EXCLK                                  | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              |
| 8          | P121   | —            | EI121                       | X1/VBAT                                   | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              |
| 9          | —      | —            | —                           | REGC                                      | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              |
| 10         | —      | —            | —                           | Vss                                       | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              |
| 11         | —      | —            | —                           | VDD                                       | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              |
| 12         | P60    | CCD04        | EO60                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | SCLA0                   | —                            | —                              |
| 13         | P61    | CCD05        | EO61                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | SDAA0                   | —                            | —                              |
| 14         | P62    | CCD06        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | SCLA1                   | —                            | —                              |
| 15         | P63    | CCD07        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | SDAA1                   | —                            | —                              |
| 16         | P31    | —            | EI31                        | PCLBUZ0                                   | —                      | —                   | —                   | INTP4            | —                | TS01               | TI03/TO03                       | —                      | —                         | —                       | —                            | —                              |
| 17         | P73    | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR3              | TS05               | —                               | —                      | —                         | —                       | —                            | —                              |
| 18         | P72    | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR2              | TS04               | —                               | —                      | SO21                      | —                       | TxDA0                        | —                              |
| 19         | P71    | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR1              | TS03               | —                               | —                      | SI21/SDA21                | —                       | RxDA0                        | —                              |
| 20         | P70    | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR0              | TS02               | —                               | —                      | SCK21/SCL21               | —                       | —                            | RIN0                           |
| 21         | P30    | —            | EI30                        | —                                         | —                      | —                   | VCOUT0              | INTP3            | —                | TSCAP              | —                               | RTC1HZ                 | SCK11/SCL11               | —                       | —                            | —                              |
| 22         | P50    | —            | EI50/EO50                   | —                                         | —                      | —                   | —                   | INTP1            | —                | TS00               | —                               | —                      | SI11/SDA11                | —                       | —                            | —                              |
| 23         | P51    | CCD02        | EI51/EO51                   | —                                         | —                      | —                   | —                   | INTP2            | —                | —                  | —                               | —                      | SO11                      | —                       | —                            | —                              |
| 24         | P17    | CCD01        | EO17                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI02/TO02                       | —                      | (TxD0)                    | —                       | —                            | —                              |
| 25         | P16    | CCD00        | EO16                        | —                                         | —                      | —                   | —                   | INTP5            | —                | —                  | TI01/TO01                       | —                      | (RxD0)                    | —                       | —                            | —                              |
| 26         | P15    | —            | EO15                        | PCLBUZ1                                   | —                      | —                   | —                   | —                | —                | —                  | (TI02)/TO02)                    | —                      | SCK20/SCL20               | —                       | —                            | —                              |
| 27         | P14    | —            | EO14                        | —                                         | —                      | —                   | VCOUT1              | —                | —                | —                  | (TI03)/TO03)                    | —                      | SI20/RxD2/SDA20           | (SCLA0)                 | —                            | —                              |
| 28         | P13    | —            | EO13                        | —                                         | —                      | —                   | IVREF1              | —                | —                | —                  | (TI04)/TO04)                    | —                      | SO20/TxD2                 | (SDAA0)                 | —                            | —                              |
| 29         | P12    | —            | EI12/EO12                   | TOOLTxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI05)/TO05)                    | —                      | SO00/TxD0                 | —                       | —                            | —                              |

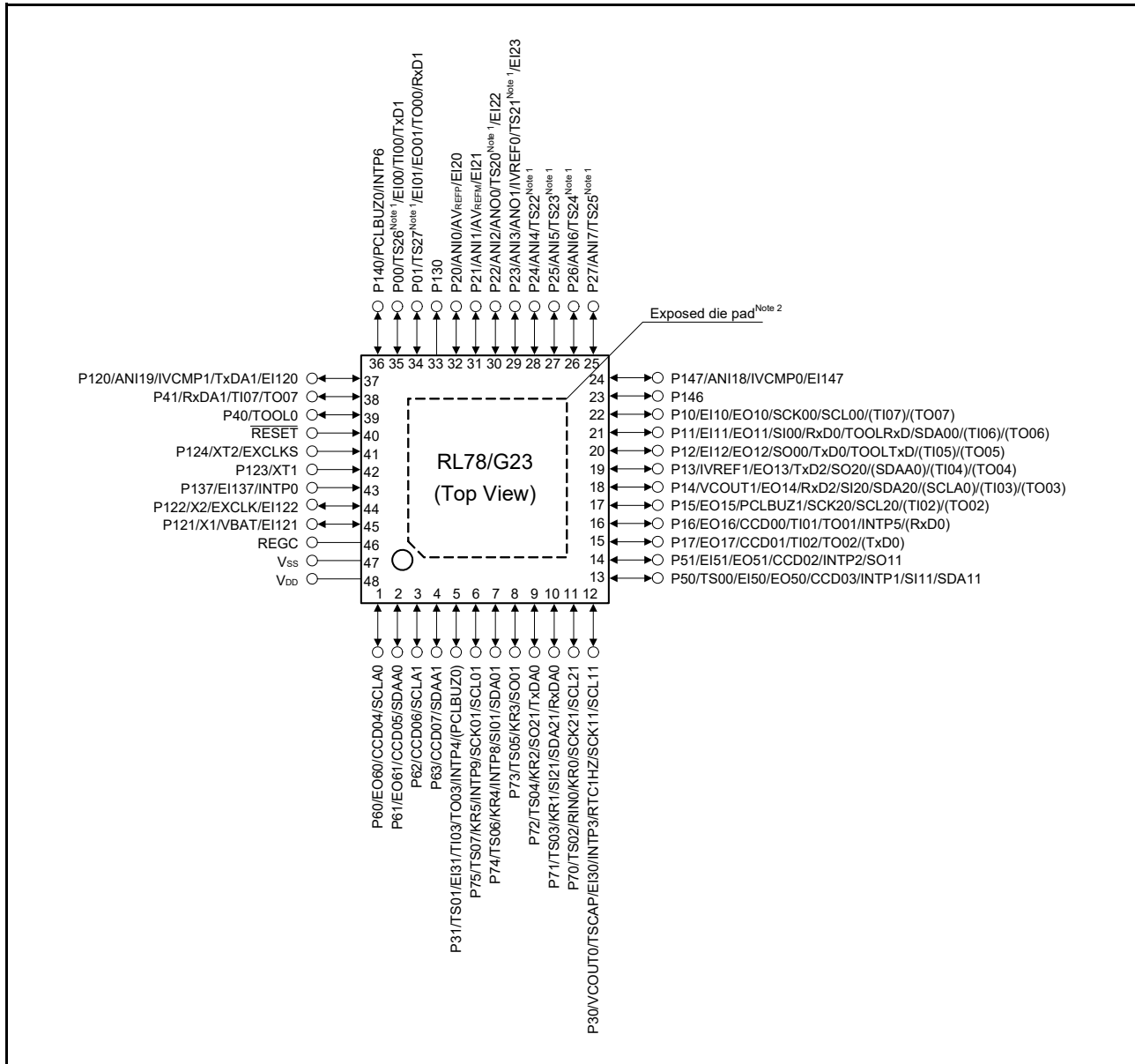
Table 1 - 6 Multiplexed Pin Functions of the 44-pin Products (2/2)

| Pin Number | I/O    |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMIs             |                  |                    | Timers                           |                        | Communications Interfaces |                         |                              |                                |
|------------|--------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|
|            | 44LQFP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSU2L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) |
| 30         | P11    | —            | EI11/EO11                   | TOOLRxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI06)/(TO06)                    | —                      | SI00/RxD0/SDA00           | —                       | —                            | —                              |
| 31         | P10    | —            | EI10/EO10                   | —                                         | —                      | —                   | —                   | —                | —                | —                  | (TI07)/(TO07)                    | —                      | SCK00/SCL00               | —                       | —                            | —                              |
| 32         | P146   | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 33         | P147   | —            | EI147                       | —                                         | ANI18                  | —                   | IVCMP0              | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 34         | P27    | —            | —                           | —                                         | ANI7                   | —                   | —                   | —                | —                | TS25<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| 35         | P26    | —            | —                           | —                                         | ANI6                   | —                   | —                   | —                | —                | TS24<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| 36         | P25    | —            | —                           | —                                         | ANI5                   | —                   | —                   | —                | —                | TS23<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| 37         | P24    | —            | —                           | —                                         | ANI4                   | —                   | —                   | —                | —                | TS22<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| 38         | P23    | —            | EI23                        | —                                         | ANI3                   | ANO1                | IVREF0              | —                | —                | TS21<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| 39         | P22    | —            | EI22                        | —                                         | ANI2                   | ANO0                | —                   | —                | —                | TS20<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| 40         | P21    | —            | EI21                        | —                                         | ANI1/<br>AVREFM        | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 41         | P20    | —            | EI20                        | —                                         | ANI0/<br>AVREFP        | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 42         | P01    | —            | EI01/EO01                   | —                                         | —                      | —                   | —                   | —                | —                | TS27<br>Note       | TO00                             | —                      | RxD1                      | —                       | —                            | —                              |
| 43         | P00    | —            | EI00                        | —                                         | —                      | —                   | —                   | —                | —                | TS26<br>Note       | TI00                             | —                      | TxD1                      | —                       | —                            | —                              |
| 44         | P120   | —            | EI120                       | —                                         | ANI19                  | —                   | IVCMP1              | —                | —                | —                  | —                                | —                      | —                         | —                       | TxDA1                        | —                              |

**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

### 1.3.6 48-pin products

- 48-pin plastic LFQFP (7 × 7 mm, 0.50-mm pitch)
- 48-pin plastic HWQFN (7 × 7 mm, 0.50-mm pitch)



**Note 1.** Not present in products with 128 or fewer Kbytes of code flash memory.

**Note 2.** The 48-pin plastic LFQFP (7 × 7 mm, 0.50-mm pitch) products do not have an exposed die pad.

**Caution** Connect the REGC pin to V<sub>SS</sub> via a capacitor (0.47 to 1 μF).

**Remark 1.** For pin identification, see 1.4 Pin Identification.

**Remark 2.** Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to **Figure 4 - 10 Format of Peripheral I/O Redirection Register (PIOR)** in the RL78/G23 User's Manual.

**Remark 3.** It is recommended to connect an exposed die pad to V<sub>SS</sub>.

Table 1 - 7 Multiplexed Pin Functions of the 48-pin Products (1/2)

| Pin Number | I/O              |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI              |                  |                    | Timers                            |                        | Communications Interfaces |                         |                              |                                |
|------------|------------------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|-----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|
|            | 48LFQFP, 48HWQFN | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUL2L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) |
| 1          | P60              | CCD04        | EO60                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | SCLA0                   | —                            | —                              |
| 2          | P61              | CCD05        | EO61                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | SDAA0                   | —                            | —                              |
| 3          | P62              | CCD06        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | SCLA1                   | —                            | —                              |
| 4          | P63              | CCD07        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | SDAA1                   | —                            | —                              |
| 5          | P31              | —            | EI31                        | (PCLBUZ0)                                 | —                      | —                   | —                   | INTP4            | —                | TS01               | TI03/TO03                         | —                      | —                         | —                       | —                            | —                              |
| 6          | P75              | —            | —                           | —                                         | —                      | —                   | —                   | INTP9            | KR5              | TS07               | —                                 | —                      | SCK01/SCL01               | —                       | —                            | —                              |
| 7          | P74              | —            | —                           | —                                         | —                      | —                   | —                   | INTP8            | KR4              | TS06               | —                                 | —                      | SI01/SDA01                | —                       | —                            | —                              |
| 8          | P73              | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR3              | TS05               | —                                 | —                      | SO01                      | —                       | —                            | —                              |
| 9          | P72              | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR2              | TS04               | —                                 | —                      | SO21                      | —                       | TxDA0                        | —                              |
| 10         | P71              | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR1              | TS03               | —                                 | —                      | SI21/SDA21                | —                       | RxDA0                        | —                              |
| 11         | P70              | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR0              | TS02               | —                                 | —                      | SCK21/SCL21               | —                       | —                            | RIN0                           |
| 12         | P30              | —            | EI30                        | —                                         | —                      | —                   | VCOUT0              | INTP3            | —                | TSCAP              | —                                 | RTC1HZ                 | SCK11/SCL11               | —                       | —                            | —                              |
| 13         | P50              | CCD03        | EI50/EO50                   | —                                         | —                      | —                   | —                   | INTP1            | —                | TS00               | —                                 | —                      | SI11/SDA11                | —                       | —                            | —                              |
| 14         | P51              | CCD02        | EI51/EO51                   | —                                         | —                      | —                   | —                   | INTP2            | —                | —                  | —                                 | —                      | SO11                      | —                       | —                            | —                              |
| 15         | P17              | CCD01        | EO17                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI02/TO02                         | —                      | (TxD0)                    | —                       | —                            | —                              |
| 16         | P16              | CCD00        | EO16                        | —                                         | —                      | —                   | —                   | INTP5            | —                | —                  | TI01/TO01                         | —                      | (RxD0)                    | —                       | —                            | —                              |
| 17         | P15              | —            | EO15                        | PCLBUZ1                                   | —                      | —                   | —                   | —                | —                | —                  | (TI02)/(TO02)                     | —                      | SCK20/SCL20               | —                       | —                            | —                              |
| 18         | P14              | —            | EO14                        | —                                         | —                      | —                   | VCOUT1              | —                | —                | —                  | (TI03)/(TO03)                     | —                      | SI20/RxD2/SDA20           | (SCLA0)                 | —                            | —                              |
| 19         | P13              | —            | EO13                        | —                                         | —                      | —                   | IVREF1              | —                | —                | —                  | (TI04)/(TO04)                     | —                      | SO20/TxD2                 | (SDAA0)                 | —                            | —                              |
| 20         | P12              | —            | EI12/EO12                   | TOOLTxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI05)/(TO05)                     | —                      | SO00/TxD0                 | —                       | —                            | —                              |
| 21         | P11              | —            | EI11/EO11                   | TOOLRxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI06)/(TO06)                     | —                      | SI00/RxD0/SDA00           | —                       | —                            | —                              |
| 22         | P10              | —            | EI10/EO10                   | —                                         | —                      | —                   | —                   | —                | —                | —                  | (TI07)/(TO07)                     | —                      | SCK00/SCL00               | —                       | —                            | —                              |
| 23         | P146             | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              |
| 24         | P147             | —            | EI147                       | —                                         | ANI18                  | —                   | IVCMP0              | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              |
| 25         | P27              | —            | —                           | —                                         | ANI7                   | —                   | —                   | —                | —                | TS25 Note          | —                                 | —                      | —                         | —                       | —                            | —                              |
| 26         | P26              | —            | —                           | —                                         | ANI6                   | —                   | —                   | —                | —                | TS24 Note          | —                                 | —                      | —                         | —                       | —                            | —                              |

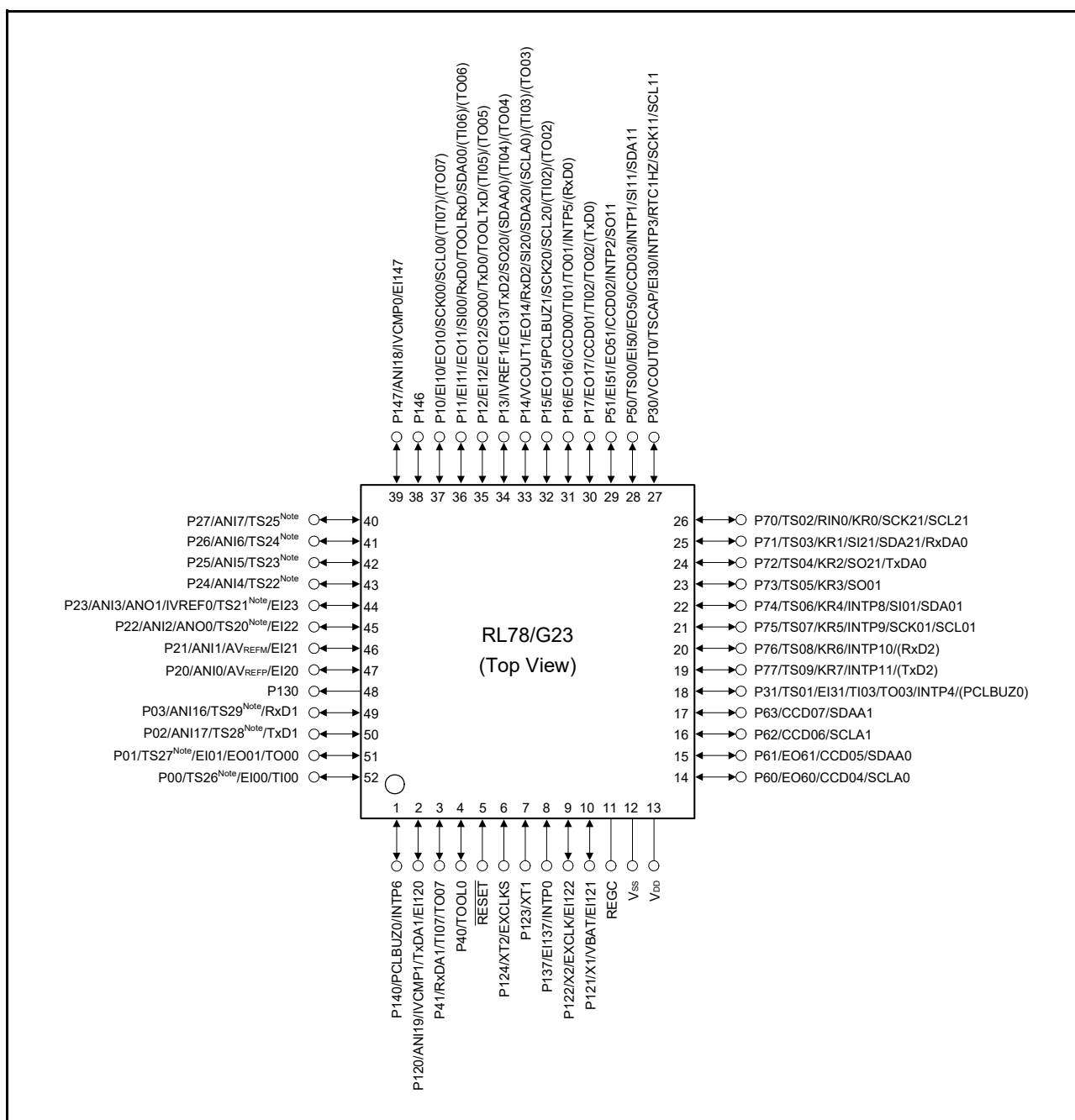
Table 1 - 7 Multiplexed Pin Functions of the 48-pin Products (2/2)

| Pin Number | I/O          |                             |                        | Power supply, system clock, and debugging | Analog Circuits     |                     |                  | HMI              |                    |                                 | Timers                 |                      | Communications Interfaces |                              |                                |                                       |
|------------|--------------|-----------------------------|------------------------|-------------------------------------------|---------------------|---------------------|------------------|------------------|--------------------|---------------------------------|------------------------|----------------------|---------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | Digital port | Output current control port | ELCL input/output port |                                           | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUL) | Timer array unit (TAU) | Realtime Clock (RTC) | Serial array unit (SAU)   | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 27         | P25          | —                           | —                      | —                                         | ANI5                | —                   | —                | —                | —                  | TS23 Note                       | —                      | —                    | —                         | —                            | —                              | —                                     |
| 28         | P24          | —                           | —                      | —                                         | ANI4                | —                   | —                | —                | —                  | TS22 Note                       | —                      | —                    | —                         | —                            | —                              | —                                     |
| 29         | P23          | —                           | EI23                   | —                                         | ANI3                | ANO1                | IVREF0           | —                | —                  | TS21 Note                       | —                      | —                    | —                         | —                            | —                              | —                                     |
| 30         | P22          | —                           | EI22                   | —                                         | ANI2                | ANO0                | —                | —                | —                  | TS20 Note                       | —                      | —                    | —                         | —                            | —                              | —                                     |
| 31         | P21          | —                           | EI21                   | —                                         | ANI1/<br>AVREFM     | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 32         | P20          | —                           | EI20                   | —                                         | ANI0/<br>AVREFP     | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 33         | P130         | —                           | —                      | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 34         | P01          | —                           | EI01/<br>EO01          | —                                         | —                   | —                   | —                | —                | —                  | TS27 Note                       | TO00                   | —                    | RxD1                      | —                            | —                              | —                                     |
| 35         | P00          | —                           | EI00                   | —                                         | —                   | —                   | —                | —                | —                  | TS26 Note                       | TI00                   | —                    | TxD1                      | —                            | —                              | —                                     |
| 36         | P140         | —                           | —                      | PCLBUZ0                                   | —                   | —                   | —                | INTP6            | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 37         | P120         | —                           | EI120                  | —                                         | ANI19               | —                   | IVCMP1           | —                | —                  | —                               | —                      | —                    | —                         | —                            | TxDA1                          | —                                     |
| 38         | P41          | —                           | —                      | —                                         | —                   | —                   | —                | —                | —                  | —                               | TI07/<br>TO07          | —                    | —                         | —                            | RxDA1                          | —                                     |
| 39         | P40          | —                           | —                      | TOOL0                                     | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 40         | —            | —                           | —                      | RESET                                     | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 41         | P124         | —                           | —                      | XT2/<br>EXCLKS                            | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 42         | P123         | —                           | —                      | XT1                                       | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 43         | P137         | —                           | EI137                  | —                                         | —                   | —                   | —                | INTP0            | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 44         | P122         | —                           | EI122                  | X2/EXCLK                                  | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 45         | P121         | —                           | EI121                  | X1/VBAT                                   | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 46         | —            | —                           | —                      | REGC                                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 47         | —            | —                           | —                      | VSS                                       | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 48         | —            | —                           | —                      | VDD                                       | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |

**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

## 1.3.7 52-pin products

- 52-pin plastic LQFP (10 × 10 mm, 0.65-mm pitch)



**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

**Caution** Connect the REGC pin to V<sub>SS</sub> via a capacitor (0.47 to 1 μF).

**Remark 1.** For pin identification, see 1.4 Pin Identification.

**Remark 2.** Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to **Figure 4 - 10 Format of Peripheral I/O Redirection Register (PIOR)** in the RL78/G23 User's Manual.

Table 1 - 8 Multiplexed Pin Functions of the 52-pin Products (1/2)

| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI              |                  |                    | Timers                            |                        | Communications Interfaces |                         |                              |                                |                                       |
|------------|---------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|-----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | 52LFQFP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUS2L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 1          | P140    | —            | —                           | PCLBUZ0                                   | —                      | —                   | —                   | INTP6            | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 2          | P120    | —            | EI120                       | —                                         | ANI19                  | —                   | IVCMP1              | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | TxDA1                          | —                                     |
| 3          | P41     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI07/TO07                         | —                      | —                         | —                       | —                            | RxDA1                          | —                                     |
| 4          | P40     | —            | —                           | TOOL0                                     | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 5          | —       | —            | —                           | RESET                                     | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 6          | P124    | —            | —                           | XT2/EXCLKS                                | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 7          | P123    | —            | —                           | XT1                                       | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 8          | P137    | —            | EI137                       | —                                         | —                      | —                   | —                   | INTP0            | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 9          | P122    | —            | EI122                       | X2/EXCLK                                  | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 10         | P121    | —            | EI121                       | X1/VBAT                                   | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 11         | —       | —            | —                           | REGC                                      | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 12         | —       | —            | —                           | Vss                                       | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 13         | —       | —            | —                           | VDD                                       | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              | —                                     |
| 14         | P60     | CCD04        | EO60                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | SCLA0                        | —                              | —                                     |
| 15         | P61     | CCD05        | EO61                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | SDAA0                        | —                              | —                                     |
| 16         | P62     | CCD06        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | SCLA1                        | —                              | —                                     |
| 17         | P63     | CCD07        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | SDAA1                        | —                              | —                                     |
| 18         | P31     | —            | EI31                        | (PCLBUZ0)                                 | —                      | —                   | —                   | INTP4            | —                | TS01               | TI03/TO03                         | —                      | —                         | —                       | —                            | —                              | —                                     |
| 19         | P77     | —            | —                           | —                                         | —                      | —                   | —                   | INTP11           | KR7              | TS09               | —                                 | —                      | (TxD2)                    | —                       | —                            | —                              | —                                     |
| 20         | P76     | —            | —                           | —                                         | —                      | —                   | —                   | INTP10           | KR6              | TS08               | —                                 | —                      | (RxD2)                    | —                       | —                            | —                              | —                                     |
| 21         | P75     | —            | —                           | —                                         | —                      | —                   | —                   | INTP9            | KR5              | TS07               | —                                 | —                      | SCK01/SCL01               | —                       | —                            | —                              | —                                     |
| 22         | P74     | —            | —                           | —                                         | —                      | —                   | —                   | INTP8            | KR4              | TS06               | —                                 | —                      | SI01/SDA01                | —                       | —                            | —                              | —                                     |
| 23         | P73     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR3              | TS05               | —                                 | —                      | SO01                      | —                       | —                            | —                              | —                                     |
| 24         | P72     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR2              | TS04               | —                                 | —                      | SO21                      | —                       | TxDA0                        | —                              | —                                     |
| 25         | P71     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR1              | TS03               | —                                 | —                      | SI21/SDA21                | —                       | RxDA0                        | —                              | —                                     |
| 26         | P70     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR0              | TS02               | —                                 | —                      | SCK21/SCL21               | —                       | —                            | —                              | RIN0                                  |
| 27         | P30     | —            | EI30                        | —                                         | —                      | —                   | VCOUT0              | INTP3            | —                | TSCAP              | —                                 | RTC1HZ                 | SCK11/SCL11               | —                       | —                            | —                              | —                                     |
| 28         | P50     | CCD03        | EI50/EO50                   | —                                         | —                      | —                   | —                   | INTP1            | —                | TS00               | —                                 | —                      | SI11/SDA11                | —                       | —                            | —                              | —                                     |
| 29         | P51     | CCD02        | EI51/EO51                   | —                                         | —                      | —                   | —                   | INTP2            | —                | —                  | —                                 | —                      | SO11                      | —                       | —                            | —                              | —                                     |
| 30         | P17     | CCD01        | EO17                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI02/TO02                         | —                      | (TxD0)                    | —                       | —                            | —                              | —                                     |
| 31         | P16     | CCD00        | EO16                        | —                                         | —                      | —                   | —                   | INTP5            | —                | —                  | TI01/TO01                         | —                      | (RxD0)                    | —                       | —                            | —                              | —                                     |

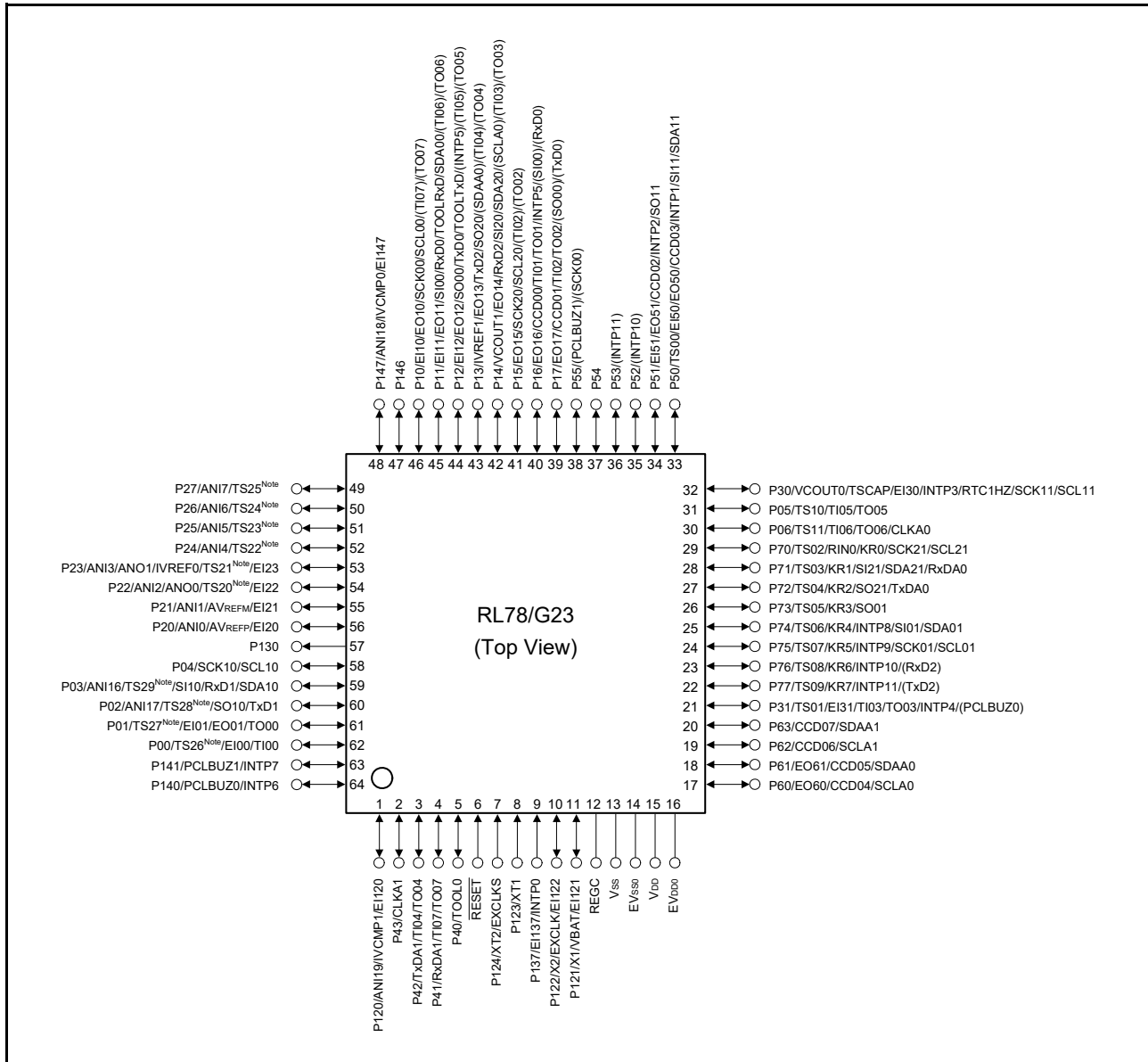
Table 1 - 8 Multiplexed Pin Functions of the 52-pin Products (2/2)

| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI              |                  |                    | Timers                           |                        | Communications Interfaces |                         |                              |                                |
|------------|---------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|
|            | 52LFQFP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSU2L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) |
| 32         | P15     | —            | EO15                        | PCLBUZ1                                   | —                      | —                   | —                   | —                | —                | —                  | (TI02)/<br>(TO02)                | —                      | SCK20/<br>SCL20           | —                       | —                            | —                              |
| 33         | P14     | —            | EO14                        | —                                         | —                      | —                   | VCOUT1              | —                | —                | —                  | (TI03)/<br>(TO03)                | —                      | SI20/<br>RxD2/<br>SDA20   | (SCLA0)                 | —                            | —                              |
| 34         | P13     | —            | EO13                        | —                                         | —                      | —                   | IVREF1              | —                | —                | —                  | (TI04)/<br>(TO04)                | —                      | SO20/<br>TxD2             | (SDAA0)                 | —                            | —                              |
| 35         | P12     | —            | EI12/<br>EO12               | TOOLTxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI05)/<br>(TO05)                | —                      | SO00/<br>TxD0             | —                       | —                            | —                              |
| 36         | P11     | —            | EI11/<br>EO11               | TOOLRxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI06)/<br>(TO06)                | —                      | SI00/<br>RxD0/<br>SDA00   | —                       | —                            | —                              |
| 37         | P10     | —            | EI10/<br>EO10               | —                                         | —                      | —                   | —                   | —                | —                | —                  | (TI07)/<br>(TO07)                | —                      | SCK00/<br>SCL00           | —                       | —                            | —                              |
| 38         | P146    | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 39         | P147    | —            | EI147                       | —                                         | ANI18                  | —                   | IVCMP0              | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 40         | P27     | —            | —                           | —                                         | ANI7                   | —                   | —                   | —                | —                | TS25<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| 41         | P26     | —            | —                           | —                                         | ANI6                   | —                   | —                   | —                | —                | TS24<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| 42         | P25     | —            | —                           | —                                         | ANI5                   | —                   | —                   | —                | —                | TS23<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| 43         | P24     | —            | —                           | —                                         | ANI4                   | —                   | —                   | —                | —                | TS22<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| 44         | P23     | —            | EI23                        | —                                         | ANI3                   | ANO1                | IVREF0              | —                | —                | TS21<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| 45         | P22     | —            | EI22                        | —                                         | ANI2                   | ANO0                | —                   | —                | —                | TS20<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| 46         | P21     | —            | EI21                        | —                                         | ANI1/<br>AVREFM        | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 47         | P20     | —            | EI20                        | —                                         | ANI0/<br>AVREFP        | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 48         | P130    | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 49         | P03     | —            | —                           | —                                         | ANI16                  | —                   | —                   | —                | —                | TS29<br>Note       | —                                | —                      | RxD1                      | —                       | —                            | —                              |
| 50         | P02     | —            | —                           | —                                         | ANI17                  | —                   | —                   | —                | —                | TS28<br>Note       | —                                | —                      | TxD1                      | —                       | —                            | —                              |
| 51         | P01     | —            | EI01/<br>EO01               | —                                         | —                      | —                   | —                   | —                | —                | TS27<br>Note       | TO00                             | —                      | —                         | —                       | —                            | —                              |
| 52         | P00     | —            | EI00                        | —                                         | —                      | —                   | —                   | —                | —                | TS26<br>Note       | TI00                             | —                      | —                         | —                       | —                            | —                              |

**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

### 1.3.8 64-pin products

- 64-pin plastic LQFP (12 × 12 mm, 0.65-mm pitch)
- 64-pin plastic LFQFP (10 × 10 mm, 0.50-mm pitch)



**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

**Caution 1.** Connect the EVSS0 pin to the same ground as the VSS pin.

**Caution 2.** Make sure that the voltage on the VDD pin is no less than that on the EVDD0 pin.

**Caution 3.** Connect the REGC pin to VSS via a capacitor (0.47 to 1 μF).

**Remark 1.** For pin identification, see 1.4 Pin Identification.

**Remark 2.** When using the microcontroller for an application where the noise generated inside the microcontroller must be reduced, it is recommended to supply separate powers to the VDD and EVDD0 pins and connect the VSS and EVSS0 pins to separate ground lines.

**Remark 3.** Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to **Figure 4 - 10 Format of Peripheral I/O Redirection Register (PIOR)** in the RL78/G23 User's Manual.

Table 1 - 9 Multiplexed Pin Functions of the 64-pin Products (1/3)

| Pin Number | I/O             |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI              |                  |                    | Timers                           |                        | Communications Interfaces |                         |                              |                                |                                       |
|------------|-----------------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | 64LFQFP, 64LQFP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTS02L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 1          | P120            | —            | —                           | EI120                                     | —                      | ANI19               | —                   | IVCMP1           | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 2          | P43             | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | CLKA1                          | —                                     |
| 3          | P42             | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | TI04/TO04              | —                         | —                       | —                            | TxDA1                          | —                                     |
| 4          | P41             | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | TI07/TO07              | —                         | —                       | —                            | RxDA1                          | —                                     |
| 5          | P40             | —            | —                           | —                                         | TOOL0                  | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 6          | —               | —            | —                           | —                                         | RESET                  | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 7          | P124            | —            | —                           | —                                         | XT2/EXCLKS             | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 8          | P123            | —            | —                           | —                                         | XT1                    | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 9          | P137            | —            | —                           | EI137                                     | —                      | —                   | —                   | —                | INTP0            | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 10         | P122            | —            | —                           | EI122                                     | X2/EXCLK               | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 11         | P121            | —            | —                           | EI121                                     | X1/VBAT                | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 12         | —               | —            | —                           | —                                         | REGC                   | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 13         | —               | —            | —                           | —                                         | Vss                    | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 14         | —               | —            | —                           | —                                         | EVss0                  | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 15         | —               | —            | —                           | —                                         | VDD                    | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 16         | —               | —            | —                           | —                                         | EVDD0                  | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 17         | P60             | CCD04        | EO60                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | SCLA0                          | —                                     |
| 18         | P61             | CCD05        | EO61                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | SDAA0                          | —                                     |
| 19         | P62             | CCD06        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | SCLA1                          | —                                     |
| 20         | P63             | CCD07        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | SDAA1                          | —                                     |
| 21         | P31             | —            | —                           | EI31                                      | (PCLBUZ0)              | —                   | —                   | —                | INTP4            | —                  | TS01                             | TI03/TO03              | —                         | —                       | —                            | —                              | —                                     |
| 22         | P77             | —            | —                           | —                                         | —                      | —                   | —                   | —                | INTP11           | KR7                | TS09                             | —                      | —                         | —                       | (TxD2)                       | —                              | —                                     |
| 23         | P76             | —            | —                           | —                                         | —                      | —                   | —                   | —                | INTP10           | KR6                | TS08                             | —                      | —                         | —                       | (RxD2)                       | —                              | —                                     |
| 24         | P75             | —            | —                           | —                                         | —                      | —                   | —                   | —                | INTP9            | KR5                | TS07                             | —                      | —                         | —                       | SCK01/SCL01                  | —                              | —                                     |
| 25         | P74             | —            | —                           | —                                         | —                      | —                   | —                   | —                | INTP8            | KR4                | TS06                             | —                      | —                         | —                       | SI01/SDA01                   | —                              | —                                     |
| 26         | P73             | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | KR3                | TS05                             | —                      | —                         | —                       | SO01                         | —                              | —                                     |
| 27         | P72             | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | KR2                | TS04                             | —                      | —                         | —                       | SO21                         | —                              | TxDA0                                 |
| 28         | P71             | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | KR1                | TS03                             | —                      | —                         | —                       | SI21/SDA21                   | —                              | RxDA0                                 |
| 29         | P70             | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | KR0                | TS02                             | —                      | —                         | —                       | SCK21/SCL21                  | —                              | RIN0                                  |
| 30         | P06             | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TS11                             | TI06/TO06              | —                         | —                       | —                            | CLKA0                          | —                                     |
| 31         | P05             | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TS10                             | TI05/TO05              | —                         | —                       | —                            | —                              | —                                     |

Table 1 - 9 Multiplexed Pin Functions of the 64-pin Products (2/3)

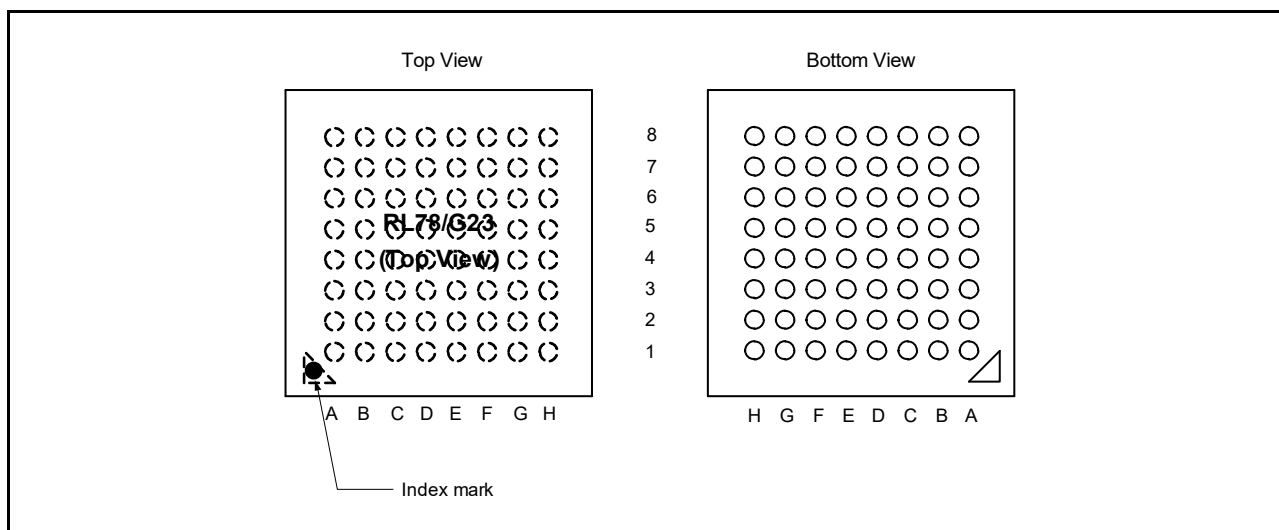
| Pin Number | I/O            |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI              |                  |                    | Timers                            |                        | Communications Interfaces |                         |                              |                                |
|------------|----------------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|-----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|
|            | 64LQFP, 64LQFP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUL2L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) |
| 32         | P30            | —            | EI30                        | —                                         | —                      | —                   | VCOUT0              | INTP3            | —                | TSCAP              | —                                 | RTC1HZ                 | SCK11/ SCL11              | —                       | —                            | —                              |
| 33         | P50            | CCD03        | EI50/ EO50                  | —                                         | —                      | —                   | —                   | INTP1            | —                | TS00               | —                                 | —                      | SI11/ SDA11               | —                       | —                            | —                              |
| 34         | P51            | CCD02        | EI51/ EO51                  | —                                         | —                      | —                   | —                   | INTP2            | —                | —                  | —                                 | —                      | SO11                      | —                       | —                            | —                              |
| 35         | P52            | —            | —                           | —                                         | —                      | —                   | —                   | (INTP10)         | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              |
| 36         | P53            | —            | —                           | —                                         | —                      | —                   | —                   | (INTP11)         | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              |
| 37         | P54            | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              |
| 38         | P55            | —            | —                           | (PCLBUZ1)                                 | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | (SCK00)                   | —                       | —                            | —                              |
| 39         | P17            | CCD01        | EO17                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI02/ TO02                        | —                      | (SO00)/ (TxD0)            | —                       | —                            | —                              |
| 40         | P16            | CCD00        | EO16                        | —                                         | —                      | —                   | —                   | INTP5            | —                | —                  | TI01/ TO01                        | —                      | (SI00)/ (RxD0)            | —                       | —                            | —                              |
| 41         | P15            | —            | EO15                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | (TI02)/ (TO02)                    | —                      | SCK20/ SCL20              | —                       | —                            | —                              |
| 42         | P14            | —            | EO14                        | —                                         | —                      | —                   | VCOUT1              | —                | —                | —                  | (TI03)/ (TO03)                    | —                      | SI20/ RxD2/ SDA20         | (SCLA0)                 | —                            | —                              |
| 43         | P13            | —            | EO13                        | —                                         | —                      | —                   | IVREF1              | —                | —                | —                  | (TI04)/ (TO04)                    | —                      | SO20/ TxD2                | (SDAA0)                 | —                            | —                              |
| 44         | P12            | —            | EI12/ EO12                  | TOOLTxD                                   | —                      | —                   | —                   | (INTP5)          | —                | —                  | (TI05)/ (TO05)                    | —                      | SO00/ TxD0                | —                       | —                            | —                              |
| 45         | P11            | —            | EI11/ EO11                  | TOOLRxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI06)/ (TO06)                    | —                      | SI00/ RxD0/ SDA00         | —                       | —                            | —                              |
| 46         | P10            | —            | EI10/ EO10                  | —                                         | —                      | —                   | —                   | —                | —                | —                  | (TI07)/ (TO07)                    | —                      | SCK00/ SCL00              | —                       | —                            | —                              |
| 47         | P146           | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              |
| 48         | P147           | —            | EI147                       | —                                         | ANI18                  | —                   | IVCMP0              | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              |
| 49         | P27            | —            | —                           | —                                         | ANI7                   | —                   | —                   | —                | —                | TS25 Note          | —                                 | —                      | —                         | —                       | —                            | —                              |
| 50         | P26            | —            | —                           | —                                         | ANI6                   | —                   | —                   | —                | —                | TS24 Note          | —                                 | —                      | —                         | —                       | —                            | —                              |
| 51         | P25            | —            | —                           | —                                         | ANI5                   | —                   | —                   | —                | —                | TS23 Note          | —                                 | —                      | —                         | —                       | —                            | —                              |
| 52         | P24            | —            | —                           | —                                         | ANI4                   | —                   | —                   | —                | —                | TS22 Note          | —                                 | —                      | —                         | —                       | —                            | —                              |
| 53         | P23            | —            | EI23                        | —                                         | ANI3                   | ANO1                | IVREF0              | —                | —                | TS21 Note          | —                                 | —                      | —                         | —                       | —                            | —                              |
| 54         | P22            | —            | EI22                        | —                                         | ANI2                   | ANO0                | —                   | —                | —                | TS20 Note          | —                                 | —                      | —                         | —                       | —                            | —                              |
| 55         | P21            | —            | EI21                        | —                                         | ANI1/ AVREFM           | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              |
| 56         | P20            | —            | EI20                        | —                                         | ANI0/ AVREFP           | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              |
| 57         | P130           | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                         | —                       | —                            | —                              |

Table 1 - 9 Multiplexed Pin Functions of the 64-pin Products (3/3)

| Pin Number | I/O          |                             |                        | Power supply, system clock, and debugging | Analog Circuits     |                     |                  | HMI              |                    |                                 | Timers                 |                      | Communications Interfaces |                              |                                |                                       |
|------------|--------------|-----------------------------|------------------------|-------------------------------------------|---------------------|---------------------|------------------|------------------|--------------------|---------------------------------|------------------------|----------------------|---------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | Digital port | Output current control port | ELCL input/output port |                                           | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTS2L) | Timer array unit (TAU) | Realtime Clock (RTC) | Serial array unit (SAU)   | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 58         | P04          | —                           | —                      | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SCK10/<br>SCL10           | —                            | —                              | —                                     |
| 59         | P03          | —                           | —                      | —                                         | ANI16               | —                   | —                | —                | —                  | TS29<br>Note                    | —                      | —                    | SI10/<br>RxD1/<br>SDA10   | —                            | —                              | —                                     |
| 60         | P02          | —                           | —                      | —                                         | ANI17               | —                   | —                | —                | —                  | TS28<br>Note                    | —                      | —                    | SO10/<br>TxD1             | —                            | —                              | —                                     |
| 61         | P01          | —                           | EI01/<br>EO01          | —                                         | —                   | —                   | —                | —                | —                  | TS27<br>Note                    | TO00                   | —                    | —                         | —                            | —                              | —                                     |
| 62         | P00          | —                           | EI00                   | —                                         | —                   | —                   | —                | —                | —                  | TS26<br>Note                    | TI00                   | —                    | —                         | —                            | —                              | —                                     |
| 63         | P141         | —                           | —                      | PCLBUZ1                                   | —                   | —                   | —                | INTP7            | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 64         | P140         | —                           | —                      | PCLBUZ0                                   | —                   | —                   | —                | INTP6            | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |

**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

- 64-pin plastic WFLGA (5 × 5 mm, 0.50-mm pitch)



|   | A                                                              | B                                                     | C                                      | D                                                  | E                                                                     | F                                                                   | G                                                 | H                                                      |
|---|----------------------------------------------------------------|-------------------------------------------------------|----------------------------------------|----------------------------------------------------|-----------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------|--------------------------------------------------------|
| 8 | EVDD0                                                          | EVSS0                                                 | P121/X1/EI121/<br>VBAT                 | P122/X2/EXCLK/<br>EI122                            | P137/INTP0/<br>EI137                                                  | P123/XT1                                                            | P124/XT2/<br>EXCLKS                               | P120/ANI19/<br>IVCMP1/EI120                            |
| 7 | P60/CCD04/<br>SCLA0/EO60                                       | VDD                                                   | VSS                                    | REGC                                               | RESET                                                                 | P01/TS27 <sup>Note</sup> /<br>EI01/EO01/<br>TO00                    | P00/TS26 <sup>Note</sup> /<br>EI00/TI00           | P140/PCLBUZ0/<br>INTP6                                 |
| 6 | P61/CCD05/<br>SDAA0/EO61                                       | P62/CCD06/<br>SCLA1                                   | P63/CCD07/<br>SDAA1                    | P40/TOOL0                                          | P41/TI07/TO07/<br>RxD A1                                              | P43/CLKA1                                                           | P02/ANI17/<br>TS28 <sup>Note</sup> /<br>SO10/TxD1 | P141/PCLBUZ1/<br>INTP7                                 |
| 5 | P77/KR7/TS09/<br>INTP11/(TxD2)                                 | P31/TI03/TO03/<br>INTP4/TS01/<br>EI31/(PCLBUZ0)       | P53/(INTP11)                           | P42/TI04/TO04/<br>TxD A1                           | P03/ANI16/<br>TS29 <sup>Note</sup> /<br>SI10/RxD1/<br>SDA10           | P04/SCK10/<br>SCL10                                                 | P130                                              | P20/ANI0/<br>AVREFP/EI20                               |
| 4 | P75/KR5/TS07/<br>INTP9/SCK01/<br>SCL01                         | P76/KR6/TS08/<br>INTP10/(RxD2)                        | P52/(INTP10)                           | P54                                                | P16/CCD00/<br>TI01/TO01/<br>INTP5/EO16/<br>(SI00)/(RxD0)              | P21/ANI1/<br>AVREFM/EI21                                            | P22/ANI2/ANO0/<br>EI22/TS20 <sup>Note</sup>       | P23/ANI3/ANO1/<br>IVREF0/EI23/<br>TS21 <sup>Note</sup> |
| 3 | P70/KR0/TS02/<br>RIN0/SCK21/<br>SCL21                          | P73/KR3/TS05/<br>SO01                                 | P74/KR4/TS06/<br>INTP8/SI01/<br>SDA01  | P17/CCD01/<br>TI02/TO02/<br>EO17/(SO00)/<br>(TxD0) | P15/SCK20/<br>SCL20/EO15/<br>(TI02)/(TO02)                            | P12/SO00/TxD0/<br>TOOLTxD/EI12/<br>EO12/(INTP5)/<br>(TI05)/(TO05)   | P24/ANI4/<br>TS22 <sup>Note</sup>                 | P26/ANI6/<br>TS24 <sup>Note</sup>                      |
| 2 | P30/INTP3/<br>TSCAP/<br>RTC1HZ/EI30/<br>VCOUT0/<br>SCK11/SCL11 | P72/KR2/TS04/<br>SO21/TxD A0                          | P71/KR1/TS03/<br>SI21/SDA21/<br>RxD A0 | P06/TS11/TI06/<br>TO06/CLKA0                       | P14/RxD2/<br>SI20/SDA20/<br>VCOUT1/EO14/<br>(SCLA0)/(TI03)/<br>(TO03) | P11/SI00/RxD0/<br>TOOLRxD/<br>SDA00/EI11/<br>EO11/(TI06)/<br>(TO06) | P25/ANI5/<br>TS23 <sup>Note</sup>                 | P27/ANI7/<br>TS25 <sup>Note</sup>                      |
| 1 | P05/TS10/TI05/<br>TO05                                         | P50/CCD03/<br>TS00/EI50/<br>EO50/INTP1/<br>SI11/SDA11 | P51/CCD02/<br>EI51/EO51/<br>INTP2/SO11 | P55/(PCLBUZ1)/<br>(SCK00)                          | P13/TxD2/SO20/<br>IVREF1/EO13/<br>(SDAA0)/(TI04)/<br>(TO04)           | P10/SCK00/<br>SCL00/EI10/<br>EO10/(TI07)/<br>(TO07)                 | P146                                              | P147/ANI18/<br>EI147/IVCMP0                            |

**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

(Cautions and Remarks are listed on the next page.)

**Caution 1.** Connect the EVSS0 pin to the same ground as the VSS pin.

**Caution 2.** Make sure that the voltage on the VDD pin is no less than that on the EVDD0 pin.

**Caution 3.** Connect the REGC pin to VSS via a capacitor (0.47 to 1  $\mu$ F).

**Remark 1.** For pin identification, see **1.4 Pin Identification**.

**Remark 2.** When using the microcontroller for an application where the noise generated inside the microcontroller must be reduced, it is recommended to supply separate powers to the VDD and EVDD0 pins and connect the VSS and EVSS0 pins to separate ground lines.

**Remark 3.** Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to **Figure 4 - 10 Format of Peripheral I/O Redirection Register (PIOR)** in the RL78/G23 User's Manual.

Table 1 - 10 Multiplexed Pin Functions 2 of the 64-pin Products (1/3)

| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI              |                  |                    | Timers                           |                        | Communications Interfaces |                         |                              |                                |
|------------|---------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|
|            | 64WFLGA | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTS02L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) |
| A1         | P05     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS10               | TI05/TO05                        | —                      | —                         | —                       | —                            | —                              |
| A2         | P30     | —            | EI30                        | —                                         | —                      | —                   | VCOUT0              | INTP3            | —                | TSCAP              | —                                | RTC1HZ                 | SCK11/SCL11               | —                       | —                            | —                              |
| A3         | P70     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR0              | TS02               | —                                | —                      | SCK21/SCL21               | —                       | —                            | RIN0                           |
| A4         | P75     | —            | —                           | —                                         | —                      | —                   | —                   | INTP9            | KR5              | TS07               | —                                | —                      | SCK01/SCL01               | —                       | —                            | —                              |
| A5         | P77     | —            | —                           | —                                         | —                      | —                   | —                   | INTP11           | KR7              | TS09               | —                                | —                      | (TxD2)                    | —                       | —                            | —                              |
| A6         | P61     | CCD05        | EO61                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | SDAA0                   | —                            | —                              |
| A7         | P60     | CCD04        | EO60                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | SCLA0                   | —                            | —                              |
| A8         | —       | —            | —                           | EVDD0                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| B1         | P50     | CCD03        | EI50/EO50                   | —                                         | —                      | —                   | —                   | INTP1            | —                | TS00               | —                                | —                      | SI11/SDA11                | —                       | —                            | —                              |
| B2         | P72     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR2              | TS04               | —                                | —                      | SO21                      | —                       | TxDA0                        | —                              |
| B3         | P73     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR3              | TS05               | —                                | —                      | SO01                      | —                       | —                            | —                              |
| B4         | P76     | —            | —                           | —                                         | —                      | —                   | —                   | INTP10           | KR6              | TS08               | —                                | —                      | (RxD2)                    | —                       | —                            | —                              |
| B5         | P31     | —            | EI31                        | (PCLBUZ0)                                 | —                      | —                   | —                   | INTP4            | —                | TS01               | TI03/TO03                        | —                      | —                         | —                       | —                            | —                              |
| B6         | P62     | CCD06        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | SCLA1                   | —                            | —                              |
| B7         | —       | —            | —                           | VDD                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| B8         | —       | —            | —                           | EVSS0                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| C1         | P51     | CCD02        | EI51/EO51                   | —                                         | —                      | —                   | —                   | INTP2            | —                | —                  | —                                | —                      | SO11                      | —                       | —                            | —                              |
| C2         | P71     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR1              | TS03               | —                                | —                      | SI21/SDA21                | —                       | RxDA0                        | —                              |
| C3         | P74     | —            | —                           | —                                         | —                      | —                   | —                   | INTP8            | KR4              | TS06               | —                                | —                      | SI01/SDA01                | —                       | —                            | —                              |
| C4         | P52     | —            | —                           | —                                         | —                      | —                   | —                   | (INTP10)         | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| C5         | P53     | —            | —                           | —                                         | —                      | —                   | —                   | (INTP11)         | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| C6         | P63     | CCD07        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | SDAA1                   | —                            | —                              |
| C7         | —       | —            | —                           | VSS                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| C8         | P121    | —            | EI121                       | X1/VBAT                                   | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| D1         | P55     | —            | —                           | (PCLBUZ1)                                 | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | (SCK00)                   | —                       | —                            | —                              |
| D2         | P06     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS11               | TI06/TO06                        | —                      | —                         | —                       | CLKA0                        | —                              |
| D3         | P17     | CCD01        | EO17                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI02/TO02                        | —                      | (SO00)/(TxD0)             | —                       | —                            | —                              |
| D4         | P54     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| D5         | P42     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI04/TO04                        | —                      | —                         | —                       | TxDA1                        | —                              |
| D6         | P40     | —            | —                           | TOOL0                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| D7         | —       | —            | —                           | REGC                                      | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |

Table 1 - 10 Multiplexed Pin Functions 2 of the 64-pin Products (2/3)

| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI              |                  |                    | Timers                          |                        | Communications Interfaces |                         |                              |                                |                                       |
|------------|---------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|---------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | 64WFLGA | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUL) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| D8         | P122    | —            | EI122                       | X2/EXCLK                                  | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| E1         | P13     | —            | EO13                        | —                                         | —                      | —                   | IVREF1              | —                | —                | —                  | (TI04)/(TO04)                   | —                      | SO20/TxD2                 | (SDAA0)                 | —                            | —                              | —                                     |
| E2         | P14     | —            | EO14                        | —                                         | —                      | —                   | VCOUT1              | —                | —                | —                  | (TI03)/(TO03)                   | —                      | SI20/RxD2/SDA20           | (SCLA0)                 | —                            | —                              | —                                     |
| E3         | P15     | —            | EO15                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | (TI02)/(TO02)                   | —                      | SCK20/SCL20               | —                       | —                            | —                              | —                                     |
| E4         | P16     | CCD00        | EO16                        | —                                         | —                      | —                   | —                   | INTP5            | —                | —                  | TI01/TO01                       | —                      | (SI00)/(RxD0)             | —                       | —                            | —                              | —                                     |
| E5         | P03     | —            | —                           | —                                         | —                      | ANI16               | —                   | —                | —                | TS29<br>Note       | —                               | —                      | SI10/RxD1/SDA10           | —                       | —                            | —                              | —                                     |
| E6         | P41     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI07/TO07                       | —                      | —                         | —                       | RxDA1                        | —                              | —                                     |
| E7         | —       | —            | —                           | RESET                                     | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| E8         | P137    | —            | EI137                       | —                                         | —                      | —                   | —                   | INTP0            | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| F1         | P10     | —            | EI10/EO10                   | —                                         | —                      | —                   | —                   | —                | —                | —                  | (TI07)/(TO07)                   | —                      | SCK00/SCL00               | —                       | —                            | —                              | —                                     |
| F2         | P11     | —            | EI11/EO11                   | TOOLRxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI06)/(TO06)                   | —                      | SI00/RxD0/SDA00           | —                       | —                            | —                              | —                                     |
| F3         | P12     | —            | EI12/EO12                   | TOOLTxD                                   | —                      | —                   | —                   | (INTP5)          | —                | —                  | (TI05)/(TO05)                   | —                      | SO00/TxD0                 | —                       | —                            | —                              | —                                     |
| F4         | P21     | —            | EI21                        | —                                         | —                      | ANI1/AVREFM         | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| F5         | P04     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | SCK10/SCL10               | —                       | —                            | —                              | —                                     |
| F6         | P43     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | CLKA1                        | —                              | —                                     |
| F7         | P01     | —            | EI01/EO01                   | —                                         | —                      | —                   | —                   | —                | —                | TS27<br>Note       | TO00                            | —                      | —                         | —                       | —                            | —                              | —                                     |
| F8         | P123    | —            | —                           | XT1                                       | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| G1         | P146    | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| G2         | P25     | —            | —                           | —                                         | —                      | ANI5                | —                   | —                | —                | TS23<br>Note       | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| G3         | P24     | —            | —                           | —                                         | —                      | ANI4                | —                   | —                | —                | TS22<br>Note       | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| G4         | P22     | —            | EI22                        | —                                         | —                      | ANI2                | ANO0                | —                | —                | TS20<br>Note       | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| G5         | P130    | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| G6         | P02     | —            | —                           | —                                         | —                      | ANI17               | —                   | —                | —                | TS28<br>Note       | —                               | —                      | SO10/TxD1                 | —                       | —                            | —                              | —                                     |
| G7         | P00     | —            | EI00                        | —                                         | —                      | —                   | —                   | —                | —                | TS26<br>Note       | TI00                            | —                      | —                         | —                       | —                            | —                              | —                                     |
| G8         | P124    | —            | —                           | XT2/EXCLKS                                | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| H1         | P147    | —            | EI147                       | —                                         | —                      | ANI18               | —                   | IVCMP0           | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |

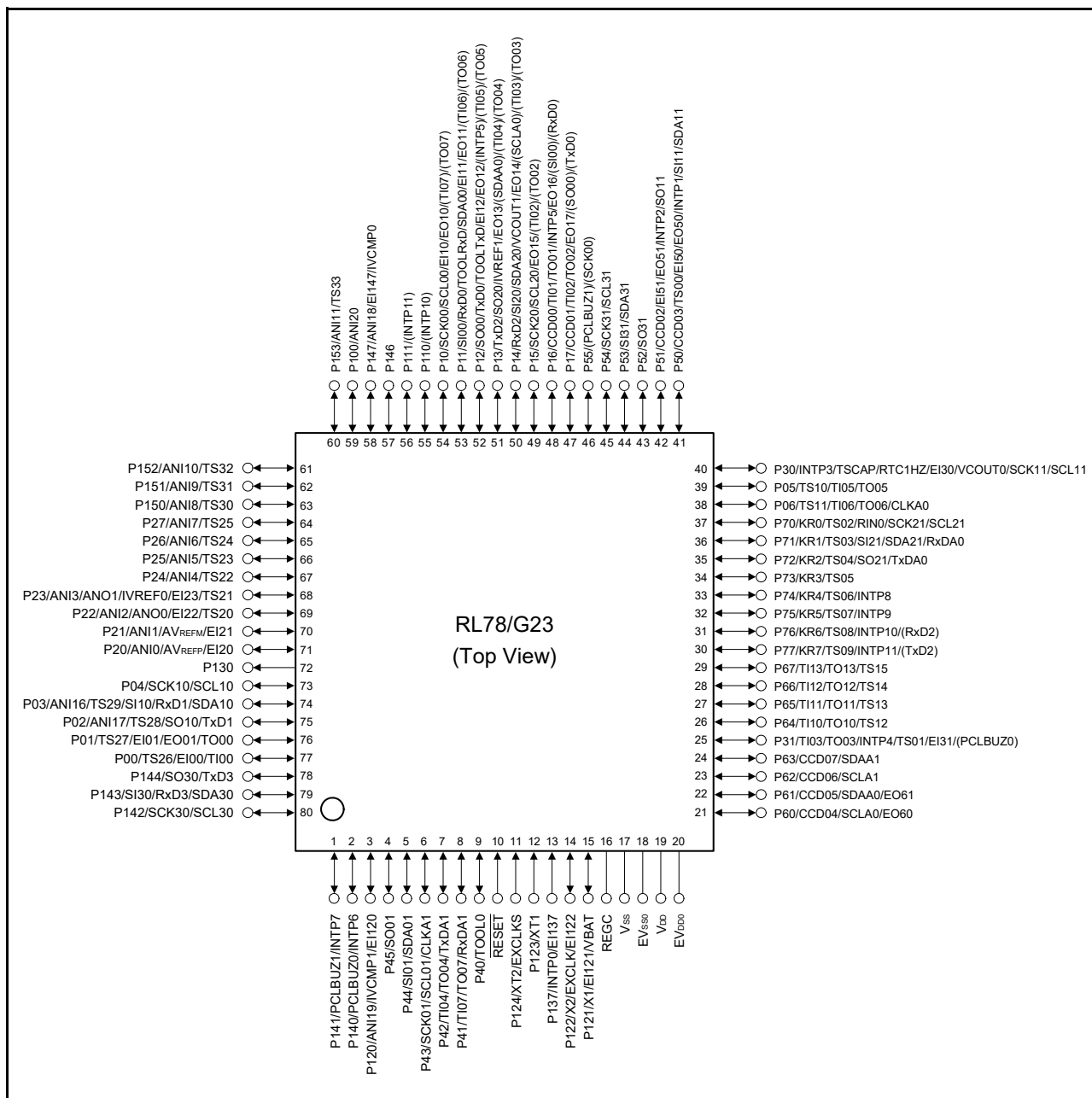
Table 1 - 10 Multiplexed Pin Functions 2 of the 64-pin Products (3/3)

| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMIs             |                  |                    | Timers                           |                        | Communications Interfaces |                         |                              |                                |
|------------|---------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|
|            | 64WFLGA | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSU2L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) |
| H2         | P27     | —            | —                           | —                                         | ANI7                   | —                   | —                   | —                | —                | TS25<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| H3         | P26     | —            | —                           | —                                         | ANI6                   | —                   | —                   | —                | —                | TS24<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| H4         | P23     | —            | EI23                        | —                                         | ANI3                   | ANO1                | IVREF0              | —                | —                | TS21<br>Note       | —                                | —                      | —                         | —                       | —                            | —                              |
| H5         | P20     | —            | EI20                        | —                                         | ANI0/<br>AVREFP        | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| H6         | P141    | —            | —                           | PCLBUZ1                                   | —                      | —                   | —                   | INTP7            | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| H7         | P140    | —            | —                           | PCLBUZ0                                   | —                      | —                   | —                   | INTP6            | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| H8         | P120    | —            | EI120                       | —                                         | ANI19                  | —                   | IVCMP1              | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |

**Note** Not present in products with 128 or fewer Kbytes of code flash memory.

## 1.3.9 80-pin products

- 80-pin plastic LQFP (14 × 14 mm, 0.65-mm pitch)
- 80-pin plastic LFQFP (12 × 12 mm, 0.50-mm pitch)



**Caution 1.** Connect the EV<sub>SS0</sub> pin to the same ground as the V<sub>SS</sub> pin.

**Caution 2.** Make sure that the voltage on the V<sub>DD</sub> pin is no less than that on the EV<sub>DD0</sub> pin.

**Caution 3.** Connect the REGC pin to V<sub>SS</sub> via a capacitor (0.47 to 1 μF).

**Remark 1.** For pin identification, see 1.4 Pin Identification.

**Remark 2.** When using the microcontroller for an application where the noise generated inside the microcontroller must be reduced, it is recommended to supply separate powers to the V<sub>DD</sub> and EV<sub>DD0</sub> pins and connect the V<sub>SS</sub> and EV<sub>SS0</sub> pins to separate ground lines.

**Remark 3.** Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to **Figure 4 - 10 Format of Peripheral I/O Redirection Register (PIOR)** in the RL78/G23 User's Manual.

Table 1 - 11 Multiplexed Pin Functions of the 80-pin Products (1/3)

| Pin Number | I/O            |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI              |                  |                    | Timers                           |                        | Communications Interfaces |                         |                              |                                |                                       |
|------------|----------------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | 80LQFP, 80LQFP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSU2L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 1          | P141           | —            | —                           | PCLBUZ1                                   | —                      | —                   | —                   | INTP7            | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 2          | P140           | —            | —                           | PCLBUZ0                                   | —                      | —                   | —                   | INTP6            | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 3          | P120           | —            | EI120                       | —                                         | ANI19                  | —                   | IVCMP1              | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 4          | P45            | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | SO01                      | —                       | —                            | —                              | —                                     |
| 5          | P44            | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | SI01/SDA01                | —                       | —                            | —                              | —                                     |
| 6          | P43            | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | SCK01/SCL01               | —                       | CLKA1                        | —                              | —                                     |
| 7          | P42            | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI04/TO04                        | —                      | —                         | —                       | TxDA1                        | —                              | —                                     |
| 8          | P41            | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI07/TO07                        | —                      | —                         | —                       | RxDA1                        | —                              | —                                     |
| 9          | P40            | —            | —                           | TOOL0                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 10         | —              | —            | —                           | RESET                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 11         | P124           | —            | —                           | XT2/EXCLKS                                | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 12         | P123           | —            | —                           | XT1                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 13         | P137           | —            | EI137                       | —                                         | —                      | —                   | —                   | INTP0            | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 14         | P122           | —            | EI122                       | X2/EXCLK                                  | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 15         | P121           | —            | EI121                       | X1/VBAT                                   | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 16         | —              | —            | —                           | REGC                                      | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 17         | —              | —            | —                           | Vss                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 18         | —              | —            | —                           | EVss0                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 19         | —              | —            | —                           | VDD                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 20         | —              | —            | —                           | EVDD0                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 21         | P60            | CCD04        | EO60                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | SCLA0                        | —                              | —                                     |
| 22         | P61            | CCD05        | EO61                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | SDAA0                        | —                              | —                                     |
| 23         | P62            | CCD06        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | SCLA1                        | —                              | —                                     |
| 24         | P63            | CCD07        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | SDAA1                        | —                              | —                                     |
| 25         | P31            | —            | EI31                        | (PCLBUZ0)                                 | —                      | —                   | —                   | INTP4            | —                | TS01               | TI03/TO03                        | —                      | —                         | —                       | —                            | —                              | —                                     |
| 26         | P64            | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS12               | TI10/TO10                        | —                      | —                         | —                       | —                            | —                              | —                                     |
| 27         | P65            | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS13               | TI11/TO11                        | —                      | —                         | —                       | —                            | —                              | —                                     |
| 28         | P66            | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS14               | TI12/TO12                        | —                      | —                         | —                       | —                            | —                              | —                                     |
| 29         | P67            | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS15               | TI13/TO13                        | —                      | —                         | —                       | —                            | —                              | —                                     |
| 30         | P77            | —            | —                           | —                                         | —                      | —                   | —                   | INTP11           | KR7              | TS09               | —                                | —                      | (TxD2)                    | —                       | —                            | —                              | —                                     |
| 31         | P76            | —            | —                           | —                                         | —                      | —                   | —                   | INTP10           | KR6              | TS08               | —                                | —                      | (RxD2)                    | —                       | —                            | —                              | —                                     |
| 32         | P75            | —            | —                           | —                                         | —                      | —                   | —                   | INTP9            | KR5              | TS07               | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |

Table 1 - 11 Multiplexed Pin Functions of the 80-pin Products (2/3)

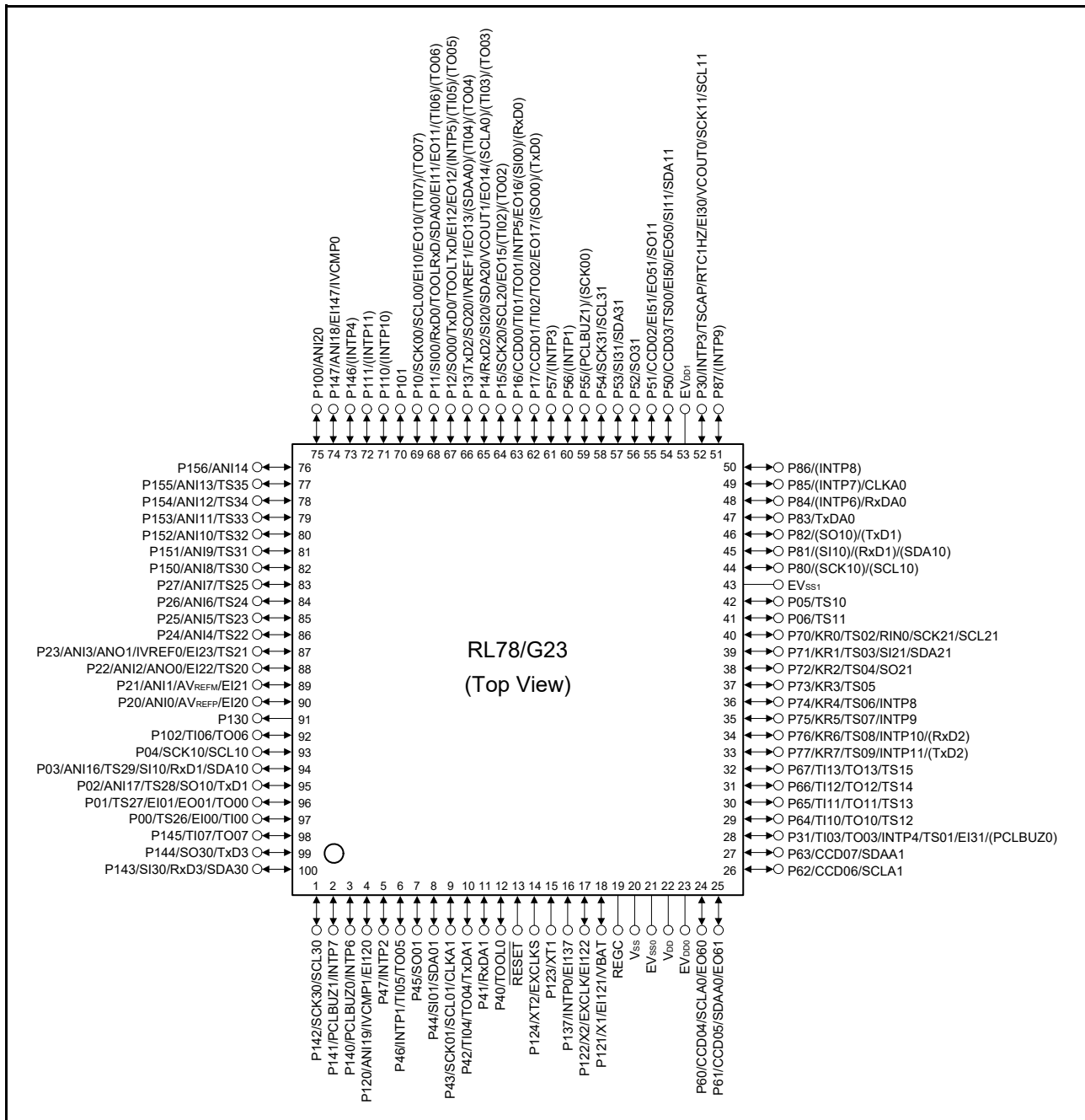
| Pin Number | I/O            |              |                             | Power supply, system clock, and debugging | Analog Circuits     |                     |                  | HMI              |                    |                                 | Timers                 |                      | Communications Interfaces |                              |                                |                                       |
|------------|----------------|--------------|-----------------------------|-------------------------------------------|---------------------|---------------------|------------------|------------------|--------------------|---------------------------------|------------------------|----------------------|---------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | 80LQFP, 80LQFP | Digital port | Output current control port |                                           | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUL) | Timer array unit (TAU) | Realtime Clock (RTC) | Serial array unit (SAU)   | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 33         | P74            | —            | —                           | —                                         | —                   | —                   | —                | INTP8            | KR4                | TS06                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 34         | P73            | —            | —                           | —                                         | —                   | —                   | —                | —                | KR3                | TS05                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 35         | P72            | —            | —                           | —                                         | —                   | —                   | —                | —                | KR2                | TS04                            | —                      | —                    | SO21                      | —                            | TxDA0                          | —                                     |
| 36         | P71            | —            | —                           | —                                         | —                   | —                   | —                | —                | KR1                | TS03                            | —                      | —                    | SI21/SDA21                | —                            | RxDA0                          | —                                     |
| 37         | P70            | —            | —                           | —                                         | —                   | —                   | —                | —                | KR0                | TS02                            | —                      | —                    | SCK21/SCL21               | —                            | —                              | RIN0                                  |
| 38         | P06            | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | TS11                            | TI06/TO06              | —                    | —                         | —                            | CLKA0                          | —                                     |
| 39         | P05            | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | TS10                            | TI05/TO05              | —                    | —                         | —                            | —                              | —                                     |
| 40         | P30            | —            | EI30                        | —                                         | —                   | —                   | VCOUT0           | INTP3            | —                  | TSCAP                           | —                      | RTC1HZ               | SCK11/SCL11               | —                            | —                              | —                                     |
| 41         | P50            | CCD03        | EI50/EO50                   | —                                         | —                   | —                   | —                | INTP1            | —                  | TS00                            | —                      | —                    | SI11/SDA11                | —                            | —                              | —                                     |
| 42         | P51            | CCD02        | EI51/EO51                   | —                                         | —                   | —                   | —                | INTP2            | —                  | —                               | —                      | —                    | SO11                      | —                            | —                              | —                                     |
| 43         | P52            | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SO31                      | —                            | —                              | —                                     |
| 44         | P53            | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SI31/SDA31                | —                            | —                              | —                                     |
| 45         | P54            | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SCK31/SCL31               | —                            | —                              | —                                     |
| 46         | P55            | —            | —                           | (PCLBUZ1)                                 | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | (SCK00)                   | —                            | —                              | —                                     |
| 47         | P17            | CCD01        | EO17                        | —                                         | —                   | —                   | —                | —                | —                  | —                               | TI02/TO02              | —                    | (SO00)/TxD0               | —                            | —                              | —                                     |
| 48         | P16            | CCD00        | EO16                        | —                                         | —                   | —                   | —                | INTP5            | —                  | —                               | TI01/TO01              | —                    | (SI00)/RxD0               | —                            | —                              | —                                     |
| 49         | P15            | —            | EO15                        | —                                         | —                   | —                   | —                | —                | —                  | —                               | (TI02)/TO02            | —                    | SCK20/SCL20               | —                            | —                              | —                                     |
| 50         | P14            | —            | EO14                        | —                                         | —                   | —                   | VCOUT1           | —                | —                  | —                               | (TI03)/TO03            | —                    | SI20/RxD2/SDA20           | (SCLA0)                      | —                              | —                                     |
| 51         | P13            | —            | EO13                        | —                                         | —                   | —                   | IVREF1           | —                | —                  | —                               | (TI04)/TO04            | —                    | SO20/TxD2                 | (SDAA0)                      | —                              | —                                     |
| 52         | P12            | —            | EI12/EO12                   | TOOLTxD                                   | —                   | —                   | —                | (INTP5)          | —                  | —                               | (TI05)/TO05            | —                    | SO00/TxD0                 | —                            | —                              | —                                     |
| 53         | P11            | —            | EI11/EO11                   | TOOLRxD                                   | —                   | —                   | —                | —                | —                  | —                               | (TI06)/TO06            | —                    | SI00/RxD0/SDA00           | —                            | —                              | —                                     |
| 54         | P10            | —            | EI10/EO10                   | —                                         | —                   | —                   | —                | —                | —                  | —                               | (TI07)/TO07            | —                    | SCK00/SCL00               | —                            | —                              | —                                     |
| 55         | P110           | —            | —                           | —                                         | —                   | —                   | —                | (INTP10)         | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 56         | P111           | —            | —                           | —                                         | —                   | —                   | —                | (INTP11)         | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 57         | P146           | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 58         | P147           | —            | EI147                       | —                                         | ANI18               | —                   | IVCMP0           | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 59         | P100           | —            | —                           | —                                         | ANI20               | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 60         | P153           | —            | —                           | —                                         | ANI11               | —                   | —                | —                | —                  | TS33                            | —                      | —                    | —                         | —                            | —                              | —                                     |

Table 1 - 11 Multiplexed Pin Functions of the 80-pin Products (3/3)

| Pin Number | I/O             |              |                             | Power supply, system clock, and debugging | Analog Circuits     |                     |                  | HMI              |                    |                                 | Timers                 |                      | Communications Interfaces |                              |                                |                                       |
|------------|-----------------|--------------|-----------------------------|-------------------------------------------|---------------------|---------------------|------------------|------------------|--------------------|---------------------------------|------------------------|----------------------|---------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | 80LFQFP, 80LQFP | Digital port | Output current control port |                                           | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTS2L) | Timer array unit (TAU) | Realtime Clock (RTC) | Serial array unit (SAU)   | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 61         | P152            | —            | —                           | —                                         | ANI10               | —                   | —                | —                | —                  | TS32                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 62         | P151            | —            | —                           | —                                         | ANI9                | —                   | —                | —                | —                  | TS31                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 63         | P150            | —            | —                           | —                                         | ANI8                | —                   | —                | —                | —                  | TS30                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 64         | P27             | —            | —                           | —                                         | ANI7                | —                   | —                | —                | —                  | TS25                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 65         | P26             | —            | —                           | —                                         | ANI6                | —                   | —                | —                | —                  | TS24                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 66         | P25             | —            | —                           | —                                         | ANI5                | —                   | —                | —                | —                  | TS23                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 67         | P24             | —            | —                           | —                                         | ANI4                | —                   | —                | —                | —                  | TS22                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 68         | P23             | —            | EI23                        | —                                         | ANI3                | ANO1                | IVREF0           | —                | —                  | TS21                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 69         | P22             | —            | EI22                        | —                                         | ANI2                | ANO0                | —                | —                | —                  | TS20                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 70         | P21             | —            | EI21                        | —                                         | ANI1/<br>AVREFM     | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 71         | P20             | —            | EI20                        | —                                         | ANI0/<br>AVREFP     | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 72         | P130            | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 73         | P04             | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SCK10/<br>SCL10           | —                            | —                              | —                                     |
| 74         | P03             | —            | —                           | —                                         | ANI16               | —                   | —                | —                | —                  | TS29                            | —                      | —                    | SI10/<br>RxD1/<br>SDA10   | —                            | —                              | —                                     |
| 75         | P02             | —            | —                           | —                                         | ANI17               | —                   | —                | —                | —                  | TS28                            | —                      | —                    | SO10/<br>TxD1             | —                            | —                              | —                                     |
| 76         | P01             | —            | EI01/<br>EO01               | —                                         | —                   | —                   | —                | —                | —                  | TS27                            | TO00                   | —                    | —                         | —                            | —                              | —                                     |
| 77         | P00             | —            | EI00                        | —                                         | —                   | —                   | —                | —                | —                  | TS26                            | TI00                   | —                    | —                         | —                            | —                              | —                                     |
| 78         | P144            | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SO30/<br>TxD3             | —                            | —                              | —                                     |
| 79         | P143            | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SI30/<br>RxD3/<br>SDA30   | —                            | —                              | —                                     |
| 80         | P142            | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SCK30/<br>SCL30           | —                            | —                              | —                                     |

## 1.3.10 100-pin products

- 100-pin plastic LFQFP (14 × 14 mm, 0.50-mm pitch)



**Caution 1.** Connect the EVSS0 and EVSS1 pins to the same ground as the VSS pin.

**Caution 2.** Make sure that the voltage on the VDD pin is no less than that on the EVDD0 and EVDD1 pins. Also make sure that the voltage on the EVDD0 is the same as that on the EVDD1 pin.

**Caution 3.** Connect the REGC pin to VSS via a capacitor (0.47 to 1 μF).

**Remark 1.** For pin identification, see 1.4 Pin Identification.

**Remark 2.** When using the microcontroller for an application where the noise generated inside the microcontroller must be reduced, it is recommended to supply separate powers to the VDD, EVDD0, and EVDD1 pins and connect the VSS, EVSS0, and EVSS1 pins to separate ground lines.

**Remark 3.** Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to Figure 4 - 10 Format of Peripheral I/O Redirection Register (PIOR) in the RL78/G23 User's Manual.

Table 1 - 12 Multiplexed Pin Functions of the 100-pin Products (1/4)

| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI              |                  |                    | Timers                          |                        | Communications Interfaces |                         |                              |                                |                                       |
|------------|---------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|---------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | 100LQFP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUL) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 1          | P142    | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | SCK30/ SCL30              | —                       | —                            | —                              | —                                     |
| 2          | P141    | —            | —                           | PCLBUZ1                                   | —                      | —                   | —                   | INTP7            | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 3          | P140    | —            | —                           | PCLBUZ0                                   | —                      | —                   | —                   | INTP6            | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 4          | P120    | —            | EI120                       | —                                         | ANI19                  | —                   | IVCMP1              | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 5          | P47     | —            | —                           | —                                         | —                      | —                   | —                   | INTP2            | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 6          | P46     | —            | —                           | —                                         | —                      | —                   | —                   | INTP1            | —                | —                  | TI05/ TO05                      | —                      | —                         | —                       | —                            | —                              | —                                     |
| 7          | P45     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | SO01                      | —                       | —                            | —                              | —                                     |
| 8          | P44     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | SI01/ SDA01               | —                       | —                            | —                              | —                                     |
| 9          | P43     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | SCK01/ SCL01              | —                       | CLKA1                        | —                              | —                                     |
| 10         | P42     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI04/ TO04                      | —                      | —                         | —                       | TxDA1                        | —                              | —                                     |
| 11         | P41     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | RxDA1                        | —                              | —                                     |
| 12         | P40     | —            | —                           | TOOL0                                     | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 13         | —       | —            | —                           | RESET                                     | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 14         | P124    | —            | —                           | XT2/ EXCLKS                               | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 15         | P123    | —            | —                           | XT1                                       | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 16         | P137    | —            | EI137                       | —                                         | —                      | —                   | —                   | INTP0            | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 17         | P122    | —            | EI122                       | X2/EXCLK                                  | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 18         | P121    | —            | EI121                       | X1/VBAT                                   | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 19         | —       | —            | —                           | REGC                                      | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 20         | —       | —            | —                           | Vss                                       | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 21         | —       | —            | —                           | EVss0                                     | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 22         | —       | —            | —                           | VDD                                       | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 23         | —       | —            | —                           | EVDD0                                     | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | —                       | —                            | —                              | —                                     |
| 24         | P60     | CCD04        | EO60                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | SCLA0                   | —                            | —                              | —                                     |
| 25         | P61     | CCD05        | EO61                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | SDAA0                   | —                            | —                              | —                                     |
| 26         | P62     | CCD06        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | SCLA1                   | —                            | —                              | —                                     |
| 27         | P63     | CCD07        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                               | —                      | —                         | SDAA1                   | —                            | —                              | —                                     |
| 28         | P31     | —            | EI31                        | (PCLBUZ0)                                 | —                      | —                   | —                   | INTP4            | —                | TS01               | TI03/ TO03                      | —                      | —                         | —                       | —                            | —                              | —                                     |
| 29         | P64     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS12               | TI10/ TO10                      | —                      | —                         | —                       | —                            | —                              | —                                     |
| 30         | P65     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS13               | TI11/ TO11                      | —                      | —                         | —                       | —                            | —                              | —                                     |
| 31         | P66     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS14               | TI12/ TO12                      | —                      | —                         | —                       | —                            | —                              | —                                     |

Table 1 - 12 Multiplexed Pin Functions of the 100-pin Products (2/4)

| Pin Number | I/O      |              |                             | Power supply, system clock, and debugging | Analog Circuits     |                     |                  | HIMs             |                    |                                  | Timers                 |                      | Communications Interfaces     |                              |                                |                                        |
|------------|----------|--------------|-----------------------------|-------------------------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|----------------------|-------------------------------|------------------------------|--------------------------------|----------------------------------------|
|            | 100LFQFP | Digital port | Output current control port | ELCL input/output port                    | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTS02L) | Timer array unit (TAU) | Realtime Clock (RTC) | Serial array unit (SAU)       | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMIC) |
| 32         | P67      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | TS15                             | TI13/TO13              | —                    | —                             | —                            | —                              | —                                      |
| 33         | P77      | —            | —                           | —                                         | —                   | —                   | —                | INTP11           | KR7                | TS09                             | —                      | —                    | (TxD2)                        | —                            | —                              | —                                      |
| 34         | P76      | —            | —                           | —                                         | —                   | —                   | —                | INTP10           | KR6                | TS08                             | —                      | —                    | (RxD2)                        | —                            | —                              | —                                      |
| 35         | P75      | —            | —                           | —                                         | —                   | —                   | —                | INTP9            | KR5                | TS07                             | —                      | —                    | —                             | —                            | —                              | —                                      |
| 36         | P74      | —            | —                           | —                                         | —                   | —                   | —                | INTP8            | KR4                | TS06                             | —                      | —                    | —                             | —                            | —                              | —                                      |
| 37         | P73      | —            | —                           | —                                         | —                   | —                   | —                | —                | KR3                | TS05                             | —                      | —                    | —                             | —                            | —                              | —                                      |
| 38         | P72      | —            | —                           | —                                         | —                   | —                   | —                | —                | KR2                | TS04                             | —                      | —                    | SO21                          | —                            | —                              | —                                      |
| 39         | P71      | —            | —                           | —                                         | —                   | —                   | —                | —                | KR1                | TS03                             | —                      | —                    | SI21/SDA21                    | —                            | —                              | —                                      |
| 40         | P70      | —            | —                           | —                                         | —                   | —                   | —                | —                | KR0                | TS02                             | —                      | —                    | SCK21/SCL21                   | —                            | —                              | RIN0                                   |
| 41         | P06      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | TS11                             | —                      | —                    | —                             | —                            | —                              | —                                      |
| 42         | P05      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | TS10                             | —                      | —                    | —                             | —                            | —                              | —                                      |
| 43         | —        | —            | —                           | EVss1                                     | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | —                             | —                            | —                              | —                                      |
| 44         | P80      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | (SCK10)/<br>(SCL10)           | —                            | —                              | —                                      |
| 45         | P81      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | (SI10)/<br>(RxD1)/<br>(SDA10) | —                            | —                              | —                                      |
| 46         | P82      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | (SO10)/<br>(TxD1)             | —                            | —                              | —                                      |
| 47         | P83      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | —                             | —                            | TxDA0                          | —                                      |
| 48         | P84      | —            | —                           | —                                         | —                   | —                   | —                | (INTP6)          | —                  | —                                | —                      | —                    | —                             | —                            | RxDA0                          | —                                      |
| 49         | P85      | —            | —                           | —                                         | —                   | —                   | —                | (INTP7)          | —                  | —                                | —                      | —                    | —                             | —                            | CLKA0                          | —                                      |
| 50         | P86      | —            | —                           | —                                         | —                   | —                   | —                | (INTP8)          | —                  | —                                | —                      | —                    | —                             | —                            | —                              | —                                      |
| 51         | P87      | —            | —                           | —                                         | —                   | —                   | —                | (INTP9)          | —                  | —                                | —                      | —                    | —                             | —                            | —                              | —                                      |
| 52         | P30      | —            | EI30                        | —                                         | —                   | —                   | VCOUT0           | INTP3            | —                  | TSCAP                            | —                      | RTC1HZ               | SCK11/<br>SCL11               | —                            | —                              | —                                      |
| 53         | —        | —            | —                           | EVDD1                                     | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | —                             | —                            | —                              | —                                      |
| 54         | P50      | CCD03        | EI50/<br>EO50               | —                                         | —                   | —                   | —                | —                | —                  | TS00                             | —                      | —                    | SI11/<br>SDA11                | —                            | —                              | —                                      |
| 55         | P51      | CCD02        | EI51/<br>EO51               | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | SO11                          | —                            | —                              | —                                      |
| 56         | P52      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | SO31                          | —                            | —                              | —                                      |
| 57         | P53      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | SI31/<br>SDA31                | —                            | —                              | —                                      |
| 58         | P54      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | SCK31/<br>SCL31               | —                            | —                              | —                                      |
| 59         | P55      | —            | —                           | (PCLBUZ1)                                 | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | (SCK00)                       | —                            | —                              | —                                      |
| 60         | P56      | —            | —                           | —                                         | —                   | —                   | —                | (INTP1)          | —                  | —                                | —                      | —                    | —                             | —                            | —                              | —                                      |
| 61         | P57      | —            | —                           | —                                         | —                   | —                   | —                | (INTP3)          | —                  | —                                | —                      | —                    | —                             | —                            | —                              | —                                      |
| 62         | P17      | CCD01        | EO17                        | —                                         | —                   | —                   | —                | —                | —                  | —                                | TI02/<br>TO02          | —                    | (SO00)/<br>(TxDO)             | —                            | —                              | —                                      |

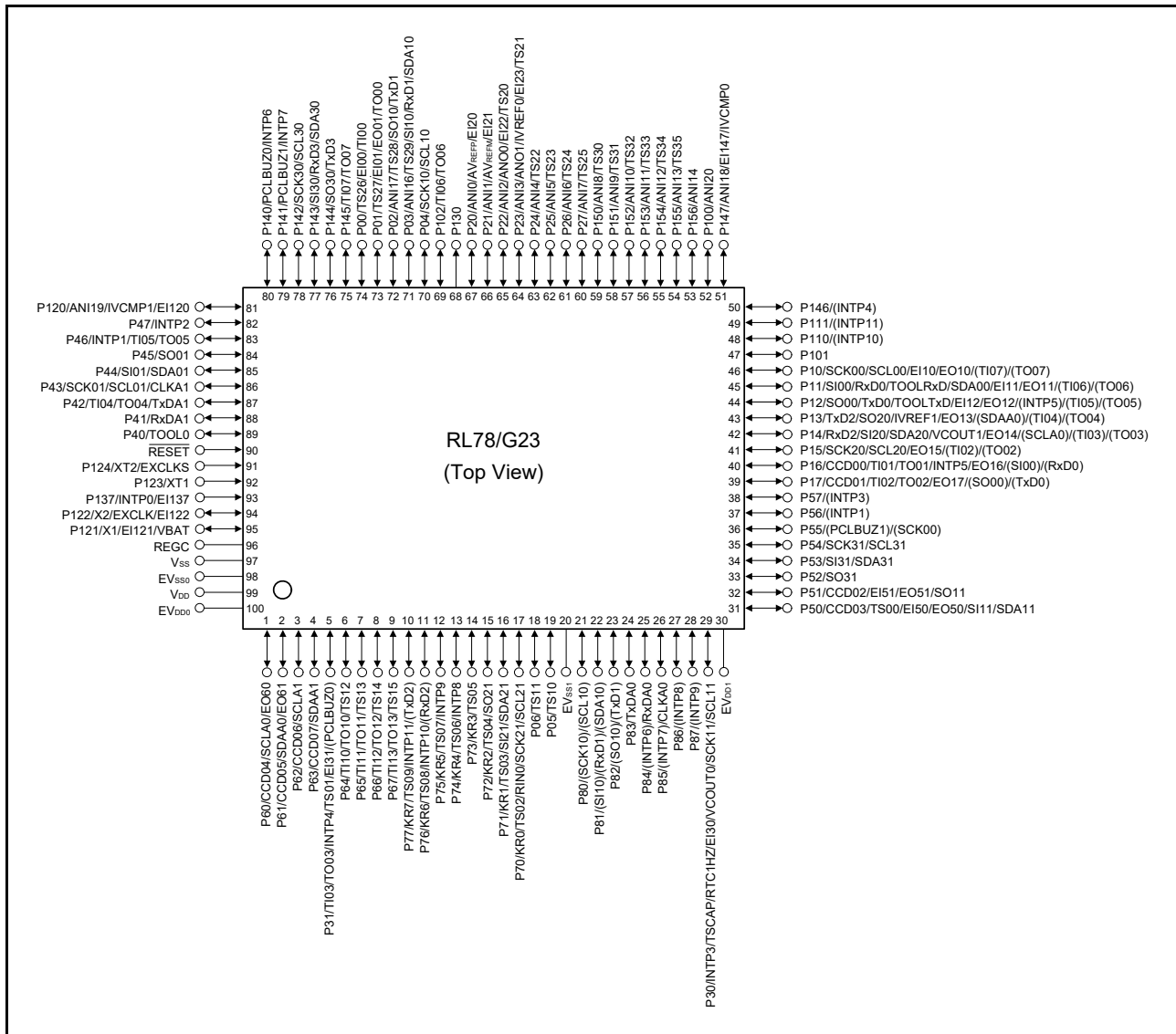
Table 1 - 12 Multiplexed Pin Functions of the 100-pin Products (3/4)

| Pin Number | I/O      |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMIs             |                  |                    | Timers                           |                        | Communications Interfaces |                         |                              |                                |
|------------|----------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|
|            | 100LFQFP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTS02L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) |
| 63         | P16      | CCD00        | EO16                        | —                                         | —                      | —                   | —                   | INTP5            | —                | —                  | TI01/TO01                        | —                      | (SI00)/ (RxD0)            | —                       | —                            | —                              |
| 64         | P15      | —            | EO15                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | (TI02)/ (TO02)                   | —                      | SCK20/ SCL20              | —                       | —                            | —                              |
| 65         | P14      | —            | EO14                        | —                                         | —                      | —                   | VCOUT1              | —                | —                | —                  | (TI03)/ (TO03)                   | —                      | SI20/ RxD2/ SDA20         | (SCLA0)                 | —                            | —                              |
| 66         | P13      | —            | EO13                        | —                                         | —                      | —                   | IVREF1              | —                | —                | —                  | (TI04)/ (TO04)                   | —                      | SO20/ TxD2                | (SDAA0)                 | —                            | —                              |
| 67         | P12      | —            | EI12/ EO12                  | TOOLTxD                                   | —                      | —                   | —                   | (INTP5)          | —                | —                  | (TI05)/ (TO05)                   | —                      | SO00/ TxD0                | —                       | —                            | —                              |
| 68         | P11      | —            | EI11/ EO11                  | TOOLRxD                                   | —                      | —                   | —                   | —                | —                | —                  | (TI06)/ (TO06)                   | —                      | SI00/ RxD0/ SDA00         | —                       | —                            | —                              |
| 69         | P10      | —            | EI10/ EO10                  | —                                         | —                      | —                   | —                   | —                | —                | —                  | (TI07)/ (TO07)                   | —                      | SCK00/ SCL00              | —                       | —                            | —                              |
| 70         | P101     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 71         | P110     | —            | —                           | —                                         | —                      | —                   | —                   | (INTP10)         | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 72         | P111     | —            | —                           | —                                         | —                      | —                   | —                   | (INTP11)         | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 73         | P146     | —            | —                           | —                                         | —                      | —                   | —                   | (INTP4)          | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 74         | P147     | —            | EI147                       | —                                         | ANI18                  | —                   | IVCMP0              | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 75         | P100     | —            | —                           | —                                         | ANI20                  | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 76         | P156     | —            | —                           | —                                         | ANI14                  | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 77         | P155     | —            | —                           | —                                         | ANI13                  | —                   | —                   | —                | —                | TS35               | —                                | —                      | —                         | —                       | —                            | —                              |
| 78         | P154     | —            | —                           | —                                         | ANI12                  | —                   | —                   | —                | —                | TS34               | —                                | —                      | —                         | —                       | —                            | —                              |
| 79         | P153     | —            | —                           | —                                         | ANI11                  | —                   | —                   | —                | —                | TS33               | —                                | —                      | —                         | —                       | —                            | —                              |
| 80         | P152     | —            | —                           | —                                         | ANI10                  | —                   | —                   | —                | —                | TS32               | —                                | —                      | —                         | —                       | —                            | —                              |
| 81         | P151     | —            | —                           | —                                         | ANI9                   | —                   | —                   | —                | —                | TS31               | —                                | —                      | —                         | —                       | —                            | —                              |
| 82         | P150     | —            | —                           | —                                         | ANI8                   | —                   | —                   | —                | —                | TS30               | —                                | —                      | —                         | —                       | —                            | —                              |
| 83         | P27      | —            | —                           | —                                         | ANI7                   | —                   | —                   | —                | —                | TS25               | —                                | —                      | —                         | —                       | —                            | —                              |
| 84         | P26      | —            | —                           | —                                         | ANI6                   | —                   | —                   | —                | —                | TS24               | —                                | —                      | —                         | —                       | —                            | —                              |
| 85         | P25      | —            | —                           | —                                         | ANI5                   | —                   | —                   | —                | —                | TS23               | —                                | —                      | —                         | —                       | —                            | —                              |
| 86         | P24      | —            | —                           | —                                         | ANI4                   | —                   | —                   | —                | —                | TS22               | —                                | —                      | —                         | —                       | —                            | —                              |
| 87         | P23      | —            | EI23                        | —                                         | ANI3                   | ANO1                | IVREF0              | —                | —                | TS21               | —                                | —                      | —                         | —                       | —                            | —                              |
| 88         | P22      | —            | EI22                        | —                                         | ANI2                   | ANO0                | —                   | —                | —                | TS20               | —                                | —                      | —                         | —                       | —                            | —                              |
| 89         | P21      | —            | EI21                        | —                                         | ANI1/ AVREFM           | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 90         | P20      | —            | EI20                        | —                                         | ANI0/ AVREFP           | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 91         | P130     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              |
| 92         | P102     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI06/ TO06                       | —                      | —                         | —                       | —                            | —                              |
| 93         | P04      | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | SCK10/ SCL10              | —                       | —                            | —                              |

Table 1 - 12 Multiplexed Pin Functions of the 100-pin Products (4/4)

| Pin Number | I/O      |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMIs             |                  |                    | Timers                           |                        | Communications Interfaces |                         |                              |                                |
|------------|----------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|
|            | 100LFQFP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSU2L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) |
| 94         | P03      | —            | —                           | —                                         | ANI16                  | —                   | —                   | —                | —                | TS29               | —                                | —                      | SI10/ RxD1/ SDA10         | —                       | —                            | —                              |
| 95         | P02      | —            | —                           | —                                         | ANI17                  | —                   | —                   | —                | —                | TS28               | —                                | —                      | SO10/ TxD1                | —                       | —                            | —                              |
| 96         | P01      | —            | EI01/ EO01                  | —                                         | —                      | —                   | —                   | —                | —                | TS27               | TO00                             | —                      | —                         | —                       | —                            | —                              |
| 97         | P00      | —            | EI00                        | —                                         | —                      | —                   | —                   | —                | —                | TS26               | TI00                             | —                      | —                         | —                       | —                            | —                              |
| 98         | P145     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI07/ TO07                       | —                      | —                         | —                       | —                            | —                              |
| 99         | P144     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | SO30/ TxD3                | —                       | —                            | —                              |
| 100        | P143     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | SI30/ RxD3/ SDA30         | —                       | —                            | —                              |

- 100-pin plastic LQFP (14 × 20 mm, 0.65-mm pitch)



**Caution 1.** Connect the EVSS0 and EVSS1 pins to the same ground as the VSS pin.

**Caution 2.** Make sure that the voltage on the VDD pin is no less than that on the EVDD0 and EVDD1 pins. Also make sure that the voltage on the EVDD0 is the same as that on the EVDD1 pin.

**Caution 3.** Connect the REGC pin to VSS via a capacitor (0.47 to 1  $\mu$ F).

**Remark 1.** For pin identification, see 1.4 Pin Identification.

**Remark 2.** When using the microcontroller for an application where the noise generated inside the microcontroller must be reduced, it is recommended to supply separate powers to the VDD, EVDD0, and EVDD1 pins and connect the VSS, EVSS0, and EVSS1 pins to separate ground lines.

**Remark 3.** Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to **Figure 4 - 10 Format of Peripheral I/O Redirection Register (PIOR)** in the RL78/G23 User's Manual.

Table 1 - 13 Multiplexed Pin Functions 2 of the 100-pin Products (1/4)

| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI's            |                  |                    | Timers                            |                        | Communications Interfaces     |                         |                              |                                |
|------------|---------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|-----------------------------------|------------------------|-------------------------------|-------------------------|------------------------------|--------------------------------|
|            | 100LQFP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUL2L) | Timer array unit (TAU) | Realtime Clock (RTC)          | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) |
| 1          | P60     | CCD04        | EO60                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                             | SCLA0                   | —                            | —                              |
| 2          | P61     | CCD05        | EO61                        | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                             | SDAA0                   | —                            | —                              |
| 3          | P62     | CCD06        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                             | SCLA1                   | —                            | —                              |
| 4          | P63     | CCD07        | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                             | SDAA1                   | —                            | —                              |
| 5          | P31     | —            | EI31                        | (PCLBUZ0)                                 | —                      | —                   | —                   | INTP4            | —                | TS01               | TI03/TO03                         | —                      | —                             | —                       | —                            | —                              |
| 6          | P64     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS12               | TI10/TO10                         | —                      | —                             | —                       | —                            | —                              |
| 7          | P65     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS13               | TI11/TO11                         | —                      | —                             | —                       | —                            | —                              |
| 8          | P66     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS14               | TI12/TO12                         | —                      | —                             | —                       | —                            | —                              |
| 9          | P67     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS15               | TI13/TO13                         | —                      | —                             | —                       | —                            | —                              |
| 10         | P77     | —            | —                           | —                                         | —                      | —                   | —                   | INTP11           | KR7              | TS09               | —                                 | —                      | (TxD2)                        | —                       | —                            | —                              |
| 11         | P76     | —            | —                           | —                                         | —                      | —                   | —                   | INTP10           | KR6              | TS08               | —                                 | —                      | (RxD2)                        | —                       | —                            | —                              |
| 12         | P75     | —            | —                           | —                                         | —                      | —                   | —                   | INTP9            | KR5              | TS07               | —                                 | —                      | —                             | —                       | —                            | —                              |
| 13         | P74     | —            | —                           | —                                         | —                      | —                   | —                   | INTP8            | KR4              | TS06               | —                                 | —                      | —                             | —                       | —                            | —                              |
| 14         | P73     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR3              | TS05               | —                                 | —                      | —                             | —                       | —                            | —                              |
| 15         | P72     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR2              | TS04               | —                                 | —                      | SO21                          | —                       | —                            | —                              |
| 16         | P71     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR1              | TS03               | —                                 | —                      | SI21/SDA21                    | —                       | —                            | —                              |
| 17         | P70     | —            | —                           | —                                         | —                      | —                   | —                   | —                | KR0              | TS02               | —                                 | —                      | SCK21/SCL21                   | —                       | —                            | RIN0                           |
| 18         | P06     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS11               | —                                 | —                      | —                             | —                       | —                            | —                              |
| 19         | P05     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | TS10               | —                                 | —                      | —                             | —                       | —                            | —                              |
| 20         | —       | —            | —                           | EVSS1                                     | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                             | —                       | —                            | —                              |
| 21         | P80     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | (SCK10)/<br>(SCL10)           | —                       | —                            | —                              |
| 22         | P81     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | (SI10)/<br>(RxD1)/<br>(SDA10) | —                       | —                            | —                              |
| 23         | P82     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | (SO10)/<br>(TxD1)             | —                       | —                            | —                              |
| 24         | P83     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                             | —                       | TxDA0                        | —                              |
| 25         | P84     | —            | —                           | —                                         | —                      | —                   | —                   | (INTP6)          | —                | —                  | —                                 | —                      | —                             | —                       | RxDA0                        | —                              |
| 26         | P85     | —            | —                           | —                                         | —                      | —                   | —                   | (INTP7)          | —                | —                  | —                                 | —                      | —                             | —                       | CLKA0                        | —                              |
| 27         | P86     | —            | —                           | —                                         | —                      | —                   | —                   | (INTP8)          | —                | —                  | —                                 | —                      | —                             | —                       | —                            | —                              |
| 28         | P87     | —            | —                           | —                                         | —                      | —                   | —                   | (INTP9)          | —                | —                  | —                                 | —                      | —                             | —                       | —                            | —                              |
| 29         | P30     | —            | EI30                        | —                                         | —                      | —                   | VCOUT0              | INTP3            | —                | TSCAP              | —                                 | RTC1HZ                 | SCK11/<br>SCL11               | —                       | —                            | —                              |
| 30         | —       | —            | —                           | EVDD1                                     | —                      | —                   | —                   | —                | —                | —                  | —                                 | —                      | —                             | —                       | —                            | —                              |

Table 1 - 13 Multiplexed Pin Functions 2 of the 100-pin Products (2/4)

| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits     |                     |                  | HMI              |                    |                                  | Timers                 |                      | Communications Interfaces |                              |                                |                                       |
|------------|---------|--------------|-----------------------------|-------------------------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|----------------------|---------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | 100LQFP | Digital port | Output current control port |                                           | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTS02L) | Timer array unit (TAU) | Realtime Clock (RTC) | Serial array unit (SAU)   | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 31         | P50     | CCD03        | EI50/EO50                   | —                                         | —                   | —                   | —                | —                | —                  | TS00                             | —                      | —                    | SI11/SDA11                | —                            | —                              | —                                     |
| 32         | P51     | CCD02        | EI51/EO51                   | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | SO11                      | —                            | —                              | —                                     |
| 33         | P52     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | SO31                      | —                            | —                              | —                                     |
| 34         | P53     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | SI31/SDA31                | —                            | —                              | —                                     |
| 35         | P54     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | SCK31/SCL31               | —                            | —                              | —                                     |
| 36         | P55     | —            | —                           | (PCLBUZ1)                                 | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | (SCK00)                   | —                            | —                              | —                                     |
| 37         | P56     | —            | —                           | —                                         | —                   | —                   | —                | (INTP1)          | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                     |
| 38         | P57     | —            | —                           | —                                         | —                   | —                   | —                | (INTP3)          | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                     |
| 39         | P17     | CCD01        | EO17                        | —                                         | —                   | —                   | —                | —                | —                  | —                                | TI02/TO02              | —                    | (SO00)/TxD0               | —                            | —                              | —                                     |
| 40         | P16     | CCD00        | EO16                        | —                                         | —                   | —                   | —                | INTP5            | —                  | —                                | TI01/TO01              | —                    | (SI00)/RxD0               | —                            | —                              | —                                     |
| 41         | P15     | —            | EO15                        | —                                         | —                   | —                   | —                | —                | —                  | —                                | (TI02)/TO02            | —                    | SCK20/SCL20               | —                            | —                              | —                                     |
| 42         | P14     | —            | EO14                        | —                                         | —                   | —                   | VCOUT1           | —                | —                  | —                                | (TI03)/TO03            | —                    | SI20/RxD2/SDA20           | (SCLA0)                      | —                              | —                                     |
| 43         | P13     | —            | EO13                        | —                                         | —                   | —                   | IVREF1           | —                | —                  | —                                | (TI04)/TO04            | —                    | SO20/TxD2                 | (SDAA0)                      | —                              | —                                     |
| 44         | P12     | —            | EI12/EO12                   | TOOLTxD                                   | —                   | —                   | —                | (INTP5)          | —                  | —                                | (TI05)/TO05            | —                    | SO00/TxD0                 | —                            | —                              | —                                     |
| 45         | P11     | —            | EI11/EO11                   | TOOLRxD                                   | —                   | —                   | —                | —                | —                  | —                                | (TI06)/TO06            | —                    | SI00/RxD0/SDA00           | —                            | —                              | —                                     |
| 46         | P10     | —            | EI10/EO10                   | —                                         | —                   | —                   | —                | —                | —                  | —                                | (TI07)/TO07            | —                    | SCK00/SCL00               | —                            | —                              | —                                     |
| 47         | P101    | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                     |
| 48         | P110    | —            | —                           | —                                         | —                   | —                   | —                | (INTP10)         | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                     |
| 49         | P111    | —            | —                           | —                                         | —                   | —                   | —                | (INTP11)         | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                     |
| 50         | P146    | —            | —                           | —                                         | —                   | —                   | —                | (INTP4)          | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                     |
| 51         | P147    | —            | EI147                       | —                                         | ANI18               | —                   | IVCMP0           | —                | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                     |
| 52         | P100    | —            | —                           | —                                         | ANI20               | —                   | —                | —                | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                     |
| 53         | P156    | —            | —                           | —                                         | ANI14               | —                   | —                | —                | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                     |
| 54         | P155    | —            | —                           | —                                         | ANI13               | —                   | —                | —                | —                  | TS35                             | —                      | —                    | —                         | —                            | —                              | —                                     |
| 55         | P154    | —            | —                           | —                                         | ANI12               | —                   | —                | —                | —                  | TS34                             | —                      | —                    | —                         | —                            | —                              | —                                     |
| 56         | P153    | —            | —                           | —                                         | ANI11               | —                   | —                | —                | —                  | TS33                             | —                      | —                    | —                         | —                            | —                              | —                                     |
| 57         | P152    | —            | —                           | —                                         | ANI10               | —                   | —                | —                | —                  | TS32                             | —                      | —                    | —                         | —                            | —                              | —                                     |
| 58         | P151    | —            | —                           | —                                         | ANI9                | —                   | —                | —                | —                  | TS31                             | —                      | —                    | —                         | —                            | —                              | —                                     |
| 59         | P150    | —            | —                           | —                                         | ANI8                | —                   | —                | —                | —                  | TS30                             | —                      | —                    | —                         | —                            | —                              | —                                     |
| 60         | P27     | —            | —                           | —                                         | ANI7                | —                   | —                | —                | —                  | TS25                             | —                      | —                    | —                         | —                            | —                              | —                                     |

Table 1 - 13 Multiplexed Pin Functions 2 of the 100-pin Products (3/4)

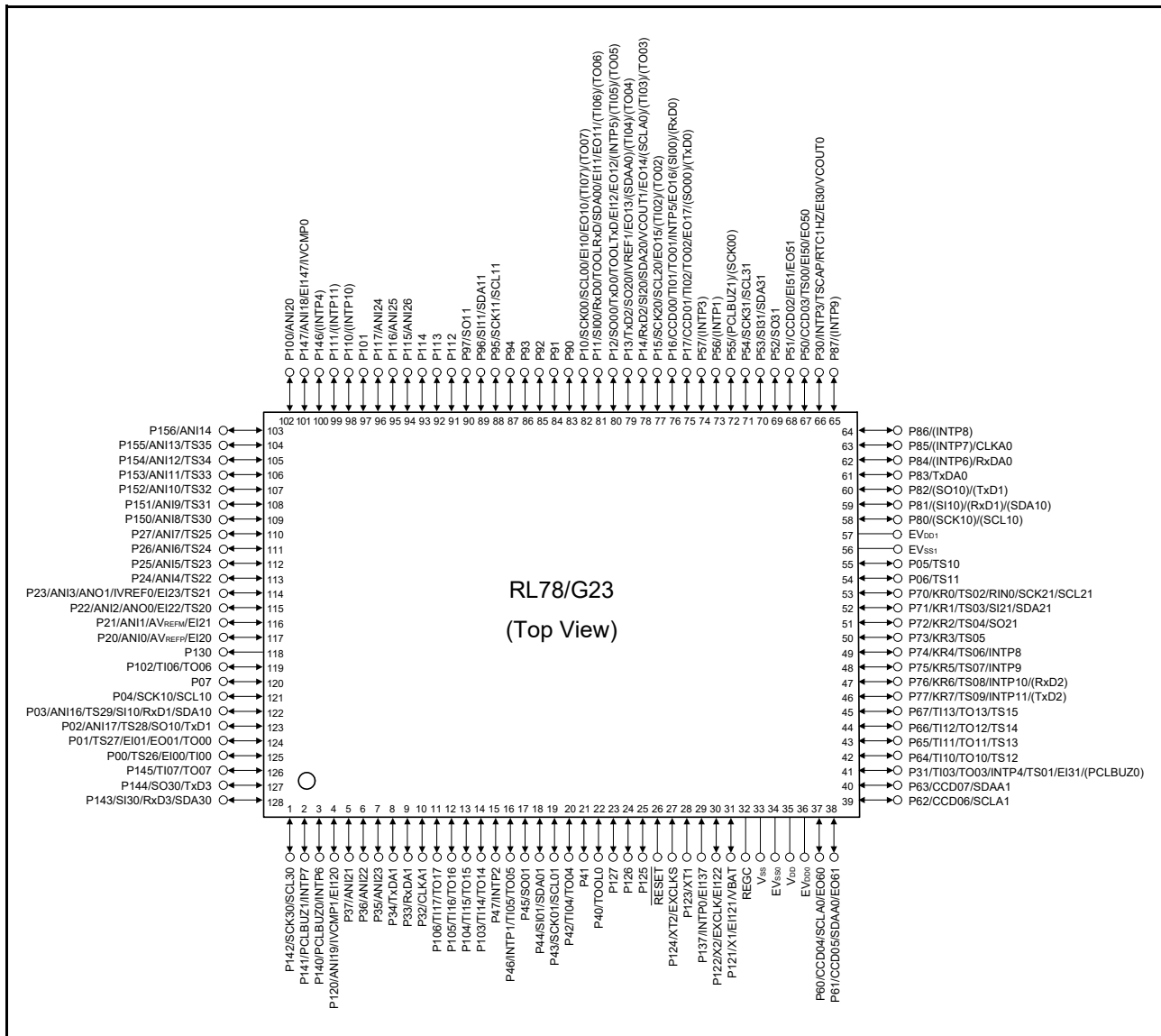
| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits     |                     |                  | HMI              |                    |                                 | Timers                 |                      | Communications Interfaces |                              |                                |                                       |
|------------|---------|--------------|-----------------------------|-------------------------------------------|---------------------|---------------------|------------------|------------------|--------------------|---------------------------------|------------------------|----------------------|---------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | 100LQFP | Digital port | Output current control port |                                           | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUL) | Timer array unit (TAU) | Realtime Clock (RTC) | Serial array unit (SAU)   | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 61         | P26     | —            | —                           | —                                         | ANI6                | —                   | —                | —                | —                  | TS24                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 62         | P25     | —            | —                           | —                                         | ANI5                | —                   | —                | —                | —                  | TS23                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 63         | P24     | —            | —                           | —                                         | ANI4                | —                   | —                | —                | —                  | TS22                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 64         | P23     | —            | EI23                        | —                                         | ANI3                | ANO1                | IVREF0           | —                | —                  | TS21                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 65         | P22     | —            | EI22                        | —                                         | ANI2                | ANO0                | —                | —                | —                  | TS20                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 66         | P21     | —            | EI21                        | —                                         | ANI1/<br>AVREFM     | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 67         | P20     | —            | EI20                        | —                                         | ANI0/<br>AVREFP     | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 68         | P130    | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 69         | P102    | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | TI06/<br>TO06          | —                    | —                         | —                            | —                              | —                                     |
| 70         | P04     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SCK10/<br>SCL10           | —                            | —                              | —                                     |
| 71         | P03     | —            | —                           | —                                         | ANI16               | —                   | —                | —                | —                  | TS29                            | —                      | —                    | SI10/<br>RxD1/<br>SDA10   | —                            | —                              | —                                     |
| 72         | P02     | —            | —                           | —                                         | ANI17               | —                   | —                | —                | —                  | TS28                            | —                      | —                    | SO10/<br>TxD1             | —                            | —                              | —                                     |
| 73         | P01     | —            | EI01/<br>EO01               | —                                         | —                   | —                   | —                | —                | —                  | TS27                            | TO00                   | —                    | —                         | —                            | —                              | —                                     |
| 74         | P00     | —            | EI00                        | —                                         | —                   | —                   | —                | —                | —                  | TS26                            | TI00                   | —                    | —                         | —                            | —                              | —                                     |
| 75         | P145    | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | TI07/<br>TO07          | —                    | —                         | —                            | —                              | —                                     |
| 76         | P144    | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SO30/<br>TxD3             | —                            | —                              | —                                     |
| 77         | P143    | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SI30/<br>RxD3/<br>SDA30   | —                            | —                              | —                                     |
| 78         | P142    | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SCK30/<br>SCL30           | —                            | —                              | —                                     |
| 79         | P141    | —            | —                           | PCLBUZ1                                   | —                   | —                   | —                | INTP7            | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 80         | P140    | —            | —                           | PCLBUZ0                                   | —                   | —                   | —                | INTP6            | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 81         | P120    | —            | EI120                       | —                                         | ANI19               | —                   | IVCMP1           | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 82         | P47     | —            | —                           | —                                         | —                   | —                   | —                | INTP2            | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 83         | P46     | —            | —                           | —                                         | —                   | —                   | —                | INTP1            | —                  | —                               | TI05/<br>TO05          | —                    | —                         | —                            | —                              | —                                     |
| 84         | P45     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SO01                      | —                            | —                              | —                                     |
| 85         | P44     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SI01/<br>SDA01            | —                            | —                              | —                                     |
| 86         | P43     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SCK01/<br>SCL01           | —                            | CLKA1                          | —                                     |
| 87         | P42     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | TI04/<br>TO04          | —                    | —                         | —                            | TxDA1                          | —                                     |
| 88         | P41     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | RxDA1                          | —                                     |
| 89         | P40     | —            | —                           | TOOL0                                     | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |

Table 1 - 13 Multiplexed Pin Functions 2 of the 100-pin Products (4/4)

| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMIs             |                  |                    | Timers                           |                        | Communications Interfaces |                         |                              |                                |                                       |
|------------|---------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | 100LQFP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTS02L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 90         | —       | —            | —                           | RESET                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 91         | P124    | —            | —                           | XT2/EXCLKS                                | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 92         | P123    | —            | —                           | XT1                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 93         | P137    | —            | EI137                       | —                                         | —                      | —                   | —                   | INTP0            | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 94         | P122    | —            | EI122                       | X2/EXCLK                                  | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 95         | P121    | —            | EI121                       | X1/VBAT                                   | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 96         | —       | —            | —                           | REGC                                      | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 97         | —       | —            | —                           | Vss                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 98         | —       | —            | —                           | EVss0                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 99         | —       | —            | —                           | VDD                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 100        | —       | —            | —                           | EVDD0                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |

## 1.3.11 128-pin products

- 128-pin plastic LFQFP (14 × 20 mm, 0.50-mm pitch)



**Caution 1.** Connect the EVss0 and EVss1 pins to the same ground as the Vss pin.

**Caution 2.** Make sure that the voltage on the VDD pin is no less than that on the EVDD0 and EVDD1 pins. Also make sure that the voltage on the EVDD0 is the same as that on the EVDD1 pin.

**Caution 3.** Connect the REGC pin to Vss via a capacitor (0.47 to 1  $\mu$ F).

**Remark 1.** For pin identification, see 1.4 Pin Identification.

**Remark 2.** When using the microcontroller for an application where the noise generated inside the microcontroller must be reduced, it is recommended to supply separate powers to the VDD, EVDD0, and EVDD1 pins and connect the Vss, EVss0, and EVss1 pins to separate ground lines.

**Remark 3.** Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to **Figure 4 - 10 Format of Peripheral I/O Redirection Register (PIOR)** in the RL78/G23 User's Manual.

Table 1 - 14 Multiplexed Pin Functions of the 128-pin Products (1/5)

| Pin Number | I/O     |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMI              |                  |                    | Timers                           |                        | Communications Interfaces |                         |                              |                                |                                       |
|------------|---------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | 128LQFP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTS02L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 1          | P142    | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | SCK30/ SCL30              | —                       | —                            | —                              | —                                     |
| 2          | P141    | —            | —                           | PCLBUZ1                                   | —                      | —                   | —                   | INTP7            | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 3          | P140    | —            | —                           | PCLBUZ0                                   | —                      | —                   | —                   | INTP6            | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 4          | P120    | —            | EI120                       | —                                         | ANI19                  | —                   | IVCMP1              | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 5          | P37     | —            | —                           | —                                         | ANI21                  | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 6          | P36     | —            | —                           | —                                         | ANI22                  | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 7          | P35     | —            | —                           | —                                         | ANI23                  | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 8          | P34     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | TxDA1                        | —                              | —                                     |
| 9          | P33     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | RxDA1                        | —                              | —                                     |
| 10         | P32     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | CLKA1                        | —                              | —                                     |
| 11         | P106    | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI17/ TO17                       | —                      | —                         | —                       | —                            | —                              | —                                     |
| 12         | P105    | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI16/ TO16                       | —                      | —                         | —                       | —                            | —                              | —                                     |
| 13         | P104    | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI15/ TO15                       | —                      | —                         | —                       | —                            | —                              | —                                     |
| 14         | P103    | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI14/ TO14                       | —                      | —                         | —                       | —                            | —                              | —                                     |
| 15         | P47     | —            | —                           | —                                         | —                      | —                   | —                   | INTP2            | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 16         | P46     | —            | —                           | —                                         | —                      | —                   | —                   | INTP1            | —                | —                  | TI05/ TO05                       | —                      | —                         | —                       | —                            | —                              | —                                     |
| 17         | P45     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | SO01                      | —                       | —                            | —                              | —                                     |
| 18         | P44     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | SI01/ SDA01               | —                       | —                            | —                              | —                                     |
| 19         | P43     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | SCK01/ SCL01              | —                       | —                            | —                              | —                                     |
| 20         | P42     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | TI04/ TO04                       | —                      | —                         | —                       | —                            | —                              | —                                     |
| 21         | P41     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 22         | P40     | —            | —                           | TOOL0                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 23         | P127    | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 24         | P126    | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 25         | P125    | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 26         | —       | —            | —                           | RESET                                     | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 27         | P124    | —            | —                           | XT2/ EXCLKS                               | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 28         | P123    | —            | —                           | XT1                                       | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 29         | P137    | —            | EI137                       | —                                         | —                      | —                   | —                   | INTP0            | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 30         | P122    | —            | EI122                       | X2/EXCLK                                  | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 31         | P121    | —            | EI121                       | X1/VBAT                                   | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |
| 32         | —       | —            | —                           | REGC                                      | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | —                         | —                       | —                            | —                              | —                                     |

Table 1 - 14 Multiplexed Pin Functions of the 128-pin Products (2/5)

| Pin Number | I/O      |              |                             | Power supply, system clock, and debugging | Analog Circuits     |                     |                  | HMI              |                    |                                 | Timers                 |                      | Communications Interfaces     |                              |                                |                                        |
|------------|----------|--------------|-----------------------------|-------------------------------------------|---------------------|---------------------|------------------|------------------|--------------------|---------------------------------|------------------------|----------------------|-------------------------------|------------------------------|--------------------------------|----------------------------------------|
|            | 128LFQFP | Digital port | Output current control port |                                           | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUL) | Timer array unit (TAU) | Realtime Clock (RTC) | Serial array unit (SAU)       | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMIC) |
| 33         | —        | —            | —                           | Vss                                       | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                             | —                            | —                              | —                                      |
| 34         | —        | —            | —                           | EVss0                                     | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                             | —                            | —                              | —                                      |
| 35         | —        | —            | —                           | VDD                                       | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                             | —                            | —                              | —                                      |
| 36         | —        | —            | —                           | EVDD0                                     | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                             | —                            | —                              | —                                      |
| 37         | P60      | CCD04        | EO60                        | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                             | SCLA0                        | —                              | —                                      |
| 38         | P61      | CCD05        | EO61                        | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                             | SDAA0                        | —                              | —                                      |
| 39         | P62      | CCD06        | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                             | SCLA1                        | —                              | —                                      |
| 40         | P63      | CCD07        | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                             | SDAA1                        | —                              | —                                      |
| 41         | P31      | —            | EI31                        | (PCLBUZ0)                                 | —                   | —                   | —                | INTP4            | —                  | TS01                            | TI03/<br>TO03          | —                    | —                             | —                            | —                              | —                                      |
| 42         | P64      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | TS12                            | TI10/<br>TO10          | —                    | —                             | —                            | —                              | —                                      |
| 43         | P65      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | TS13                            | TI11/<br>TO11          | —                    | —                             | —                            | —                              | —                                      |
| 44         | P66      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | TS14                            | TI12/<br>TO12          | —                    | —                             | —                            | —                              | —                                      |
| 45         | P67      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | TS15                            | TI13/<br>TO13          | —                    | —                             | —                            | —                              | —                                      |
| 46         | P77      | —            | —                           | —                                         | —                   | —                   | —                | INTP11           | KR7                | TS09                            | —                      | —                    | (TxD2)                        | —                            | —                              | —                                      |
| 47         | P76      | —            | —                           | —                                         | —                   | —                   | —                | INTP10           | KR6                | TS08                            | —                      | —                    | (RxD2)                        | —                            | —                              | —                                      |
| 48         | P75      | —            | —                           | —                                         | —                   | —                   | —                | INTP9            | KR5                | TS07                            | —                      | —                    | —                             | —                            | —                              | —                                      |
| 49         | P74      | —            | —                           | —                                         | —                   | —                   | —                | INTP8            | KR4                | TS06                            | —                      | —                    | —                             | —                            | —                              | —                                      |
| 50         | P73      | —            | —                           | —                                         | —                   | —                   | —                | —                | KR3                | TS05                            | —                      | —                    | —                             | —                            | —                              | —                                      |
| 51         | P72      | —            | —                           | —                                         | —                   | —                   | —                | —                | KR2                | TS04                            | —                      | —                    | SO21                          | —                            | —                              | —                                      |
| 52         | P71      | —            | —                           | —                                         | —                   | —                   | —                | —                | KR1                | TS03                            | —                      | —                    | SI21/<br>SDA21                | —                            | —                              | —                                      |
| 53         | P70      | —            | —                           | —                                         | —                   | —                   | —                | —                | KR0                | TS02                            | —                      | —                    | SCK21/<br>SCL21               | —                            | —                              | RIN0                                   |
| 54         | P06      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | TS11                            | —                      | —                    | —                             | —                            | —                              | —                                      |
| 55         | P05      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | TS10                            | —                      | —                    | —                             | —                            | —                              | —                                      |
| 56         | —        | —            | —                           | EVss1                                     | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                             | —                            | —                              | —                                      |
| 57         | —        | —            | —                           | EVDD1                                     | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                             | —                            | —                              | —                                      |
| 58         | P80      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | (SCK10)/<br>(SCL10)           | —                            | —                              | —                                      |
| 59         | P81      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | (SI10)/<br>(RxD1)/<br>(SDA10) | —                            | —                              | —                                      |
| 60         | P82      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | (SO10)/<br>(TxD1)             | —                            | —                              | —                                      |
| 61         | P83      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                             | —                            | TxDA0                          | —                                      |
| 62         | P84      | —            | —                           | —                                         | —                   | —                   | —                | (INTP6)          | —                  | —                               | —                      | —                    | —                             | —                            | RxDA0                          | —                                      |
| 63         | P85      | —            | —                           | —                                         | —                   | —                   | —                | (INTP7)          | —                  | —                               | —                      | —                    | —                             | —                            | CLKA0                          | —                                      |
| 64         | P86      | —            | —                           | —                                         | —                   | —                   | —                | (INTP8)          | —                  | —                               | —                      | —                    | —                             | —                            | —                              | —                                      |

Table 1 - 14 Multiplexed Pin Functions of the 128-pin Products (3/5)

| Pin Number | I/O      |              |                             | Power supply, system clock, and debugging | Analog Circuits     |                     |                  | HMI              |                    |                                  | Timers                 |                      | Communications Interfaces |                              |                                |                                        |
|------------|----------|--------------|-----------------------------|-------------------------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|----------------------|---------------------------|------------------------------|--------------------------------|----------------------------------------|
|            | 128LFQFP | Digital port | Output current control port | ELCL input/output port                    | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTS02L) | Timer array unit (TAU) | Realtime Clock (RTC) | Serial array unit (SAU)   | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMIC) |
| 65         | P87      | —            | —                           | —                                         | —                   | —                   | —                | (INTP9)          | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                      |
| 66         | P30      | —            | EI30                        | —                                         | —                   | —                   | VCOUT0           | INTP3            | —                  | TSCAP                            | —                      | RTC1HZ               | —                         | —                            | —                              | —                                      |
| 67         | P50      | CCD03        | EI50/<br>EO50               | —                                         | —                   | —                   | —                | —                | —                  | TS00                             | —                      | —                    | —                         | —                            | —                              | —                                      |
| 68         | P51      | CCD02        | EI51/<br>EO51               | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                      |
| 69         | P52      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | SO31                      | —                            | —                              | —                                      |
| 70         | P53      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | SI31/<br>SDA31            | —                            | —                              | —                                      |
| 71         | P54      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | SCK31/<br>SCL31           | —                            | —                              | —                                      |
| 72         | P55      | —            | —                           | (PCLBUZ1)                                 | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | (SCK00)                   | —                            | —                              | —                                      |
| 73         | P56      | —            | —                           | —                                         | —                   | —                   | —                | (INTP1)          | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                      |
| 74         | P57      | —            | —                           | —                                         | —                   | —                   | —                | (INTP3)          | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                      |
| 75         | P17      | CCD01        | EO17                        | —                                         | —                   | —                   | —                | —                | —                  | —                                | TI02/<br>TO02          | —                    | (SO00)/<br>(TxD0)         | —                            | —                              | —                                      |
| 76         | P16      | CCD00        | EO16                        | —                                         | —                   | —                   | —                | INTP5            | —                  | —                                | TI01/<br>TO01          | —                    | (SI00)/<br>(RxD0)         | —                            | —                              | —                                      |
| 77         | P15      | —            | EO15                        | —                                         | —                   | —                   | —                | —                | —                  | —                                | (TI02)/<br>(TO02)      | —                    | SCK20/<br>SCL20           | —                            | —                              | —                                      |
| 78         | P14      | —            | EO14                        | —                                         | —                   | —                   | VCOUT1           | —                | —                  | —                                | (TI03)/<br>(TO03)      | —                    | SI20/<br>RxD2/<br>SDA20   | (SCLA0)                      | —                              | —                                      |
| 79         | P13      | —            | EO13                        | —                                         | —                   | —                   | IVREF1           | —                | —                  | —                                | (TI04)/<br>(TO04)      | —                    | SO20/<br>TxD2             | (SDAA0)                      | —                              | —                                      |
| 80         | P12      | —            | EI12/<br>EO12               | TOOLTxD                                   | —                   | —                   | —                | (INTP5)          | —                  | —                                | (TI05)/<br>(TO05)      | —                    | SO00/<br>TxD0             | —                            | —                              | —                                      |
| 81         | P11      | —            | EI11/<br>EO11               | TOOLRxD                                   | —                   | —                   | —                | —                | —                  | —                                | (TI06)/<br>(TO06)      | —                    | SI00/<br>RxD0/<br>SDA00   | —                            | —                              | —                                      |
| 82         | P10      | —            | EI10/<br>EO10               | —                                         | —                   | —                   | —                | —                | —                  | —                                | (TI07)/<br>(TO07)      | —                    | SCK00/<br>SCL00           | —                            | —                              | —                                      |
| 83         | P90      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                      |
| 84         | P91      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                      |
| 85         | P92      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                      |
| 86         | P93      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                      |
| 87         | P94      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                      |
| 88         | P95      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | SCK11/<br>SCL11           | —                            | —                              | —                                      |
| 89         | P96      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | SI11/<br>SDA11            | —                            | —                              | —                                      |
| 90         | P97      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | SO11                      | —                            | —                              | —                                      |
| 91         | P112     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                      |
| 92         | P113     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                      |
| 93         | P114     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                                | —                      | —                    | —                         | —                            | —                              | —                                      |

Table 1 - 14 Multiplexed Pin Functions of the 128-pin Products (4/5)

| Pin Number | I/O      |              |                             | Power supply, system clock, and debugging | Analog Circuits     |                     |                  | HMI              |                    |                                 | Timers                 |                      | Communications Interfaces |                              |                                |                                       |
|------------|----------|--------------|-----------------------------|-------------------------------------------|---------------------|---------------------|------------------|------------------|--------------------|---------------------------------|------------------------|----------------------|---------------------------|------------------------------|--------------------------------|---------------------------------------|
|            | 128LFQFP | Digital port | Output current control port |                                           | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSUL) | Timer array unit (TAU) | Realtime Clock (RTC) | Serial array unit (SAU)   | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) | Remote control signal receiver (REMC) |
| 94         | P115     | —            | —                           | —                                         | ANI26               | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 95         | P116     | —            | —                           | —                                         | ANI25               | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 96         | P117     | —            | —                           | —                                         | ANI24               | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 97         | P101     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 98         | P110     | —            | —                           | —                                         | —                   | —                   | —                | (INTP10)         | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 99         | P111     | —            | —                           | —                                         | —                   | —                   | —                | (INTP11)         | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 100        | P146     | —            | —                           | —                                         | —                   | —                   | —                | (INTP4)          | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 101        | P147     | —            | EI147                       | —                                         | ANI18               | —                   | IVCMP0           | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 102        | P100     | —            | —                           | —                                         | ANI20               | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 103        | P156     | —            | —                           | —                                         | ANI14               | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 104        | P155     | —            | —                           | —                                         | ANI13               | —                   | —                | —                | —                  | TS35                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 105        | P154     | —            | —                           | —                                         | ANI12               | —                   | —                | —                | —                  | TS34                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 106        | P153     | —            | —                           | —                                         | ANI11               | —                   | —                | —                | —                  | TS33                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 107        | P152     | —            | —                           | —                                         | ANI10               | —                   | —                | —                | —                  | TS32                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 108        | P151     | —            | —                           | —                                         | ANI9                | —                   | —                | —                | —                  | TS31                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 109        | P150     | —            | —                           | —                                         | ANI8                | —                   | —                | —                | —                  | TS30                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 110        | P27      | —            | —                           | —                                         | ANI7                | —                   | —                | —                | —                  | TS25                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 111        | P26      | —            | —                           | —                                         | ANI6                | —                   | —                | —                | —                  | TS24                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 112        | P25      | —            | —                           | —                                         | ANI5                | —                   | —                | —                | —                  | TS23                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 113        | P24      | —            | —                           | —                                         | ANI4                | —                   | —                | —                | —                  | TS22                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 114        | P23      | —            | EI23                        | —                                         | ANI3                | ANO1                | IVREF0           | —                | —                  | TS21                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 115        | P22      | —            | EI22                        | —                                         | ANI2                | ANO0                | —                | —                | —                  | TS20                            | —                      | —                    | —                         | —                            | —                              | —                                     |
| 116        | P21      | —            | EI21                        | —                                         | ANI1/<br>AVREFM     | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 117        | P20      | —            | EI20                        | —                                         | ANI0/<br>AVREFP     | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 118        | P130     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 119        | P102     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | TI06/<br>TO06          | —                    | —                         | —                            | —                              | —                                     |
| 120        | P07      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | —                         | —                            | —                              | —                                     |
| 121        | P04      | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | —                      | —                    | SCK10/<br>SCL10           | —                            | —                              | —                                     |
| 122        | P03      | —            | —                           | —                                         | ANI16               | —                   | —                | —                | —                  | TS29                            | —                      | —                    | SI10/<br>RxD1/<br>SDA10   | —                            | —                              | —                                     |
| 123        | P02      | —            | —                           | —                                         | ANI17               | —                   | —                | —                | —                  | TS28                            | —                      | —                    | SO10/<br>TxD1             | —                            | —                              | —                                     |
| 124        | P01      | —            | EI01/<br>EO01               | —                                         | —                   | —                   | —                | —                | —                  | TS27                            | TO00                   | —                    | —                         | —                            | —                              | —                                     |
| 125        | P00      | —            | EI00                        | —                                         | —                   | —                   | —                | —                | —                  | TS26                            | TI00                   | —                    | —                         | —                            | —                              | —                                     |
| 126        | P145     | —            | —                           | —                                         | —                   | —                   | —                | —                | —                  | —                               | TI07/<br>TO07          | —                    | —                         | —                            | —                              | —                                     |

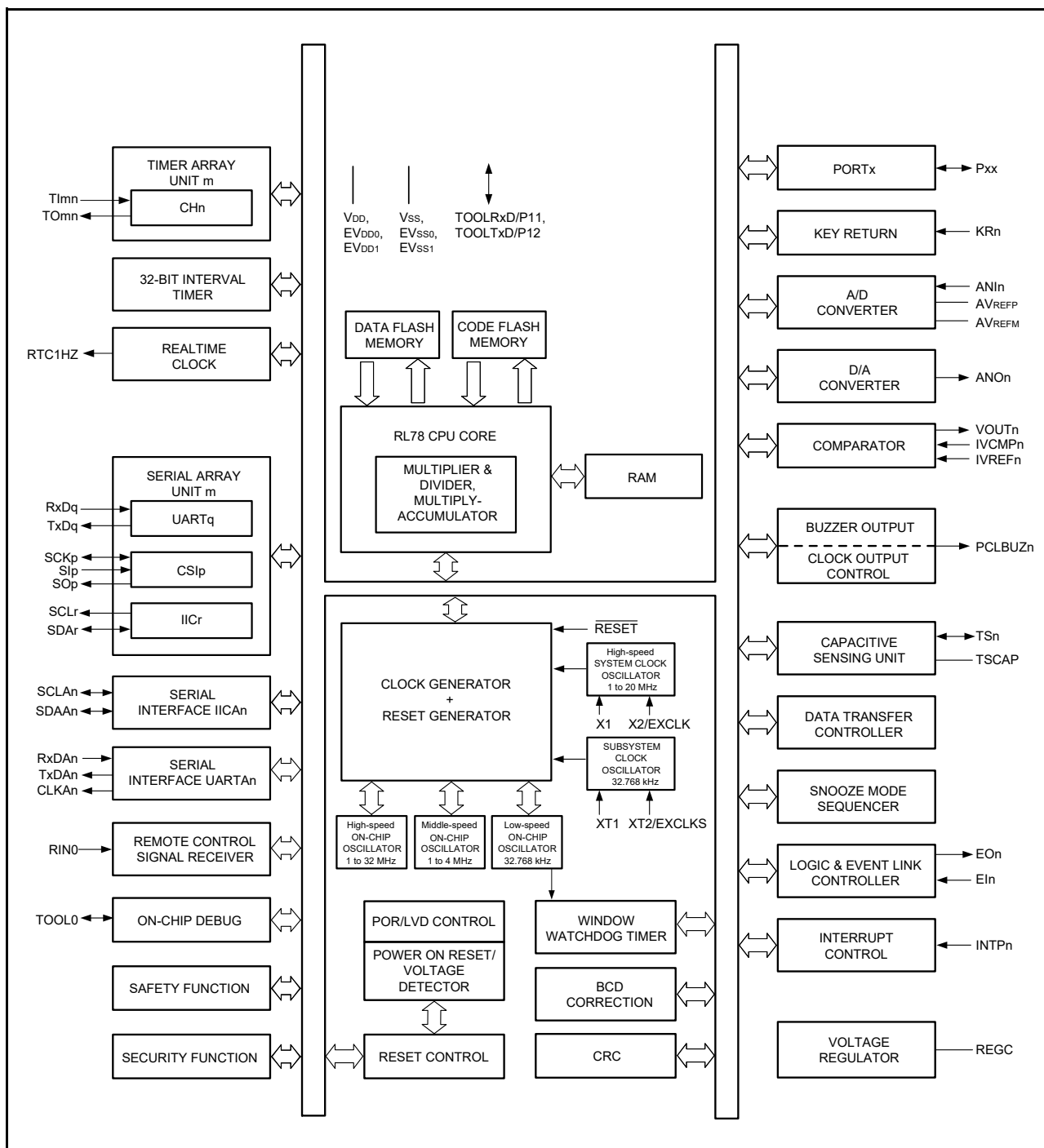
Table 1 - 14 Multiplexed Pin Functions of the 128-pin Products (5/5)

| Pin Number | I/O      |              |                             | Power supply, system clock, and debugging | Analog Circuits        |                     |                     | HMIs             |                  |                    | Timers                           |                        | Communications Interfaces |                         |                              |                                |
|------------|----------|--------------|-----------------------------|-------------------------------------------|------------------------|---------------------|---------------------|------------------|------------------|--------------------|----------------------------------|------------------------|---------------------------|-------------------------|------------------------------|--------------------------------|
|            | 128LFQFP | Digital port | Output current control port |                                           | ELCL input/output port | A/D converter (ADC) | D/A converter (DAC) | Comparator (CMP) | Interrupt (INTP) | Key interrupt (KR) | Capacitive sensing unit (CTSU2L) | Timer array unit (TAU) | Realtime Clock (RTC)      | Serial array unit (SAU) | Serial interface IICA (IICA) | Serial interface UARTA (UARTA) |
| 127        | P144     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | SO30/TxD3                 | —                       | —                            | —                              |
| 128        | P143     | —            | —                           | —                                         | —                      | —                   | —                   | —                | —                | —                  | —                                | —                      | SI30/RxD3/SDA30           | —                       | —                            | —                              |

## 1.4 Pin Identification

|                           |                                              |                             |                                               |
|---------------------------|----------------------------------------------|-----------------------------|-----------------------------------------------|
| ANI0 to ANI14,            |                                              | PCLBUZ0, PCLBUZ1:           | Programmable clock output/buzzer output       |
| ANI16 to ANI26:           | Analog input                                 |                             |                                               |
| ANO0, ANO1:               | Analog output                                | REGC:                       | Regulator capacitance                         |
| AVREFM:                   | Analog reference voltage minus               | RESET:                      | Reset                                         |
| AVREFP:                   | Analog reference voltage plus                | RIN0:                       | IR remote controller input                    |
| CCD00 to CCD07:           | Controlled current drive output              | RTC1HZ:                     | Realtime clock correction clock (1 Hz) output |
| CLKA0, CLKA1:             | Asynchronous serial clock output             |                             |                                               |
| EI00, EI01, EI10 to EI12, |                                              | RxD0 to RxD3,               |                                               |
| EI20 to EI23, EI30, EI31, |                                              | RxDA0, RxDA1:               | Receive data                                  |
| EI50, EI51,               |                                              | SCLA0, SCLA1,               |                                               |
| EI120 to EI122,           |                                              | SCK00, SCK01, SCK10,        |                                               |
| EI137, EI147:             | Logic & event link controller input          | SCK11, SCK20, SCK21,        |                                               |
| EO01, EO10 to EO17,       |                                              | SCK30, SCK31:               | Serial clock input/output                     |
| EO50, EO51,               |                                              | SCL00, SCL01, SCL10,        |                                               |
| EO60, EO61:               | Logic & event link controller output         | SCL11, SCL20, SCL21,        |                                               |
| EVDD0, EVDD1:             | Power supply for port                        | SCL30, SCL31:               | Serial clock output                           |
| EVSS0, EVSS1:             | Ground for port                              | SDAA0, SDAA1, SDA00,        |                                               |
| EXCLK:                    | External clock input<br>(main system clock)  | SDA01, SDA10, SDA11,        |                                               |
| EXCLKS:                   | External clock input<br>(subsystem clock)    | SDA20, SDA21, SDA30,        |                                               |
| INTP0 to INTP11:          | Interrupt request from<br>peripheral modules | SDA31:                      | Serial data input/output                      |
| IVCMP0, IVCMP1:           | Comparator input                             | SI00, SI01, SI10, SI11,     |                                               |
| IVREF0, IVREF1:           | Comparator reference input                   | SI20, SI21, SI30, SI31:     | Serial data input                             |
| KR0 to KR7:               | Key return                                   | SO00, SO01, SO10,           |                                               |
| P00 to P07:               | Port 0                                       | SO11, SO20, SO21,           |                                               |
| P10 to P17:               | Port 1                                       | SO30, SO31:                 | Serial data output                            |
| P20 to P27:               | Port 2                                       | TSCAP:                      | Touch sensor capacitance                      |
| P30 to P37:               | Port 3                                       | TI00 to TI07, TI10 to TI17: | Timer input                                   |
| P40 to P47:               | Port 4                                       | TO00 to TO07,               |                                               |
| P50 to P57:               | Port 5                                       | TO10 to TO17:               | Timer output                                  |
| P60 to P67:               | Port 6                                       | TOOL0:                      | Data input/output for tool                    |
| P70 to P77:               | Port 7                                       | TOOLRxD, TOOLTxD:           | Data input/output for external device         |
| P80 to P87:               | Port 8                                       | TS00 to TS15, TS20 to TS35: | Capacitive sensor                             |
| P90 to P97:               | Port 9                                       | TxD0 to TxD3,               |                                               |
| P100 to P106:             | Port 10                                      | TxDA0, TxDA1:               | Transmit data                                 |
| P110 to P117:             | Port 11                                      | VBAT:                       | Battery backup power supply                   |
| P120 to P127:             | Port 12                                      | VCOU0, VCOU1:               | Comparator output                             |
| P130, P137:               | Port 13                                      | VDD:                        | Power supply                                  |
| P140 to P147:             | Port 14                                      | VSS:                        | Ground                                        |
| P150 to P156:             | Port 15                                      | X1, X2:                     | Crystal oscillator (main system clock)        |
|                           |                                              | XT1, XT2:                   | Crystal oscillator (subsystem clock)          |

## 1.5 Block Diagram



**Caution 1.** 32- to 128-pin products incorporate the remote control signal receiver.

**Caution 2.** 36- to 128-pin products incorporate the serial interface UARTA.

**Caution 3.** 40- to 128-pin products incorporate the key return function.

**Remark** m: Unit number, n: Channel number, p: CSI number, q: UART number, r: Simplified I<sup>2</sup>C number, xx: Port number

## 1.6 Outline of Functions

[30-, 32-, 36-, 40-, 44-, and 48-pin products]

**Caution** This outline describes the functions at the time when peripheral I/O redirection register (PIOR) is set to 00H.

(1/3)

| Item                                                           |                                              | 30-pin                                                                                                                                                                                                                                                                                                                                                                                                                               | 32-pin                                                  | 36-pin                                                  | 40-pin                                                  | 44-pin                                                  | 48-pin                                                  |
|----------------------------------------------------------------|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|
|                                                                |                                              | R7F100GAx                                                                                                                                                                                                                                                                                                                                                                                                                            | R7F100GBx                                               | R7F100GCx                                               | R7F100GEx                                               | R7F100GFx                                               | R7F100GGx                                               |
| Code flash memory                                              |                                              | 96 to 256 KB                                                                                                                                                                                                                                                                                                                                                                                                                         | 96 to 256 KB                                            | 96 to 256 KB                                            | 96 to 256 KB                                            | 96 to 768 KB                                            | 96 to 768 KB                                            |
| Data flash memory                                              |                                              | 8 KB                                                                                                                                                                                                                                                                                                                                                                                                                                 | 8 KB                                                    | 8 KB                                                    | 8 KB                                                    | 8 KB                                                    | 8 KB                                                    |
| RAM                                                            |                                              | 12 to 24 KB                                                                                                                                                                                                                                                                                                                                                                                                                          | 12 to 24 KB                                             | 12 to 24 KB                                             | 12 to 24 KB                                             | 12 to 48 KB                                             | 12 to 48 KB                                             |
| Address space                                                  |                                              | 1 MB                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                         |                                                         |                                                         |                                                         |                                                         |
| CPU/<br>peripheral<br>hardware<br>clock<br>frequency<br>(fCLK) | Main system clock                            | HS (high-speed main) mode: 1 to 32 MHz (VDD = 1.8 to 5.5 V)<br>HS (high-speed main) mode: 1 to 4 MHz <sup>Note 1</sup> (VDD = 1.6 to 5.5 V)<br>LS (low-speed main) mode: 1 to 24 MHz (VDD = 1.8 to 5.5 V)<br>LS (low-speed main) mode: 1 to 4 MHz <sup>Note 1</sup> (VDD = 1.6 to 5.5 V)<br>LP (low-power main) mode: 1 to 2 MHz <sup>Note 2</sup> (VDD = 1.6 to 5.5 V)                                                              |                                                         |                                                         |                                                         |                                                         |                                                         |
|                                                                | Subsystem clock                              | SUB mode: 32.768 kHz (VDD = 1.6 to 5.5 V)                                                                                                                                                                                                                                                                                                                                                                                            |                                                         |                                                         |                                                         |                                                         |                                                         |
| Main system<br>clock                                           | High-speed system clock (fmx)                | 1 to 20 MHz                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                         |                                                         |                                                         |                                                         |                                                         |
|                                                                | High-speed on-chip oscillator clock (fih)    | 1 MHz, 2 MHz, 3 MHz, 4 MHz, 6 MHz, 8 MHz, 12 MHz, 16 MHz, 24 MHz, 32 MHz                                                                                                                                                                                                                                                                                                                                                             |                                                         |                                                         |                                                         |                                                         |                                                         |
|                                                                | Middle-speed on-chip oscillator clock (fim)  | 1 MHz, 2 MHz, 4 MHz                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                         |                                                         |                                                         |                                                         |                                                         |
| Subsystem<br>clock                                             | Subsystem clock X (fsx)                      | 32.768 kHz (VDD = 2.4 to 5.5 V)                                                                                                                                                                                                                                                                                                                                                                                                      |                                                         |                                                         | 32.768 kHz (VDD = 1.6 to 5.5 V)                         |                                                         |                                                         |
|                                                                | Low-speed on-chip oscillator clock (fil)     | 32.768 kHz (typ.)                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                         |                                                         |                                                         |                                                         |                                                         |
| General-purpose registers                                      |                                              | 8 bits × 32 registers (8 bits × 8 registers × 4 banks)                                                                                                                                                                                                                                                                                                                                                                               |                                                         |                                                         |                                                         |                                                         |                                                         |
| Minimum instruction execution time                             |                                              | 0.03125 μs (at the 32-MHz operation with the high-speed on-chip oscillator clock (fih))                                                                                                                                                                                                                                                                                                                                              |                                                         |                                                         |                                                         |                                                         |                                                         |
| Instruction set                                                |                                              | <ul style="list-style-type: none"><li>• Data transfer (8/16 bits)</li><li>• Adder and subtractor/logical operation (8/16 bits)</li><li>• Multiplication (8 bits × 8 bits, 16 bits × 16 bits), division (16 bits ÷ 16 bits, 32 bits ÷ 32 bits)</li><li>• Multiplication and accumulation (16 bits × 16 bits + 32 bits)</li><li>• Rotate, barrel shift, and bit manipulation (set, reset, test, and Boolean operation), etc.</li></ul> |                                                         |                                                         |                                                         |                                                         |                                                         |
| I/O port                                                       | Total number of pins                         | 26                                                                                                                                                                                                                                                                                                                                                                                                                                   | 28                                                      | 32                                                      | 36                                                      | 40                                                      | 44                                                      |
|                                                                | CMOS I/O                                     | 23<br>(N-ch open drain I/O [VDD withstand voltage]: 10)                                                                                                                                                                                                                                                                                                                                                                              | 24<br>(N-ch open drain I/O [VDD withstand voltage]: 10) | 28<br>(N-ch open drain I/O [VDD withstand voltage]: 12) | 30<br>(N-ch open drain I/O [VDD withstand voltage]: 12) | 33<br>(N-ch open drain I/O [VDD withstand voltage]: 12) | 36<br>(N-ch open drain I/O [VDD withstand voltage]: 13) |
|                                                                | CMOS input                                   | 1                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1                                                       | 1                                                       | 3                                                       | 3                                                       | 3                                                       |
|                                                                | CMOS output                                  | —                                                                                                                                                                                                                                                                                                                                                                                                                                    | —                                                       | —                                                       | —                                                       | —                                                       | 1                                                       |
|                                                                | N-ch open drain I/O (withstand voltage: 6 V) | 2                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3                                                       | 3                                                       | 3                                                       | 4                                                       | 4                                                       |
|                                                                | Output current control port                  | 6                                                                                                                                                                                                                                                                                                                                                                                                                                    | 7                                                       | 7                                                       | 7                                                       | 7                                                       | 8                                                       |

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| Item                                   |                               | 30-pin                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 32-pin     | 36-pin     | 40-pin     | 44-pin                                                                                                                    | 48-pin     |
|----------------------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|------------|---------------------------------------------------------------------------------------------------------------------------|------------|
|                                        |                               | R7F100GAx                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | R7F100GBx  | R7F100GCx  | R7F100GEx  | R7F100GFx                                                                                                                 | R7F100GGx  |
| Timers                                 | 16-bit timer                  | 8 channels                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |            |            |                                                                                                                           |            |
|                                        | Watchdog timer                | 1 channel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |            |            |                                                                                                                           |            |
|                                        | Realtime clock (RTC)          | 1 channel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |            |            |                                                                                                                           |            |
|                                        | 32-bit interval timer (TML32) | 1 channel in 32-bit counter mode,<br>2 channels in 16-bit counter mode,<br>4 channels in 8-bit counter mode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |            |            |                                                                                                                           |            |
|                                        | Timer output                  | 4 channels (PWM outputs: 3 <sup>Note 3</sup> ),<br>8 channels (PWM outputs: 7 <sup>Note 3</sup> ) <sup>Note 4</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            |            |            | 5 channels<br>(PWM outputs: 4 <sup>Note 3</sup> ),<br>8 channels<br>(PWM outputs: 7 <sup>Note 3</sup> ) <sup>Note 4</sup> |            |
|                                        | RTC output                    | 1 channel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |            |            |                                                                                                                           |            |
| Clock output/buzzer output             |                               | 2 channels                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |            |            |                                                                                                                           |            |
|                                        |                               | • 3.91 kHz, 7.81 kHz, 15.63 kHz, 2 MHz, 4 MHz, 8 MHz, 16 MHz<br>(at the 32-MHz operation with the main system clock (fMAIN))<br>• 256 Hz, 512 Hz, 1.024 kHz, 2.048 kHz, 4.096 kHz, 8.192 kHz, 16.384 kHz, 32.768 kHz<br>(at the 32.768-kHz operation with the low-speed peripheral clock (fsxp))                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |            |            |                                                                                                                           |            |
| 8-/10-/12-bit resolution A/D converter |                               | 8 channels                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |            | 9 channels | 10 channels                                                                                                               |            |
| D/A converter                          |                               | 2 channels                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |            |            |                                                                                                                           |            |
| Comparator                             |                               | 2 channels                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |            |            |                                                                                                                           |            |
| Serial interface                       |                               | [30- and 32-pin products]<br>• Simplified SPI (CSI): 1 channel/simplified I <sup>2</sup> C: 1 channel/UART: 1 channel<br>• Simplified SPI (CSI): 1 channel/simplified I <sup>2</sup> C: 1 channel/UART: 1 channel<br>• Simplified SPI (CSI): 1 channel/simplified I <sup>2</sup> C: 1 channel/UART (UART supporting LIN-bus): 1 channel<br>[36-, 40-, and 44-pin products]<br>• Simplified SPI (CSI): 1 channel/simplified I <sup>2</sup> C: 1 channel/UART: 1 channel<br>• Simplified SPI (CSI): 1 channel/simplified I <sup>2</sup> C: 1 channel/UART: 1 channel<br>• Simplified SPI (CSI): 2 channels/simplified I <sup>2</sup> C: 2 channels/UART (UART supporting LIN-bus): 1 channel<br>[48-pin products]<br>• Simplified SPI (CSI): 2 channels/simplified I <sup>2</sup> C: 2 channels/UART: 1 channel<br>• Simplified SPI (CSI): 1 channel/simplified I <sup>2</sup> C: 1 channel/UART: 1 channel<br>• Simplified SPI (CSI): 2 channels/simplified I <sup>2</sup> C: 2 channels/UART (UART supporting LIN-bus): 1 channel |            |            |            |                                                                                                                           |            |
|                                        |                               | UARTA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            | 1 channel  |            | 2 channels                                                                                                                |            |
|                                        |                               | I <sup>2</sup> C bus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            | 1 channel  |            |                                                                                                                           | 2 channels |
| Remote control signal receiver         |                               | —                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1 channel  |            |            |                                                                                                                           |            |
| Data transfer controller (DTC)         |                               | 30 sources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 30 sources | 32 sources | 33 sources | 35 sources                                                                                                                | 36 sources |
| Logic and event link controller (ELCL) |                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |            |            |                                                                                                                           |            |
| SNOOZE mode sequencer (SMS)            |                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |            |            |                                                                                                                           |            |
| Capacitive sensing unit                | ROM size: 96 to 128 KB        | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3          | 5          | 6          | 6                                                                                                                         | 8          |
|                                        | ROM size: 192 to 768 KB       | 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 7          | 11         | 13         | 14                                                                                                                        | 16         |
| Vectored interrupt sources             | Internal                      | 31                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 32         | 35         | 35         | 39                                                                                                                        | 39         |
|                                        | External                      | 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 6          | 6          | 7          | 7                                                                                                                         | 10         |
| Key interrupt                          |                               | —                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |            | 4          |                                                                                                                           | 6          |

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| Item                          |      | 30-pin                                                                                                                                                                                                                                                                                                                                                                                                     | 32-pin    | 36-pin    | 40-pin    | 44-pin    | 48-pin    |
|-------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|
|                               |      | R7F100GAx                                                                                                                                                                                                                                                                                                                                                                                                  | R7F100GBx | R7F100GCx | R7F100GEx | R7F100GFx | R7F100GGx |
| Reset                         |      | <ul style="list-style-type: none"> <li>• Reset by RESET pin</li> <li>• Internal reset by watchdog timer</li> <li>• Internal reset by power-on-reset</li> <li>• Internal reset by voltage detectors (LVD0 and LVD1)</li> <li>• Internal reset by illegal instruction execution<sup>Note 5</sup></li> <li>• Internal reset by RAM parity error</li> <li>• Internal reset by illegal-memory access</li> </ul> |           |           |           |           |           |
| Power-on-reset circuit        |      | Detection voltage <ul style="list-style-type: none"> <li>• 1.50 V (typ.)</li> </ul>                                                                                                                                                                                                                                                                                                                        |           |           |           |           |           |
| Voltage detector              | LVD0 | Detection voltage <ul style="list-style-type: none"> <li>• Rising edge: 1.69 V to 3.96 V (6 stages)</li> <li>• Falling edge: 1.65 V to 3.88 V (6 stages)</li> </ul>                                                                                                                                                                                                                                        |           |           |           |           |           |
|                               | LVD1 | Detection voltage <ul style="list-style-type: none"> <li>• Rising edge: 1.67 V to 4.16 V (18 stages)</li> <li>• Falling edge: 1.63 V to 4.08 V (18 stages)</li> </ul>                                                                                                                                                                                                                                      |           |           |           |           |           |
| On-chip debugging             |      | Available (tracing supported)                                                                                                                                                                                                                                                                                                                                                                              |           |           |           |           |           |
| Power supply voltage          |      | VDD = 1.6 to 5.5 V                                                                                                                                                                                                                                                                                                                                                                                         |           |           |           |           |           |
| Operating ambient temperature |      | TA = -40 to +85°C (2D: Consumer applications), TA = -40 to +105°C (3C: Industrial applications)                                                                                                                                                                                                                                                                                                            |           |           |           |           |           |

**Note 1.** Overwrite the flash memory during operation at 2 MHz or a lower frequency.

**Note 2.** When the flash memory is to be overwritten, switch to high-speed main (HS) mode or low-speed main (LS) mode.

**Note 3.** The number of PWM outputs varies depending on the setting of channels in use (the number of masters and slaves).  
For details, see **7.9.3 Operation for the multiple PWM output function** in the RL78/G23 User's Manual.

**Note 4.** This applies when the setting of the PIOR0 bit is 1.

**Note 5.** In normal operation, executing the instruction code FFH triggers an internal reset, but this is not the case during emulation by the on-chip debugging emulator.

**[52-, 64-, 80-, 100-, and 128-pin products]**

**Caution** This outline describes the functions at the time when peripheral I/O redirection register (PIOR) is set to 00H.

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| Item                                                           |                                                          | 52-pin                                                                                                                                                                                                                                                                                                                                                                                                                                     | 64-pin                                                                                                                  | 80-pin                                                                  | 100-pin                                                                 | 128-pin                                                                  |
|----------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------|
|                                                                |                                                          | R7F100GJx                                                                                                                                                                                                                                                                                                                                                                                                                                  | R7F100GLx                                                                                                               | R7F100GMx                                                               | R7F100GPx                                                               | R7F100GSx                                                                |
| Code flash memory                                              |                                                          | 96 to 768 KB                                                                                                                                                                                                                                                                                                                                                                                                                               | 96 to 768 KB                                                                                                            | 128 to 768 KB                                                           | 128 to 768 KB                                                           | 256 to 768 KB                                                            |
| Data flash memory                                              |                                                          | 8 KB                                                                                                                                                                                                                                                                                                                                                                                                                                       | 8 KB                                                                                                                    | 8 KB                                                                    | 8 KB                                                                    | 8 KB                                                                     |
| RAM                                                            |                                                          | 12 to 48 KB                                                                                                                                                                                                                                                                                                                                                                                                                                | 12 to 48 KB                                                                                                             | 16 to 48 KB                                                             | 16 to 48 KB                                                             | 24 to 48 KB                                                              |
| Address space                                                  |                                                          | 1 MB                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                         |                                                                         |                                                                         |                                                                          |
| CPU/<br>peripheral<br>hardware<br>clock<br>frequency<br>(fCLK) | Main system clock                                        | HS (high-speed main) mode: 1 to 32 MHz (V <sub>DD</sub> = 1.8 to 5.5 V)<br>HS (high-speed main) mode: 1 to 4 MHz <sup>Note 1</sup> (V <sub>DD</sub> = 1.6 to 5.5 V)<br>LS (low-speed main) mode: 1 to 24 MHz (V <sub>DD</sub> = 1.8 to 5.5 V)<br>LS (low-speed main) mode: 1 to 4 MHz <sup>Note 1</sup> (V <sub>DD</sub> = 1.6 to 5.5 V)<br>LP (low-power main) mode: 1 to 2 MHz <sup>Note 2</sup> (V <sub>DD</sub> = 1.6 to 5.5 V)        |                                                                                                                         |                                                                         |                                                                         |                                                                          |
|                                                                | Subsystem clock                                          | SUB mode: 32.768 kHz (V <sub>DD</sub> = 1.6 to 5.5 V)                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                         |                                                                         |                                                                         |                                                                          |
| Main<br>system<br>clock                                        | High-speed system clock (f <sub>MX</sub> )               | 1 to 20 MHz                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                         |                                                                         |                                                                         |                                                                          |
|                                                                | High-speed on-chip oscillator clock (f <sub>IH</sub> )   | 1 MHz, 2 MHz, 3 MHz, 4 MHz, 6 MHz, 8 MHz, 12 MHz, 16 MHz, 24 MHz, 32 MHz                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                         |                                                                         |                                                                         |                                                                          |
|                                                                | Middle-speed on-chip oscillator clock (f <sub>IM</sub> ) | 1 MHz, 2 MHz, 4 MHz                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                         |                                                                         |                                                                         |                                                                          |
| Subsystem<br>clock                                             | Subsystem clock X (f <sub>SX</sub> )                     | 32.768 kHz (V <sub>DD</sub> = 1.6 to 5.5 V)                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                         |                                                                         |                                                                         |                                                                          |
|                                                                | Low-speed on-chip oscillator clock (f <sub>IL</sub> )    | 32.768 kHz (typ.)                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                         |                                                                         |                                                                         |                                                                          |
| General-purpose registers                                      |                                                          | 8 bits × 32 registers (8 bits × 8 registers × 4 banks)                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                         |                                                                         |                                                                         |                                                                          |
| Minimum instruction execution time                             |                                                          | 0.03125 μs (at the 32-MHz operation with the high-speed on-chip oscillator clock (f <sub>IH</sub> ))                                                                                                                                                                                                                                                                                                                                       |                                                                                                                         |                                                                         |                                                                         |                                                                          |
| Instruction set                                                |                                                          | <ul style="list-style-type: none"> <li>• Data transfer (8/16 bits)</li> <li>• Adder and subtractor/logical operation (8/16 bits)</li> <li>• Multiplication (8 bits × 8 bits, 16 bits × 16 bits), division (16 bits ÷ 16 bits, 32 bits ÷ 32 bits)</li> <li>• Multiplication and accumulation (16 bits × 16 bits + 32 bits)</li> <li>• Rotate, barrel shift, and bit manipulation (set, reset, test, and Boolean operation), etc.</li> </ul> |                                                                                                                         |                                                                         |                                                                         |                                                                          |
| I/O port                                                       | Total number of pins                                     | 48                                                                                                                                                                                                                                                                                                                                                                                                                                         | 58                                                                                                                      | 74                                                                      | 92                                                                      | 120                                                                      |
|                                                                | CMOS I/O                                                 | 40<br>(N-ch open drain I/O<br>[V <sub>DD</sub> withstand voltage]: 15)                                                                                                                                                                                                                                                                                                                                                                     | 50<br>(N-ch open drain I/O<br>[E <sub>VDD</sub> withstand voltage]:<br>22 <sup>Note 3</sup> /<br>18 <sup>Note 4</sup> ) | 66<br>(N-ch open drain I/O<br>[E <sub>VDD</sub> withstand voltage]: 27) | 84<br>(N-ch open drain I/O<br>[E <sub>VDD</sub> withstand voltage]: 31) | 112<br>(N-ch open drain I/O<br>[E <sub>VDD</sub> withstand voltage]: 33) |
|                                                                | CMOS input                                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3                                                                                                                       | 3                                                                       | 3                                                                       | 3                                                                        |
|                                                                | CMOS output                                              | 1                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1                                                                                                                       | 1                                                                       | 1                                                                       | 1                                                                        |
|                                                                | N-ch open drain I/O<br>(withstand voltage: 6 V)          | 4                                                                                                                                                                                                                                                                                                                                                                                                                                          | 4                                                                                                                       | 4                                                                       | 4                                                                       | 4                                                                        |
|                                                                | Output current control port                              | 8                                                                                                                                                                                                                                                                                                                                                                                                                                          | 8                                                                                                                       | 8                                                                       | 8                                                                       | 8                                                                        |

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| Item                                   |                               | 52-pin                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 64-pin                                            | 80-pin                                              | 100-pin     | 128-pin                                             |
|----------------------------------------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|-----------------------------------------------------|-------------|-----------------------------------------------------|
|                                        |                               | R7F100GJx                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | R7F100GLx                                         | R7F100GMx                                           | R7F100GPx   | R7F100GSx                                           |
| Timers                                 | 16-bit timer                  | 8 channels                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                   | 12 channels                                         |             | 16 channels                                         |
|                                        | Watchdog timer                | 1 channel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                   |                                                     |             |                                                     |
|                                        | Realtime clock (RTC)          | 1 channel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                   |                                                     |             |                                                     |
|                                        | 32-bit interval timer (TML32) | 1 channel in 32-bit counter mode,<br>2 channels in 16-bit counter mode,<br>4 channels in 8-bit counter mode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                   |                                                     |             |                                                     |
|                                        | Timer output                  | 5 channels<br>(PWM outputs: 4 <sup>Note 5</sup> ),<br>8 channels<br>(PWM outputs: 7 <sup>Note 5</sup> ) <sup>Note 6</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 8 channels<br>(PWM outputs: 7 <sup>Note 5</sup> ) | 12 channels<br>(PWM outputs: 10 <sup>Note 5</sup> ) |             | 16 channels<br>(PWM outputs: 14 <sup>Note 5</sup> ) |
|                                        | RTC output                    | 1 channel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                   |                                                     |             |                                                     |
| Clock output/buzzer output             |                               | 2 channels                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                   |                                                     |             |                                                     |
|                                        |                               | • 3.91 kHz, 7.81 kHz, 15.63 kHz, 2 MHz, 4 MHz, 8 MHz, 16 MHz<br>(at the 32-MHz operation with the main system clock (f <sub>MAIN</sub> ))<br>• 256 Hz, 512 Hz, 1.024 kHz, 2.048 kHz, 4.096 kHz, 8.192 kHz, 16.384 kHz, 32.768 kHz<br>(at the 32.768-kHz operation with the low-speed peripheral clock (f <sub>SXP</sub> ))                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                   |                                                     |             |                                                     |
| 8-/10-/12-bit resolution A/D converter |                               | 12 channels                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 12 channels                                       | 17 channels                                         | 20 channels | 26 channels                                         |
| D/A converter                          |                               | 2 channels                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                   |                                                     |             |                                                     |
| Comparator                             |                               | 2 channels                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                   |                                                     |             |                                                     |
| Serial interfaces                      |                               | [52-pin products]<br>• Simplified SPI (CSI): 2 channels/simplified I <sup>2</sup> C: 2 channels/UART: 1 channel<br>• Simplified SPI (CSI): 1 channel/simplified I <sup>2</sup> C: 1 channel/UART: 1 channel<br>• Simplified SPI (CSI): 2 channels/simplified I <sup>2</sup> C: 2 channels/UART (UART supporting LIN-bus): 1 channel<br>[64-pin products]<br>• Simplified SPI (CSI): 2 channels/simplified I <sup>2</sup> C: 2 channels/UART: 1 channel<br>• Simplified SPI (CSI): 2 channels/simplified I <sup>2</sup> C: 2 channels/UART: 1 channel<br>• Simplified SPI (CSI): 2 channels/simplified I <sup>2</sup> C: 2 channels/UART (UART supporting LIN-bus): 1 channel<br>[80-, 100-, and 128-pin products]<br>• Simplified SPI (CSI): 2 channels/simplified I <sup>2</sup> C: 2 channels/UART: 1 channel<br>• Simplified SPI (CSI): 2 channels/simplified I <sup>2</sup> C: 2 channels/UART: 1 channel<br>• Simplified SPI (CSI): 2 channels/simplified I <sup>2</sup> C: 2 channels/UART (UART supporting LIN-bus): 1 channel<br>• Simplified SPI (CSI): 2 channels/simplified I <sup>2</sup> C: 2 channels/UART: 1 channel |                                                   |                                                     |             |                                                     |
|                                        |                               | UARTA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                   |                                                     |             |                                                     |
|                                        |                               | I <sup>2</sup> C bus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                   |                                                     |             |                                                     |
| Remote control signal receiver         |                               | 1 channel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                   |                                                     |             |                                                     |
| Data transfer controller (DTC)         |                               | 36 sources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 37 sources                                        | 39 sources                                          |             |                                                     |
| Logic and event link controller (ELCL) |                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                   |                                                     |             |                                                     |
| SNOOZE mode sequencer (SMS)            |                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                   |                                                     |             |                                                     |
| Capacitive sensing unit                | ROM size: 96 to 128 KB        | 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 12                                                | 30                                                  | 32          | 32                                                  |
|                                        | ROM size: 192 to 768 KB       | 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 22                                                | 30                                                  | 32          | 32                                                  |
| Vectored interrupt sources             | Internal                      | 39                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 39                                                | 44                                                  | 44          | 48                                                  |
|                                        | External                      | 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 13                                                | 13                                                  | 13          | 13                                                  |
| Key interrupt                          |                               | 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                   |                                                     |             |                                                     |

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| Item                          |      | 52-pin                                                                                                                                                                                                                                                                                                                                                                                                                      | 64-pin    | 80-pin    | 100-pin   | 128-pin   |
|-------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|
|                               |      | R7F100GJx                                                                                                                                                                                                                                                                                                                                                                                                                   | R7F100GLx | R7F100GMx | R7F100GPx | R7F100GSx |
| Reset                         |      | <ul style="list-style-type: none"> <li>Reset by <math>\overline{\text{RESET}}</math> pin</li> <li>Internal reset by watchdog timer</li> <li>Internal reset by power-on-reset</li> <li>Internal reset by voltage detectors (LVD0 and LVD1)</li> <li>Internal reset by illegal instruction execution<sup>Note 7</sup></li> <li>Internal reset by RAM parity error</li> <li>Internal reset by illegal-memory access</li> </ul> |           |           |           |           |
| Power-on-reset circuit        |      | Detection voltage<br>• 1.50 V (typ.)                                                                                                                                                                                                                                                                                                                                                                                        |           |           |           |           |
| Voltage detector              | LVD0 | Detection voltage<br>• Rising edge: 1.69 V to 3.96 V (6 stages)<br>• Falling edge: 1.65 V to 3.88 V (6 stages)                                                                                                                                                                                                                                                                                                              |           |           |           |           |
|                               | LVD1 | Detection voltage<br>• Rising edge: 1.67 V to 4.16 V (18 stages)<br>• Falling edge: 1.63 V to 4.08 V (18 stages)                                                                                                                                                                                                                                                                                                            |           |           |           |           |
| On-chip debugging             |      | Available (tracing supported)                                                                                                                                                                                                                                                                                                                                                                                               |           |           |           |           |
| Power supply voltage          |      | VDD = 1.6 to 5.5 V                                                                                                                                                                                                                                                                                                                                                                                                          |           |           |           |           |
| Operating ambient temperature |      | TA = -40 to +85°C (2D: Consumer applications), TA = -40 to +105°C (3C: Industrial applications)                                                                                                                                                                                                                                                                                                                             |           |           |           |           |

**Note 1.** Overwrite the flash memory during operation at 2 MHz or a lower frequency.

**Note 2.** When the flash memory is to be overwritten, switch to high-speed main (HS) mode or low-speed main (LS) mode.

**Note 3.** This only applies to the products with 96- and 128-Kbyte flash memory.

**Note 4.** This only applies to the products with 192- to 768-Kbyte flash memory.

**Note 5.** The number of PWM outputs varies depending on the setting of channels in use (the number of masters and slaves).  
For details, see **7.9.3 Operation for the multiple PWM output function** in the RL78/G23 User's Manual.

**Note 6.** This applies when the setting of the PIOR0 bit is 1.

**Note 7.** In normal operation, executing the instruction code FFH triggers an internal reset, but this is not the case during emulation by the on-chip debugging emulator.

## 2. Electrical Characteristics

This section describes the electrical characteristics of the following products.

- 2D: Consumer applications,  $T_A = -40$  to  $+85^{\circ}\text{C}$   
R7F100Gxx2Dxx
- 3C: Industrial applications,  $T_A = -40$  to  $+105^{\circ}\text{C}$   
R7F100Gxx3Cxx

- Caution 1.** RL78 microcontrollers have on-chip debugging functionality for use in the development and evaluation of user systems. Do not use on-chip debugging with products designated as part of mass production, because using this function may cause the guaranteed number of times the flash memory is rewritten to be exceeded, and product reliability therefore cannot be guaranteed. Renesas Electronics is not liable for problems occurring when on-chip debugging is used with products designated as part of mass production.
- Caution 2.** For the consumer application products, the ambient operating temperature of  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  applies.
- Caution 3.** For products that do not have an EVDD0, EVDD1, EVSS0, or EVSS1 pin, read EVDD0 and EVDD1 as VDD, and EVSS0 and EVSS1 as VSS.
- Caution 4.** The present pins differ depending on the products. For details, see section 2.1 Functions of Port Pins through section 2.2.1 Functions for each product in the RL78/G23 User's Manual.

## 2.1 Absolute Maximum Ratings

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| Item                   | Symbols      | Conditions                                                                                                                                                                                 | Ratings                                                              | Unit |
|------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|------|
| Supply voltage         | VDD          |                                                                                                                                                                                            | -0.5 to +6.5                                                         | V    |
|                        | EVDD0, EVDD1 | EVDD0 = EVDD1                                                                                                                                                                              | -0.5 to +6.5                                                         | V    |
|                        | EVSS0, EVSS1 | EVSS0 = EVSS1                                                                                                                                                                              | -0.5 to +0.3                                                         | V    |
| REGC pin input voltage | VIREGC       | REGC                                                                                                                                                                                       | -0.3 to +2.1<br>and -0.3 to VDD + 0.3 <sup>Note 1</sup>              | V    |
| Input voltage          | Vi1          | P00 to P07, P10 to P17, P30 to P37,<br>P40 to P47, P50 to P57, P64 to P67,<br>P70 to P77, P80 to P87, P90 to P97,<br>P100 to P106, P110 to P117, P120,<br>P125 to P127, P140 to P147       | -0.3 to EVDD0 + 0.3<br>and -0.3 to VDD + 0.3 <sup>Note 2</sup>       | V    |
|                        | Vi2          | P60 to P63 (N-ch open-drain)                                                                                                                                                               | -0.3 to +6.5                                                         | V    |
|                        | Vi3          | P20 to P27, P121 to P124, P137,<br>P150 to P156, EXCLK, EXCLKS, RESET                                                                                                                      | -0.3 to VDD + 0.3 <sup>Note 2</sup>                                  | V    |
| Output voltage         | VO1          | P00 to P07, P10 to P17, P30 to P37,<br>P40 to P47, P50 to P57, P60 to P67,<br>P70 to P77, P80 to P87, P90 to P97,<br>P100 to P106, P110 to P117, P120,<br>P125 to P127, P130, P140 to P147 | -0.3 to EVDD0 + 0.3<br>and -0.3 to VDD + 0.3 <sup>Note 2</sup>       | V    |
|                        | VO2          | P20 to P27, P121, P122, P150 to P156                                                                                                                                                       | -0.3 to VDD + 0.3 <sup>Note 2</sup>                                  | V    |
| Analog input voltage   | VAI1         | ANI16 to ANI26                                                                                                                                                                             | -0.3 to EVDD0 + 0.3<br>and -0.3 to AVREFP + 0.3<br><b>Notes 2, 3</b> | V    |
|                        | VAI2         | ANI0 to ANI14                                                                                                                                                                              | -0.3 to VDD + 0.3<br>and -0.3 to AVREFP + 0.3<br><b>Notes 2, 3</b>   | V    |

**Note 1.** Connect the REGC pin to Vss via a capacitor (0.47 to 1  $\mu$ F). The listed value is the absolute maximum rating of the REGC pin. Only use the capacitor connection. Do not apply a specific voltage to this pin.

**Note 2.** This voltage must be no higher than 6.5 V.

**Note 3.** The voltage on a pin in use for A/D conversion must not exceed AVREFP + 0.3.

**Caution** Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameter. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that the absolute maximum ratings are not exceeded.

**Remark 1.** The characteristics of functions multiplexed on a given pin are the same as those for the port pin unless otherwise specified.

**Remark 2.** AVREFP refers to the positive reference voltage of the A/D converter.

**Remark 3.** The reference voltage is Vss.

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| Item                          | Symbols          | Conditions                       |                                                                                                                                                                                | Ratings     | Unit |
|-------------------------------|------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------|
| High-level output current     | IOH1             | Per pin                          | P00 to P07, P10 to P17, P30 to P37, P40 to P47, P50 to P57, P64 to P67, P70 to P77, P80 to P87, P90 to P97, P100 to P106, P110 to P117, P120, P125 to P127, P130, P140 to P147 | -40         | mA   |
|                               |                  | Total of all pins<br>-170 mA     | P00 to P04, P07, P32 to P37, P40 to P47, P102 to P106, P120, P125 to P127, P130, P140 to P145                                                                                  | -70         | mA   |
|                               |                  |                                  | P05, P06, P10 to P17, P30, P31, P50 to P57, P64 to P67, P70 to P77, P80 to P87, P90 to P97, P100, P101, P110 to P117, P146, P147                                               | -100        | mA   |
|                               | IOH2             | Per pin                          | P20 to P27, P121, P122, P150 to P156                                                                                                                                           | -5          | mA   |
|                               |                  | Total of all pins                |                                                                                                                                                                                | -20         | mA   |
| Low-level output current      | IOL1             | Per pin                          | P00 to P07, P10 to P17, P30 to P37, P40 to P47, P50 to P57, P60 to P67, P70 to P77, P80 to P87, P90 to P97, P100 to P106, P110 to P117, P120, P125 to P127, P130, P140 to P147 | 40Note      | mA   |
|                               |                  | Total of all pins<br>170 mA      | P00 to P04, P07, P32 to P37, P40 to P47, P102 to P106, P120, P125 to P127, P130, P140 to P145                                                                                  | 70          | mA   |
|                               |                  |                                  | P05, P06, P10 to P17, P30, P31, P50 to P57, P60 to P67, P70 to P77, P80 to P87, P90 to P97, P100, P101, P110 to P117, P146, P147                                               | 100         | mA   |
|                               | IOL2             | Per pin                          | P20 to P27, P121, P122, P150 to P156                                                                                                                                           | 10          | mA   |
|                               |                  | Total of all pins                |                                                                                                                                                                                | 20          | mA   |
| Ambient operating temperature | TA               | In normal operation mode         | 3C: Industrial applications                                                                                                                                                    | -40 to +105 | °C   |
|                               |                  |                                  | 2D: Consumer applications                                                                                                                                                      | -40 to +85  |      |
|                               |                  | In flash memory programming mode | 3C: Industrial applications                                                                                                                                                    | -40 to +105 |      |
|                               |                  |                                  | 2D: Consumer applications                                                                                                                                                      | -40 to +85  |      |
| Storage temperature           | T <sub>stg</sub> |                                  |                                                                                                                                                                                | -65 to +150 | °C   |

**Note** The rating for the following port pins is 80 mA when IOL1 = 40.0 mA is specified by the 40-mA port output control register (PTDC).

- Pins P04, P10, and P120 of the 64- to 100-pin package products with 384- to 768-Kbyte flash ROM
- Pin P110 of the 100-pin package products with 384- to 768-Kbyte flash ROM
- Pins P17 and P51 of the 30- to 52-pin package products
- Pin P70 of the 32- to 52-pin package products

**Caution** Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameter. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that the absolute maximum ratings are not exceeded.

**Remark** The characteristics of functions multiplexed on a given pin are the same as those for the port pin unless otherwise specified.

## 2.2 Characteristics of the Oscillators

### 2.2.1 Characteristics of the X1 oscillator

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.6\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ ,  $V_{SS} = 0\text{ V}$ )

| Item                                                            | Resonator                               | Conditions | Min. | Typ. | Max. | Unit          |
|-----------------------------------------------------------------|-----------------------------------------|------------|------|------|------|---------------|
| X1 clock oscillation allowable input cycle time <sup>Note</sup> | Ceramic resonator/<br>crystal resonator |            | 0.05 |      | 1    | $\mu\text{s}$ |

**Note** The listed time and frequency indicate permissible ranges of the oscillator. For actual applications, request evaluation by the manufacturer of the oscillator circuit mounted on a board so you can use appropriate values. Refer to AC Characteristics for instruction execution time.

**Caution** Since the CPU is started by the high-speed on-chip oscillator clock after release from the reset state, the user should use the oscillation stabilization time counter status register (OSTC) to check the X1 clock oscillation stabilization time. Specify the values for the oscillation stabilization time in the OSTC register and the oscillation stabilization time select register (OSTS) after having sufficiently evaluated the oscillation stabilization time with the resonator to be used.

### 2.2.2 Characteristics of the XT1 oscillator

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}$  for the 30- to 36-pin products,  $1.6\text{ V} \leq V_{DD} \leq 5.5\text{ V}$  for the 40- to 128-pin products,  $V_{SS} = 0\text{ V}$ )

| Item                                                         | Resonator         | Conditions | Min. | Typ.   | Max. | Unit |
|--------------------------------------------------------------|-------------------|------------|------|--------|------|------|
| XT1 clock oscillation frequency ( $f_{XT}$ ) <sup>Note</sup> | Crystal resonator |            |      | 32.768 |      | kHz  |

**Note** The listed time and frequency indicate permissible ranges of the oscillator. For actual applications, request evaluation by the manufacturer of the oscillator circuit mounted on a board so you can use appropriate values. Refer to AC Characteristics for instruction execution time.

### 2.2.3 Characteristics of the On-chip Oscillators

(TA = -40 to +105°C, 1.6 V ≤ VDD ≤ 5.5 V, VSS = 0 V)

| Item                                                                       | Symbol          | Conditions                   |               |                                 | Min. | Typ.   | Max.                       | Unit |
|----------------------------------------------------------------------------|-----------------|------------------------------|---------------|---------------------------------|------|--------|----------------------------|------|
| High-speed on-chip oscillator clock frequency                              | f <sub>IH</sub> |                              |               |                                 | 1    |        | 32                         | MHz  |
| High-speed on-chip oscillator clock frequency accuracy <sup>Note 1</sup>   |                 | HIPREC = 1                   | +85 to +105°C | 1.8 V ≤ V <sub>DD</sub> ≤ 5.5 V | -2.0 |        | +2.0                       | %    |
|                                                                            |                 |                              |               | 1.6 V ≤ V <sub>DD</sub> ≤ 5.5 V | -6.0 |        | +6.0                       | %    |
|                                                                            |                 |                              | -20 to +85°C  | 1.8 V ≤ V <sub>DD</sub> ≤ 5.5 V | -1.0 |        | +1.0                       | %    |
|                                                                            |                 |                              |               | 1.6 V ≤ V <sub>DD</sub> ≤ 5.5 V | -5.0 |        | +5.0                       | %    |
|                                                                            |                 |                              | -40 to -20°C  | 1.8 V ≤ V <sub>DD</sub> ≤ 5.5 V | -1.5 |        | +1.5                       | %    |
|                                                                            |                 |                              |               | 1.6 V ≤ V <sub>DD</sub> ≤ 5.5 V | -5.5 |        | +5.5                       | %    |
|                                                                            |                 | HIPREC = 0 <sup>Note 2</sup> |               |                                 | -15  |        | 0                          | %    |
| High-speed on-chip oscillator clock correction resolution                  |                 |                              |               |                                 |      | 0.05   |                            | %    |
| Middle-speed on-chip oscillator clock frequency <sup>Note 3</sup>          | f <sub>IM</sub> |                              |               |                                 | 1    |        | 4                          | MHz  |
| Middle-speed on-chip oscillator clock frequency accuracy <sup>Note 1</sup> |                 |                              |               |                                 | -12  |        | +12                        | %    |
| Middle-speed on-chip oscillator clock correction resolution                |                 |                              |               |                                 |      | 0.15   |                            | %    |
| Middle-speed on-chip oscillator frequency temperature coefficient          |                 |                              |               |                                 |      |        | ±0.17<br><sup>Note 4</sup> | %/°C |
| Low-speed on-chip oscillator clock frequency <sup>Note 3</sup>             | f <sub>IL</sub> |                              |               |                                 |      | 32.768 |                            | kHz  |
| Low-speed on-chip oscillator clock frequency accuracy <sup>Note 1</sup>    |                 |                              |               |                                 | -15  |        | +15                        | %    |
| Low-speed on-chip oscillator clock correction resolution                   |                 |                              |               |                                 |      | 0.3    |                            | %    |
| Low-speed on-chip oscillator frequency temperature coefficient             |                 |                              |               |                                 |      |        | ±0.21<br><sup>Note 4</sup> | %/°C |

**Note 1.** The accuracy values were obtained in testing of this product.

**Note 2.** The listed condition applies when the setting of the FRQSEL3 bit is 1.

**Note 3.** The listed values only indicate the characteristics of the oscillators. Refer to AC Characteristics for instruction execution time.

**Note 4.** Guaranteed by characterization results.

## 2.3 DC Characteristics

### 2.3.1 Pin characteristics

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

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| Item                                                  | Symbol | Conditions                                                                                                                                                                                 | Min.                  | Typ. | Max.                    | Unit |
|-------------------------------------------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------|-------------------------|------|
| Allowable high-level output current <sup>Note 1</sup> | IOH1   | Per pin for P00 to P07, P10 to P17, P30 to P37, P40 to P47, P50 to P57, P64 to P67, P70 to P77, P80 to P87, P90 to P97, P100 to P106, P110 to P117, P120, P125 to P127, P130, P140 to P147 | 1.6 V ≤ EVDD0 ≤ 5.5 V |      | -10.0<br><b>Note 2</b>  | mA   |
|                                                       |        | Total of P00 to P04, P07, P32 to P37, P40 to P47, P102 to P106, P120, P125 to P127, P130, P140 to P145<br>(when duty ≤ 70% <b>Note 3</b> )                                                 | 4.0 V ≤ EVDD0 ≤ 5.5 V |      | -55.0<br><b>Note 4</b>  | mA   |
|                                                       |        |                                                                                                                                                                                            | 2.7 V ≤ EVDD0 < 4.0 V |      | -10.0                   | mA   |
|                                                       |        |                                                                                                                                                                                            | 1.8 V ≤ EVDD0 < 2.7 V |      | -5.0                    | mA   |
|                                                       |        |                                                                                                                                                                                            | 1.6 V ≤ EVDD0 < 1.8 V |      | -2.5                    | mA   |
|                                                       |        | Total of P05, P06, P10 to P17, P30, P31, P50 to P57, P64 to P67, P70 to P77, P80 to P87, P90 to P97, P100, P101, P110 to P117, P146, P147<br>(when duty ≤ 70% <b>Note 3</b> )              | 4.0 V ≤ EVDD0 ≤ 5.5 V |      | -80.0<br><b>Note 5</b>  | mA   |
|                                                       |        |                                                                                                                                                                                            | 2.7 V ≤ EVDD0 < 4.0 V |      | -19.0                   | mA   |
|                                                       |        |                                                                                                                                                                                            | 1.8 V ≤ EVDD0 < 2.7 V |      | -10.0                   | mA   |
|                                                       |        |                                                                                                                                                                                            | 1.6 V ≤ EVDD0 < 1.8 V |      | -5.0                    | mA   |
|                                                       |        | Total of all pins<br>(when duty ≤ 70% <b>Note 3</b> )                                                                                                                                      | 1.6 V ≤ EVDD0 ≤ 5.5 V |      | -135.0<br><b>Note 6</b> | mA   |
|                                                       | IOH2   | Per pin for P20 to P27, P121, P122, P150 to P156                                                                                                                                           | 4.0 V ≤ VDD ≤ 5.5 V   |      | -3.0<br><b>Note 2</b>   | mA   |
|                                                       |        |                                                                                                                                                                                            | 2.7 V ≤ VDD < 4.0 V   |      | -1.0<br><b>Note 2</b>   | mA   |
|                                                       |        |                                                                                                                                                                                            | 1.8 V ≤ VDD < 2.7 V   |      | -1.0<br><b>Note 2</b>   | mA   |
|                                                       |        |                                                                                                                                                                                            | 1.6 V ≤ VDD < 1.8 V   |      | -0.5<br><b>Note 2</b>   | mA   |
|                                                       |        | Total of all pins<br>(when duty ≤ 70% <b>Note 3</b> )                                                                                                                                      | 4.0 V ≤ VDD ≤ 5.5 V   |      | -20.0                   | mA   |
|                                                       |        |                                                                                                                                                                                            | 2.7 V ≤ VDD < 4.0 V   |      | -10.0                   | mA   |
|                                                       |        |                                                                                                                                                                                            | 1.8 V ≤ VDD < 2.7 V   |      | -5.0                    | mA   |
|                                                       |        |                                                                                                                                                                                            | 1.6 V ≤ VDD < 1.8 V   |      | -5.0                    | mA   |

**Note 1.** Device operation is guaranteed at the listed currents even if current is flowing from the EVDD0, EVDD1, or VDD pin to an output pin.

**Note 2.** The combination of these and other pins must also not exceed the value for maximum total current.

**Note 3.** The listed currents apply when the duty cycle is no greater than 70%. Use the following formula to calculate the output current when the duty cycle is greater than 70%, where n is the duty cycle.

• Total output current from the listed pins = (IOH × 0.7)/(n × 0.01)

Example when n = 80% and IOH = -10.0 mA

Total output current from the listed pins = (-10.0 × 0.7)/(80 × 0.01) ≈ -8.7 mA

Note that the duty cycle has no effect on the current that is allowed to flow into a single pin. A current higher than the absolute maximum rating must not flow into a single pin.

(Notes, Caution, and Remark continue on the next page.)

**Note 4.** The maximum value is -30 mA in the products for industrial applications (R7F100Gxx3Cxx) with an ambient operating temperature range of +85°C to +105°C.

**Note 5.** The maximum value is -50 mA in the products for industrial applications (R7F100Gxx3Cxx) with an ambient operating temperature range of +85°C to +105°C.

**Note 6.** The maximum values are respectively -100 mA and -60 mA in the products for industrial applications (R7F100Gxx3Cxx) with an ambient operating temperature range of -40°C to +85°C and of +85°C to +105°C.

**Caution**    **The following pins are not capable of the output of high-level signals in the N-ch open-drain mode.**  
**P00, P02 to P04, P10 to P15, P17, P34, P42 to P45, P50, P52 to P55, P71, P72, P74, P80 to P83, P96, P120, and P142 to P144**

**Remark**    The characteristics of functions multiplexed on a given pin are the same as those for the port pin unless otherwise specified.

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

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| Item                                                 | Symbol | Conditions                                                                                                                                                                                 | Min.                  | Typ. | Max.               | Unit |
|------------------------------------------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------|--------------------|------|
| Allowable low-level output current <sup>Note 1</sup> | IOL1   | Per pin for P00 to P07, P10 to P17, P30 to P37, P40 to P47, P50 to P57, P64 to P67, P70 to P77, P80 to P87, P90 to P97, P100 to P106, P110 to P117, P120, P125 to P127, P130, P140 to P147 |                       |      | 20.0<br>Notes 2, 3 | mA   |
|                                                      |        | Per pin for P60 to P63                                                                                                                                                                     |                       |      | 15.0<br>Note 2     | mA   |
|                                                      |        | Total of P00 to P04, P07, P32 to P37, P40 to P47, P102 to P106, P120, P125 to P127, P130, P140 to P145<br>(when duty ≤ 70% <sup>Note 4</sup> )                                             | 4.0 V ≤ EVDD0 ≤ 5.5 V |      | 70.0<br>Note 5     | mA   |
|                                                      |        |                                                                                                                                                                                            | 2.7 V ≤ EVDD0 < 4.0 V |      | 15.0               | mA   |
|                                                      |        |                                                                                                                                                                                            | 1.8 V ≤ EVDD0 < 2.7 V |      | 9.0                | mA   |
|                                                      |        |                                                                                                                                                                                            | 1.6 V ≤ EVDD0 < 1.8 V |      | 4.5                | mA   |
|                                                      |        | Total of P05, P06, P10 to P17, P30, P31, P50 to P57, P60 to P67, P70 to P77, P80 to P87, P90 to P97, P100, P101, P110 to P117, P146, P147<br>(when duty ≤ 70% <sup>Note 4</sup> )          | 4.0 V ≤ EVDD0 ≤ 5.5 V |      | 80.0<br>Note 5     | mA   |
|                                                      |        |                                                                                                                                                                                            | 2.7 V ≤ EVDD0 < 4.0 V |      | 35.0               | mA   |
|                                                      |        |                                                                                                                                                                                            | 1.8 V ≤ EVDD0 < 2.7 V |      | 20.0               | mA   |
|                                                      |        |                                                                                                                                                                                            | 1.6 V ≤ EVDD0 < 1.8 V |      | 10.0               | mA   |
|                                                      |        | Total of all pins<br>(when duty ≤ 70% <sup>Note 4</sup> )                                                                                                                                  |                       |      | 150.0<br>Note 6    | mA   |
|                                                      | IOL2   | Per pin for P20 to P27, P121, P122, P150 to P156                                                                                                                                           | 4.0 V ≤ VDD ≤ 5.5 V   |      | 8.5<br>Note 2      | mA   |
|                                                      |        |                                                                                                                                                                                            | 2.7 V ≤ VDD < 4.0 V   |      | 1.5<br>Note 2      | mA   |
|                                                      |        |                                                                                                                                                                                            | 1.8 V ≤ VDD < 2.7 V   |      | 0.6<br>Note 2      | mA   |
|                                                      |        |                                                                                                                                                                                            | 1.6 V ≤ VDD < 1.8 V   |      | 0.4<br>Note 2      | mA   |
|                                                      |        | Total of all pins<br>(when duty ≤ 70% <sup>Note 4</sup> )                                                                                                                                  | 4.0 V ≤ VDD ≤ 5.5 V   |      | 20                 | mA   |
|                                                      |        |                                                                                                                                                                                            | 2.7 V ≤ VDD < 4.0 V   |      | 20                 | mA   |
|                                                      |        |                                                                                                                                                                                            | 1.8 V ≤ VDD < 2.7 V   |      | 15                 | mA   |
|                                                      |        |                                                                                                                                                                                            | 1.6 V ≤ VDD < 1.8 V   |      | 10                 | mA   |

**Note 1.** Device operation is guaranteed at the listed currents even if current is flowing from an output pin to the EVSS0, EVSS1, or VSS pin.

**Note 2.** The combination of these and other pins must also not exceed the value for maximum total current.

**Note 3.** The maximum rating for the following port pins is 40 mA when IOL1 = 40.0 mA is specified by the 40-mA port output control register (PTDC).

- Pins P04, P10, and P120 of the 64- to 100-pin package products with 384- to 768-Kbyte flash ROM
- Pin P101 of the 100-pin package products with 384- to 768-Kbyte flash ROM
- Pins P17 and P51 of the 30- to 52-pin package products
- Pin P70 of the 32- to 52-pin package products

**Note 4.** The listed currents apply when the duty cycle is no greater than 70%. Use the following formula to calculate the output current when the duty cycle is greater than 70%, where n is the duty cycle.

- Total output current from the listed pins = (IOL × 0.7)/(n × 0.01)

Example when n = 80% and IOL = 10.0 mA

Total output current from the listed pins = (10.0 × 0.7)/(80 × 0.01) ≈ 8.7 mA

Note that the duty cycle has no effect on the current that is allowed to flow into a single pin. A current higher than the absolute maximum rating must not flow into a single pin.

(Notes and Remark continue on the next page.)

**Note 5.** The maximum value is 40 mA in the products for industrial applications (R7F100Gxx3Cxx) with an ambient operating temperature range of +85°C to +105°C.

**Note 6.** The maximum value is 80 mA in the products for industrial applications (R7F100Gxx3Cxx) with an ambient operating temperature range of +85°C to +105°C.

**Remark** The characteristics of functions multiplexed on a given pin are the same as those for the port pin unless otherwise specified.

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

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| Item                | Symbol | Conditions                                                                                                                                                               |                                           | Min.      | Typ. | Max.      | Unit |
|---------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-----------|------|-----------|------|
| Input voltage, high | VIH1   | P00 to P07, P10 to P17, P30 to P37, P40 to P47, P50 to P57, P64 to P67, P70 to P77, P80 to P87, P90 to P97, P100 to P106, P110 to P117, P120, P125 to P127, P140 to P147 | Normal input buffer                       | 0.8 EVDD0 |      | EVDD0     | V    |
|                     | VIH2   | P01, P03, P04, P10, P11, P13 to P17, P43, P44, P53 to P55, P80, P81, P142, P143                                                                                          | TTL input buffer<br>4.0 V ≤ EVDD0 ≤ 5.5 V | 2.2       |      | EVDD0     | V    |
|                     |        |                                                                                                                                                                          | TTL input buffer<br>3.3 V ≤ EVDD0 < 4.0 V | 2.0       |      | EVDD0     | V    |
|                     |        |                                                                                                                                                                          | TTL input buffer<br>1.6 V ≤ EVDD0 < 3.3 V | 1.5       |      | EVDD0     | V    |
|                     | VIH3   | P20 to P27, P150 to P156                                                                                                                                                 |                                           | 0.7 VDD   |      | VDD       | V    |
|                     | VIH4   | P60 to P63                                                                                                                                                               |                                           | 0.7 EVDD0 |      | 6.0       | V    |
|                     | VIH5   | P121 to P124, P137, EXCLK, EXCLKS, $\overline{\text{RESET}}$                                                                                                             |                                           | 0.8 VDD   |      | VDD       | V    |
| Input voltage, low  | VIL1   | P00 to P07, P10 to P17, P30 to P37, P40 to P47, P50 to P57, P64 to P67, P70 to P77, P80 to P87, P90 to P97, P100 to P106, P110 to P117, P120, P125 to P127, P140 to P147 | Normal input buffer                       | 0         |      | 0.2 EVDD0 | V    |
|                     | VIL2   | P01, P03, P04, P10, P11, P13 to P17, P43, P44, P53 to P55, P80, P81, P142, P143                                                                                          | TTL input buffer<br>4.0 V ≤ EVDD0 ≤ 5.5 V | 0         |      | 0.8       | V    |
|                     |        |                                                                                                                                                                          | TTL input buffer<br>3.3 V ≤ EVDD0 < 4.0 V | 0         |      | 0.5       | V    |
|                     |        |                                                                                                                                                                          | TTL input buffer<br>1.6 V ≤ EVDD0 < 3.3 V | 0         |      | 0.32      | V    |
|                     | VIL3   | P20 to P27, P150 to P156                                                                                                                                                 |                                           | 0         |      | 0.3 VDD   | V    |
|                     | VIL4   | P60 to P63                                                                                                                                                               |                                           | 0         |      | 0.3 EVDD0 | V    |
|                     | VIL5   | P121 to P124, P137, EXCLK, EXCLKS, $\overline{\text{RESET}}$                                                                                                             |                                           | 0         |      | 0.2 VDD   | V    |

**Caution** The maximum value of VIH of pins P00, P02 to P04, P10 to P15, P17, P34, P42 to P45, P50, P52 to P55, P71, P72, P74, P80 to P83, P96, P120, and P142 to P144 is EVDD0, even in the N-ch open-drain mode.

**Remark** The characteristics of functions multiplexed on a given pin are the same as those for the port pin unless otherwise specified.

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

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| Item                 | Symbol | Conditions                                                                                                                                                                                          | Min.                                      | Typ.           | Max. | Unit |
|----------------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|----------------|------|------|
| Output voltage, high | VOH1   | P00 to P07, P10 to P17,<br>P30 to P37, P40 to P47,<br>P50 to P57, P64 to P67,<br>P70 to P77, P80 to P87,<br>P90 to P97, P100 to P106,<br>P110 to P117, P120,<br>P125 to P127, P130,<br>P140 to P147 | 4.0 V ≤ EVDD0 ≤ 5.5 V,<br>IOH1 = -10.0 mA | EVDD0<br>- 1.5 |      | V    |
|                      |        |                                                                                                                                                                                                     | 4.0 V ≤ EVDD0 ≤ 5.5 V,<br>IOH1 = -3.0 mA  | EVDD0<br>- 0.7 |      | V    |
|                      |        |                                                                                                                                                                                                     | 2.7 V ≤ EVDD0 ≤ 5.5 V,<br>IOH1 = -2.0 mA  | EVDD0<br>- 0.6 |      | V    |
|                      |        |                                                                                                                                                                                                     | 1.8 V ≤ EVDD0 ≤ 5.5 V,<br>IOH1 = -1.5 mA  | EVDD0<br>- 0.5 |      | V    |
|                      |        |                                                                                                                                                                                                     | 1.6 V ≤ EVDD0 < 5.5 V,<br>IOH1 = -1.0 mA  | EVDD0<br>- 0.5 |      | V    |
|                      | VOH2   | P20 to P27, P121, P122,<br>P150 to P156                                                                                                                                                             | 4.0 V ≤ VDD ≤ 5.5 V,<br>IOH2 = -3.0 mA    | VDD<br>- 0.7   |      | V    |
|                      |        |                                                                                                                                                                                                     | 2.7 V ≤ VDD < 4.0 V,<br>IOH2 = -1.0 mA    | VDD<br>- 0.5   |      | V    |
|                      |        |                                                                                                                                                                                                     | 1.8 V ≤ VDD < 2.7 V,<br>IOH2 = -1.0 mA    | VDD<br>- 0.5   |      | V    |
|                      |        |                                                                                                                                                                                                     | 1.6 V ≤ VDD < 1.8 V,<br>IOH2 = -0.5 mA    | VDD<br>- 0.5   |      | V    |

**Caution** P00, P02 to P04, P10 to P15, P17, P34, P42 to P45, P50, P52 to P55, P71, P72, P74, P80 to P83, P96, P120, and P142 to P144 do not output high-level signals in the N-ch open-drain mode.

**Remark** The characteristics of functions multiplexed on a given pin are the same as those for the port pin unless otherwise specified.

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

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| Item                | Symbol | Conditions                                                                                                                                                                                          |                                       | Min.                           | Typ. | Max. | Unit |   |
|---------------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------|------|------|------|---|
| Output voltage, low | VOL1   | P00 to P07, P10 to P17,<br>P30 to P37, P40 to P47,<br>P50 to P57, P64 to P67,<br>P70 to P77, P80 to P87,<br>P90 to P97, P100 to P106,<br>P110 to P117, P120,<br>P125 to P127, P130,<br>P140 to P147 | 4.0 V ≤ EVDD0 ≤ 5.5 V                 | IOL1 = 20.0 mA                 |      |      | 1.3  | V |
|                     |        |                                                                                                                                                                                                     |                                       | IOL1 = 40.0 mA <sup>Note</sup> |      |      | 1.3  | V |
|                     |        |                                                                                                                                                                                                     | 4.0 V ≤ EVDD0 ≤ 5.5 V                 | IOL1 = 8.5 mA                  |      |      | 0.7  | V |
|                     |        |                                                                                                                                                                                                     |                                       | IOL1 = 17.0 mA <sup>Note</sup> |      |      | 0.7  | V |
|                     |        |                                                                                                                                                                                                     | 2.7 V ≤ EVDD0 ≤ 5.5 V                 | IOL1 = 3.0 mA                  |      |      | 0.6  | V |
|                     |        |                                                                                                                                                                                                     |                                       | IOL1 = 6.0 mA <sup>Note</sup>  |      |      | 0.6  | V |
|                     |        |                                                                                                                                                                                                     | 2.7 V ≤ EVDD0 ≤ 5.5 V                 | IOL1 = 1.5 mA                  |      |      | 0.4  | V |
|                     |        |                                                                                                                                                                                                     |                                       | IOL1 = 3.0 mA <sup>Note</sup>  |      |      | 0.4  | V |
|                     |        |                                                                                                                                                                                                     | 1.8 V ≤ EVDD0 ≤ 5.5 V                 | IOL1 = 0.6 mA                  |      |      | 0.4  | V |
|                     |        |                                                                                                                                                                                                     |                                       | IOL1 = 1.2 mA <sup>Note</sup>  |      |      | 0.4  | V |
|                     |        |                                                                                                                                                                                                     | 1.6 V ≤ EVDD0 ≤ 5.5 V                 | IOL1 = 0.3 mA                  |      |      | 0.4  | V |
|                     |        |                                                                                                                                                                                                     |                                       | IOL1 = 0.6 mA <sup>Note</sup>  |      |      | 0.4  | V |
|                     | VOL2   | P20 to P27, P121, P122,<br>P150 to P156                                                                                                                                                             | 4.0 V ≤ VDD ≤ 5.5 V, IOL2 = 8.5 mA    |                                |      |      | 0.7  | V |
|                     |        |                                                                                                                                                                                                     | 2.7 V ≤ VDD < 4.0 V, IOL2 = 1.5 mA    |                                |      |      | 0.5  | V |
|                     |        |                                                                                                                                                                                                     | 1.8 V ≤ VDD < 2.7 V, IOL2 = 0.6 mA    |                                |      |      | 0.4  | V |
|                     |        |                                                                                                                                                                                                     | 1.6 V ≤ VDD < 1.8 V, IOL2 = 0.4 mA    |                                |      |      | 0.4  | V |
|                     | VOL3   | P60 to P63                                                                                                                                                                                          | 4.0 V ≤ EVDD0 ≤ 5.5 V, IOL3 = 15.0 mA |                                |      |      | 2.0  | V |
|                     |        |                                                                                                                                                                                                     | 4.0 V ≤ EVDD0 ≤ 5.5 V, IOL3 = 5.0 mA  |                                |      |      | 0.4  | V |
|                     |        |                                                                                                                                                                                                     | 2.7 V ≤ EVDD0 ≤ 5.5 V, IOL3 = 3.0 mA  |                                |      |      | 0.4  | V |
|                     |        |                                                                                                                                                                                                     | 1.8 V ≤ EVDD0 ≤ 5.5 V, IOL3 = 2.0 mA  |                                |      |      | 0.4  | V |
|                     |        |                                                                                                                                                                                                     | 1.6 V ≤ EVDD0 ≤ 5.5 V, IOL3 = 1.0 mA  |                                |      |      | 0.4  | V |

**Note** The listed value applies when IOL1 = 40.0 mA is specified for the following port pins by the 40-mA port output control register (PTDC).

- Pins P04, P10, and P120 of the 64- to 100-pin package products with 384- to 768-Kbyte flash ROM
- Pin P101 of the 100-pin package products with 384- to 768-Kbyte flash ROM
- Pins P17 and P51 of the 30- to 52-pin package products
- Pin P70 of the 32- to 52-pin products

**Remark** The characteristics of functions multiplexed on a given pin are the same as those for the port pin unless otherwise specified.

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

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| Item                           | Symbol | Conditions                        |            |                       | Min. | Typ. | Max. | Unit |
|--------------------------------|--------|-----------------------------------|------------|-----------------------|------|------|------|------|
| Output current <sup>Note</sup> | CCDIOL | P16, P17, P50, P51,<br>P60 to P63 | CCSm = 01H | 4.0 V ≤ EVDD0 ≤ 5.5 V | 1.0  | 1.8  | 2.6  | mA   |
|                                |        |                                   |            | 2.7 V ≤ EVDD0 < 4.0 V | 0.8  | 1.5  | 2.3  | mA   |
|                                |        |                                   | CCSm = 02H | 4.0 V ≤ EVDD0 ≤ 5.5 V | 3.0  | 4.9  | 6.5  | mA   |
|                                |        |                                   |            | 3.0 V ≤ EVDD0 < 4.0 V | 2.7  | 4.3  | 5.9  | mA   |
|                                |        |                                   | CCSm = 03H | 4.0 V ≤ EVDD0 ≤ 5.5 V | 6.6  | 10.0 | 13.2 | mA   |
|                                |        |                                   |            | 3.3 V ≤ EVDD0 < 4.0 V | 6.0  | 9.1  | 12.1 | mA   |
|                                |        | P60 to P63                        | CCSm = 04H | 4.0 V ≤ EVDD0 ≤ 5.5 V | 10.2 | 15.0 | 19.8 | mA   |
|                                |        |                                   |            | 3.3 V ≤ EVDD0 < 4.0 V | 9.4  | 13.8 | 18.2 | mA   |

**Note** The listed currents apply when the output current control function is enabled.

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

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| Item                        | Symbol            | Conditions                                                                                                                                                                       | Min. | Typ. | Max. | Unit |
|-----------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| Input leakage current, high | ILI <sub>H1</sub> | P00 to P07, P10 to P17, P30 to P37, P40 to P47, P50 to P57, P60 to P67, P70 to P77, P80 to P87, P90 to P97, P100 to P106, P110 to P117, P120, P125 to P127, P140 to P147         |      |      | 0.5  | μA   |
|                             | ILI <sub>H2</sub> | P20 to P27, P137, P150 to P156, RESET                                                                                                                                            |      |      | 0.5  | μA   |
|                             | ILI <sub>H3</sub> | P121 to P124 (X1, X2, XT1, XT2, EXCLK, EXCLKS)                                                                                                                                   |      |      | 0.5  | μA   |
| Input leakage current, low  | ILI <sub>L1</sub> | P00 to P07, P10 to P17, P30 to P37, P40 to P47, P50 to P57, P60 to P67, P70 to P77, P80 to P87, P90 to P97, P100 to P106, P110 to P117, P120, P125 to P127, P140 to P147         |      |      | -0.5 | μA   |
|                             | ILI <sub>L2</sub> | P20 to P27, P137, P150 to P156, RESET                                                                                                                                            |      |      | -0.5 | μA   |
|                             | ILI <sub>L3</sub> | P121 to P124 (X1, X2, XT1, XT2, EXCLK, EXCLKS)                                                                                                                                   |      |      | -0.5 | μA   |
| On-chip pll-up resistance   | RU                | P00 to P07, P10 to P17, P30 to P37, P40 to P47, P50 to P57, P64 to P67, P70 to P77, P80 to P87, P90 to P97, P100 to P106, P110 to P117, P120 to P122, P125 to P127, P140 to P147 | 10   | 20   | 100  | kΩ   |

**Remark** The characteristics of functions multiplexed on a given pin are the same as those for the port pin unless otherwise specified.

### 2.3.2 Supply current characteristics

#### 1. 30- to 64-pin package products with 96- to 128-Kbyte flash ROM

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.6\text{ V} \leq \text{EVDD0} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = 0\text{ V}$ )

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| Item                     | Symbol | Conditions                                |                                                                   |                                            |                         |                         | Min. | Typ. | Max. | Unit |
|--------------------------|--------|-------------------------------------------|-------------------------------------------------------------------|--------------------------------------------|-------------------------|-------------------------|------|------|------|------|
| Supply current<br>Note 1 | IDD1   | Operating mode                            | HS (high-speed main) mode                                         | f <sub>IH</sub> = 32 MHz <sup>Note 2</sup> | Basic operation         | V <sub>DD</sub> = 5.0 V |      | 1.3  | —    | mA   |
|                          |        |                                           |                                                                   |                                            |                         | V <sub>DD</sub> = 1.8 V |      | 1.3  | —    |      |
|                          |        |                                           |                                                                   |                                            | Normal operation        | V <sub>DD</sub> = 5.0 V |      | 3.0  | 5.0  | mA   |
|                          |        |                                           |                                                                   |                                            |                         | V <sub>DD</sub> = 1.8 V |      | 3.0  | 5.0  |      |
|                          |        |                                           | LS (low-speed main) mode                                          | f <sub>IH</sub> = 24 MHz <sup>Note 2</sup> | Normal operation        | V <sub>DD</sub> = 5.0 V |      | 2.3  | 3.8  | mA   |
|                          |        |                                           |                                                                   |                                            |                         | V <sub>DD</sub> = 1.8 V |      | 2.3  | 3.8  |      |
|                          |        |                                           |                                                                   | f <sub>IH</sub> = 16 MHz <sup>Note 2</sup> | Normal operation        | V <sub>DD</sub> = 5.0 V |      | 1.7  | 2.7  | mA   |
|                          |        |                                           |                                                                   |                                            |                         | V <sub>DD</sub> = 1.8 V |      | 1.7  | 2.7  |      |
|                          |        |                                           |                                                                   | f <sub>IM</sub> = 4 MHz <sup>Note 3</sup>  | Normal operation        | V <sub>DD</sub> = 5.0 V |      | 0.4  | 0.7  | mA   |
|                          |        |                                           |                                                                   |                                            |                         | V <sub>DD</sub> = 1.6 V |      | 0.4  | 0.7  |      |
|                          |        |                                           | LP (low-power main) mode                                          | f <sub>IM</sub> = 2 MHz <sup>Note 3</sup>  | Normal operation        | V <sub>DD</sub> = 5.0 V |      | 200  | 325  | μA   |
|                          |        |                                           |                                                                   |                                            |                         | V <sub>DD</sub> = 1.6 V |      | 200  | 325  |      |
|                          |        | f <sub>IM</sub> = 1 MHz <sup>Note 3</sup> |                                                                   | Normal operation                           | V <sub>DD</sub> = 5.0 V |                         | 112  | 178  | μA   |      |
|                          |        |                                           |                                                                   |                                            | V <sub>DD</sub> = 1.6 V |                         | 111  | 176  |      |      |
|                          |        | HS (high-speed main) mode                 | f <sub>MX</sub> = 20 MHz <sup>Note 4</sup> , Square wave input    | Normal operation                           | V <sub>DD</sub> = 5.0 V |                         | 1.9  | 3.2  | mA   |      |
|                          |        |                                           |                                                                   |                                            | V <sub>DD</sub> = 1.8 V |                         | 1.9  | 3.2  |      |      |
|                          |        | LS (low-speed main) mode                  | f <sub>MX</sub> = 20 MHz <sup>Note 4</sup> , Square wave input    | Normal operation                           | V <sub>DD</sub> = 5.0 V |                         | 1.8  | 3.0  | mA   |      |
|                          |        |                                           |                                                                   |                                            | V <sub>DD</sub> = 1.8 V |                         | 1.7  | 3.0  |      |      |
|                          |        |                                           | f <sub>MX</sub> = 20 MHz <sup>Note 4</sup> , Resonator connection | Normal operation                           | V <sub>DD</sub> = 5.0 V |                         | 1.9  | 3.2  | mA   |      |
|                          |        |                                           |                                                                   |                                            | V <sub>DD</sub> = 1.8 V |                         | 1.9  | 3.2  |      |      |
|                          |        |                                           | f <sub>MX</sub> = 10 MHz <sup>Note 4</sup> , Square wave input    | Normal operation                           | V <sub>DD</sub> = 5.0 V |                         | 0.9  | 1.6  | mA   |      |
|                          |        |                                           |                                                                   |                                            | V <sub>DD</sub> = 1.8 V |                         | 0.9  | 1.6  |      |      |
|                          |        |                                           | f <sub>MX</sub> = 10 MHz <sup>Note 4</sup> , Resonator connection | Normal operation                           | V <sub>DD</sub> = 5.0 V |                         | 1.0  | 1.7  | mA   |      |
|                          |        |                                           |                                                                   |                                            | V <sub>DD</sub> = 1.8 V |                         | 1.0  | 1.7  |      |      |
|                          |        |                                           | f <sub>MX</sub> = 8 MHz <sup>Note 4</sup> , Square wave input     | Normal operation                           | V <sub>DD</sub> = 5.0 V |                         | 0.8  | 1.3  | mA   |      |
|                          |        |                                           |                                                                   |                                            | V <sub>DD</sub> = 1.8 V |                         | 0.7  | 1.3  |      |      |
|                          |        |                                           | f <sub>MX</sub> = 8 MHz <sup>Note 4</sup> , Resonator connection  | Normal operation                           | V <sub>DD</sub> = 5.0 V |                         | 0.9  | 1.4  | mA   |      |
|                          |        |                                           |                                                                   |                                            | V <sub>DD</sub> = 1.8 V |                         | 0.8  | 1.4  |      |      |

**Note 1.** The listed currents are the total currents flowing into VDD and EVDD0, including the input leakage currents flowing when the level of the input pin is fixed to VDD, EVDD0 or VSS, EVSS0. The following points apply in the HS (high-speed main), LS (low-speed main), and LP (low-power main) modes.

- The currents in the "Typ." column do not include the operating currents of the peripheral modules.
- The currents in the "Max." column include the operating currents of the peripheral modules, except for those flowing into the A/D converter, LVD circuit, I/O port, and on-chip pull-up/pull-down resistors, and those flowing while the data flash memory is being rewritten.

**Note 2.** The listed currents apply when the high-speed system clock, middle-speed on-chip oscillator, low-speed on-chip oscillator, and subsystem clock are stopped.

**Note 3.** The listed currents apply when the high-speed on-chip oscillator, high-speed system clock, low-speed on-chip oscillator, and subsystem clock are stopped.

(Note and Remarks are listed on the next page.)

<R>

**Note 4.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, low-speed on-chip oscillator, and subsystem clock are stopped.

**Remark 1.** f<sub>IH</sub>: High-speed on-chip oscillator clock frequency

**Remark 2.** f<sub>IM</sub>: Middle-speed on-chip oscillator clock frequency

**Remark 3.** f<sub>MX</sub>: High-speed system clock frequency (X1 clock oscillation frequency or external main system clock frequency)

**Remark 4.** The typical value for the ambient operating temperature (T<sub>A</sub>) is +25°C unless otherwise specified.

## 1. 30- to 64-pin package products with 96- to 128-Kbyte flash ROM

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = 0 V)

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| Item                     | Symbol | Conditions     |                                |                                                                                 |                  |             | Min. | Typ. | Max. | Unit |
|--------------------------|--------|----------------|--------------------------------|---------------------------------------------------------------------------------|------------------|-------------|------|------|------|------|
| Supply current<br>Note 1 | IDD1   | Operating mode | Subsystem clock operation mode | fsUB = 32.768 kHz <sup>Note 2</sup> ,<br>Low-speed on-chip oscillator operation | Normal operation | TA = -40°C  |      | 3.2  | 5.5  | μA   |
|                          |        |                |                                |                                                                                 |                  | TA = +25°C  |      | 3.5  | 5.8  |      |
|                          |        |                |                                |                                                                                 |                  | TA = +50°C  |      | 3.8  | 8.5  |      |
|                          |        |                |                                |                                                                                 |                  | TA = +70°C  |      | 4.4  | 13.8 |      |
|                          |        |                |                                |                                                                                 |                  | TA = +85°C  |      | 5.3  | 22.1 |      |
|                          |        |                |                                |                                                                                 |                  | TA = +105°C |      | 7.7  | 40.9 |      |
|                          |        |                |                                | fsUB = 32.768 kHz <sup>Note 3</sup> ,<br>Square wave input                      | Normal operation | TA = -40°C  |      | 3.2  | 5.6  | μA   |
|                          |        |                |                                |                                                                                 |                  | TA = +25°C  |      | 3.4  | 5.7  |      |
|                          |        |                |                                |                                                                                 |                  | TA = +50°C  |      | 3.7  | 8.5  |      |
|                          |        |                |                                |                                                                                 |                  | TA = +70°C  |      | 4.3  | 13.7 |      |
|                          |        |                |                                |                                                                                 |                  | TA = +85°C  |      | 5.2  | 21.4 |      |
|                          |        |                |                                |                                                                                 |                  | TA = +105°C |      | 7.6  | 39.0 |      |
|                          |        |                |                                | fsUB = 32.768 kHz <sup>Note 3</sup> ,<br>Resonator connection                   | Normal operation | TA = -40°C  |      | 3.2  | 5.2  | μA   |
|                          |        |                |                                |                                                                                 |                  | TA = +25°C  |      | 3.4  | 5.4  |      |
|                          |        |                |                                |                                                                                 |                  | TA = +50°C  |      | 3.7  | 7.7  |      |
|                          |        |                |                                |                                                                                 |                  | TA = +70°C  |      | 4.3  | 13.4 |      |
|                          |        |                |                                |                                                                                 |                  | TA = +85°C  |      | 5.2  | 20.9 |      |
|                          |        |                |                                |                                                                                 |                  | TA = +105°C |      | 7.7  | 38.5 |      |

<R> **Note 1.** The listed currents are the total currents flowing into VDD and EVDD0, including the input leakage currents flowing when the level of the input pin is fixed to VDD, EVDD0 or VSS, EVSS0. In the subsystem clock operation mode, the currents in both the "Typ." and "Max." columns do not include the operating currents of the peripheral modules.

<R> **Note 2.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, high-speed system clock, and subsystem clock are stopped.

<R> **Note 3.** The listed currents apply when the high-speed on-chip oscillator, high-speed system clock, middle-speed on-chip oscillator, and low-speed on-chip oscillator are stopped, and the low power consumption oscillation 3 is specified (AMPHS1, AMPHS0 = 1, 1).

**Remark 1.** fIL: Low-speed on-chip oscillator clock frequency

**Remark 2.** fsUB: Subsystem clock frequency (XT1 clock oscillation frequency)

## 1. 30- to 64-pin package products with 96- to 128-Kbyte flash ROM

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = 0 V)

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| Item                            | Symbol                       | Conditions |                                 |                                                                  |             | Min. | Typ. | Max. | Unit |
|---------------------------------|------------------------------|------------|---------------------------------|------------------------------------------------------------------|-------------|------|------|------|------|
| Supply current<br><b>Note 1</b> | <b>IDD2</b><br><b>Note 2</b> | HALT mode  | HS<br>(high-speed main)<br>mode | f <sub>IH</sub> = 32 MHz <b>Note 3</b>                           | VDD = 5.0 V |      | 0.54 | 1.93 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.53 | 1.92 |      |
|                                 |                              |            | LS<br>(low-speed main)<br>mode  | f <sub>IH</sub> = 24 MHz <b>Note 3</b>                           | VDD = 5.0 V |      | 0.45 | 1.50 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.44 | 1.49 |      |
|                                 |                              |            |                                 | f <sub>IH</sub> = 16 MHz <b>Note 3</b>                           | VDD = 5.0 V |      | 0.45 | 1.19 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.44 | 1.18 |      |
|                                 |                              |            |                                 | f <sub>IM</sub> = 4 MHz <b>Note 4</b>                            | VDD = 5.0 V |      | 0.08 | 0.26 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.6 V |      | 0.08 | 0.26 |      |
|                                 |                              |            | LP<br>(low-power main)<br>mode  | f <sub>IM</sub> = 2 MHz <b>Note 4</b>                            | VDD = 5.0 V |      | 33   | 120  | μA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.6 V |      | 33   | 120  |      |
|                                 |                              |            |                                 | f <sub>IM</sub> = 1 MHz <b>Note 4</b>                            | VDD = 5.0 V |      | 29   | 76   | μA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.6 V |      | 28   | 74   |      |
|                                 |                              |            | HS<br>(high-speed main)<br>mode | f <sub>MX</sub> = 20 MHz <b>Note 5</b> ,<br>Square wave input    | VDD = 5.0 V |      | 0.22 | 1.07 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.19 | 1.03 |      |
|                                 |                              |            | LS<br>(low-speed main)<br>mode  | f <sub>MX</sub> = 20 MHz <b>Note 5</b> ,<br>Square wave input    | VDD = 5.0 V |      | 0.22 | 1.07 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.19 | 1.03 |      |
|                                 |                              |            |                                 | f <sub>MX</sub> = 20 MHz <b>Note 5</b> ,<br>Resonator connection | VDD = 5.0 V |      | 0.40 | 1.28 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.39 | 1.27 |      |
|                                 |                              |            |                                 | f <sub>MX</sub> = 10 MHz <b>Note 5</b> ,<br>Square wave input    | VDD = 5.0 V |      | 0.14 | 0.57 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.12 | 0.54 |      |
|                                 |                              |            |                                 | f <sub>MX</sub> = 10 MHz <b>Note 5</b> ,<br>Resonator connection | VDD = 5.0 V |      | 0.24 | 0.69 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.23 | 0.68 |      |
|                                 |                              |            |                                 | f <sub>MX</sub> = 8 MHz <b>Note 5</b> ,<br>Square wave input     | VDD = 5.0 V |      | 0.12 | 0.47 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.10 | 0.44 |      |
|                                 |                              |            |                                 | f <sub>MX</sub> = 8 MHz <b>Note 5</b> ,<br>Resonator connection  | VDD = 5.0 V |      | 0.21 | 0.58 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.20 | 0.57 |      |

**Note 1.** The listed currents are the total currents flowing into VDD and EVDD0, including the input leakage currents flowing when the level of the input pin is fixed to VDD, EVDD0 or VSS, EVSS0. The following points apply in the HS (high-speed main), LS (low-speed main), and LP (low-power main) modes.

- The currents in the "Typ." column do not include the operating currents of the peripheral modules.
- The currents in the "Max." column include the operating currents of the peripheral modules, except for those flowing into the A/D converter, LVD circuit, I/O port, and on-chip pull-up/pull-down resistors, and those flowing while the data flash memory is being rewritten.

**Note 2.** The listed currents apply when the HALT instruction has been fetched from the flash memory for execution.

**Note 3.** The listed currents apply when the high-speed system clock, middle-speed on-chip oscillator, low-speed on-chip oscillator, and subsystem clock are stopped.

**Note 4.** The listed currents apply when the high-speed on-chip oscillator, high-speed system clock, low-speed on-chip oscillator, and subsystem clock are stopped.

**Note 5.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, low-speed on-chip oscillator, and subsystem clock are stopped.

(Remarks are listed on the next page.)

**Remark 1.** f<sub>IH</sub>: High-speed on-chip oscillator clock frequency

**Remark 2.** f<sub>IM</sub>: Middle-speed on-chip oscillator clock frequency

**Remark 3.** f<sub>MX</sub>: High-speed system clock frequency (X1 clock oscillation frequency or external main system clock frequency)

**Remark 4.** The typical value for the ambient operating temperature (T<sub>A</sub>) is +25°C unless otherwise specified.

## 1. 30- to 64-pin package products with 96- to 128-Kbyte flash ROM

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = 0 V)

(4/4)

| Item                                                 | Symbol         | Conditions |                                |                                                                    |             | Min.      | Typ.             | Max.        | Unit |      |      |    |
|------------------------------------------------------|----------------|------------|--------------------------------|--------------------------------------------------------------------|-------------|-----------|------------------|-------------|------|------|------|----|
| Supply current<br>Note 1                             | IDD2<br>Note 2 | HALT mode  | Subsystem clock operation mode | fSUB = 32.768 kHzNote 3,<br>Low-speed on-chip oscillator operation | TA = -40°C  |           | 0.53             | 2.31        | μA   |      |      |    |
|                                                      |                |            |                                |                                                                    | TA = +25°C  |           | 0.65             | 2.38        |      |      |      |    |
|                                                      |                |            |                                |                                                                    | TA = +50°C  |           | 0.80             | 4.95        |      |      |      |    |
|                                                      |                |            |                                |                                                                    | TA = +70°C  |           | 1.17             | 9.97        |      |      |      |    |
|                                                      |                |            |                                |                                                                    | TA = +85°C  |           | 1.78             | 17.96       |      |      |      |    |
|                                                      |                |            |                                |                                                                    | TA = +105°C |           | 4.41             | 37.71       |      |      |      |    |
|                                                      |                |            |                                | fSUB = 32.768 kHz,<br>Square wave input Note 4                     | TA = -40°C  |           | 0.20             | 1.97        | μA   |      |      |    |
|                                                      |                |            |                                |                                                                    | TA = +25°C  |           | 0.29             | 2.00        |      |      |      |    |
|                                                      |                |            |                                |                                                                    | TA = +50°C  |           | 0.54             | 5.33        |      |      |      |    |
|                                                      |                |            |                                |                                                                    | TA = +70°C  |           | 0.99             | 10.94       |      |      |      |    |
|                                                      |                |            |                                |                                                                    | TA = +85°C  |           | 1.70             | 19.62       |      |      |      |    |
|                                                      |                |            |                                |                                                                    | TA = +105°C |           | 4.10             | 41.82       |      |      |      |    |
|                                                      |                |            |                                | fSUB = 32.768 kHz,<br>Resonator connection Note 5                  | TA = -40°C  |           | 0.21             | 2.04        | μA   |      |      |    |
|                                                      |                |            |                                |                                                                    | TA = +25°C  |           | 0.33             | 2.28        |      |      |      |    |
|                                                      |                |            |                                |                                                                    | TA = +50°C  |           | 0.49             | 4.98        |      |      |      |    |
|                                                      |                |            |                                |                                                                    | TA = +70°C  |           | 1.05             | 11.36       |      |      |      |    |
|                                                      |                |            |                                |                                                                    | TA = +85°C  |           | 1.76             | 20.04       |      |      |      |    |
|                                                      |                |            |                                |                                                                    | TA = +105°C |           | 4.20             | 42.52       |      |      |      |    |
|                                                      |                |            |                                |                                                                    | IDD3        | STOP mode | RAMSDS = 0Note 6 | TA = -40°C  |      | 0.15 | 1.45 | μA |
|                                                      |                |            |                                |                                                                    |             |           |                  | TA = +25°C  |      | 0.23 | 1.45 |    |
|                                                      |                |            |                                |                                                                    |             |           |                  | TA = +50°C  |      | 0.45 | 4    |    |
|                                                      |                |            |                                |                                                                    |             |           |                  | TA = +70°C  |      | 0.9  | 9    |    |
|                                                      |                |            |                                |                                                                    |             |           |                  | TA = +85°C  |      | 1.6  | 17   |    |
|                                                      |                |            |                                |                                                                    |             |           |                  | TA = +105°C |      | 4    | 35   |    |
| RAMSDS = 1Note 7                                     | TA = -40°C     |            | 0.14                           |                                                                    |             |           |                  | 1.45        | μA   |      |      |    |
|                                                      | TA = +25°C     |            | 0.21                           |                                                                    |             |           |                  | 1.45        |      |      |      |    |
|                                                      | TA = +50°C     |            | 0.4                            |                                                                    |             |           |                  | 3.5         |      |      |      |    |
|                                                      | TA = +70°C     |            | 0.8                            |                                                                    |             |           |                  | 8.5         |      |      |      |    |
|                                                      | TA = +85°C     |            | 1.4                            |                                                                    |             |           |                  | 15          |      |      |      |    |
|                                                      | TA = +105°C    |            | 3.2                            |                                                                    |             |           |                  | 30          |      |      |      |    |
| RAMSDS = 1,<br>128-Hz realtime clock operationNote 8 | TA = -40°C     |            | 0.22                           |                                                                    |             |           | 1.53             | μA          |      |      |      |    |
|                                                      | TA = +25°C     |            | 0.32                           |                                                                    |             |           | 1.56             |             |      |      |      |    |
|                                                      | TA = +50°C     |            | 0.53                           |                                                                    |             |           | 3.62             |             |      |      |      |    |
|                                                      | TA = +70°C     |            | 0.94                           |                                                                    |             |           | 8.64             |             |      |      |      |    |
|                                                      | TA = +85°C     |            | 1.55                           |                                                                    |             |           | 15.15            |             |      |      |      |    |
|                                                      | TA = +105°C    |            | 3.40                           |                                                                    |             |           | 30.20            |             |      |      |      |    |

(Notes and Remarks are listed on the next page.)

- <R> **Note 1.** The listed currents are the total currents flowing into VDD and EVDD0, including the input leakage currents flowing when the level of the input pin is fixed to VDD, EVDD0 or VSS, EVSS0. In the subsystem clock operation mode or the STOP mode, the currents in both the "Typ." and "Max." columns do not include the operating currents of the peripheral modules.
- Note 2.** The listed currents apply when the HALT instruction has been fetched from the flash memory for execution.
- <R> **Note 3.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, high-speed system clock, and subsystem clock are stopped.
- <R> **Note 4.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, high-speed system clock, and low-speed on-chip oscillator are stopped.
- <R> **Note 5.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, high-speed system clock, and low-speed on-chip oscillator are stopped, and the setting of RTCLPC is 1, and the low power consumption oscillation 3 is specified (AMPHS1, AMPHS0 = 1, 1).
- <R> **Note 6.** The listed currents with this setting allow retention of the contents of the entire RAM area. The listed currents apply when the low-speed on-chip oscillator and subsystem clock oscillation are stopped. For the current for operation of the subsystem clock in the STOP mode, refer to that in the HALT mode.
- <R> **Note 7.** The listed currents with this setting allow retention of the contents of a specified 4-Kbyte area of the RAM. The listed currents apply when the low-speed on-chip oscillator and subsystem clock oscillation are stopped.
- <R> **Note 8.** The listed currents with this setting allow retention of the contents of a specified 4-Kbyte area of the RAM. The listed currents apply when the low-speed on-chip oscillator is stopped, the setting of RTCLPC is 1, and the low power consumption oscillation 3 is specified (AMPHS1, AMPHS0 = 1, 1). The current flowing into the RTC is included.

**Remark 1.** fIL: Low-speed on-chip oscillator clock frequency

**Remark 2.** fSUB: Subsystem clock frequency (XT1 clock oscillation frequency)

2. 30- to 64-pin package products with 192- to 256-Kbyte flash ROM and 80-pin package product with 128- to 256-Kbyte flash ROM

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = 0 V)

(1/4)

| Item                     | Symbol | Conditions     |                           |                                                                   |                  |             | Min. | Typ. | Max. | Unit |
|--------------------------|--------|----------------|---------------------------|-------------------------------------------------------------------|------------------|-------------|------|------|------|------|
| Supply current<br>Note 1 | IDD1   | Operating mode | HS (high-speed main) mode | f <sub>IH</sub> = 32 MHz <sup>Note 2</sup>                        | Basic operation  | VDD = 5.0 V |      | 1.4  | —    | mA   |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 1.4  | —    |      |
|                          |        |                |                           |                                                                   | Normal operation | VDD = 5.0 V |      | 3.0  | 5.0  | mA   |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 3.0  | 5.0  |      |
|                          |        |                | LS (low-speed main) mode  | f <sub>IH</sub> = 24 MHz <sup>Note 2</sup>                        | Normal operation | VDD = 5.0 V |      | 2.3  | 3.8  | mA   |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 2.3  | 3.8  |      |
|                          |        |                |                           | f <sub>IH</sub> = 16 MHz <sup>Note 2</sup>                        | Normal operation | VDD = 5.0 V |      | 1.7  | 2.8  | mA   |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 1.7  | 2.7  |      |
|                          |        |                |                           | f <sub>IM</sub> = 4 MHz <sup>Note 3</sup>                         | Normal operation | VDD = 5.0 V |      | 0.4  | 0.7  | mA   |
|                          |        |                |                           |                                                                   |                  | VDD = 1.6 V |      | 0.4  | 0.7  |      |
|                          |        |                | LP (low-power main) mode  | f <sub>IM</sub> = 2 MHz <sup>Note 3</sup>                         | Normal operation | VDD = 5.0 V |      | 203  | 329  | μA   |
|                          |        |                |                           |                                                                   |                  | VDD = 1.6 V |      | 202  | 328  |      |
|                          |        |                |                           | f <sub>IM</sub> = 1 MHz <sup>Note 3</sup>                         | Normal operation | VDD = 5.0 V |      | 115  | 181  | μA   |
|                          |        |                |                           |                                                                   |                  | VDD = 1.6 V |      | 114  | 180  |      |
|                          |        |                | HS (high-speed main) mode | f <sub>MX</sub> = 20 MHz <sup>Note 4</sup> , Square wave input    | Normal operation | VDD = 5.0 V |      | 1.9  | 3.2  | mA   |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 1.9  | 3.2  |      |
|                          |        |                | LS (low-speed main) mode  | f <sub>MX</sub> = 20 MHz <sup>Note 4</sup> , Square wave input    | Normal operation | VDD = 5.0 V |      | 1.8  | 3.0  | mA   |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 1.7  | 3.0  |      |
|                          |        |                |                           | f <sub>MX</sub> = 20 MHz <sup>Note 4</sup> , Resonator connection | Normal operation | VDD = 5.0 V |      | 1.9  | 3.2  | mA   |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 1.9  | 3.2  |      |
|                          |        |                |                           | f <sub>MX</sub> = 10 MHz <sup>Note 4</sup> , Square wave input    | Normal operation | VDD = 5.0 V |      | 0.9  | 1.6  | mA   |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 0.9  | 1.6  |      |
|                          |        |                |                           | f <sub>MX</sub> = 10 MHz <sup>Note 4</sup> , Resonator connection | Normal operation | VDD = 5.0 V |      | 1.0  | 1.7  | mA   |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 1.0  | 1.7  |      |
|                          |        |                |                           | f <sub>MX</sub> = 8 MHz <sup>Note 4</sup> , Square wave input     | Normal operation | VDD = 5.0 V |      | 0.8  | 1.3  | mA   |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 0.7  | 1.3  |      |
|                          |        |                |                           | f <sub>MX</sub> = 8 MHz <sup>Note 4</sup> , Resonator connection  | Normal operation | VDD = 5.0 V |      | 0.9  | 1.4  | mA   |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 0.8  | 1.4  |      |

**Note 1.** The listed currents are the total currents flowing into VDD and EVDD0, including the input leakage currents flowing when the level of the input pin is fixed to VDD, EVDD0 or VSS, EVSS0. The following points apply in the HS (high-speed main), LS (low-speed main), and LP (low-power main) modes.

- The currents in the "Typ." column do not include the operating currents of the peripheral modules.
- The currents in the "Max." column include the operating currents of the peripheral modules, except for those flowing into the A/D converter, LVD circuit, I/O port, and on-chip pull-up/pull-down resistors, and those flowing while the data flash memory is being rewritten.

**Note 2.** The listed currents apply when the high-speed system clock, middle-speed on-chip oscillator, low-speed on-chip oscillator, and subsystem clock are stopped.

**Note 3.** The listed currents apply when the high-speed on-chip oscillator, high-speed system clock, low-speed on-chip oscillator, and subsystem clock are stopped.

(Note and Remarks are listed on the next page.)

**Note 4.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, low-speed on-chip oscillator, and subsystem clock are stopped.

**Remark 1.** f<sub>IH</sub>: High-speed on-chip oscillator clock frequency

**Remark 2.** f<sub>IM</sub>: Middle-speed on-chip oscillator clock frequency

**Remark 3.** f<sub>MX</sub>: High-speed system clock frequency (X1 clock oscillation frequency or external main system clock frequency)

**Remark 4.** The typical value for the ambient operating temperature (T<sub>A</sub>) is +25°C unless otherwise specified.

2. 30- to 64-pin package products with 192- to 256-Kbyte flash ROM and 80-pin package product with 128- to 256-Kbyte flash ROM

( $T_A = -40$  to  $+105^{\circ}\text{C}$ ,  $1.6\text{ V} \leq \text{EVDD0} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = 0\text{ V}$ )

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| Item                     | Symbol | Conditions     |                                |                                                                    |                  |             | Min. | Typ. | Max. | Unit |
|--------------------------|--------|----------------|--------------------------------|--------------------------------------------------------------------|------------------|-------------|------|------|------|------|
| Supply current<br>Note 1 | IDD1   | Operating mode | Subsystem clock operation mode | fsUB = 32.768 kHzNote 2,<br>Low-speed on-chip oscillator operation | Normal operation | TA = -40°C  |      | 3.3  | 6.1  | μA   |
|                          |        |                |                                |                                                                    |                  | TA = +25°C  |      | 3.6  | 6.3  |      |
|                          |        |                |                                |                                                                    |                  | TA = +50°C  |      | 3.9  | 9.6  |      |
|                          |        |                |                                |                                                                    |                  | TA = +70°C  |      | 4.5  | 15.9 |      |
|                          |        |                |                                |                                                                    |                  | TA = +85°C  |      | 5.4  | 25.3 |      |
|                          |        |                |                                |                                                                    |                  | TA = +105°C |      | 7.8  | 56.3 |      |
|                          |        |                |                                | fsUB = 32.768 kHzNote 3,<br>Square wave input                      | Normal operation | TA = -40°C  |      | 3.3  | 6.1  | μA   |
|                          |        |                |                                |                                                                    |                  | TA = +25°C  |      | 3.5  | 6.4  |      |
|                          |        |                |                                |                                                                    |                  | TA = +50°C  |      | 3.8  | 9.6  |      |
|                          |        |                |                                |                                                                    |                  | TA = +70°C  |      | 4.4  | 16.1 |      |
|                          |        |                |                                |                                                                    |                  | TA = +85°C  |      | 5.3  | 26.4 |      |
|                          |        |                |                                |                                                                    |                  | TA = +105°C |      | 7.8  | 57.0 |      |
|                          |        |                |                                | fsUB = 32.768 kHzNote 3,<br>Resonator connection                   | Normal operation | TA = -40°C  |      | 3.3  | 6.0  | μA   |
|                          |        |                |                                |                                                                    |                  | TA = +25°C  |      | 3.5  | 6.0  |      |
|                          |        |                |                                |                                                                    |                  | TA = +50°C  |      | 3.8  | 8.9  |      |
|                          |        |                |                                |                                                                    |                  | TA = +70°C  |      | 4.4  | 15.3 |      |
|                          |        |                |                                |                                                                    |                  | TA = +85°C  |      | 5.3  | 25.6 |      |
|                          |        |                |                                |                                                                    |                  | TA = +105°C |      | 7.9  | 55.3 |      |

**Note 1.** The listed currents are the total currents flowing into VDD and EVDD0, including the input leakage currents flowing when the level of the input pin is fixed to VDD, EVDD0 or VSS, EVSS0. In the subsystem clock operation mode, the currents in both the "Typ." and "Max." columns do not include the operating currents of the peripheral modules.

**Note 2.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, high-speed system clock, and subsystem clock are stopped.

**Note 3.** The listed currents apply when the high-speed on-chip oscillator, high-speed system clock, middle-speed on-chip oscillator, and low-speed on-chip oscillator are stopped, and the low power consumption oscillation 3 is specified (AMPHS1, AMPHS0 = 1, 1).

**Remark 1.** fIL: Low-speed on-chip oscillator clock frequency

**Remark 2.** fsUB: Subsystem clock frequency (XT1 clock oscillation frequency)

2. 30- to 64-pin package products with 192- to 256-Kbyte flash ROM and 80-pin package product with 128- to 256-Kbyte flash ROM

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = 0 V)

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| Item                             | Symbol                 | Conditions |                           |                                                                   |             | Min. | Typ. | Max. | Unit |
|----------------------------------|------------------------|------------|---------------------------|-------------------------------------------------------------------|-------------|------|------|------|------|
| Supply current <sup>Note 1</sup> | IDD2 <sup>Note 2</sup> | HALT mode  | HS (high-speed main) mode | f <sub>IH</sub> = 32 MHz <sup>Note 3</sup>                        | VDD = 5.0 V |      | 0.57 | 1.97 | mA   |
|                                  |                        |            |                           |                                                                   | VDD = 1.8 V |      | 0.56 | 1.96 |      |
|                                  |                        |            | LS (low-speed main) mode  | f <sub>IH</sub> = 24 MHz <sup>Note 3</sup>                        | VDD = 5.0 V |      | 0.47 | 1.53 | mA   |
|                                  |                        |            |                           |                                                                   | VDD = 1.8 V |      | 0.47 | 1.52 |      |
|                                  |                        |            |                           | f <sub>IH</sub> = 16 MHz <sup>Note 3</sup>                        | VDD = 5.0 V |      | 0.48 | 1.22 | mA   |
|                                  |                        |            |                           |                                                                   | VDD = 1.8 V |      | 0.47 | 1.21 |      |
|                                  |                        |            |                           | f <sub>IM</sub> = 4 MHz <sup>Note 4</sup>                         | VDD = 5.0 V |      | 0.08 | 0.27 | mA   |
|                                  |                        |            |                           |                                                                   | VDD = 1.6 V |      | 0.08 | 0.26 |      |
|                                  |                        |            | LP (low-power main) mode  | f <sub>IM</sub> = 2 MHz <sup>Note 4</sup>                         | VDD = 5.0 V |      | 38   | 126  | μA   |
|                                  |                        |            |                           |                                                                   | VDD = 1.6 V |      | 37   | 125  |      |
|                                  |                        |            |                           | f <sub>IM</sub> = 1 MHz <sup>Note 4</sup>                         | VDD = 5.0 V |      | 32   | 79   | μA   |
|                                  |                        |            |                           |                                                                   | VDD = 1.6 V |      | 32   | 79   |      |
|                                  |                        |            | HS (high-speed main) mode | f <sub>MX</sub> = 20 MHz <sup>Note 5</sup> , Square wave input    | VDD = 5.0 V |      | 0.23 | 1.07 | mA   |
|                                  |                        |            |                           |                                                                   | VDD = 1.8 V |      | 0.19 | 1.03 |      |
|                                  |                        |            | LS (low-speed main) mode  | f <sub>MX</sub> = 20 MHz <sup>Note 5</sup> , Square wave input    | VDD = 5.0 V |      | 0.23 | 1.07 | mA   |
|                                  |                        |            |                           |                                                                   | VDD = 1.8 V |      | 0.19 | 1.03 |      |
|                                  |                        |            |                           | f <sub>MX</sub> = 20 MHz <sup>Note 5</sup> , Resonator connection | VDD = 5.0 V |      | 0.41 | 1.30 | mA   |
|                                  |                        |            |                           |                                                                   | VDD = 1.8 V |      | 0.40 | 1.28 |      |
|                                  |                        |            |                           | f <sub>MX</sub> = 10 MHz <sup>Note 5</sup> , Square wave input    | VDD = 5.0 V |      | 0.14 | 0.57 | mA   |
|                                  |                        |            |                           |                                                                   | VDD = 1.8 V |      | 0.12 | 0.54 |      |
|                                  |                        |            |                           | f <sub>MX</sub> = 10 MHz <sup>Note 5</sup> , Resonator connection | VDD = 5.0 V |      | 0.24 | 0.69 | mA   |
|                                  |                        |            |                           |                                                                   | VDD = 1.8 V |      | 0.23 | 0.68 |      |
|                                  |                        |            |                           | f <sub>MX</sub> = 8 MHz <sup>Note 5</sup> , Square wave input     | VDD = 5.0 V |      | 0.12 | 0.47 | mA   |
|                                  |                        |            |                           |                                                                   | VDD = 1.8 V |      | 0.10 | 0.44 |      |
|                                  |                        |            |                           | f <sub>MX</sub> = 8 MHz <sup>Note 5</sup> , Resonator connection  | VDD = 5.0 V |      | 0.21 | 0.58 | mA   |
|                                  |                        |            |                           |                                                                   | VDD = 1.8 V |      | 0.20 | 0.57 |      |

<R>

**Note 1.** The listed currents are the total currents flowing into VDD and EVDD0, including the input leakage currents flowing when the level of the input pin is fixed to VDD, EVDD0 or VSS, EVSS0. The following points apply in the HS (high-speed main), LS (low-speed main), and LP (low-power main) modes.

- The currents in the "Typ." column do not include the operating currents of the peripheral modules.
- The currents in the "Max." column include the operating currents of the peripheral modules, except for those flowing into the A/D converter, LVD circuit, I/O port, and on-chip pull-up/pull-down resistors, and those flowing while the data flash memory is being rewritten.

**Note 2.** The listed currents apply when the HALT instruction has been fetched from the flash memory for execution.

**Note 3.** The listed currents apply when the high-speed system clock, middle-speed on-chip oscillator, low-speed on-chip oscillator, and subsystem clock are stopped.

**Note 4.** The listed currents apply when the high-speed on-chip oscillator, high-speed system clock, low-speed on-chip oscillator, and subsystem clock are stopped.

**Note 5.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, low-speed on-chip oscillator, and subsystem clock are stopped.

(Remarks are listed on the next page.)

**Remark 1.** f<sub>IH</sub>: High-speed on-chip oscillator clock frequency

**Remark 2.** f<sub>IM</sub>: Middle-speed on-chip oscillator clock frequency

**Remark 3.** f<sub>MX</sub>: High-speed system clock frequency (X1 clock oscillation frequency or external main system clock frequency)

**Remark 4.** The typical value for the ambient operating temperature (T<sub>A</sub>) is +25°C unless otherwise specified.

2. 30- to 64-pin package products with 192- to 256-Kbyte flash ROM and 80-pin package product with 128- to 256-Kbyte flash ROM

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.6\text{ V} \leq \text{EVDD0} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = 0\text{ V}$ )

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| Item                                                 | Symbol         | Conditions |                                |                                                                    |                  | Min.        | Typ.  | Max.  | Unit  |    |
|------------------------------------------------------|----------------|------------|--------------------------------|--------------------------------------------------------------------|------------------|-------------|-------|-------|-------|----|
| Supply current<br>Note 1                             | IDD2<br>Note 2 | HALT mode  | Subsystem clock operation mode | fSUB = 32.768 kHzNote 3,<br>Low-speed on-chip oscillator operation | TA = -40°C       |             | 0.62  | 2.94  | μA    |    |
|                                                      |                |            |                                |                                                                    | TA = +25°C       |             | 0.74  | 3.00  |       |    |
|                                                      |                |            |                                |                                                                    | TA = +50°C       |             | 0.88  | 6.00  |       |    |
|                                                      |                |            |                                |                                                                    | TA = +70°C       |             | 1.22  | 12.01 |       |    |
|                                                      |                |            |                                |                                                                    | TA = +85°C       |             | 2.69  | 22.92 |       |    |
|                                                      |                |            |                                |                                                                    | TA = +105°C      |             | 5.08  | 54.47 |       |    |
|                                                      |                |            |                                | fSUB = 32.768 kHz,<br>Square wave inputNote 4                      | TA = -40°C       |             | 0.25  | 2.54  | μA    |    |
|                                                      |                |            |                                |                                                                    | TA = +25°C       |             | 0.37  | 2.73  |       |    |
|                                                      |                |            |                                |                                                                    | TA = +50°C       |             | 0.74  | 7.35  |       |    |
|                                                      |                |            |                                |                                                                    | TA = +70°C       |             | 1.33  | 15.13 |       |    |
|                                                      |                |            |                                |                                                                    | TA = +85°C       |             | 2.35  | 27.33 |       |    |
|                                                      |                |            |                                |                                                                    | TA = +105°C      |             | 4.81  | 62.95 |       |    |
|                                                      |                |            |                                | fSUB = 32.768 kHz,<br>Resonator connectionNote 5                   | TA = -40°C       |             | 0.27  | 2.68  | μA    |    |
|                                                      |                |            |                                |                                                                    | TA = +25°C       |             | 0.39  | 2.87  |       |    |
|                                                      |                |            |                                |                                                                    | TA = +50°C       |             | 0.78  | 7.63  |       |    |
|                                                      |                |            |                                |                                                                    | TA = +70°C       |             | 1.34  | 15.20 |       |    |
|                                                      |                |            |                                |                                                                    | TA = +85°C       |             | 2.35  | 27.33 |       |    |
|                                                      |                |            |                                |                                                                    | TA = +105°C      |             | 4.67  | 61.97 |       |    |
|                                                      |                |            | IDD3                           | STOP mode                                                          | RAMSDS = 0Note 6 | TA = -40°C  |       | 0.19  | 2.00  | μA |
|                                                      |                |            |                                |                                                                    |                  | TA = +25°C  |       | 0.30  | 2.00  |    |
|                                                      |                |            |                                |                                                                    |                  | TA = +50°C  |       | 0.65  | 5.00  |    |
|                                                      |                |            |                                |                                                                    |                  | TA = +70°C  |       | 1.20  | 11.00 |    |
|                                                      |                |            |                                |                                                                    |                  | TA = +85°C  |       | 2.20  | 20.00 |    |
|                                                      |                |            |                                |                                                                    |                  | TA = +105°C |       | 4.50  | 50.00 |    |
| RAMSDS = 1Note 7                                     | TA = -40°C     |            |                                |                                                                    |                  | 0.18        | 2.00  | μA    |       |    |
|                                                      | TA = +25°C     |            |                                |                                                                    |                  | 0.29        | 2.00  |       |       |    |
|                                                      | TA = +50°C     |            |                                |                                                                    |                  | 0.60        | 4.50  |       |       |    |
|                                                      | TA = +70°C     |            |                                |                                                                    |                  | 1.10        | 10.00 |       |       |    |
|                                                      | TA = +85°C     |            |                                |                                                                    |                  | 2.00        | 19.00 |       |       |    |
|                                                      | TA = +105°C    |            |                                |                                                                    |                  | 4.00        | 45.00 |       |       |    |
| RAMSDS = 1,<br>128-Hz realtime clock operationNote 8 | TA = -40°C     |            |                                |                                                                    | 0.23             | 2.05        | μA    |       |       |    |
|                                                      | TA = +25°C     |            |                                |                                                                    | 0.40             | 2.11        |       |       |       |    |
|                                                      | TA = +50°C     |            |                                |                                                                    | 0.72             | 4.62        |       |       |       |    |
|                                                      | TA = +70°C     |            |                                |                                                                    | 1.23             | 10.13       |       |       |       |    |
|                                                      | TA = +85°C     |            |                                |                                                                    | 2.14             | 19.14       |       |       |       |    |
|                                                      | TA = +105°C    |            |                                |                                                                    | 4.16             | 45.16       |       |       |       |    |

(Notes and Remarks are listed on the next page.)

- <R> **Note 1.** The listed currents are the total currents flowing into VDD and EVDD0, including the input leakage currents flowing when the level of the input pin is fixed to VDD, EVDD0 or VSS, EVSS0. In the subsystem clock operation mode or the STOP mode, the currents in both the "Typ." and "Max." columns do not include the operating currents of the peripheral modules.
- Note 2.** The listed currents apply when the HALT instruction has been fetched from the flash memory for execution.
- <R> **Note 3.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, high-speed system clock, and subsystem clock are stopped.
- <R> **Note 4.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, high-speed system clock, and low-speed on-chip oscillator are stopped.
- <R> **Note 5.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, high-speed system clock, and low-speed on-chip oscillator are stopped, and the setting of RTCLPC is 1, and the low power consumption oscillation 3 is specified (AMPHS1, AMPHS0 = 1, 1).
- <R> **Note 6.** The listed currents with this setting allow retention of the contents of the entire RAM area. The listed currents apply when the low-speed on-chip oscillator and subsystem clock oscillation are stopped. For the current for operation of the subsystem clock in the STOP mode, refer to that in the HALT mode.
- <R> **Note 7.** The listed currents with this setting allow retention of the contents of a specified 4-Kbyte area of the RAM. The listed currents apply when the low-speed on-chip oscillator and subsystem clock oscillation are stopped.
- <R> **Note 8.** The listed currents with this setting allow retention of the contents of a specified 4-Kbyte area of the RAM. The listed currents apply when the low-speed on-chip oscillator is stopped, the setting of RTCLPC is 1, and the low power consumption oscillation 3 is specified (AMPHS1, AMPHS0 = 1, 1). The current flowing into the RTC is included.

**Remark 1.** fIL: Low-speed on-chip oscillator clock frequency

**Remark 2.** fSUB: Subsystem clock frequency (XT1 clock oscillation frequency)

## 3. 44- to 80-pin package products with 384- to 768-Kbyte flash ROM and 100- to 128-pin package products

&lt;R&gt; (TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

(1/4)

| Item                     | Symbol | Conditions     |                           |                                                                   |                  | Min.        | Typ. | Max. | Unit |    |
|--------------------------|--------|----------------|---------------------------|-------------------------------------------------------------------|------------------|-------------|------|------|------|----|
| Supply current<br>Note 1 | IDD1   | Operating mode | HS (high-speed main) mode | f <sub>IH</sub> = 32 MHz <sup>Note 2</sup>                        | Basic operation  | VDD = 5.0 V |      | 1.6  | —    | mA |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 1.5  | —    |    |
|                          |        |                |                           |                                                                   | Normal operation | VDD = 5.0 V |      | 3.5  | 5.6  | mA |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 3.5  | 5.6  |    |
|                          |        |                | LS (low-speed main) mode  | f <sub>IH</sub> = 24 MHz <sup>Note 2</sup>                        | Normal operation | VDD = 5.0 V |      | 2.6  | 4.2  | mA |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 2.6  | 4.2  |    |
|                          |        |                |                           | f <sub>IH</sub> = 16 MHz <sup>Note 2</sup>                        | Normal operation | VDD = 5.0 V |      | 2.0  | 3.1  | mA |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 1.9  | 3.1  |    |
|                          |        |                |                           | f <sub>IM</sub> = 4 MHz <sup>Note 3</sup>                         | Normal operation | VDD = 5.0 V |      | 0.5  | 0.9  | mA |
|                          |        |                |                           |                                                                   |                  | VDD = 1.6 V |      | 0.5  | 0.8  |    |
|                          |        |                | LP (low-power main) mode  | f <sub>IM</sub> = 2 MHz <sup>Note 3</sup>                         | Normal operation | VDD = 5.0 V |      | 229  | 361  | μA |
|                          |        |                |                           |                                                                   |                  | VDD = 1.6 V |      | 227  | 358  |    |
|                          |        |                |                           | f <sub>IM</sub> = 1 MHz <sup>Note 3</sup>                         | Normal operation | VDD = 5.0 V |      | 128  | 197  | μA |
|                          |        |                |                           |                                                                   |                  | VDD = 1.6 V |      | 125  | 193  |    |
|                          |        |                | HS (high-speed main) mode | f <sub>MX</sub> = 20 MHz <sup>Note 4</sup> , Square wave input    | Normal operation | VDD = 5.0 V |      | 2.2  | 3.5  | mA |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 2.2  | 3.5  |    |
|                          |        |                | LS (low-speed main) mode  | f <sub>MX</sub> = 20 MHz <sup>Note 4</sup> , Square wave input    | Normal operation | VDD = 5.0 V |      | 2.1  | 3.4  | mA |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 2.0  | 3.3  |    |
|                          |        |                |                           | f <sub>MX</sub> = 20 MHz <sup>Note 4</sup> , Resonator connection | Normal operation | VDD = 5.0 V |      | 2.2  | 3.6  | mA |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 2.2  | 3.5  |    |
|                          |        |                |                           | f <sub>MX</sub> = 10 MHz <sup>Note 4</sup> , Square wave input    | Normal operation | VDD = 5.0 V |      | 1.1  | 1.8  | mA |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 1.1  | 1.8  |    |
|                          |        |                |                           | f <sub>MX</sub> = 10 MHz <sup>Note 4</sup> , Resonator connection | Normal operation | VDD = 5.0 V |      | 1.2  | 1.9  | mA |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 1.2  | 1.9  |    |
|                          |        |                |                           | f <sub>MX</sub> = 8 MHz <sup>Note 4</sup> , Square wave input     | Normal operation | VDD = 5.0 V |      | 0.9  | 1.5  | mA |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 0.9  | 1.5  |    |
|                          |        |                |                           | f <sub>MX</sub> = 8 MHz <sup>Note 4</sup> , Resonator connection  | Normal operation | VDD = 5.0 V |      | 1.0  | 1.6  | mA |
|                          |        |                |                           |                                                                   |                  | VDD = 1.8 V |      | 1.0  | 1.6  |    |

<R> **Note 1.** The listed currents are the total currents flowing into VDD, EVDD0 and EVDD1, including the input leakage currents flowing when the level of the input pin is fixed to VDD, EVDD0, EVDD1 or VSS, EVSS0, EVSS1. The following points apply in the HS (high-speed main), LS (low-speed main), and LP (low-power main) modes.

- The currents in the "Typ." column do not include the operating currents of the peripheral modules.
- The currents in the "Max." column include the operating currents of the peripheral modules, except for those flowing into the A/D converter, LVD circuit, I/O port, and on-chip pull-up/pull-down resistors, and those flowing while the data flash memory is being rewritten.

**Note 2.** The listed currents apply when the high-speed system clock, middle-speed on-chip oscillator, low-speed on-chip oscillator, and subsystem clock are stopped.

**Note 3.** The listed currents apply when the high-speed on-chip oscillator, high-speed system clock, low-speed on-chip oscillator, and subsystem clock are stopped.

**Note 4.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, low-speed on-chip oscillator, and subsystem clock are stopped.

(Remarks are listed on the next page.)

**Remark 1.** f<sub>IH</sub>: High-speed on-chip oscillator clock frequency

**Remark 2.** f<sub>IM</sub>: Middle-speed on-chip oscillator clock frequency

**Remark 3.** f<sub>MX</sub>: High-speed system clock frequency (X1 clock oscillation frequency or external main system clock frequency)

**Remark 4.** The typical value for the ambient operating temperature (T<sub>A</sub>) is +25°C unless otherwise specified.

## 3. 44- to 80-pin package products with 384- to 768-Kbyte flash ROM and 100- to 128-pin package products

<R> ( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.6\text{ V} \leq \text{EVDD0} = \text{EVDD1} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = \text{EVSS1} = 0\text{ V}$ )

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| Item                     | Symbol | Conditions     |                                |                                                                                     |                  |                            | Min. | Typ. | Max. | Unit          |
|--------------------------|--------|----------------|--------------------------------|-------------------------------------------------------------------------------------|------------------|----------------------------|------|------|------|---------------|
| Supply current<br>Note 1 | IDD1   | Operating mode | Subsystem clock operation mode | $f_{\text{SUB}} = 32.768\text{ kHz}$ Note 2, Low-speed on-chip oscillator operation | Normal operation | $T_A = -40^\circ\text{C}$  |      | 3.8  | 7.7  | $\mu\text{A}$ |
|                          |        |                |                                |                                                                                     |                  | $T_A = +25^\circ\text{C}$  |      | 4.1  | 8.0  |               |
|                          |        |                |                                |                                                                                     |                  | $T_A = +50^\circ\text{C}$  |      | 4.6  | 13.5 |               |
|                          |        |                |                                |                                                                                     |                  | $T_A = +70^\circ\text{C}$  |      | 5.6  | 24.0 |               |
|                          |        |                |                                |                                                                                     |                  | $T_A = +85^\circ\text{C}$  |      | 7.1  | 40.8 |               |
|                          |        |                |                                |                                                                                     |                  | $T_A = +105^\circ\text{C}$ |      | 11.1 | 88.8 |               |
|                          |        |                |                                | $f_{\text{SUB}} = 32.768\text{ kHz}$ Note 3, Square wave input                      | Normal operation | $T_A = -40^\circ\text{C}$  |      | 3.8  | 7.7  | $\mu\text{A}$ |
|                          |        |                |                                |                                                                                     |                  | $T_A = +25^\circ\text{C}$  |      | 4.0  | 8.0  |               |
|                          |        |                |                                |                                                                                     |                  | $T_A = +50^\circ\text{C}$  |      | 4.5  | 13.6 |               |
|                          |        |                |                                |                                                                                     |                  | $T_A = +70^\circ\text{C}$  |      | 5.3  | 24.1 |               |
|                          |        |                |                                |                                                                                     |                  | $T_A = +85^\circ\text{C}$  |      | 6.7  | 40.3 |               |
|                          |        |                |                                |                                                                                     |                  | $T_A = +105^\circ\text{C}$ |      | 10.7 | 88.1 |               |
|                          |        |                |                                | $f_{\text{SUB}} = 32.768\text{ kHz}$ Note 3, Resonator connection                   | Normal operation | $T_A = -40^\circ\text{C}$  |      | 3.8  | 7.4  | $\mu\text{A}$ |
|                          |        |                |                                |                                                                                     |                  | $T_A = +25^\circ\text{C}$  |      | 4.1  | 7.8  |               |
|                          |        |                |                                |                                                                                     |                  | $T_A = +50^\circ\text{C}$  |      | 4.5  | 12.6 |               |
|                          |        |                |                                |                                                                                     |                  | $T_A = +70^\circ\text{C}$  |      | 5.4  | 24.2 |               |
|                          |        |                |                                |                                                                                     |                  | $T_A = +85^\circ\text{C}$  |      | 6.8  | 39.8 |               |
|                          |        |                |                                |                                                                                     |                  | $T_A = +105^\circ\text{C}$ |      | 10.8 | 87.4 |               |

<R> **Note 1.** The listed currents are the total currents flowing into VDD, EVDD0 and EVDD1, including the input leakage currents flowing when the level of the input pin is fixed to VDD, EVDD0, EVDD1 or VSS, EVSS0, EVSS1. In the subsystem clock operation mode, the currents in both the "Typ." and "Max." columns do not include the operating currents of the peripheral modules.

<R> **Note 2.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, high-speed system clock, and subsystem clock are stopped.

<R> **Note 3.** The listed currents apply when the high-speed on-chip oscillator, high-speed system clock, middle-speed on-chip oscillator, and low-speed on-chip oscillator are stopped, and the low power consumption oscillation 3 is specified (AMPHS1, AMPHS0 = 1, 1).

**Remark 1.**  $f_{\text{IL}}$ : Low-speed on-chip oscillator clock frequency

**Remark 2.**  $f_{\text{SUB}}$ : Subsystem clock frequency (XT1 clock oscillation frequency)

## 3. 44- to 80-pin package products with 384- to 768-Kbyte flash ROM and 100- to 128-pin package products

&lt;R&gt; (TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

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| Item                            | Symbol                       | Conditions |                                 |                                                                  |             | Min. | Typ. | Max. | Unit |
|---------------------------------|------------------------------|------------|---------------------------------|------------------------------------------------------------------|-------------|------|------|------|------|
| Supply current<br><b>Note 1</b> | <b>IDD2</b><br><b>Note 2</b> | HALT mode  | HS<br>(high-speed main)<br>mode | f <sub>IH</sub> = 32 MHz <b>Note 3</b>                           | VDD = 5.0 V |      | 0.60 | 2.00 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.59 | 1.99 |      |
|                                 |                              |            | LS<br>(low-speed main)<br>mode  | f <sub>IH</sub> = 24 MHz <b>Note 3</b>                           | VDD = 5.0 V |      | 0.49 | 1.56 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.48 | 1.55 |      |
|                                 |                              |            |                                 | f <sub>IH</sub> = 16 MHz <b>Note 3</b>                           | VDD = 5.0 V |      | 0.49 | 1.24 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.48 | 1.23 |      |
|                                 |                              |            |                                 | f <sub>IM</sub> = 4 MHz <b>Note 4</b>                            | VDD = 5.0 V |      | 0.09 | 0.28 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.6 V |      | 0.09 | 0.27 |      |
|                                 |                              |            | LP<br>(low-power main)<br>mode  | f <sub>IM</sub> = 2 MHz <b>Note 4</b>                            | VDD = 5.0 V |      | 40   | 129  | μA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.6 V |      | 37   | 125  |      |
|                                 |                              |            |                                 | f <sub>IM</sub> = 1 MHz <b>Note 4</b>                            | VDD = 5.0 V |      | 33   | 80   | μA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.6 V |      | 32   | 79   |      |
|                                 |                              |            | HS<br>(high-speed main)<br>mode | f <sub>MX</sub> = 20 MHz <b>Note 5</b> ,<br>Square wave input    | VDD = 5.0 V |      | 0.25 | 1.10 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.21 | 1.05 |      |
|                                 |                              |            | LS<br>(low-speed main)<br>mode  | f <sub>MX</sub> = 20 MHz <b>Note 5</b> ,<br>Square wave input    | VDD = 5.0 V |      | 0.25 | 1.10 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.21 | 1.05 |      |
|                                 |                              |            |                                 | f <sub>MX</sub> = 20 MHz <b>Note 5</b> ,<br>Resonator connection | VDD = 5.0 V |      | 0.41 | 1.30 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.40 | 1.28 |      |
|                                 |                              |            |                                 | f <sub>MX</sub> = 10 MHz <b>Note 5</b> ,<br>Square wave input    | VDD = 5.0 V |      | 0.15 | 0.59 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.13 | 0.55 |      |
|                                 |                              |            |                                 | f <sub>MX</sub> = 10 MHz <b>Note 5</b> ,<br>Resonator connection | VDD = 5.0 V |      | 0.25 | 0.70 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.24 | 0.69 |      |
|                                 |                              |            |                                 | f <sub>MX</sub> = 8 MHz <b>Note 5</b> ,<br>Square wave input     | VDD = 5.0 V |      | 0.13 | 0.48 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.11 | 0.45 |      |
|                                 |                              |            |                                 | f <sub>MX</sub> = 8 MHz <b>Note 5</b> ,<br>Resonator connection  | VDD = 5.0 V |      | 0.22 | 0.59 | mA   |
|                                 |                              |            |                                 |                                                                  | VDD = 1.8 V |      | 0.21 | 0.58 |      |

- <R> **Note 1.** The listed currents are the total currents flowing into VDD, EVDD0 and EVDD1, including the input leakage currents flowing when the level of the input pin is fixed to VDD, EVDD0, EVDD1 or VSS, EVSS0, EVSS1. The following points apply in the HS (high-speed main), LS (low-speed main), and LP (low-power main) modes.
- The currents in the "Typ." column do not include the operating currents of the peripheral modules.
  - The currents in the "Max." column include the operating currents of the peripheral modules, except for those flowing into the A/D converter, LVD circuit, I/O port, and on-chip pull-up/pull-down resistors, and those flowing while the data flash memory is being rewritten.
- Note 2.** The listed currents apply when the HALT instruction has been fetched from the flash memory for execution.
- Note 3.** The listed currents apply when the high-speed system clock, middle-speed on-chip oscillator, low-speed on-chip oscillator, and subsystem clock are stopped.
- Note 4.** The listed currents apply when the high-speed on-chip oscillator, high-speed system clock, low-speed on-chip oscillator, and subsystem clock are stopped.
- Note 5.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, low-speed on-chip oscillator, and subsystem clock are stopped.

(Remarks are listed on the next page.)

**Remark 1.** f<sub>IH</sub>: High-speed on-chip oscillator clock frequency

**Remark 2.** f<sub>IM</sub>: Middle-speed on-chip oscillator clock frequency

**Remark 3.** f<sub>MX</sub>: High-speed system clock frequency (X1 clock oscillation frequency or external main system clock frequency)

**Remark 4.** The typical value for the ambient operating temperature (T<sub>A</sub>) is +25°C unless otherwise specified.

## 3. 44- to 80-pin package products with 384- to 768-Kbyte flash ROM and 100- to 128-pin package products

&lt;R&gt; (TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

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| Item                                                 | Symbol         | Conditions |                                |                                                                    |             | Min.             | Typ.        | Max.  | Unit |       |    |
|------------------------------------------------------|----------------|------------|--------------------------------|--------------------------------------------------------------------|-------------|------------------|-------------|-------|------|-------|----|
| Supply current<br>Note 1                             | IDD2<br>Note 2 | HALT mode  | Subsystem clock operation mode | fSUB = 32.768 kHzNote 3,<br>Low-speed on-chip oscillator operation | TA = -40°C  |                  | 0.62        | 3.95  | μA   |       |    |
|                                                      |                |            |                                |                                                                    | TA = +25°C  |                  | 0.78        | 4.00  |      |       |    |
|                                                      |                |            |                                |                                                                    | TA = +50°C  |                  | 1.03        | 9.16  |      |       |    |
|                                                      |                |            |                                |                                                                    | TA = +70°C  |                  | 1.62        | 19.34 |      |       |    |
|                                                      |                |            |                                |                                                                    | TA = +85°C  |                  | 3.50        | 37.35 |      |       |    |
|                                                      |                |            |                                |                                                                    | TA = +105°C |                  | 6.77        | 85.36 |      |       |    |
|                                                      |                |            |                                | fSUB = 32.768 kHz,<br>Square wave inputNote 4                      | TA = -40°C  |                  | 0.25        | 3.55  | μA   |       |    |
|                                                      |                |            |                                |                                                                    | TA = +25°C  |                  | 0.41        | 3.73  |      |       |    |
|                                                      |                |            |                                |                                                                    | TA = +50°C  |                  | 0.90        | 10.93 |      |       |    |
|                                                      |                |            |                                |                                                                    | TA = +70°C  |                  | 1.76        | 23.42 |      |       |    |
|                                                      |                |            |                                |                                                                    | TA = +85°C  |                  | 2.92        | 41.07 |      |       |    |
|                                                      |                |            |                                |                                                                    | TA = +105°C |                  | 6.27        | 94.30 |      |       |    |
|                                                      |                |            |                                | fSUB = 32.768 kHz,<br>Resonator connectionNote 5                   | TA = -40°C  |                  | 0.27        | 3.62  | μA   |       |    |
|                                                      |                |            |                                |                                                                    | TA = +25°C  |                  | 0.43        | 3.87  |      |       |    |
|                                                      |                |            |                                |                                                                    | TA = +50°C  |                  | 0.92        | 11.07 |      |       |    |
|                                                      |                |            |                                |                                                                    | TA = +70°C  |                  | 1.79        | 23.63 |      |       |    |
|                                                      |                |            |                                |                                                                    | TA = +85°C  |                  | 2.94        | 41.21 |      |       |    |
|                                                      |                |            |                                |                                                                    | TA = +105°C |                  | 6.28        | 94.37 |      |       |    |
|                                                      |                |            |                                | IDD3                                                               | STOP mode   | RAMSDS = 0Note 6 | TA = -40°C  |       | 0.21 | 3.00  | μA |
|                                                      |                |            |                                |                                                                    |             |                  | TA = +25°C  |       | 0.35 | 3.00  |    |
|                                                      |                |            |                                |                                                                    |             |                  | TA = +50°C  |       | 0.75 | 8.00  |    |
|                                                      |                |            |                                |                                                                    |             |                  | TA = +70°C  |       | 1.60 | 18.00 |    |
|                                                      |                |            |                                |                                                                    |             |                  | TA = +85°C  |       | 2.80 | 34.00 |    |
|                                                      |                |            |                                |                                                                    |             |                  | TA = +105°C |       | 6.00 | 80.00 |    |
| RAMSDS = 1Note 7                                     | TA = -40°C     |            |                                |                                                                    |             |                  | 0.19        | 3.00  | μA   |       |    |
|                                                      | TA = +25°C     |            |                                |                                                                    |             |                  | 0.32        | 3.00  |      |       |    |
|                                                      | TA = +50°C     |            |                                |                                                                    |             |                  | 0.65        | 7.00  |      |       |    |
|                                                      | TA = +70°C     |            |                                |                                                                    |             |                  | 1.25        | 17.00 |      |       |    |
|                                                      | TA = +85°C     |            |                                |                                                                    |             |                  | 2.10        | 30.00 |      |       |    |
|                                                      | TA = +105°C    |            |                                |                                                                    |             |                  | 4.50        | 70.00 |      |       |    |
| RAMSDS = 1,<br>128-Hz realtime clock operationNote 8 | TA = -40°C     |            |                                |                                                                    |             |                  | 0.27        | 3.08  | μA   |       |    |
|                                                      | TA = +25°C     |            |                                |                                                                    |             |                  | 0.42        | 3.10  |      |       |    |
|                                                      | TA = +50°C     |            |                                |                                                                    |             |                  | 0.76        | 7.11  |      |       |    |
|                                                      | TA = +70°C     |            |                                |                                                                    |             |                  | 1.38        | 17.13 |      |       |    |
|                                                      | TA = +85°C     |            |                                |                                                                    |             |                  | 2.23        | 30.13 |      |       |    |
|                                                      | TA = +105°C    |            |                                |                                                                    |             |                  | 4.64        | 70.14 |      |       |    |

(Notes and Remarks are listed on the next page.)

- <R> **Note 1.** The listed currents are the total currents flowing into VDD, EVDD0 and EVDD1, including the input leakage currents flowing when the level of the input pin is fixed to VDD, EVDD0, EVDD1 or VSS, EVSS0, EVSS1. In the subsystem clock operation mode or the STOP mode, the currents in both the “Typ.” and “Max.” columns do not include the operating currents of the peripheral modules.
- Note 2.** The listed currents apply when the HALT instruction has been fetched from the flash memory for execution.
- <R> **Note 3.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, high-speed system clock, and subsystem clock are stopped.
- <R> **Note 4.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, high-speed system clock, and low-speed on-chip oscillator are stopped.
- <R> **Note 5.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, high-speed system clock, and low-speed on-chip oscillator are stopped, and the setting of RTCLPC is 1, and the low power consumption oscillation 3 is specified (AMPHS1, AMPHS0 = 1, 1).
- <R> **Note 6.** The listed currents with this setting allow retention of the contents of the entire RAM area. The listed currents apply when the low-speed on-chip oscillator and subsystem clock oscillation are stopped. For the current for operation of the subsystem clock in the STOP mode, refer to that in the HALT mode.
- <R> **Note 7.** The listed currents with this setting allow retention of the contents of a specified 4-Kbyte area of the RAM. The listed currents apply when the low-speed on-chip oscillator and subsystem clock oscillation are stopped.
- <R> **Note 8.** The listed currents with this setting allow retention of the contents of a specified 4-Kbyte area of the RAM. The listed currents apply when the low-speed on-chip oscillator is stopped, the setting of RTCLPC is 1, and the low power consumption oscillation 3 is specified (AMPHS1, AMPHS0 = 1, 1). The current flowing into the RTC is included.

**Remark 1.** f<sub>IL</sub>: Low-speed on-chip oscillator clock frequency

**Remark 2.** f<sub>SUB</sub>: Subsystem clock frequency (XT1 clock oscillation frequency)

## 4. Peripheral Functions (Common to all products)

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

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| Item                                              | Symbol                       | Conditions                       |                                        | Min. | Typ.  | Max. | Unit |
|---------------------------------------------------|------------------------------|----------------------------------|----------------------------------------|------|-------|------|------|
| High-speed on-chip oscillator operating current   | IFIH <b>Note 1</b>           |                                  |                                        |      | 380   |      | μA   |
| Middle-speed on-chip oscillator operating current | IFIM <b>Note 1</b>           |                                  |                                        |      | 20    |      | μA   |
| Low-speed on-chip oscillator operating current    | IFIL <b>Note 1</b>           |                                  |                                        |      | 0.3   |      | μA   |
| RTC operating current                             | IRTC<br><b>Notes 1, 2, 3</b> | fRTCCLK = 32.768 kHz             |                                        |      | 0.005 |      | μA   |
|                                                   |                              | fRTCCLK = 128 Hz                 |                                        |      | 0.002 |      | μA   |
| 32-bit interval timer operating current           | IIT<br><b>Notes 1, 2, 4</b>  |                                  |                                        |      | 0.04  |      | μA   |
| Watchdog timer operating current                  | IWDT<br><b>Notes 1, 2, 5</b> | fIL = 32.768 kHz (typ.)          |                                        |      | 0.32  |      | μA   |
| A/D converter operating current                   | IADC<br><b>Notes 1, 6</b>    | When conversion at maximum speed | Normal mode, AVREFP = VDD = 5.0 V      |      | 0.95  | 1.6  | mA   |
|                                                   |                              |                                  | Low voltage mode, AVREFP = VDD = 3.0 V |      | 0.5   | 0.75 | mA   |
| AVREFP current                                    | IADREF<br><b>Note 7</b>      | AVREFP = 5.0 V                   |                                        |      | 52    |      | μA   |
| A/D converter internal reference voltage current  | IADREF<br><b>Note 1</b>      |                                  |                                        |      | 114   |      | μA   |
| Temperature sensor operating current              | ITMPS <b>Note 1</b>          |                                  |                                        |      | 110   |      | μA   |
| D/A converter operating current                   | IDAC<br><b>Notes 1, 8</b>    | Per channel                      |                                        |      | 150   |      | μA   |
| Comparator operating current                      | ICMP<br><b>Notes 1, 9</b>    |                                  |                                        |      | 6     |      | μA   |
| LVD operating current                             | ILVD0<br><b>Notes 1, 10</b>  |                                  |                                        |      | 0.02  |      | μA   |
|                                                   | ILVD1<br><b>Notes 1, 10</b>  |                                  |                                        |      | 0.02  |      | μA   |
| Self-programming operating current                | IFSP<br><b>Notes 1, 11</b>   |                                  |                                        |      | 2.5   | 12.2 | mA   |
| Data flash rewrite operating current              | IBGO<br><b>Notes 1, 12</b>   |                                  |                                        |      | 2.5   | 12.2 | mA   |

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

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| Item                                                  | Symbol                             | Conditions                                       |                                                                                                                             | Min.                                                                                                                        | Typ. | Max. | Unit |    |
|-------------------------------------------------------|------------------------------------|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------|------|------|----|
| SNOOZE mode sequencer operating current               | ISMS<br>Notes 1, 13                | f <sub>IH</sub> = 32 MHz                         |                                                                                                                             | 30- to 64-pin package products with 96- to 128-Kbyte flash ROM                                                              |      | 1.1  |      | mA |
|                                                       |                                    |                                                  |                                                                                                                             | 30- to 64-pin package products with 192- to 256-Kbyte flash ROM and 80-pin package product with 128- to 256-Kbyte flash ROM |      | 1.1  |      |    |
|                                                       |                                    |                                                  |                                                                                                                             | 44- to 80-pin package products with 384- to 768-Kbyte flash ROM and 100- to 128-pin package products                        |      | 1.4  |      |    |
|                                                       |                                    | f <sub>IL</sub> = 32.768 kHz                     |                                                                                                                             | 30- to 64-pin package products with 96- to 128-Kbyte flash ROM                                                              |      | 1.2  |      | μA |
|                                                       |                                    |                                                  |                                                                                                                             | 30- to 64-pin package products with 192- to 256-Kbyte flash ROM and 80-pin package product with 128- to 256-Kbyte flash ROM |      | 1.2  |      |    |
|                                                       |                                    |                                                  |                                                                                                                             | 44- to 80-pin package products with 384- to 768-Kbyte flash ROM and 100- to 128-pin package products                        |      | 1.6  |      |    |
| SNOOZE operating current                              | ISNOZ<br>Note 1                    | f <sub>IH</sub> =32 MHz                          | ADC to be in use                                                                                                            | The ADC is shifting from the STOP mode to the SNOOZE mode. <b>Note 14</b>                                                   |      | 0.6  | 0.81 | mA |
|                                                       |                                    |                                                  |                                                                                                                             | The ADC is operating in the low-voltage mode.<br>AVREFP = VDD = 3.0 V                                                       |      | 1.2  | 1.56 |    |
|                                                       |                                    | Simplified SPI (CSI)/UART to be in use           |                                                                                                                             |                                                                                                                             | 0.7  | 0.92 | mA   |    |
|                                                       |                                    | SMS <b>Note 15</b>                               | 30- to 64-pin package products with 96- to 128-Kbyte flash ROM                                                              |                                                                                                                             | 1.6  |      | mA   |    |
|                                                       |                                    |                                                  | 30- to 64-pin package products with 192- to 256-Kbyte flash ROM and 80-pin package product with 128- to 256-Kbyte flash ROM |                                                                                                                             | 1.7  |      |      |    |
|                                                       |                                    |                                                  | 44- to 80-pin package products with 384- to 768-Kbyte flash ROM, and 100- to 128-pin package products                       |                                                                                                                             | 2.0  |      |      |    |
|                                                       |                                    | Remote control signal receiver operating current | I <sub>REM</sub><br>Notes 1, 16                                                                                             |                                                                                                                             |      |      | 0.03 |    |
| Low-speed peripheral clock supply current             | I <sub>XP</sub><br>Notes 1, 17     | RTCLPC = 0                                       |                                                                                                                             |                                                                                                                             | 0.22 |      | μA   |    |
| Output current control operating current              | IC <sub>CD</sub> A<br>Notes 1, 18  | The setting of the CCDE register is not 00H.     |                                                                                                                             |                                                                                                                             | 100  |      | μA   |    |
|                                                       | IC <sub>CD</sub> P<br>Notes 19, 20 | Per single output current control port           | Setting of the low-level output current: Hi-Z                                                                               |                                                                                                                             | 30   |      | μA   |    |
|                                                       |                                    |                                                  | Setting of the low-level output current: 2 to 15 mA                                                                         |                                                                                                                             | 200  |      | μA   |    |
| Operating current of the true random number generator | I <sub>TRNG</sub><br>Note 1        |                                                  |                                                                                                                             |                                                                                                                             | 1.1  |      | mA   |    |

(Notes and Remarks continue on the next page.)

- Note 1.** This current flows into VDD.
- Note 2.** The listed currents apply when the high-speed on-chip oscillator, middle-speed on-chip oscillator, and high-speed system clock are stopped.
- Note 3.** This current flows into the realtime clock (RTC). It does not include the operating current of the low-speed on-chip oscillator or the XT1 oscillator. The supply current of the RL78 microcontrollers is the sum of either IDD1 or IDD2, and IRTC, when the realtime clock is operating or in the HALT mode. When the low-speed on-chip oscillator is selected, IFIL should be included in the supply current. IDD2 in the subsystem clock operation mode includes the operating current of the realtime clock.
- Note 4.** This current only flows to the 32-bit interval timer. It does not include the operating current of the low-speed on-chip oscillator or the XT1 oscillator. The supply current of the RL78 microcontrollers is the sum of either IDD1 or IDD2, and IIT, when the 32-bit interval timer is operating or in the HALT mode. When the low-speed on-chip oscillator is selected, IFIL should be included in the supply current.
- Note 5.** This current only flows to the watchdog timer. It includes the operating current of the low-speed on-chip oscillator. The supply current of the RL78 microcontrollers is the sum of IDD1, IDD2 or IDD3 and IWDI when the watchdog timer is operating.
- Note 6.** This current only flows to the A/D converter. The supply current of the RL78 microcontrollers is the sum of IDD1 or IDD2 and IADC when the A/D converter is operating or in the HALT mode.
- Note 7.** This current flows into AVREFP.
- Note 8.** This current only flows to the D/A converter. The supply current of the RL78 microcontrollers is the sum of the values of either IDD1 or IDD2, and IDAC, when the D/A converter is operating or in the HALT mode.
- Note 9.** This current only flows to the comparator. The supply current of the RL78 microcontrollers is the sum of IDD1, IDD2 or IDD3 and ICMP when the comparator is in operation.
- Note 10.** This current only flows to the LVD circuit. The supply current of the RL78 microcontrollers is the sum of IDD1, IDD2 or IDD3 and ILVD when the LVD circuit is in operation.
- Note 11.** This current only flows during self programming.
- Note 12.** This current only flows while the data flash memory is being rewritten.
- Note 13.** This current only flows into the SNOOZE mode sequencer. Note that the operating current of the low-speed on-chip oscillator and the XT1 oscillator are not included. The supply current of the RL78 microcontrollers is the sum of either IDD1 or IDD2, and ISMS, when the SNOOZE mode sequencer is operating or in the HALT mode.
- Note 14.** For shift time to the SNOOZE mode, see **23.3.3 SNOOZE mode** in the RL78/G23 User's Manual.
- Note 15.** The listed values apply when the SNOOZE mode sequencer is in normal operation equivalent to IDD1. They do not include the current flowing into the peripheral functions other than the SNOOZE mode sequencer.
- Note 16.** This current flows into the remote control signal receiver. It does not include the operating current of the low-speed on-chip oscillator or the XT1 oscillator. The supply current of the RL78 microcontrollers is the sum of either IDD1 or IDD2, and IIT, when the remote control signal receiver is operating or in the HALT mode. When the low-speed on-chip oscillator is selected, IFIL should be included in the supply current.
- Note 17.** This current is added to the supply current in the HALT mode when the setting of RTCLPC is 0 in the STOP mode, or when the setting of RTCLPC is 0 with the subsystem clock X (fsx) selected as the CPU clock, while the subsystem clock X (fsx) is oscillating.
- Note 18.** This current is added to the supply current when the output voltage control port is set.
- Note 19.** This current does not include the current flowing into the I/O port pins.
- Note 20.** This current only flows to EVBD0 and EVBD1.

**Remark 1.** fIL: Low-speed on-chip oscillator clock frequency

**Remark 2.** fsx: Subsystem clock X frequency

**Remark 3.** fCLK: CPU/peripheral hardware clock frequency

**Remark 4.** The typical value for the ambient operating temperature (TA) is +25°C unless otherwise specified.

## 2.4 AC Characteristics

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

&lt;R&gt;

| Item                                                                     | Symbol          | Conditions                                            |                                 |                       | Min.                | Typ.   | Max. | Unit               |    |
|--------------------------------------------------------------------------|-----------------|-------------------------------------------------------|---------------------------------|-----------------------|---------------------|--------|------|--------------------|----|
| Instruction cycle<br>(minimum instruction<br>execution time)             | TCY             | Main system clock<br>(fMAIN) operation                | HS<br>(high-speed main)<br>mode | 1.8 V ≤ VDD ≤ 5.5 V   | 0.03125             |        | 1    | μs                 |    |
|                                                                          |                 |                                                       |                                 | 1.6 V ≤ VDD ≤ 1.8 V   | 0.25                |        | 1    | μs                 |    |
|                                                                          |                 |                                                       | LS<br>(low-speed main)<br>mode  | 1.8 V ≤ VDD ≤ 5.5 V   | 0.04167             |        | 1    | μs                 |    |
|                                                                          |                 |                                                       |                                 | 1.6 V ≤ VDD ≤ 1.8 V   | 0.25                |        | 1    | μs                 |    |
|                                                                          |                 |                                                       | LP<br>(low-power main)<br>mode  | 1.6 V ≤ VDD ≤ 5.5 V   | 0.5                 |        | 1    | μs                 |    |
|                                                                          |                 | Subsystem clock (fSUB) operation                      |                                 |                       | 1.6 V ≤ VDD ≤ 5.5 V | 26.041 | 30.5 | 31.3               | μs |
|                                                                          |                 | In the self<br>programming<br>mode                    | HS<br>(high-speed main)<br>mode | 1.8 V ≤ VDD ≤ 5.5 V   | 0.03125             |        | 1    | μs                 |    |
|                                                                          |                 |                                                       |                                 | 1.6 V ≤ VDD ≤ 1.8 V   | 0.5                 |        | 1    | μs                 |    |
|                                                                          |                 |                                                       | LS<br>(low-speed main)<br>mode  | 1.8 V ≤ VDD ≤ 5.5 V   | 0.04167             |        | 1    | μs                 |    |
|                                                                          |                 |                                                       |                                 | 1.6 V ≤ VDD ≤ 1.8 V   | 0.5                 |        | 1    | μs                 |    |
| External system clock<br>frequency                                       | fEX             | 1.8 V ≤ VDD ≤ 5.5 V                                   |                                 |                       | 1.0                 |        | 20.0 | MHz                |    |
|                                                                          |                 | 1.6 V ≤ VDD < 1.8 V                                   |                                 |                       | 1.0                 |        | 4.0  | MHz                |    |
|                                                                          | fEXS            |                                                       |                                 |                       | 32                  |        | 38.4 | kHz                |    |
| External system clock<br>input high-level width,<br>low-level width      | tEXH,<br>tEXL   | 1.8 V ≤ VDD ≤ 5.5 V                                   |                                 |                       | 24                  |        |      | ns                 |    |
|                                                                          |                 | 1.6 V ≤ VDD < 1.8 V                                   |                                 |                       | 120                 |        |      | ns                 |    |
|                                                                          | tEXHS,<br>tEXLS |                                                       |                                 |                       | 13.7                |        |      | μs                 |    |
| TI00 to TI07, TI10 to TI17<br>input high-level width,<br>low-level width | tTIH,<br>tTIL   |                                                       |                                 |                       | 1/fMCK<br>+ 10      |        |      | ns <sup>Note</sup> |    |
| TO00 to TO07, TO10 to<br>TO17 output frequency                           | fTO             | HS (high-speed main) mode<br>LS (low-speed main) mode |                                 | 4.0 V ≤ EVDD0 ≤ 5.5 V |                     |        | 16   | MHz                |    |
|                                                                          |                 |                                                       |                                 | 2.7 V ≤ EVDD0 < 4.0 V |                     |        | 8    | MHz                |    |
|                                                                          |                 |                                                       |                                 | 1.8 V ≤ EVDD0 < 2.7 V |                     |        | 4    | MHz                |    |
|                                                                          |                 |                                                       |                                 | 1.6 V ≤ EVDD0 < 1.8 V |                     |        | 2    | MHz                |    |
|                                                                          |                 | LP (low-power main) mode                              |                                 | 1.6 V ≤ EVDD0 ≤ 5.5 V |                     |        | 2    | MHz                |    |
| PCLBUZ0, PCLBUZ1<br>output frequency                                     | fPCL            | HS (high-speed main) mode<br>LS (low-speed main) mode |                                 | 4.0 V ≤ EVDD0 ≤ 5.5 V |                     |        | 16   | MHz                |    |
|                                                                          |                 |                                                       |                                 | 2.7 V ≤ EVDD0 < 4.0 V |                     |        | 8    | MHz                |    |
|                                                                          |                 |                                                       |                                 | 1.8 V ≤ EVDD0 < 2.7 V |                     |        | 4    | MHz                |    |
|                                                                          |                 |                                                       |                                 | 1.6 V ≤ EVDD0 < 1.8 V |                     |        | 2    | MHz                |    |
|                                                                          |                 | LP (low-power main) mode                              |                                 | 1.6 V ≤ EVDD0 < 1.8 V |                     |        | 2    | MHz                |    |
| Interrupt input high-level<br>width, low-level width                     | fINTH,<br>fINTL | INTP0                                                 |                                 | 1.6 V ≤ VDD ≤ 5.5 V   | 1                   |        |      | μs                 |    |
|                                                                          |                 | INTP1 to INTP11                                       |                                 | 1.6 V ≤ EVDD0 ≤ 5.5 V | 1                   |        |      | μs                 |    |
| Key interrupt input low-<br>level width                                  | fKRH,<br>fKRL   | KR0 to KR7                                            |                                 | 1.8 V ≤ EVDD0 ≤ 5.5 V | 250                 |        |      | ns                 |    |
|                                                                          |                 |                                                       |                                 | 1.6 V ≤ EVDD0 < 1.8 V | 1                   |        |      | μs                 |    |
| RESET low-level width                                                    | trSL            |                                                       |                                 |                       | 10                  |        |      | μs                 |    |

(Note and Remark are listed on the next page.)

**Note** The following conditions are required for low voltage interface when  $EVDD0 < VDD$ .

1.8 V  $\leq$  EVDD0 < 2.7 V: 125 ns min.

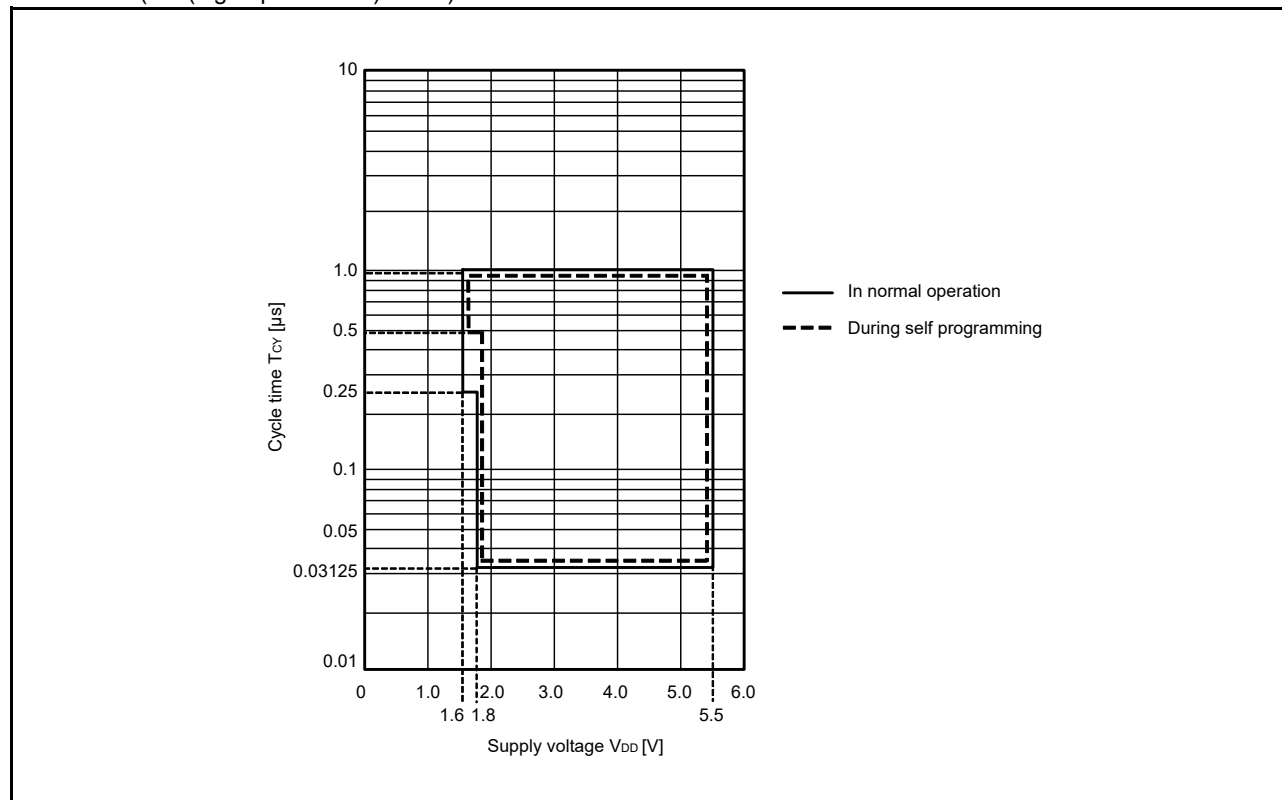
1.6 V  $\leq$  EVDD0 < 1.8 V: 250 ns min.

**Remark** fMCK: Timer array unit operating clock frequency

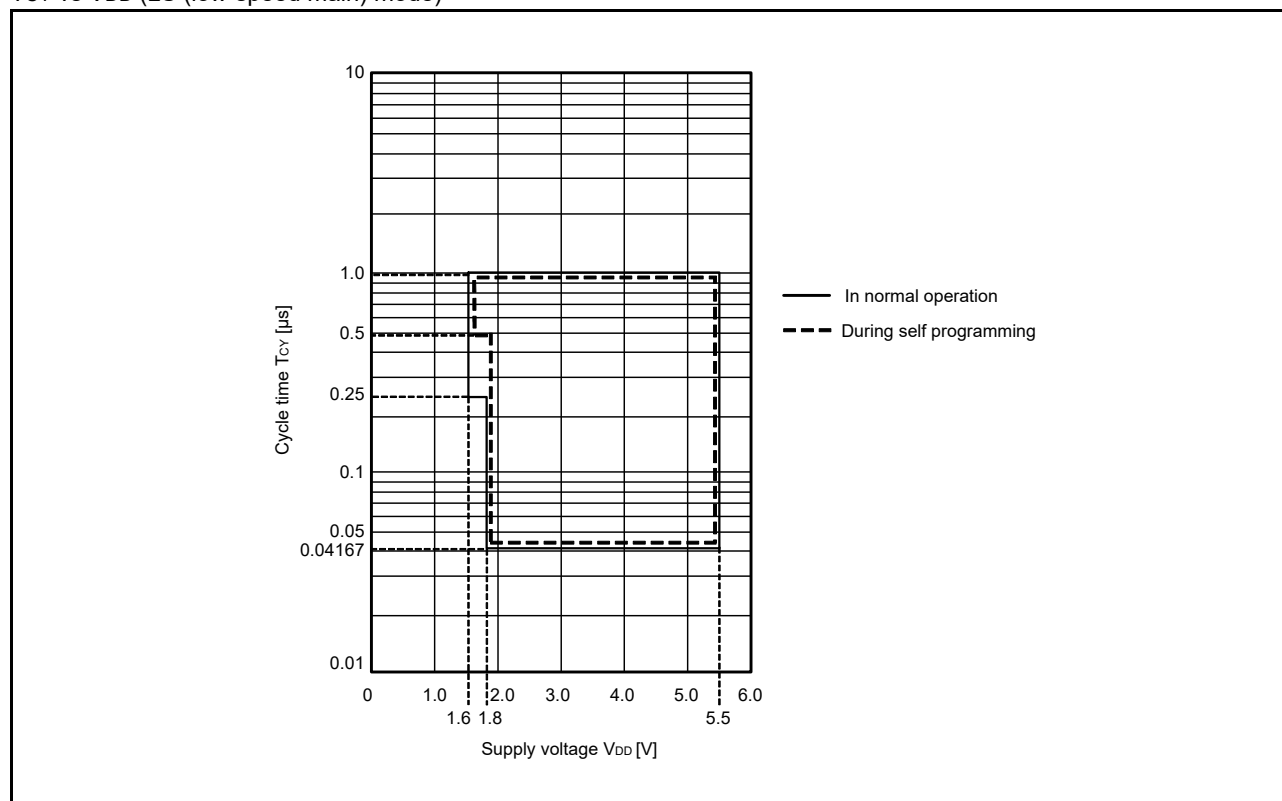
(To set this operating clock, use the CKSmn0 and CKSmn1 bits of the timer mode register mn (TMRmn) (m: Unit number (m = 0, 1), n: Channel number (n = 0 to 7).)

## Minimum Instruction Execution Time during Main System Clock Operation

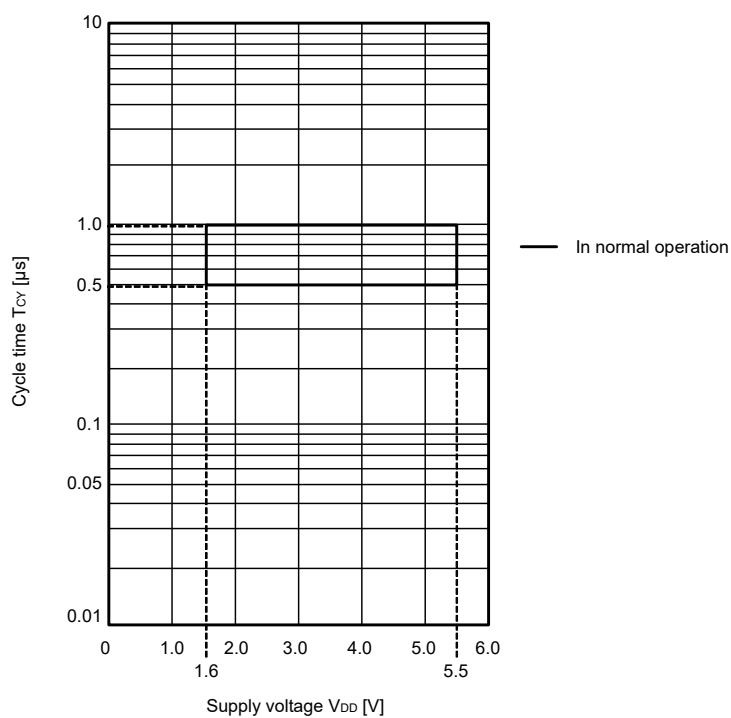
TCY vs VDD (HS (high-speed main) mode)



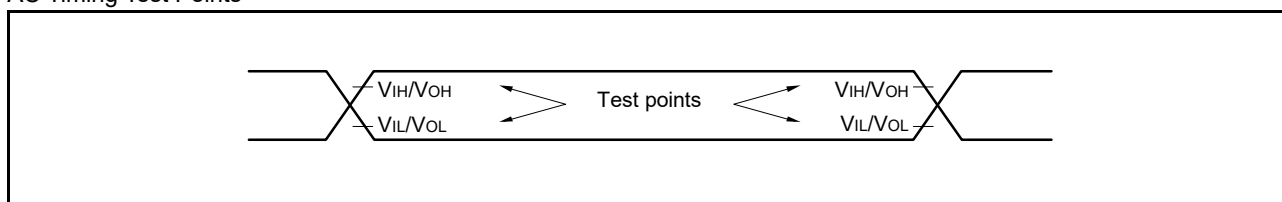
TCY vs VDD (LS (low-speed main) mode)



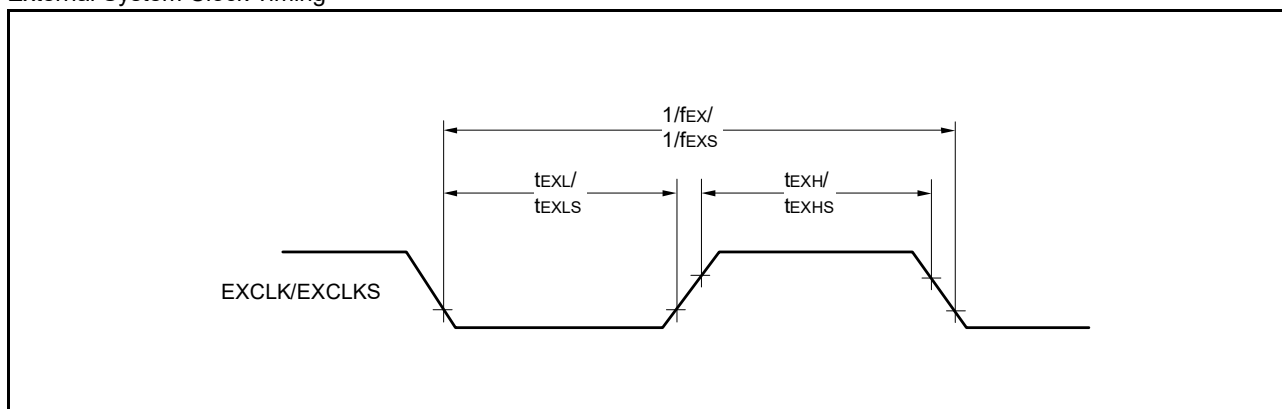
TCY vs VDD (LP (low-power main) mode)



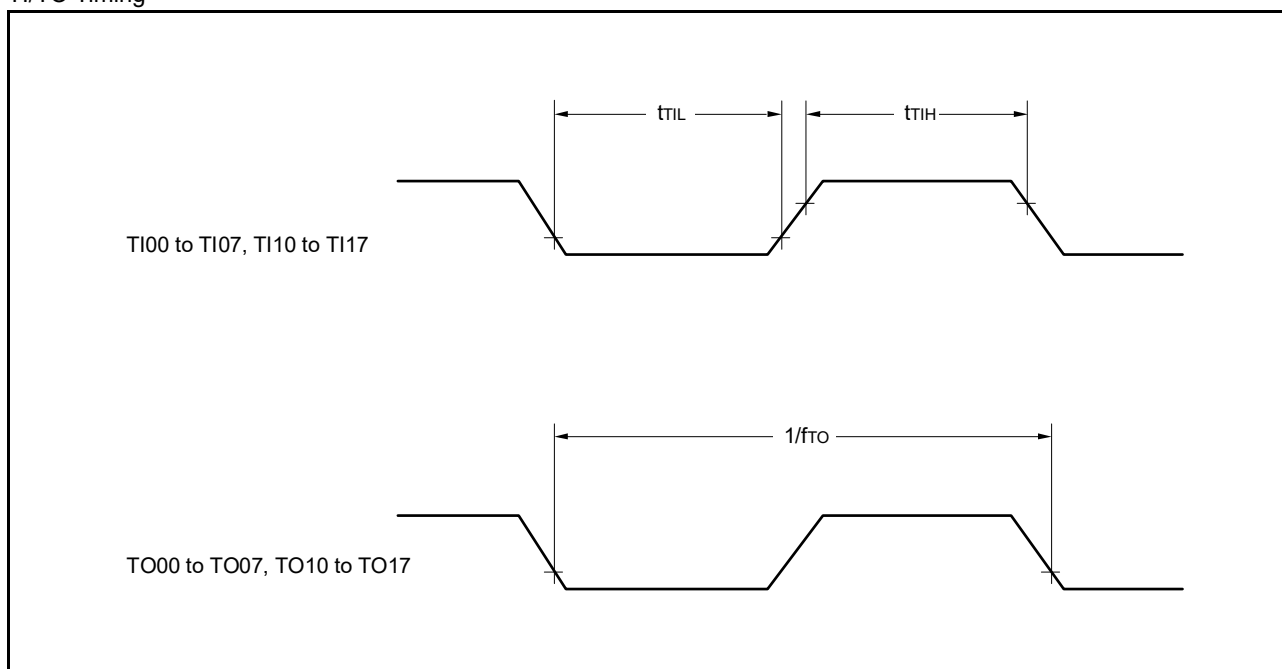
## AC Timing Test Points



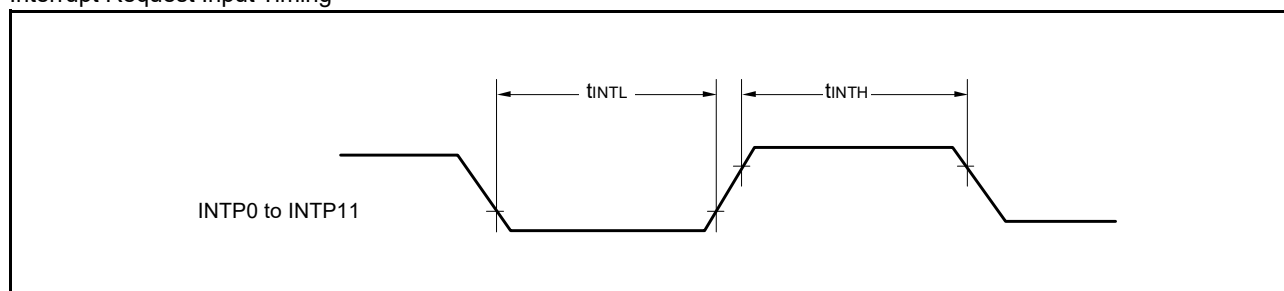
## External System Clock Timing



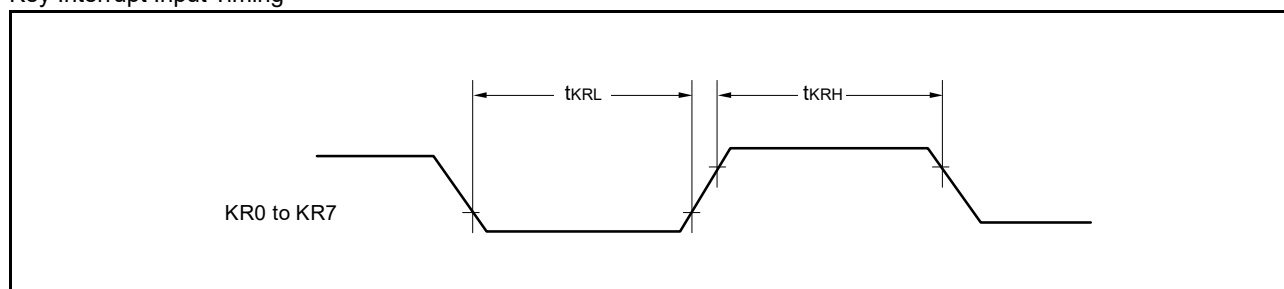
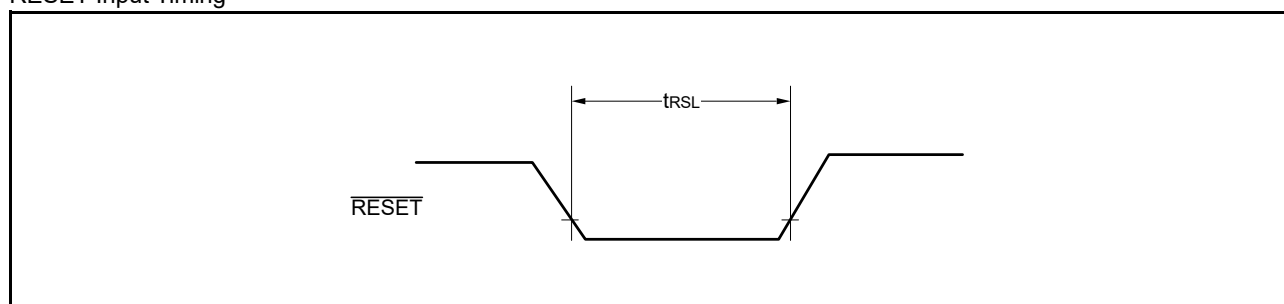
## TI/TO Timing



## Interrupt Request Input Timing

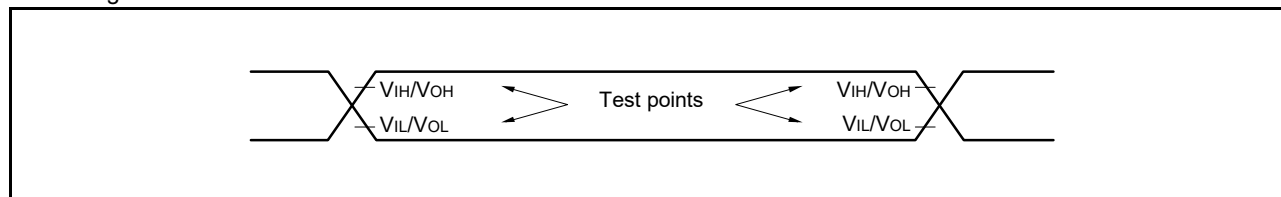


## Key Interrupt Input Timing

 $\overline{\text{RESET}}$  Input Timing

## 2.5 Characteristics of the Peripheral Functions

### AC Timing Test Points



### 2.5.1 Serial array unit

1. In UART communications with devices operating at same voltage levels

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.6\text{ V} \leq \text{EVDD0} = \text{EVDD1} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = \text{EVSS1} = 0\text{ V}$ )

| Item                           | Symbol | Conditions                                                                  | HS<br>(High-Speed Main)<br>Mode |                         | LS<br>(Low-Speed Main)<br>Mode |                         | LP<br>(Low-Power Main)<br>Mode |        | Unit |
|--------------------------------|--------|-----------------------------------------------------------------------------|---------------------------------|-------------------------|--------------------------------|-------------------------|--------------------------------|--------|------|
|                                |        |                                                                             | Min.                            | Max.                    | Min.                           | Max.                    | Min.                           | Max.   |      |
| Transfer rate<br><b>Note 1</b> |        | $1.6\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$                          |                                 | fMCK/6<br><b>Note 2</b> |                                | fMCK/6<br><b>Note 2</b> |                                | fMCK/6 | bps  |
|                                |        | Theoretical value of the maximum transfer rate<br>fMCK = fCLK <b>Note 3</b> |                                 | 5.3                     |                                | 4                       |                                | 0.33   | Mbps |

**Note 1.** The transfer rate in the SNOOZE mode is within the range from 4800 to 9600 bps.

**Note 2.** The following conditions are required for low voltage interface when  $\text{EVDD0} < \text{VDD}$ .

$2.4\text{ V} \leq \text{EVDD0} < 2.7\text{ V}$ : 2.6 Mbps max.

$1.8\text{ V} \leq \text{EVDD0} < 2.4\text{ V}$ : 1.3 Mbps max.

$1.6\text{ V} \leq \text{EVDD0} < 1.8\text{ V}$ : 0.6 Mbps max.

**Note 3.** The maximum operating frequencies of the CPU/peripheral hardware clock (fCLK) are as follows.

HS (high-speed main) mode : 32 MHz ( $1.8\text{ V} \leq \text{VDD} \leq 5.5\text{ V}$ )

4 MHz ( $1.6\text{ V} \leq \text{VDD} \leq 5.5\text{ V}$ )

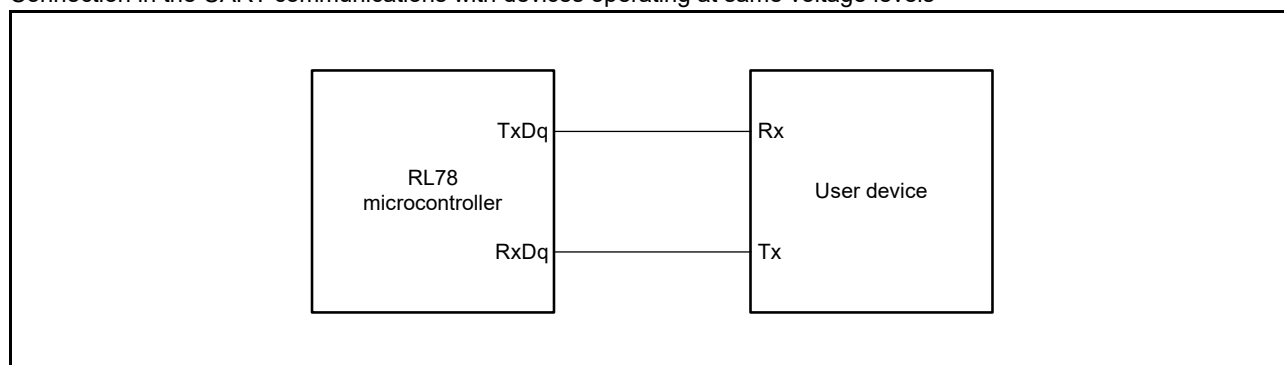
LS (low-speed main) mode : 24 MHz ( $1.8\text{ V} \leq \text{VDD} \leq 5.5\text{ V}$ )

4 MHz ( $1.6\text{ V} \leq \text{VDD} \leq 5.5\text{ V}$ )

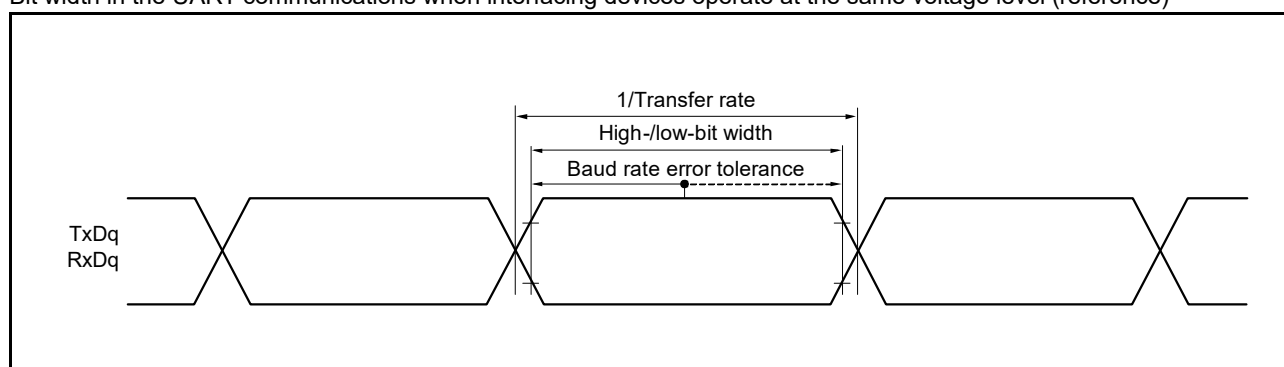
LP (low-power main) mode : 2 MHz ( $1.6\text{ V} \leq \text{VDD} \leq 5.5\text{ V}$ )

**Caution** Select the normal input buffer for the RxDq pin and the normal output mode for the TxDq pin by using port input mode register g (PIMg) and port output mode register g (POMg).

Connection in the UART communications with devices operating at same voltage levels



Bit width in the UART communications when interfacing devices operate at the same voltage level (reference)



**Remark 1.** q: UART number (q = 0 to 3), g: PIM and POM number (g = 0, 1, 8, 14)

**Remark 2.** fMCK: Serial array unit operation clock frequency

(To set this operating clock, set the CKSMn bit in the serial mode register mn (SMRmn) (m: Unit number, n: Channel number (mn = 00 to 03, 10 to 13).)

2. In simplified SPI (CSI) communications in the master mode with devices operating at same voltage levels with the internal SCKp clock (the ratings below are only applicable to CSI00)

( $T_A = -40$  to  $+85^\circ\text{C}$ ,  $2.7\text{ V} \leq \text{EVDD0} = \text{EVDD1} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = \text{EVSS1} = 0\text{ V}$ )

| Item                                                    | Symbol        | Conditions                                         |                                                    | HS<br>(High-Speed Main)<br>Mode |      | LS<br>(Low-Speed Main)<br>Mode |      | LP<br>(Low-Power Main)<br>Mode |      | Unit |
|---------------------------------------------------------|---------------|----------------------------------------------------|----------------------------------------------------|---------------------------------|------|--------------------------------|------|--------------------------------|------|------|
|                                                         |               |                                                    |                                                    | Min.                            | Max. | Min.                           | Max. | Min.                           | Max. |      |
| SCKp cycle time                                         | tkCY1         | $\text{tkCY1} \geq 2/\text{fCLK}$                  | $4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ | 62.5                            |      | 83.3                           |      | 1000                           |      | ns   |
|                                                         |               |                                                    | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ | 83.3                            |      | 125                            |      | 1000                           |      | ns   |
| SCKp high-/low-level width                              | tkH1,<br>tkL1 | $4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                                    | tkCY1/2<br>- 7                  |      | tkCY1/2<br>- 10                |      | tkCY1/2<br>- 50                |      | ns   |
|                                                         |               | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                                    | tkCY1/2<br>- 10                 |      | tkCY1/2<br>- 15                |      | tkCY1/2<br>- 50                |      | ns   |
| Slp setup time<br>(to SCKp↑) <b>Note 1</b>              | tSIK1         | $4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                                    | 23                              |      | 33                             |      | 110                            |      | ns   |
|                                                         |               | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                                    | 33                              |      | 50                             |      | 110                            |      | ns   |
| Slp hold time<br>(from SCKp↑) <b>Note 1</b>             | tKS1          | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                                    | 10                              |      | 10                             |      | 10                             |      | ns   |
| Delay time from<br>SCKp↓ to SOp<br>output <b>Note 2</b> | tKSO1         | $C = 20\text{ pF}$ <b>Note 3</b>                   |                                                    |                                 | 10   |                                | 10   |                                | 10   | ns   |

**Note 1.** The setting applies when DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The setting for the Slp setup time becomes “to SCKp↓” and that for the Slp hold time becomes “from SCKp↓” when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

**Note 2.** This setting applies when DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The setting for the delay time to SOp output becomes “from SCKp↑” when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

**Note 3.** C is the load capacitance of the SCKp and SOp output lines.

**Caution** Select the normal input buffer for the Slp pin and the normal output mode for the SOp pin and SCKp pin by using the port input mode register g (PIMg) and the port output mode register g (POMg).

**Remark 1.** The listed times are only valid when the peripheral I/O redirect function of CSI00 is not in use.

**Remark 2.** p: CSI number (p = 00), m: Unit number (m = 0), n: Channel number (n = 0), g: PIM and POM numbers (g = 1)

**Remark 3.** fMCK: Serial array unit operation clock frequency

(To set this operating clock, use the CKSmn bit in the serial mode register mn (SMRmn) (m: Unit number, n: Channel number (mn = 00).)

3. In simplified SPI (CSI) communications in the master mode with devices operating at same voltage levels with the internal SCKp clock

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

| Item                                                        | Symbol     | Conditions                                           | HS<br>(High-Speed Main)<br>Mode |      | LS<br>(Low-Speed Main)<br>Mode |      | LP<br>(Low-Power Main)<br>Mode |      | Unit |
|-------------------------------------------------------------|------------|------------------------------------------------------|---------------------------------|------|--------------------------------|------|--------------------------------|------|------|
|                                                             |            |                                                      | Min.                            | Max. | Min.                           | Max. | Min.                           | Max. |      |
| SCKp cycle time                                             | tkCY1      | tkCY1 ≥ 4/fCLK                                       | 2.7 V ≤ EVDD0 ≤ 5.5 V           | 125  |                                | 166  |                                | 2000 | ns   |
|                                                             |            |                                                      | 2.4 V ≤ EVDD0 ≤ 5.5 V           | 250  |                                | 250  |                                | 2000 | ns   |
|                                                             |            |                                                      | 1.8 V ≤ EVDD0 ≤ 5.5 V           | 500  |                                | 500  |                                | 2000 | ns   |
|                                                             |            |                                                      | 1.6 V ≤ EVDD0 ≤ 5.5 V           | 1000 |                                | 1000 |                                | 2000 | ns   |
| SCKp high-/low-level width                                  | tkH1, tkL1 | 4.0 V ≤ EVDD0 ≤ 5.5 V                                | tkCY1/2 - 12                    |      | tkCY1/2 - 21                   |      | tkCY1/2 - 50                   |      | ns   |
|                                                             |            | 2.7 V ≤ EVDD0 ≤ 5.5 V                                | tkCY1/2 - 18                    |      | tkCY1/2 - 25                   |      | tkCY1/2 - 50                   |      | ns   |
|                                                             |            | 2.4 V ≤ EVDD0 ≤ 5.5 V                                | tkCY1/2 - 38                    |      | tkCY1/2 - 38                   |      | tkCY1/2 - 50                   |      | ns   |
|                                                             |            | 1.8 V ≤ EVDD0 ≤ 5.5 V                                | tkCY1/2 - 50                    |      | tkCY1/2 - 50                   |      | tkCY1/2 - 50                   |      | ns   |
|                                                             |            | 1.6 V ≤ EVDD0 ≤ 5.5 V                                | tkCY1/2 - 100                   |      | tkCY1/2 - 100                  |      | tkCY1/2 - 100                  |      | ns   |
| Slp setup time<br>(to SCKp↑) <sup>Note 1</sup>              | tsIK1      | 4.0 V ≤ EVDD0 ≤ 5.5 V                                | 44                              |      | 54                             |      | 110                            |      | ns   |
|                                                             |            | 2.7 V ≤ EVDD0 ≤ 5.5 V                                | 44                              |      | 54                             |      | 110                            |      | ns   |
|                                                             |            | 2.4 V ≤ EVDD0 ≤ 5.5 V                                | 75                              |      | 75                             |      | 110                            |      | ns   |
|                                                             |            | 1.8 V ≤ EVDD0 ≤ 5.5 V                                | 110                             |      | 110                            |      | 110                            |      | ns   |
|                                                             |            | 1.6 V ≤ EVDD0 ≤ 5.5 V                                | 220                             |      | 220                            |      | 220                            |      | ns   |
| Slp hold time<br>(from SCKp↑)<br><sup>Note 1</sup>          | tkSI1      | 1.6 V ≤ EVDD0 ≤ 5.5 V                                | 19                              |      | 19                             |      | 19                             |      | ns   |
| Delay time from<br>SCKp↓ to SOp<br>output <sup>Note 2</sup> | tkSO1      | 1.6 V ≤ EVDD0 ≤ 5.5 V<br>C = 30 pF <sup>Note 3</sup> |                                 | 25   |                                | 25   |                                | 25   | ns   |

**Note 1.** This setting applies when DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The setting for the Slp setup time becomes “to SCKp↓” and that for the Slp hold time becomes “from SCKp↓” when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

**Note 2.** This setting applies when DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The setting for the delay time to SOp output becomes “from SCKp↑” when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

**Note 3.** C is the load capacitance of the SCKp and SOp output lines.

**Caution** Select the normal input buffer for the Slp pin and the normal output mode for the SOp pin and SCKp pin by using the port input mode register g (PIMg) and the port output mode register g (POMg).

**Remark 1.** p: CSI number (p = 00, 01, 10, 11, 20, 21, 30, 31), m: Unit number (m = 0, 1), n: Channel number (n = 0 to 3), g: PIM and POM numbers (g = 0, 1, 4, 5, 8, 14)

**Remark 2.** fMCK: Serial array unit operation clock frequency

(To set this operating clock, use the CKSmn bit in the serial mode register mn (SMRmn) (m: Unit number, n: Channel number = 00 to 03, 10 to 13).)

4. In simplified SPI (CSI) communications in the slave mode with devices operating at same voltage levels with the SCKp external clock

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.6\text{ V} \leq \text{EVDD0} = \text{EVDD1} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = \text{EVSS1} = 0\text{ V}$ )

(1/2)

| Item                           | Symbol        | Conditions                                         |                                  | HS<br>(High-Speed Main)<br>Mode |      | LS<br>(Low-Speed Main)<br>Mode |      | LP<br>(Low-Power Main)<br>Mode |      | Unit |
|--------------------------------|---------------|----------------------------------------------------|----------------------------------|---------------------------------|------|--------------------------------|------|--------------------------------|------|------|
|                                |               |                                                    |                                  | Min.                            | Max. | Min.                           | Max. | Min.                           | Max. |      |
| SCKp cycle time<br>Note 1      | tkCY2         | $4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ | $20\text{ MHz} < \text{fMCK}$    | 8/fMCK                          |      | 8/fMCK                         |      | —                              |      | ns   |
|                                |               |                                                    | $\text{fMCK} \leq 20\text{ MHz}$ | 6/fMCK                          |      | 6/fMCK                         |      | 6/fMCK                         |      | ns   |
|                                |               | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ | $16\text{ MHz} < \text{fMCK}$    | 8/fMCK                          |      | 8/fMCK                         |      | —                              |      | ns   |
|                                |               |                                                    | $\text{fMCK} \leq 16\text{ MHz}$ | 6/fMCK                          |      | 6/fMCK                         |      | 6/fMCK                         |      | ns   |
|                                |               | $2.4\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                  | 6/fMCK<br>and 500               |      | 6/fMCK<br>and 500              |      | 6/fMCK<br>and 500              |      | ns   |
|                                |               | $1.8\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                  | 6/fMCK<br>and 750               |      | 6/fMCK<br>and 750              |      | 6/fMCK<br>and 750              |      | ns   |
|                                |               | $1.6\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                  | 6/fMCK<br>and 1500              |      | 6/fMCK<br>and 1500             |      | 6/fMCK<br>and 1500             |      | ns   |
| SCKp high-/<br>low-level width | tkH2,<br>tkL2 | $4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                  | tkCY2/2 - 7                     |      | tkCY2/2 - 7                    |      | tkCY2/2 - 7                    |      | ns   |
|                                |               | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                  | tkCY2/2 - 8                     |      | tkCY2/2 - 8                    |      | tkCY2/2 - 8                    |      | ns   |
|                                |               | $1.8\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                  | tkCY2/2<br>- 18                 |      | tkCY2/2<br>- 18                |      | tkCY2/2<br>- 18                |      | ns   |
|                                |               | $1.6\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                  | tkCY2/2<br>- 66                 |      | tkCY2/2<br>- 66                |      | tkCY2/2<br>- 66                |      | ns   |

(Notes, Caution, and Remarks are listed on the next page.)

4. In simplified SPI (CSI) communications in the slave mode with devices operating at same voltage levels with the SCKp external clock

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.6\text{ V} \leq \text{EVDD0} = \text{EVDD1} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = \text{EVSS1} = 0\text{ V}$ )

(2/2)

| Item                                                    | Symbol | Conditions                                         |                                                    | HS<br>(High-Speed Main)<br>Mode |                          | LS<br>(Low-Speed Main)<br>Mode |                          | LP<br>(Low-Power Main)<br>Mode |                          | Unit |
|---------------------------------------------------------|--------|----------------------------------------------------|----------------------------------------------------|---------------------------------|--------------------------|--------------------------------|--------------------------|--------------------------------|--------------------------|------|
|                                                         |        |                                                    |                                                    | Min.                            | Max.                     | Min.                           | Max.                     | Min.                           | Max.                     |      |
| Slp setup time<br>(to SCKp↑) <b>Note 2</b>              | tsIK2  | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                                    | $1/\text{fMCK}$<br>+ 20         |                          | $1/\text{fMCK}$<br>+ 30        |                          | $1/\text{fMCK}$<br>+ 30        |                          | ns   |
|                                                         |        | $1.8\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                                    | $1/\text{fMCK}$<br>+ 30         |                          | $1/\text{fMCK}$<br>+ 30        |                          | $1/\text{fMCK}$<br>+ 30        |                          | ns   |
|                                                         |        | $1.6\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                                    | $1/\text{fMCK}$<br>+ 40         |                          | $1/\text{fMCK}$<br>+ 40        |                          | $1/\text{fMCK}$<br>+ 40        |                          | ns   |
| Slp hold time<br>(from SCKp↑) <b>Note 2</b>             | tKSI2  | $1.8\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                                    | $1/\text{fMCK}$<br>+ 31         |                          | $1/\text{fMCK}$<br>+ 31        |                          | $1/\text{fMCK}$<br>+ 31        |                          | ns   |
|                                                         |        | $1.6\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                                    | $1/\text{fMCK}$<br>+ 250        |                          | $1/\text{fMCK}$<br>+ 250       |                          | $1/\text{fMCK}$<br>+ 250       |                          | ns   |
| Delay time from<br>SCKp↓ to SOp output<br><b>Note 3</b> | tKSO2  | $C = 30\text{ pF}$<br><b>Note 4</b>                | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                 | $2/\text{fMCK}$<br>+ 44  |                                | $2/\text{fMCK}$<br>+ 110 |                                | $2/\text{fMCK}$<br>+ 110 | ns   |
|                                                         |        |                                                    | $2.4\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                 | $2/\text{fMCK}$<br>+ 75  |                                | $2/\text{fMCK}$<br>+ 110 |                                | $2/\text{fMCK}$<br>+ 110 | ns   |
|                                                         |        |                                                    | $1.8\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                 | $2/\text{fMCK}$<br>+ 110 |                                | $2/\text{fMCK}$<br>+ 110 |                                | $2/\text{fMCK}$<br>+ 110 | ns   |
|                                                         |        |                                                    | $1.6\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ |                                 | $2/\text{fMCK}$<br>+ 220 |                                | $2/\text{fMCK}$<br>+ 220 |                                | $2/\text{fMCK}$<br>+ 220 | ns   |

**Note 1.** Transfer rate in the SNOOZE mode is 1 Mbps at the maximum.

**Note 2.** This setting applies when DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The setting for the Slp setup time becomes “to SCKp↓” and that for the Slp hold time becomes “from SCKp↓” when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

**Note 3.** This setting applies when DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The setting for the delay time to SOp output becomes “from SCKp↑” when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

**Note 4.** C is the load capacitance of the SOp output line.

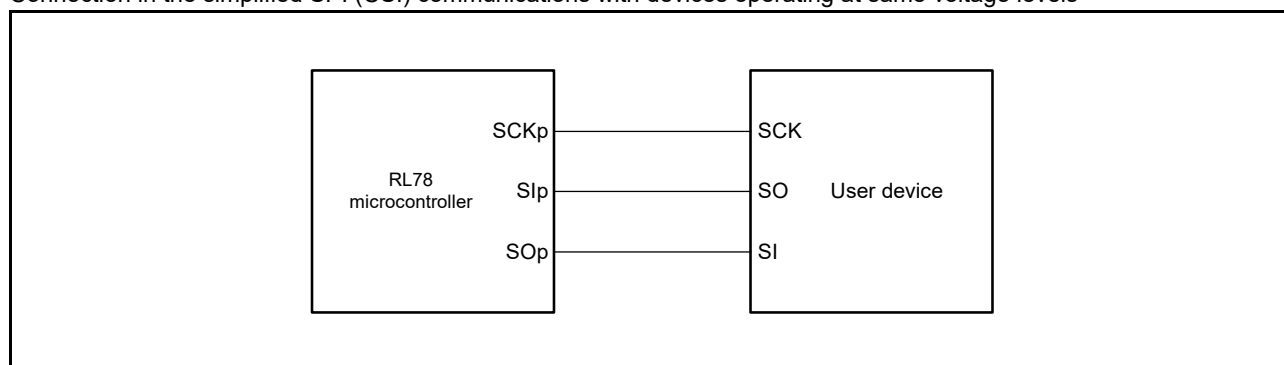
**Caution** Select the normal input buffer for the Slp pin and SCKp pin and the normal output mode for the SOp pin by using the port input mode register g (PIMg) and the port output mode register g (POMg).

**Remark 1.** p: CSI number (p = 00, 01, 10, 11, 20, 21, 30, 31), m: Unit number (m = 0, 1), n: Channel number (n = 0 to 3), g: PIM and POM numbers (g = 0, 1, 4, 5, 8, 14)

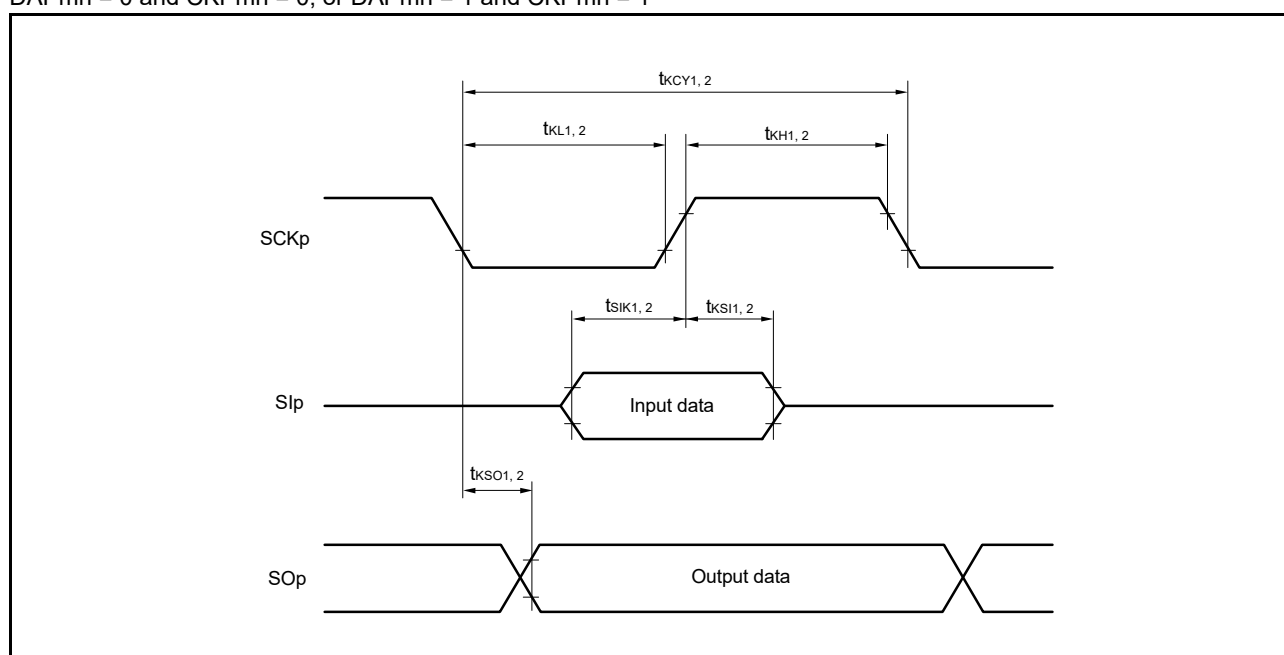
**Remark 2.** fMCK: Serial array unit operation clock frequency

(To set this operating clock, use the CKSmn bit in the serial mode register mn (SMRmn) (m: Unit number, n: Channel number = 00 to 03, 10 to 13).)

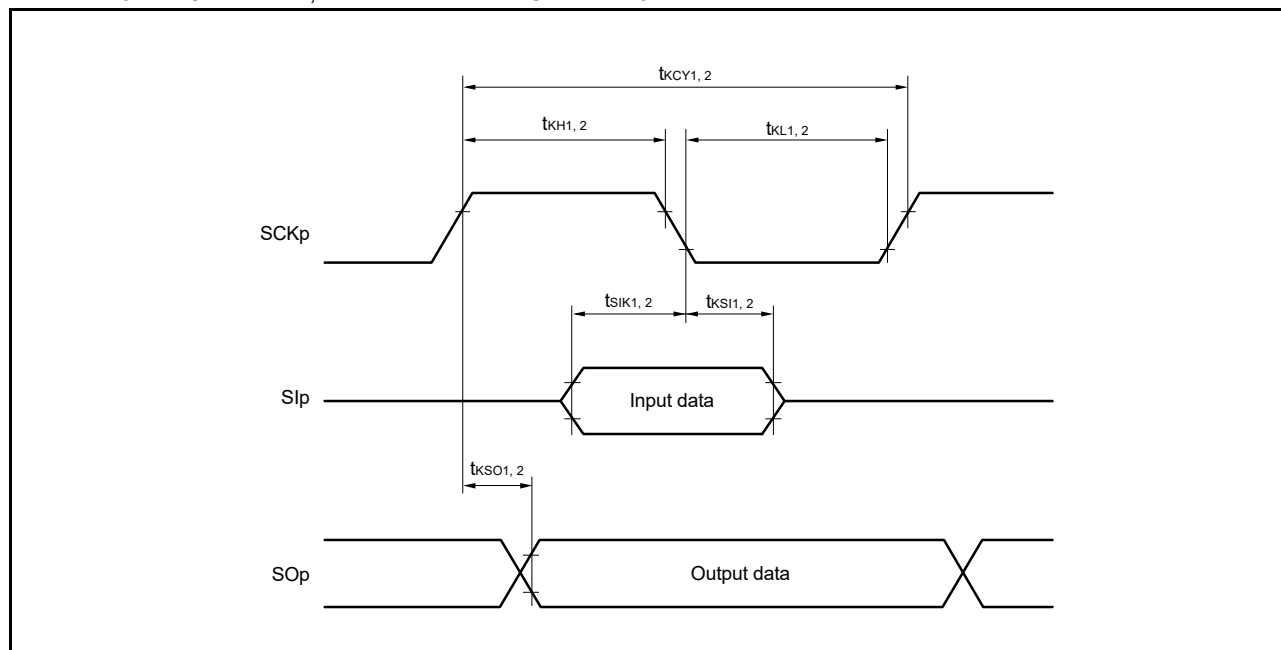
Connection in the simplified SPI (CSI) communications with devices operating at same voltage levels



Timing of serial transfer in the simplified SPI (CSI) communications with devices operating at same voltage levels when DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1



Timing of serial transfer in the simplified SPI (CSI) communications with devices operating at same voltage levels when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0



**Remark 1.** p: CSI number (p = 00, 01, 10, 11, 20, 21, 30, 31)

**Remark 2.** m: Unit number, n: Channel number (mn = 00 to 03, 10 to 13)

5. In simplified I<sup>2</sup>C communications with devices operating at same voltage levels

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

(1/2)

| Item                           | Symbol | Conditions                                        | HS<br>(High-Speed Main)<br>Mode |                | LS<br>(Low-Speed Main)<br>Mode |                | LP<br>(Low-Power Main)<br>Mode |           | Unit |
|--------------------------------|--------|---------------------------------------------------|---------------------------------|----------------|--------------------------------|----------------|--------------------------------|-----------|------|
|                                |        |                                                   | Min.                            | Max.           | Min.                           | Max.           | Min.                           | Max.      |      |
| SCLr clock frequency           | fSCL   | 2.7 V ≤ EVDD0 ≤ 5.5 V,<br>Cb = 50 pF, Rb = 2.7 kΩ |                                 | 1000<br>Note 1 |                                | 1000<br>Note 1 |                                | 400Note 1 | kHz  |
|                                |        | 1.8 V ≤ EVDD0 ≤ 5.5 V,<br>Cb = 100 pF, Rb = 3 kΩ  |                                 | 400Note 1      |                                | 400Note 1      |                                | 400Note 1 | kHz  |
|                                |        | 1.8 V ≤ EVDD0 < 2.7 V,<br>Cb = 100 pF, Rb = 5 kΩ  |                                 | 300Note 1      |                                | 300Note 1      |                                | 300Note 1 | kHz  |
|                                |        | 1.6 V ≤ EVDD0 < 1.8 V,<br>Cb = 100 pF, Rb = 5 kΩ  |                                 | 250Note 1      |                                | 250Note 1      |                                | 250Note 1 | kHz  |
| Hold time when SCLr<br>is low  | tLOW   | 2.7 V ≤ EVDD0 ≤ 5.5 V,<br>Cb = 50 pF, Rb = 2.7 kΩ | 475                             |                | 475                            |                | 1150                           |           | ns   |
|                                |        | 1.8 V ≤ EVDD0 ≤ 5.5 V,<br>Cb = 100 pF, Rb = 3 kΩ  | 1150                            |                | 1150                           |                | 1150                           |           | ns   |
|                                |        | 1.8 V ≤ EVDD0 < 2.7 V,<br>Cb = 100 pF, Rb = 5 kΩ  | 1550                            |                | 1550                           |                | 1550                           |           | ns   |
|                                |        | 1.6 V ≤ EVDD0 < 1.8 V,<br>Cb = 100 pF, Rb = 5 kΩ  | 1850                            |                | 1850                           |                | 1850                           |           | ns   |
| Hold time when SCLr<br>is high | tHIGH  | 2.7 V ≤ EVDD0 ≤ 5.5 V,<br>Cb = 50 pF, Rb = 2.7 kΩ | 475                             |                | 475                            |                | 1150                           |           | ns   |
|                                |        | 1.8 V ≤ EVDD0 ≤ 5.5 V,<br>Cb = 100 pF, Rb = 3 kΩ  | 1150                            |                | 1150                           |                | 1150                           |           | ns   |
|                                |        | 1.8 V ≤ EVDD0 < 2.7 V,<br>Cb = 100 pF, Rb = 5 kΩ  | 1550                            |                | 1550                           |                | 1550                           |           | ns   |
|                                |        | 1.6 V ≤ EVDD0 < 1.8 V,<br>Cb = 100 pF, Rb = 5 kΩ  | 1850                            |                | 1850                           |                | 1850                           |           | ns   |

(Notes and Caution are listed on the next page, and Remarks are listed on page 120.)

5. In simplified I<sup>2</sup>C communications with devices operating at same voltage levels(T<sub>A</sub> = -40 to +105°C, 1.6 V ≤ EV<sub>DD0</sub> = EV<sub>DD1</sub> ≤ V<sub>DD</sub> ≤ 5.5 V, V<sub>SS</sub> = EV<sub>SS0</sub> = EV<sub>SS1</sub> = 0 V)

(2/2)

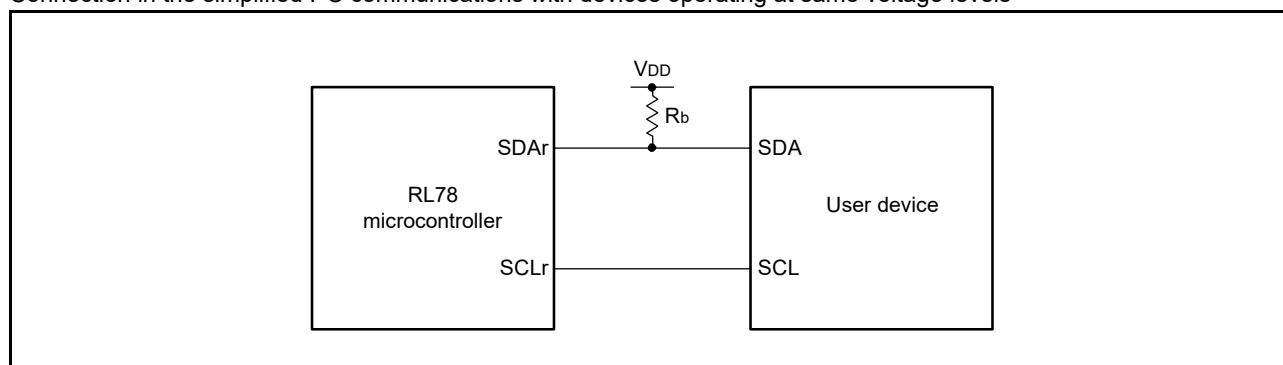
| Item                             | Symbol              | Conditions                                                                            | HS<br>(High-Speed Main)<br>Mode              |      | LS<br>(Low-Speed Main)<br>Mode               |      | LP<br>(Low-Power Main)<br>Mode               |      | Unit |
|----------------------------------|---------------------|---------------------------------------------------------------------------------------|----------------------------------------------|------|----------------------------------------------|------|----------------------------------------------|------|------|
|                                  |                     |                                                                                       | Min.                                         | Max. | Min.                                         | Max. | Min.                                         | Max. |      |
| Data setup time<br>(reception)   | t <sub>SU:DAT</sub> | 2.7 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ | 1/f <sub>MCK</sub><br>+ 85<br><b>Note 2</b>  |      | 1/f <sub>MCK</sub><br>+ 85<br><b>Note 2</b>  |      | 1/f <sub>MCK</sub><br>+ 145<br><b>Note 2</b> |      | ns   |
|                                  |                     | 1.8 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 3 kΩ  | 1/f <sub>MCK</sub><br>+ 145<br><b>Note 2</b> |      | 1/f <sub>MCK</sub><br>+ 145<br><b>Note 2</b> |      | 1/f <sub>MCK</sub><br>+ 145<br><b>Note 2</b> |      | ns   |
|                                  |                     | 1.8 V ≤ EV <sub>DD0</sub> < 2.7 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5 kΩ  | 1/f <sub>MCK</sub><br>+ 230<br><b>Note 2</b> |      | 1/f <sub>MCK</sub><br>+ 230<br><b>Note 2</b> |      | 1/f <sub>MCK</sub><br>+ 230<br><b>Note 2</b> |      | ns   |
|                                  |                     | 1.6 V ≤ EV <sub>DD0</sub> < 1.8 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5 kΩ  | 1/f <sub>MCK</sub><br>+ 290<br><b>Note 2</b> |      | 1/f <sub>MCK</sub><br>+ 290<br><b>Note 2</b> |      | 1/f <sub>MCK</sub><br>+ 290<br><b>Note 2</b> |      | ns   |
| Data hold time<br>(transmission) | t <sub>HD:DAT</sub> | 2.7 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ | 0                                            | 305  | 0                                            | 305  | 0                                            | 305  | ns   |
|                                  |                     | 1.8 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 3 kΩ  | 0                                            | 355  | 0                                            | 355  | 0                                            | 355  | ns   |
|                                  |                     | 1.8 V ≤ EV <sub>DD0</sub> < 2.7 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5 kΩ  | 0                                            | 405  | 0                                            | 405  | 0                                            | 405  | ns   |
|                                  |                     | 1.6 V ≤ EV <sub>DD0</sub> < 1.8 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5 kΩ  | 0                                            | 405  | 0                                            | 405  | 0                                            | 405  | ns   |

**Note 1.** The listed times must be no greater than f<sub>MCK</sub>/4.**Note 2.** Set f<sub>MCK</sub> so that it will not exceed the hold time when SCLr is low or high.

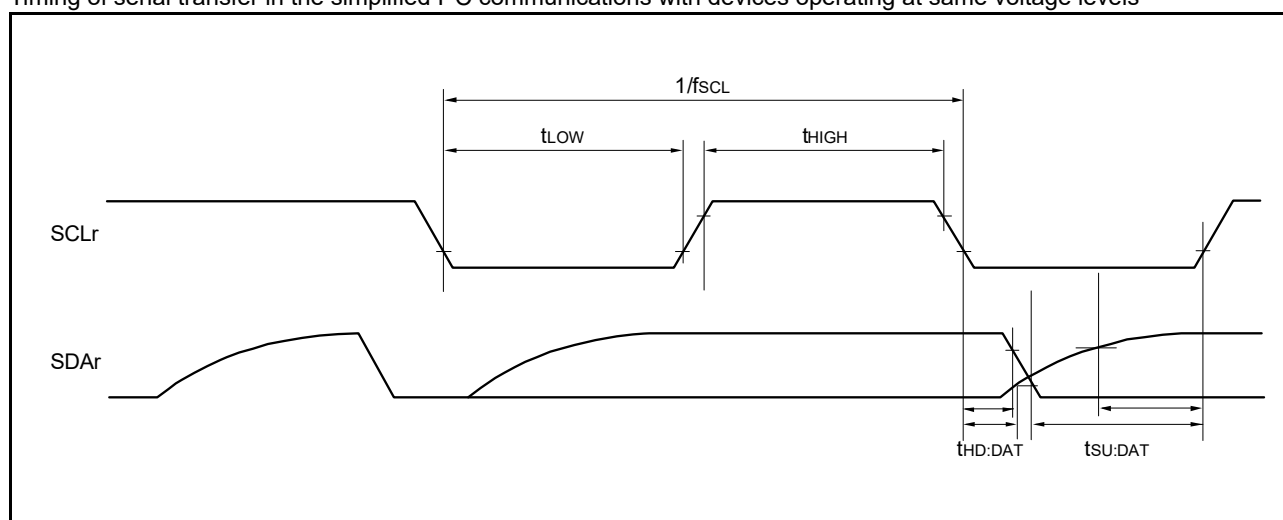
**Caution** Select the normal input buffer and the N-ch open drain output (withstand voltage of V<sub>DD</sub> (when 30- to 52-pin products)/withstand voltage of EV<sub>DD</sub> (when 64- to 128-pin products)) mode for the SDAr pin and the normal output mode for the SCLr pin by using port input mode register g (PIMg) and port output mode register h (POMh).

(Remarks are listed on the next page.)

Connection in the simplified I<sup>2</sup>C communications with devices operating at same voltage levels



Timing of serial transfer in the simplified I<sup>2</sup>C communications with devices operating at same voltage levels



**Remark 1.** R<sub>b</sub>[Ω]: Communication line (SDAr) pull-up resistance, C<sub>b</sub>[F]: Communication line (SDAr, SCLr) load capacitance

**Remark 2.** r: IIC number (r = 00, 01, 10, 11, 20, 21, 30, 31), g: PIM number (g = 0, 1, 4, 5, 8, 14), h: POM number (g = 0, 1, 4, 5, 7 to 9, 14)

**Remark 3.** f<sub>MCK</sub>: Serial array unit operation clock frequency

(To set this operating clock, use the CKSMn bit in the serial mode register mn (SMRmn) (m: Unit number, n: Channel number = 00 to 03, 10 to 13).)

## 6. In UART communications with devices operating at different voltage levels (1.8 V, 2.5 V, 3 V)

(TA = -40 to +105°C, 1.8 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

(1/2)

| Item          | Symbol | Conditions | HS<br>(High-Speed Main)<br>Mode                                           |      | LS<br>(Low-Speed Main)<br>Mode |                         | LP<br>(Low-Power Main)<br>Mode |                      | Unit |
|---------------|--------|------------|---------------------------------------------------------------------------|------|--------------------------------|-------------------------|--------------------------------|----------------------|------|
|               |        |            | Min.                                                                      | Max. | Min.                           | Max.                    | Min.                           | Max.                 |      |
| Transfer rate |        | Reception  | 4.0 V ≤ EVDD0 ≤ 5.5 V,<br>2.7 V ≤ Vb ≤ 4.0 V                              |      |                                | fMCK/6<br>Note 1        |                                | fMCK/6<br>Note 1     | bps  |
|               |        |            | Theoretical value of<br>the maximum transfer<br>rate<br>fMCK = fCLKNote 2 |      |                                | 5.3                     |                                | 4                    | Mbps |
|               |        |            | 2.7 V ≤ EVDD0 < 4.0 V,<br>2.3 V ≤ Vb ≤ 2.7 V                              |      |                                | fMCK/6<br>Note 1        |                                | fMCK/6<br>Note 1     | bps  |
|               |        |            | Theoretical value of<br>the maximum transfer<br>rate<br>fMCK = fCLKNote 2 |      |                                | 5.3                     |                                | 4                    | Mbps |
|               |        |            | 1.8 V ≤ EVDD0 < 3.3 V,<br>1.6 V ≤ Vb ≤ 2.0 V                              |      |                                | fMCK/6<br>Notes 1, 3, 4 |                                | fMCK/6<br>Notes 1, 3 | bps  |
|               |        |            | Theoretical value of<br>the maximum transfer<br>rate<br>fMCK = fCLKNote 2 |      |                                | 5.3                     |                                | 4                    | Mbps |

**Note 1.** Transfer rate in the SNOOZE mode is within the range from 4800 to 9600 bps.**Note 2.** The maximum operating frequencies of the CPU/peripheral hardware clock (fCLK) are:

HS (high-speed main) mode : 32 MHz (1.8 V ≤ VDD ≤ 5.5 V)

4 MHz (1.6 V ≤ VDD ≤ 5.5 V)

LS (low-speed main) mode : 24 MHz (1.8 V ≤ VDD ≤ 5.5 V)

4 MHz (1.6 V ≤ VDD ≤ 5.5 V)

LP (low-power main) mode : 2 MHz (1.6 V ≤ VDD ≤ 5.5 V)

**Note 3.** Use this rate with EVDD0 ≥ Vb.**Note 4.** The following conditions are required for low voltage interface when EVDD0 < VDD.

2.4 V ≤ EVDD0 &lt; 2.7 V: 2.6 Mbps (max.)

1.8 V ≤ EVDD0 &lt; 2.4 V: 1.3 Mbps (max.)

**Caution** Select the TTL input buffer for the RxDq pin and the N-ch open drain output (withstand voltage of VDD (when 30- to 52-pin products)/withstand voltage of EVDD (when 64- to 128-pin products)) mode for the TxDq pin by using port input mode register g (PIMg) and port output mode register g (POMg). For VIH and VIL, see the DC characteristics with TTL input buffer selected.

**Remark 1.** Vb[V]: Communication line voltage**Remark 2.** q: UART number (q = 0 to 3), g: PIM and POM number (g = 0, 1, 8, 14)**Remark 3.** fMCK: Serial array unit operation clock frequency

(To set this operating clock, use the CKSmn bit in the serial mode register mn (SMRmn) (m: Unit number, n: Channel number = 00 to 03, 10 to 13).)

**Remark 4.** Communications by using UART2 with devices operating at different voltage levels are not possible when the setting of bit 1 (PIOR1) of the peripheral I/O redirection register (PIOR) is 1.

## 6. In UART communications with devices operating at different voltage levels (1.8 V, 2.5 V, 3 V)

(TA = -40 to +105°C, 1.8 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

(2/2)

| Item          | Symbol | Conditions   | HS<br>(High-Speed Main)<br>Mode                                                             |      | LS<br>(Low-Speed Main)<br>Mode |                | LP<br>(Low-Power Main)<br>Mode |                | Unit |
|---------------|--------|--------------|---------------------------------------------------------------------------------------------|------|--------------------------------|----------------|--------------------------------|----------------|------|
|               |        |              | Min.                                                                                        | Max. | Min.                           | Max.           | Min.                           | Max.           |      |
| Transfer rate |        | Transmission | 4.0 V ≤ EVDD0 ≤ 5.5 V,<br>2.7 V ≤ Vb ≤ 4.0 V                                                |      |                                | Note 1         |                                | Note 1         | bps  |
|               |        |              | Theoretical value of the maximum transfer rate<br>Cb = 50 pF,<br>Rb = 1.4 kΩ,<br>Vb = 2.7 V |      |                                | 2.8Note 2      |                                | 2.8Note 2      | Mbps |
|               |        |              | 2.7 V ≤ EVDD0 < 4.0 V,<br>2.3 V ≤ Vb ≤ 2.7 V                                                |      |                                | Note 3         |                                | Note 3         | bps  |
|               |        |              | Theoretical value of the maximum transfer rate<br>Cb = 50 pF,<br>Rb = 2.7 kΩ,<br>Vb = 2.3 V |      |                                | 1.2Note 4      |                                | 1.2Note 4      | Mbps |
|               |        |              | 1.8 V ≤ EVDD0 < 3.3 V,<br>1.6 V ≤ Vb ≤ 2.0 V                                                |      |                                | Notes 5, 6     |                                | Notes 5, 6     | bps  |
|               |        |              | Theoretical value of the maximum transfer rate<br>Cb = 50 pF,<br>Rb = 5.5 kΩ,<br>Vb = 1.6 V |      |                                | 0.43<br>Note 7 |                                | 0.43<br>Note 7 | Mbps |

**Note 1.** The smaller maximum transfer rate derived by using fmck/6 or the following expression is the valid maximum transfer rate.  
Expression for calculating the transfer rate when 4.0 V ≤ EVDD0 ≤ 5.5 V, 2.7 V ≤ Vb ≤ 4.0 V

$$\text{Maximum transfer rate} = \frac{1}{\{-C_b \times R_b \times \ln(1 - \frac{2.2}{V_b})\} \times 3} \text{ [bps]}$$

$$\text{Baud rate error (theoretical value)} = \frac{\frac{1}{\text{Transfer rate} \times 2} - \{-C_b \times R_b \times \ln(1 - \frac{2.2}{V_b})\}}{(\frac{1}{\text{Transfer rate}}) \times \text{Number of transferred bits}} \times 100 [\%]$$

\* This value is the theoretical value of the relative difference between the transmission and reception sides.

**Note 2.** This rate is calculated as an example when the conditions described in the “Conditions” column are met. See **Note 1** above to calculate the maximum transfer rate under conditions of the customer.

(Notes and Caution continue in the next page.)

**Note 3.** The smaller maximum transfer rate derived by using  $f_{MCK}/6$  or the following expression is the valid maximum transfer rate. Expression for calculating the transfer rate when  $2.7\text{ V} \leq E_{VDD0} < 4.0\text{ V}$ ,  $2.3\text{ V} \leq V_b \leq 2.7\text{ V}$

$$\text{Maximum transfer rate} = \frac{1}{\{-C_b \times R_b \times \ln(1 - \frac{2.0}{V_b})\} \times 3} \text{ [bps]}$$

$$\text{Baud rate error (theoretical value)} = \frac{\frac{1}{\text{Transfer rate} \times 2} - \{-C_b \times R_b \times \ln(1 - \frac{2.0}{V_b})\}}{(\frac{1}{\text{Transfer rate}}) \times \text{Number of transferred bits}} \times 100 [\%]$$

\* This value is the theoretical value of the relative difference between the transmission and reception sides.

**Note 4.** This rate is calculated as an example when the conditions described in the “Conditions” column are met. See **Note 3** above to calculate the maximum transfer rate under conditions of the customer.

**Note 5.** Use this rate with  $E_{VDD0} \geq V_b$ .

**Note 6.** The smaller maximum transfer rate derived by using  $f_{MCK}/6$  or the following expression is the valid maximum transfer rate. Expression for calculating the transfer rate when  $1.8\text{ V} \leq E_{VDD0} < 3.3\text{ V}$ ,  $1.6\text{ V} \leq V_b \leq 2.0\text{ V}$

$$\text{Maximum transfer rate} = \frac{1}{\{-C_b \times R_b \times \ln(1 - \frac{1.5}{V_b})\} \times 3} \text{ [bps]}$$

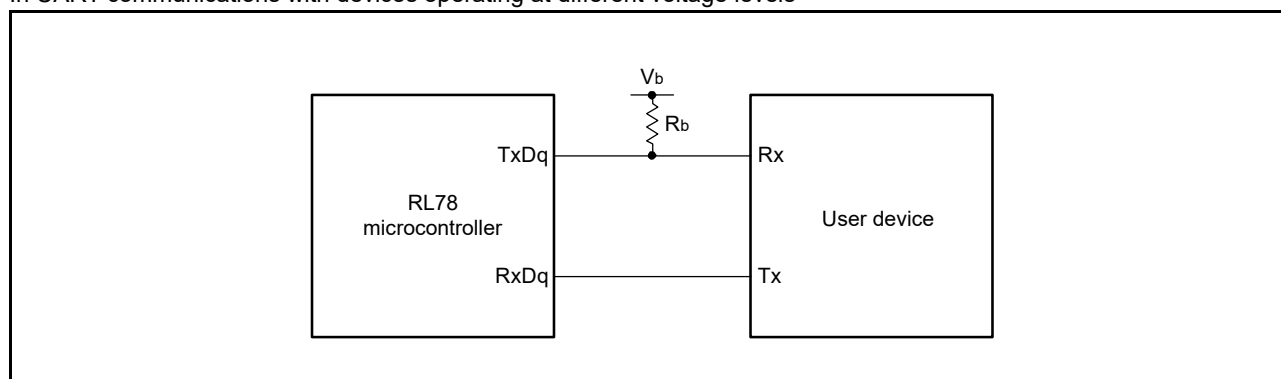
$$\text{Baud rate error (theoretical value)} = \frac{\frac{1}{\text{Transfer rate} \times 2} - \{-C_b \times R_b \times \ln(1 - \frac{1.5}{V_b})\}}{(\frac{1}{\text{Transfer rate}}) \times \text{Number of transferred bits}} \times 100 [\%]$$

\* This value is the theoretical value of the relative difference between the transmission and reception sides.

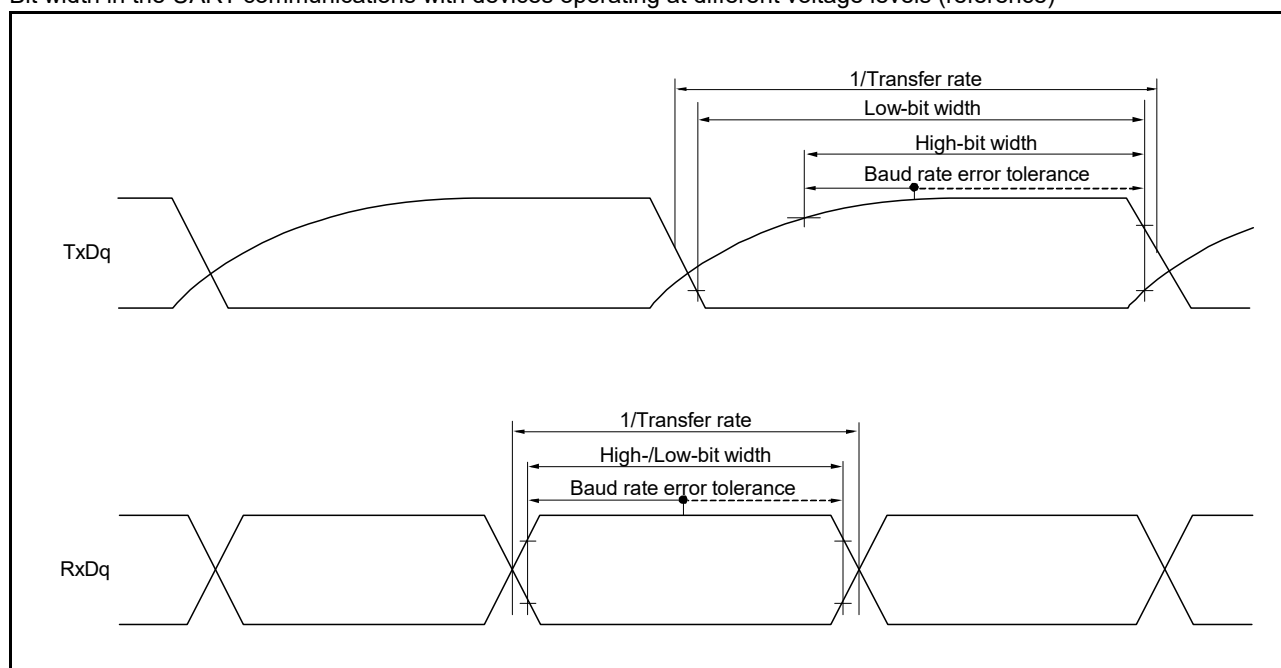
**Note 7.** This rate is calculated as an example when the conditions described in the “Conditions” column are met. Refer to **Note 6** above to calculate the maximum transfer rate under conditions of the customer.

**Caution** Select the TTL input buffer for the RxDq pin and the N-ch open drain output (withstand voltage of  $V_{DD}$  (when 30- to 52-pin products)/withstand voltage of  $E_{VDD}$  (when 64- to 128-pin products)) mode for the TxDq pin by using port input mode register g (PIMg) and port output mode register g (POMg). For  $V_{IH}$  and  $V_{IL}$ , see the DC characteristics with TTL input buffer selected.

In UART communications with devices operating at different voltage levels



Bit width in the UART communications with devices operating at different voltage levels (reference)



**Remark 1.**  $R_b[\Omega]$ : Communication line (TxDq) pull-up resistance,  $C_b[F]$ : Communication line (TxDq) load capacitance,  $V_b[V]$ : Communication line voltage

**Remark 2.** q: UART number (q = 0 to 3), g: PIM and POM number (g = 0, 1, 8, 14)

**Remark 3.** f<sub>MCK</sub>: Serial array unit operation clock frequency

(To set this operating clock, use the CKSmn bit in the serial mode register mn (SMRmn) (m: Unit number, n: Channel number = 00 to 03, 10 to 13).)

**Remark 4.** Communications by using UART2 with devices operating at different voltage levels are not possible when the setting of bit 1 (PIOR1) of the peripheral I/O redirection register (PIOR) is 1.

7. In simplified SPI (CSI) communications in the master mode with devices operating at different voltage levels (2.5 V or 3 V) with the internal SCKp clock (the ratings below are only applicable to CSI00)

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $2.7\text{ V} \leq \text{EVDD0} = \text{EVDD1} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = \text{EVSS1} = 0\text{ V}$ )

(1/2)

| Item                                                                    | Symbol | Conditions                                                                                           |                                                                                                         | HS<br>(High-Speed Main)<br>Mode |      | LS<br>(Low-Speed Main)<br>Mode |      | LP<br>(Low-Power Main)<br>Mode |      | Unit |
|-------------------------------------------------------------------------|--------|------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|---------------------------------|------|--------------------------------|------|--------------------------------|------|------|
|                                                                         |        |                                                                                                      |                                                                                                         | Min.                            | Max. | Min.                           | Max. | Min.                           | Max. |      |
| SCKp cycle time                                                         | tkCY1  | tkCY1 $\geq$ 2/fCLK                                                                                  | 4.0 V $\leq$ EVDD0 $\leq$ 5.5 V,<br>2.7 V $\leq$ Vb $\leq$ 4.0 V,<br>Cb = 20 pF,<br>Rb = 1.4 k $\Omega$ | 200                             |      | 200                            |      | 2300                           |      | ns   |
|                                                                         |        |                                                                                                      | 2.7 V $\leq$ EVDD0 < 4.0 V,<br>2.3 V $\leq$ Vb $\leq$ 2.7 V,<br>Cb = 20 pF,<br>Rb = 2.7 k $\Omega$      | 300                             |      | 300                            |      | 2300                           |      | ns   |
| SCKp high-level width                                                   | tkH1   | 4.0 V $\leq$ EVDD0 $\leq$ 5.5 V,<br>2.7 V $\leq$ Vb $\leq$ 4.0 V,<br>Cb = 20 pF, Rb = 1.4 k $\Omega$ |                                                                                                         | tkCY1/2<br>- 50                 |      | tkCY1/2<br>- 50                |      | tkCY1/2<br>- 50                |      | ns   |
|                                                                         |        | 2.7 V $\leq$ EVDD0 < 4.0 V,<br>2.3 V $\leq$ Vb $\leq$ 2.7 V,<br>Cb = 20 pF, Rb = 2.7 k $\Omega$      |                                                                                                         | tkCY1/2<br>- 120                |      | tkCY1/2<br>- 120               |      | tkCY1/2<br>- 120               |      | ns   |
| SCKp low-level width                                                    | tkL1   | 4.0 V $\leq$ EVDD0 $\leq$ 5.5 V,<br>2.7 V $\leq$ Vb $\leq$ 4.0 V,<br>Cb = 20 pF, Rb = 1.4 k $\Omega$ |                                                                                                         | tkCY1/2<br>- 7                  |      | tkCY1/2<br>- 7                 |      | tkCY1/2<br>- 50                |      | ns   |
|                                                                         |        | 2.7 V $\leq$ EVDD0 < 4.0 V,<br>2.3 V $\leq$ Vb $\leq$ 2.7 V,<br>Cb = 20 pF, Rb = 2.7 k $\Omega$      |                                                                                                         | tkCY1/2<br>- 10                 |      | tkCY1/2<br>- 10                |      | tkCY1/2<br>- 50                |      | ns   |
| Slp setup time<br>(to SCKp $\uparrow$ ) <sup>Note 1</sup>               | tsIK1  | 4.0 V $\leq$ EVDD0 $\leq$ 5.5 V,<br>2.7 V $\leq$ Vb $\leq$ 4.0 V,<br>Cb = 20 pF, Rb = 1.4 k $\Omega$ |                                                                                                         | 58                              |      | 58                             |      | 479                            |      | ns   |
|                                                                         |        | 2.7 V $\leq$ EVDD0 < 4.0 V,<br>2.3 V $\leq$ Vb $\leq$ 2.7 V,<br>Cb = 20 pF, Rb = 2.7 k $\Omega$      |                                                                                                         | 121                             |      | 121                            |      | 479                            |      | ns   |
| Slp hold time<br>(from SCKp $\uparrow$ ) <sup>Note 1</sup>              | tkSI1  | 4.0 V $\leq$ EVDD0 $\leq$ 5.5 V,<br>2.7 V $\leq$ Vb $\leq$ 4.0 V,<br>Cb = 20 pF, Rb = 1.4 k $\Omega$ |                                                                                                         | 10                              |      | 10                             |      | 10                             |      | ns   |
|                                                                         |        | 2.7 V $\leq$ EVDD0 < 4.0 V,<br>2.3 V $\leq$ Vb $\leq$ 2.7 V,<br>Cb = 20 pF, Rb = 2.7 k $\Omega$      |                                                                                                         | 10                              |      | 10                             |      | 10                             |      | ns   |
| Delay time from<br>SCKp $\downarrow$ to SOp<br>output <sup>Note 1</sup> | tkSO1  | 4.0 V $\leq$ EVDD0 $\leq$ 5.5 V,<br>2.7 V $\leq$ Vb $\leq$ 4.0 V,<br>Cb = 20 pF, Rb = 1.4 k $\Omega$ |                                                                                                         |                                 | 60   |                                | 60   |                                | 60   | ns   |
|                                                                         |        | 2.7 V $\leq$ EVDD0 < 4.0 V,<br>2.3 V $\leq$ Vb $\leq$ 2.7 V,<br>Cb = 20 pF, Rb = 2.7 k $\Omega$      |                                                                                                         |                                 | 130  |                                | 130  |                                | 130  | ns   |

(Notes, Caution, and Remarks are listed on the next page.)

7. In simplified SPI (CSI) communications in the master mode with devices operating at different voltage levels (2.5 V or 3 V) with the internal SCKp clock (the ratings below are only applicable to CSI00)

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $2.7\text{ V} \leq \text{EVDD0} = \text{EVDD1} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = \text{EVSS1} = 0\text{ V}$ )

(2/2)

| Item                                                     | Symbol | Conditions                                                                                                                                                                    | HS<br>(High-Speed Main)<br>Mode |      | LS<br>(Low-Speed Main)<br>Mode |      | LP<br>(Low-Power Main)<br>Mode |      | Unit |
|----------------------------------------------------------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------|--------------------------------|------|--------------------------------|------|------|
|                                                          |        |                                                                                                                                                                               | Min.                            | Max. | Min.                           | Max. | Min.                           | Max. |      |
| Slp setup time<br>(to SCKp↓) <sup>Note 2</sup>           | tsIK1  | $4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq \text{V}_b \leq 4.0\text{ V}$ ,<br>$\text{C}_b = 20\text{ pF}$ , $\text{R}_b = 1.4\text{ k}\Omega$ | 23                              |      | 23                             |      | 110                            |      | ns   |
|                                                          |        | $2.7\text{ V} \leq \text{EVDD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq \text{V}_b \leq 2.7\text{ V}$ ,<br>$\text{C}_b = 20\text{ pF}$ , $\text{R}_b = 2.7\text{ k}\Omega$    | 33                              |      | 33                             |      | 110                            |      | ns   |
| Slp hold time<br>(from SCKp↓) <sup>Note 2</sup>          | tkSI1  | $4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq \text{V}_b \leq 4.0\text{ V}$ ,<br>$\text{C}_b = 20\text{ pF}$ , $\text{R}_b = 1.4\text{ k}\Omega$ | 10                              |      | 10                             |      | 10                             |      | ns   |
|                                                          |        | $2.7\text{ V} \leq \text{EVDD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq \text{V}_b \leq 2.7\text{ V}$ ,<br>$\text{C}_b = 20\text{ pF}$ , $\text{R}_b = 2.7\text{ k}\Omega$    | 10                              |      | 10                             |      | 10                             |      | ns   |
| Delay time from SCKp↑<br>to SOp output <sup>Note 2</sup> | tkSO1  | $4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq \text{V}_b \leq 4.0\text{ V}$ ,<br>$\text{C}_b = 20\text{ pF}$ , $\text{R}_b = 1.4\text{ k}\Omega$ |                                 | 10   |                                | 10   |                                | 10   | ns   |
|                                                          |        | $2.7\text{ V} \leq \text{EVDD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq \text{V}_b \leq 2.7\text{ V}$ ,<br>$\text{C}_b = 20\text{ pF}$ , $\text{R}_b = 2.7\text{ k}\Omega$    |                                 | 10   |                                | 10   |                                | 10   | ns   |

**Note 1.** This setting applies when DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1.

**Note 2.** This setting applies when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

**Caution** Select the TTL input buffer for the Slp pin and the N-ch open drain output (withstand voltage of VDD (when 30- to 52-pin products)/withstand voltage of EVDD (when 64- to 128-pin products)) mode for the SOp pin and SCKp pin by using port input mode register g (PIMg) and port output mode register g (POMg). For VIH and VIL, see the DC characteristics with TTL input buffer selected.

**Remark 1.**  $\text{R}_b[\Omega]$ : Communication line (SCKp, SOp) pull-up resistance,  $\text{C}_b[\text{F}]$ : Communication line (SCKp, SOp) load capacitance,  $\text{V}_b[\text{V}]$ : Communication line voltage

**Remark 2.** p: CSI number (p = 00), m: Unit number (m = 0), n: Channel number (n = 0), g: PIM and POM numbers (g = 1)

**Remark 3.** fMCK: Serial array unit operation clock frequency

(To set this operating clock, use the CKSmn bit in the serial mode register mn (SMRmn) (m: Unit number, n: Channel number = 00).)

**Remark 4.** The listed times are only valid when the peripheral I/O redirect function of CSI00 is not in use.

8. In simplified SPI (CSI) communications in the master mode with devices operating at different voltage levels (1.8 V, 2.5 V, or 3 V) with the internal SCKp clock

(TA = -40 to +105°C, 1.8 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

(1/3)

| Item                  | Symbol | Conditions     |                                                                                              | HS<br>(High-Speed Main)<br>Mode |      | LS<br>(Low-Speed Main)<br>Mode |      | LP<br>(Low-Power Main)<br>Mode |      | Unit |
|-----------------------|--------|----------------|----------------------------------------------------------------------------------------------|---------------------------------|------|--------------------------------|------|--------------------------------|------|------|
|                       |        |                |                                                                                              | Min.                            | Max. | Min.                           | Max. | Min.                           | Max. |      |
| SCKp cycle time       | tKCY1  | tKCY1 ≥ 4/fCLK | 4.0 V ≤ EVDD0 ≤ 5.5 V,<br>2.7 V ≤ Vb ≤ 4.0 V,<br>Cb = 30 pF,<br>Rb = 1.4 kΩ                  | 300                             |      | 300                            |      | 2300                           |      | ns   |
|                       |        |                | 2.7 V ≤ EVDD0 < 4.0 V,<br>2.3 V ≤ Vb ≤ 2.7 V,<br>Cb = 30 pF,<br>Rb = 2.7 kΩ                  | 500                             |      | 500                            |      | 2300                           |      | ns   |
|                       |        |                | 1.8 V ≤ EVDD0 < 3.3 V,<br>1.6 V ≤ Vb ≤ 2.0 V <sup>Note</sup> ,<br>Cb = 30 pF,<br>Rb = 5.5 kΩ | 1150                            |      | 1150                           |      | 2300                           |      | ns   |
| SCKp high-level width | tkH1   |                | 4.0 V ≤ EVDD0 ≤ 5.5 V,<br>2.7 V ≤ Vb ≤ 4.0 V,<br>Cb = 30 pF, Rb = 1.4 kΩ                     | tKCY1/2<br>- 75                 |      | tKCY1/2<br>- 75                |      | tKCY1/2<br>- 75                |      | ns   |
|                       |        |                | 2.7 V ≤ EVDD0 < 4.0 V,<br>2.3 V ≤ Vb ≤ 2.7 V,<br>Cb = 30 pF, Rb = 2.7 kΩ                     | tKCY1/2<br>- 170                |      | tKCY1/2<br>- 170               |      | tKCY1/2<br>- 170               |      | ns   |
|                       |        |                | 1.8 V ≤ EVDD0 < 3.3 V,<br>1.6 V ≤ Vb ≤ 2.0 V <sup>Note</sup> ,<br>Cb = 30 pF, Rb = 5.5 kΩ    | tKCY1/2<br>- 458                |      | tKCY1/2<br>- 458               |      | tKCY1/2<br>- 458               |      | ns   |
| SCKp low-level width  | tkL1   |                | 4.0 V ≤ EVDD0 ≤ 5.5 V,<br>2.7 V ≤ Vb ≤ 4.0 V,<br>Cb = 30 pF, Rb = 1.4 kΩ                     | tKCY1/2<br>- 12                 |      | tKCY1/2<br>- 12                |      | tKCY1/2<br>- 50                |      | ns   |
|                       |        |                | 2.7 V ≤ EVDD0 < 4.0 V,<br>2.3 V ≤ Vb ≤ 2.7 V,<br>Cb = 30 pF, Rb = 2.7 kΩ                     | tKCY1/2<br>- 18                 |      | tKCY1/2<br>- 18                |      | tKCY1/2<br>- 50                |      | ns   |
|                       |        |                | 1.8 V ≤ EVDD0 < 3.3 V,<br>1.6 V ≤ Vb ≤ 2.0 V <sup>Note</sup> ,<br>Cb = 30 pF, Rb = 5.5 kΩ    | tKCY1/2<br>- 50                 |      | tKCY1/2<br>- 50                |      | tKCY1/2<br>- 50                |      | ns   |

**Note** Use this setting with EVDD0 ≥ Vb.

**Caution** Select the TTL input buffer for the SIp pin and the N-ch open drain output (withstand voltage of VDD (when 30- to 52-pin products)/withstand voltage of EVDD (when 64- to 128-pin products)) mode for the SOp pin and SCKp pin by using port input mode register g (PIMg) and port output mode register g (POMg). For VIH and VIL, see the DC characteristics with TTL input buffer selected.

(Remarks are listed on page 130.)

8. In simplified SPI (CSI) communications in the master mode with devices operating at different voltage levels (1.8 V, 2.5 V, or 3 V) with the internal SCKp clock

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.8\text{ V} \leq \text{EVDD0} = \text{EVDD1} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = \text{EVSS1} = 0\text{ V}$ )

(2/3)

| Item                                                                 | Symbol | Conditions                                                                                                                                                                                | HS<br>(High-Speed Main)<br>Mode |      | LS<br>(Low-Speed Main)<br>Mode |      | LP<br>(Low-Power Main)<br>Mode |      | Unit |
|----------------------------------------------------------------------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------|--------------------------------|------|--------------------------------|------|------|
|                                                                      |        |                                                                                                                                                                                           | Min.                            | Max. | Min.                           | Max. | Min.                           | Max. |      |
| Slp setup time<br>(to SCKp $\uparrow$ ) <sup>Note 1</sup>            | tSIK1  | $4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq \text{Vb} \leq 4.0\text{ V}$ ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 1.4\text{ k}\Omega$                | 81                              |      | 81                             |      | 479                            |      | ns   |
|                                                                      |        | $2.7\text{ V} \leq \text{EVDD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq \text{Vb} \leq 2.7\text{ V}$ ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 2.7\text{ k}\Omega$                   | 177                             |      | 177                            |      | 479                            |      | ns   |
|                                                                      |        | $1.8\text{ V} \leq \text{EVDD0} < 3.3\text{ V}$ ,<br>$1.6\text{ V} \leq \text{Vb} \leq 2.0\text{ V}$ <sup>Note 2</sup> ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 5.5\text{ k}\Omega$ | 479                             |      | 479                            |      | 479                            |      | ns   |
| Slp hold time<br>(from SCKp $\uparrow$ ) <sup>Note 1</sup>           | tKSI1  | $4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq \text{Vb} \leq 4.0\text{ V}$ ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 1.4\text{ k}\Omega$                | 19                              |      | 19                             |      | 19                             |      | ns   |
|                                                                      |        | $2.7\text{ V} \leq \text{EVDD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq \text{Vb} \leq 2.7\text{ V}$ ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 2.7\text{ k}\Omega$                   | 19                              |      | 19                             |      | 19                             |      | ns   |
|                                                                      |        | $1.8\text{ V} \leq \text{EVDD0} < 3.3\text{ V}$ ,<br>$1.6\text{ V} \leq \text{Vb} \leq 2.0\text{ V}$ <sup>Note 2</sup> ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 5.5\text{ k}\Omega$ | 19                              |      | 19                             |      | 19                             |      | ns   |
| Delay time from SCKp $\downarrow$<br>to SOp output <sup>Note 1</sup> | tKSO1  | $4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq \text{Vb} \leq 4.0\text{ V}$ ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 1.4\text{ k}\Omega$                |                                 | 100  |                                | 100  |                                | 100  | ns   |
|                                                                      |        | $2.7\text{ V} \leq \text{EVDD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq \text{Vb} \leq 2.7\text{ V}$ ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 2.7\text{ k}\Omega$                   |                                 | 195  |                                | 195  |                                | 195  | ns   |
|                                                                      |        | $1.8\text{ V} \leq \text{EVDD0} < 3.3\text{ V}$ ,<br>$1.6\text{ V} \leq \text{Vb} \leq 2.0\text{ V}$ <sup>Note 2</sup> ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 5.5\text{ k}\Omega$ |                                 | 483  |                                | 483  |                                | 483  | ns   |

**Note 1.** This setting applies when DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1.

**Note 2.** Use this setting with  $\text{EVDD0} \geq \text{Vb}$ .

**Caution** Select the TTL input buffer for the Slp pin and the N-ch open drain output (withstand voltage of VDD (when 30- to 52-pin products)/withstand voltage of EVDD (when 64- to 128-pin products)) mode for the SOp pin and SCKp pin by using port input mode register g (PIMg) and port output mode register g (POMg). For VIH and VIL, see the DC characteristics with TTL input buffer selected.

(Remarks are listed on page 130.)

8. In simplified SPI (CSI) communications in the master mode with devices operating at different voltage levels (1.8 V, 2.5 V, or 3 V) with the internal SCKp clock

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.8\text{ V} \leq \text{EVDD0} = \text{EVDD1} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = \text{EVSS1} = 0\text{ V}$ )

(3/3)

| Item                                                     | Symbol | Conditions                                                                                                                                                                                | HS<br>(High-Speed Main)<br>Mode |      | LS<br>(Low-Speed Main)<br>Mode |      | LP<br>(Low-Power Main)<br>Mode |      | Unit |
|----------------------------------------------------------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------|--------------------------------|------|--------------------------------|------|------|
|                                                          |        |                                                                                                                                                                                           | Min.                            | Max. | Min.                           | Max. | Min.                           | Max. |      |
| Slp setup time<br>(to SCKp↓) <sup>Note 1</sup>           | tsIK1  | $4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq \text{Vb} \leq 4.0\text{ V}$ ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 1.4\text{ k}\Omega$                | 44                              |      | 44                             |      | 110                            |      | ns   |
|                                                          |        | $2.7\text{ V} \leq \text{EVDD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq \text{Vb} \leq 2.7\text{ V}$ ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 2.7\text{ k}\Omega$                   | 44                              |      | 44                             |      | 110                            |      | ns   |
|                                                          |        | $1.8\text{ V} \leq \text{EVDD0} < 3.3\text{ V}$ ,<br>$1.6\text{ V} \leq \text{Vb} \leq 2.0\text{ V}$ <sup>Note 2</sup> ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 5.5\text{ k}\Omega$ | 110                             |      | 110                            |      | 110                            |      | ns   |
| Slp hold time<br>(from SCKp↓) <sup>Note 1</sup>          | tkSI1  | $4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq \text{Vb} \leq 4.0\text{ V}$ ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 1.4\text{ k}\Omega$                | 19                              |      | 19                             |      | 19                             |      | ns   |
|                                                          |        | $2.7\text{ V} \leq \text{EVDD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq \text{Vb} \leq 2.7\text{ V}$ ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 2.7\text{ k}\Omega$                   | 19                              |      | 19                             |      | 19                             |      | ns   |
|                                                          |        | $1.8\text{ V} \leq \text{EVDD0} < 3.3\text{ V}$ ,<br>$1.6\text{ V} \leq \text{Vb} \leq 2.0\text{ V}$ <sup>Note 2</sup> ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 5.5\text{ k}\Omega$ | 19                              |      | 19                             |      | 19                             |      | ns   |
| Delay time from SCKp↑<br>to SOp output <sup>Note 1</sup> | tkSO1  | $4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq \text{Vb} \leq 4.0\text{ V}$ ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 1.4\text{ k}\Omega$                |                                 | 25   |                                | 25   |                                | 25   | ns   |
|                                                          |        | $2.7\text{ V} \leq \text{EVDD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq \text{Vb} \leq 2.7\text{ V}$ ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 2.7\text{ k}\Omega$                   |                                 | 25   |                                | 25   |                                | 25   | ns   |
|                                                          |        | $1.8\text{ V} \leq \text{EVDD0} < 3.3\text{ V}$ ,<br>$1.6\text{ V} \leq \text{Vb} \leq 2.0\text{ V}$ <sup>Note 2</sup> ,<br>$\text{Cb} = 30\text{ pF}$ , $\text{Rb} = 5.5\text{ k}\Omega$ |                                 | 25   |                                | 25   |                                | 25   | ns   |

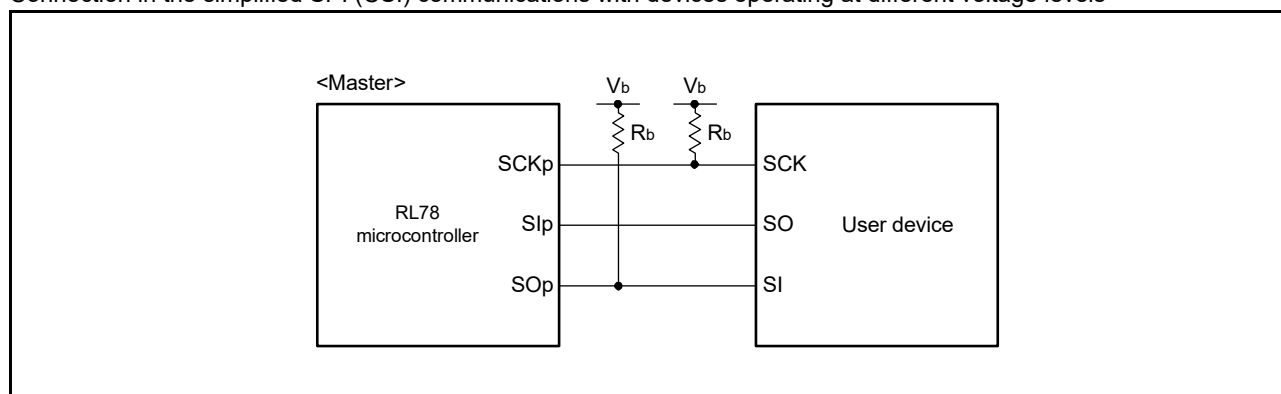
**Note 1.** This setting applies when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

**Note 2.** Use this setting with  $\text{EVDD0} \geq \text{Vb}$ .

**Caution** Select the TTL input buffer for the Slp pin and the N-ch open drain output (withstand voltage of VDD (when 30- to 52-pin products)/withstand voltage of EVDD (when 64- to 128-pin products)) mode for the SOp pin and SCKp pin by using port input mode register g (PIMg) and port output mode register g (POMg). For VIH and VIL, see the DC characteristics with TTL input buffer selected.

(Remarks are listed on the next page.)

### Connection in the simplified SPI (CSI) communications with devices operating at different voltage levels



**Remark 1.**  $R_b[\Omega]$ : Communication line (SCKp, SOp) pull-up resistance,  $C_b[F]$ : Communication line (SCKp, SOp) load capacitance,  $V_b[V]$ : Communication line voltage

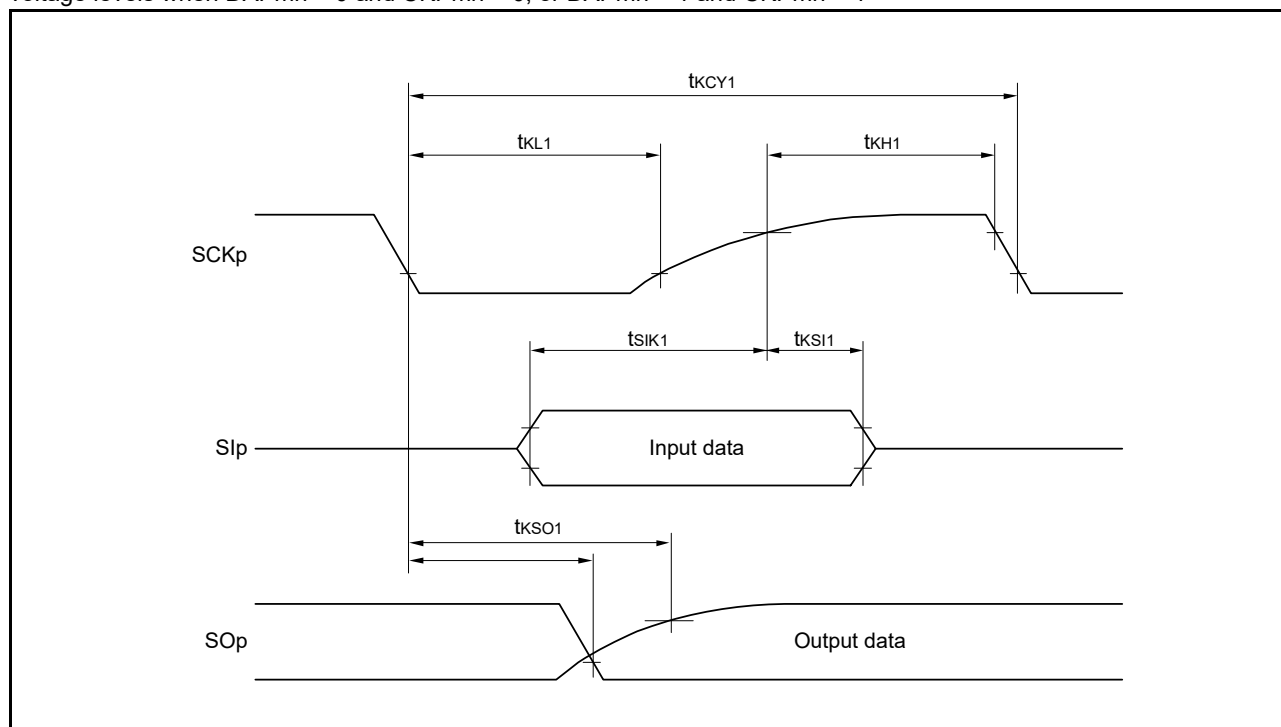
**Remark 2.** p: CSI number (p = 00, 01, 10, 20, 30, 31), m: Unit number, n: Channel number (mn = 00, 01, 02, 10, 12, 13), g: PIM and POM number (g = 0, 1, 4, 5, 8, 14)

**Remark 3.** f<sub>MCK</sub>: Serial array unit operation clock frequency

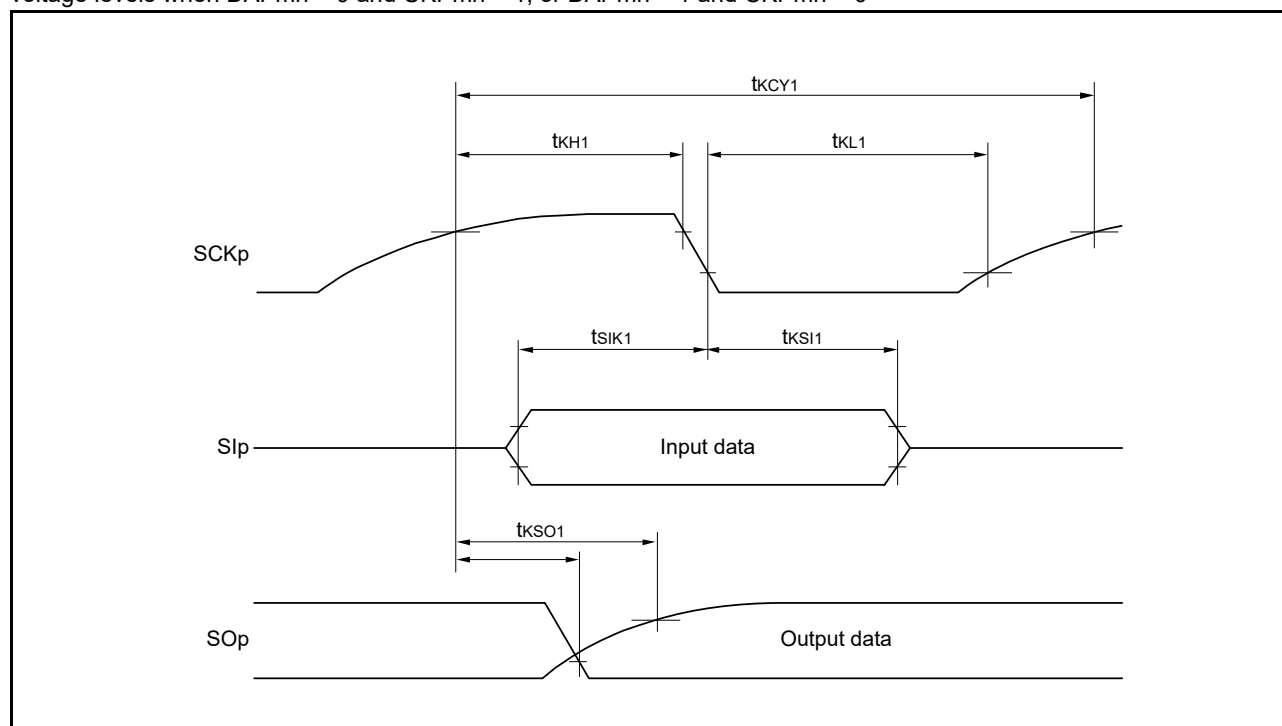
(To set this operating clock, use the CKSMn bit in the serial mode register mn (SMRmn) (m: Unit number, n: Channel number = 00).)

**Remark 4.** Communications by using CSI01 of 48-, 52-, and 64-pin products, and CSI11 and CSI21 with devices operating at different voltage levels are not possible. Use other CSI channels to handle such communications.

Timing of serial transfer in the simplified SPI (CSI) communications in the master mode with devices operating at different voltage levels when DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1



Timing of serial transfer in the simplified SPI (CSI) communications in the master mode with devices operating at different voltage levels when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0



**Remark 1.** p: CSI number (p = 00, 01, 10, 20, 30, 31), m: Unit number, n: Channel number (mn = 00, 01, 02, 10, 12, 13), g: PIM and POM number (g = 0, 1, 4, 5, 8, 14)

**Remark 2.** Communications by using CSI01 of 48-, 52-, and 64-pin products, and CSI11 and CSI21 with devices operating at different voltage levels are not possible. Use other CSI channels to handle such communications.

9. In simplified SPI (CSI) communications in the slave mode with devices operating at different voltage levels (1.8 V, 2.5 V, or 3 V) with the external SCKp clock

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.8\text{ V} \leq \text{EVDD0} = \text{EVDD1} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = \text{EVSS1} = 0\text{ V}$ )

(1/2)

| Item                            | Symbol | Conditions                                                                                                     |                                                  | HS<br>(High-Speed Main)<br>Mode |      | LS<br>(Low-Speed Main)<br>Mode |      | LP<br>(Low-Power Main)<br>Mode |      | Unit |
|---------------------------------|--------|----------------------------------------------------------------------------------------------------------------|--------------------------------------------------|---------------------------------|------|--------------------------------|------|--------------------------------|------|------|
|                                 |        |                                                                                                                |                                                  | Min.                            | Max. | Min.                           | Max. | Min.                           | Max. |      |
| SCKp<br>cycle<br>time<br>Note 1 | tkCY2  | $4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq \text{Vb} \leq 4.0\text{ V}$        | $24\text{ MHz} < \text{fMCK}$                    | 14/fMCK                         |      | —                              |      | —                              |      | ns   |
|                                 |        |                                                                                                                | $20\text{ MHz} < \text{fMCK} \leq 24\text{ MHz}$ | 12/fMCK                         |      | 12/fMCK                        |      | —                              |      | ns   |
|                                 |        |                                                                                                                | $8\text{ MHz} < \text{fMCK} \leq 20\text{ MHz}$  | 10/fMCK                         |      | 10/fMCK                        |      | —                              |      | ns   |
|                                 |        |                                                                                                                | $4\text{ MHz} < \text{fMCK} \leq 8\text{ MHz}$   | 8/fMCK                          |      | 8/fMCK                         |      | —                              |      | ns   |
|                                 |        |                                                                                                                | $\text{fMCK} \leq 4\text{ MHz}$                  | 6/fMCK                          |      | 6/fMCK                         |      | 10/fMCK                        |      | ns   |
|                                 |        | $2.7\text{ V} \leq \text{EVDD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq \text{Vb} \leq 2.7\text{ V}$ ,         | $24\text{ MHz} < \text{fMCK}$                    | 20/fMCK                         |      | —                              |      | —                              |      | ns   |
|                                 |        |                                                                                                                | $20\text{ MHz} < \text{fMCK} \leq 24\text{ MHz}$ | 16/fMCK                         |      | 16/fMCK                        |      | —                              |      | ns   |
|                                 |        |                                                                                                                | $16\text{ MHz} < \text{fMCK} \leq 20\text{ MHz}$ | 14/fMCK                         |      | 14/fMCK                        |      | —                              |      | ns   |
|                                 |        |                                                                                                                | $8\text{ MHz} < \text{fMCK} \leq 16\text{ MHz}$  | 12/fMCK                         |      | 12/fMCK                        |      | —                              |      | ns   |
|                                 |        |                                                                                                                | $4\text{ MHz} < \text{fMCK} \leq 8\text{ MHz}$   | 8/fMCK                          |      | 8/fMCK                         |      | —                              |      | ns   |
|                                 |        |                                                                                                                | $\text{fMCK} \leq 4\text{ MHz}$                  | 6/fMCK                          |      | 6/fMCK                         |      | 10/fMCK                        |      | ns   |
|                                 |        | $1.8\text{ V} \leq \text{EVDD0} < 3.3\text{ V}$ ,<br>$1.6\text{ V} \leq \text{Vb} \leq 2.0\text{ V}$<br>Note 2 | $24\text{ MHz} < \text{fMCK}$                    | 48/fMCK                         |      | —                              |      | —                              |      | ns   |
|                                 |        |                                                                                                                | $20\text{ MHz} < \text{fMCK} \leq 24\text{ MHz}$ | 36/fMCK                         |      | 36/fMCK                        |      | —                              |      | ns   |
|                                 |        |                                                                                                                | $16\text{ MHz} < \text{fMCK} \leq 20\text{ MHz}$ | 32/fMCK                         |      | 32/fMCK                        |      | —                              |      | ns   |
|                                 |        |                                                                                                                | $8\text{ MHz} < \text{fMCK} \leq 16\text{ MHz}$  | 26/fMCK                         |      | 26/fMCK                        |      | —                              |      | ns   |
|                                 |        |                                                                                                                | $4\text{ MHz} < \text{fMCK} \leq 8\text{ MHz}$   | 16/fMCK                         |      | 16/fMCK                        |      | —                              |      | ns   |
|                                 |        |                                                                                                                | $\text{fMCK} \leq 4\text{ MHz}$                  | 10/fMCK                         |      | 10/fMCK                        |      | 10/fMCK                        |      | ns   |

(Notes and Caution are listed on the next page, and Remarks are listed on page 134.)

9. In simplified SPI (CSI) communications in the slave mode with devices operating at different voltage levels (1.8 V, 2.5 V, or 3 V) with the external SCKp clock

(TA = -40 to +105°C, 1.8 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

(2/2)

| Item                                                     | Symbol        | Conditions                                                                                  | HS<br>(High-Speed Main)<br>Mode |                 | LS<br>(Low-Speed Main)<br>Mode |                 | LP<br>(Low-Power Main)<br>Mode |                 | Unit |
|----------------------------------------------------------|---------------|---------------------------------------------------------------------------------------------|---------------------------------|-----------------|--------------------------------|-----------------|--------------------------------|-----------------|------|
|                                                          |               |                                                                                             | Min.                            | Max.            | Min.                           | Max.            | Min.                           | Max.            |      |
| SCKp high-/low-level width                               | tkH2,<br>tkL2 | 4.0 V ≤ EVDD0 ≤ 5.5 V,<br>2.7 V ≤ Vb ≤ 4.0 V                                                | tkCY2/2<br>- 12                 |                 | tkCY2/2<br>- 12                |                 | tkCY2/2<br>- 50                |                 | ns   |
|                                                          |               | 2.7 V ≤ EVDD0 < 4.0 V,<br>2.3 V ≤ Vb ≤ 2.7 V                                                | tkCY2/2<br>- 18                 |                 | tkCY2/2<br>- 18                |                 | tkCY2/2<br>- 50                |                 | ns   |
|                                                          |               | 1.8 V ≤ EVDD0 < 3.3 V,<br>1.6 V ≤ Vb ≤ 2.0 V <sup>Note 2</sup>                              | tkCY2/2<br>- 50                 |                 | tkCY2/2<br>- 50                |                 | tkCY2/2<br>- 50                |                 | ns   |
| Slp setup time<br>(to SCKp↑) <sup>Note 3</sup>           | tsIK2         | 4.0 V ≤ EVDD0 ≤ 5.5 V,<br>2.7 V ≤ Vb ≤ 4.0 V                                                | 1/fMCK<br>+ 20                  |                 | 1/fMCK<br>+ 20                 |                 | 1/fMCK<br>+ 30                 |                 | ns   |
|                                                          |               | 2.7 V ≤ EVDD0 < 4.0 V,<br>2.3 V ≤ Vb ≤ 2.7 V                                                | 1/fMCK<br>+ 20                  |                 | 1/fMCK<br>+ 20                 |                 | 1/fMCK<br>+ 30                 |                 | ns   |
|                                                          |               | 1.8 V ≤ EVDD0 < 3.3 V,<br>1.6 V ≤ Vb ≤ 2.0 V <sup>Note 2</sup>                              | 1/fMCK<br>+ 30                  |                 | 1/fMCK<br>+ 30                 |                 | 1/fMCK<br>+ 30                 |                 | ns   |
| Slp hold time<br>(from SCKp↑) <sup>Note 3</sup>          | tsIS2         |                                                                                             | 1/fMCK<br>+ 31                  |                 | 1/fMCK<br>+ 31                 |                 | 1/fMCK<br>+ 31                 |                 | ns   |
| Delay time from SCKp↓<br>to SOp output <sup>Note 4</sup> | tkSO2         | 4.0 V ≤ EVDD0 ≤ 5.5 V,<br>2.7 V ≤ Vb ≤ 4.0 V,<br>Cb = 30 pF, Rb = 1.4 kΩ                    |                                 | 2/fMCK<br>+ 120 |                                | 2/fMCK<br>+ 120 |                                | 2/fMCK<br>+ 573 | ns   |
|                                                          |               | 2.7 V ≤ EVDD0 < 4.0 V,<br>2.3 V ≤ Vb ≤ 2.7 V,<br>Cb = 30 pF, Rb = 2.7 kΩ                    |                                 | 2/fMCK<br>+ 214 |                                | 2/fMCK<br>+ 214 |                                | 2/fMCK<br>+ 573 | ns   |
|                                                          |               | 1.8 V ≤ EVDD0 < 3.3 V,<br>1.6 V ≤ Vb ≤ 2.0 V <sup>Note 2</sup> ,<br>Cb = 30 pF, Rb = 5.5 kΩ |                                 | 2/fMCK<br>+ 573 |                                | 2/fMCK<br>+ 573 |                                | 2/fMCK<br>+ 573 | ns   |

**Note 1.** Transfer rate in the SNOOZE mode: 1 Mbps (max.)

**Note 2.** Use this setting with EVDD0 ≥ Vb.

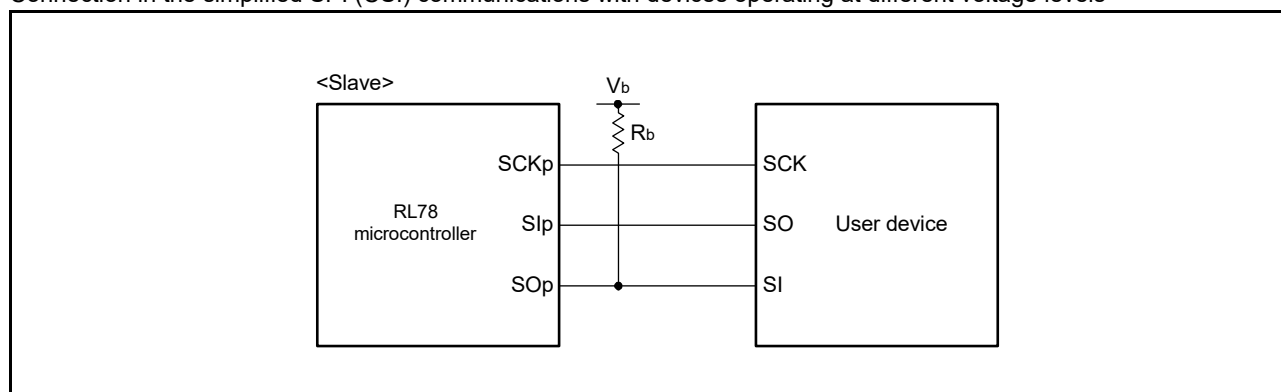
**Note 3.** This setting applies when DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The Slp setup time becomes “to SCKp↓” and Slp hold time becomes “from SCKp↓” when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

**Note 4.** This setting applies when DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The delay time to SOp output becomes “from SCKp↑” when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

**Caution** Select the TTL input buffer for the Slp pin and the N-ch open drain output (withstand voltage of VDD (for the 30- to 52-pin products)/withstand voltage of EVDD (for the 64- to 128-pin products)) mode for the SOp pin and SCKp pin by using port input mode register g (PIMg) and port output mode register g (POMg). For VIH and VIL, see the DC characteristics with TTL input buffer selected.

(Remarks are listed on the next page.)

### Connection in the simplified SPI (CSI) communications with devices operating at different voltage levels



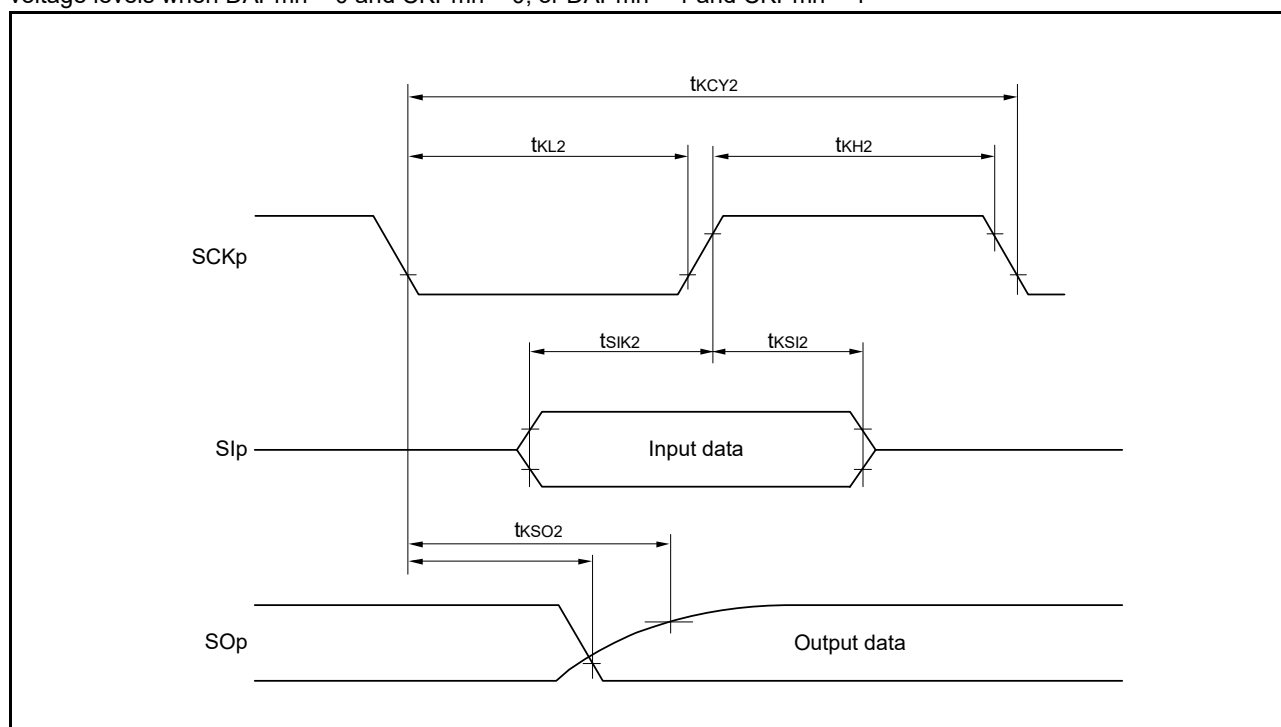
**Remark 1.**  $R_b[\Omega]$ : Communication line (SO<sub>p</sub>) pull-up resistance,  $C_b[F]$ : Communication line (SO<sub>p</sub>) load capacitance,  $V_b[V]$ : Communication line voltage

**Remark 2.** p: CSI number (p = 00, 01, 10, 20, 30, 31), m: Unit number, n: Channel number (mn = 00, 01, 02, 10, 12, 13), g: PIM and POM number (g = 0, 1, 4, 5, 8, 14)

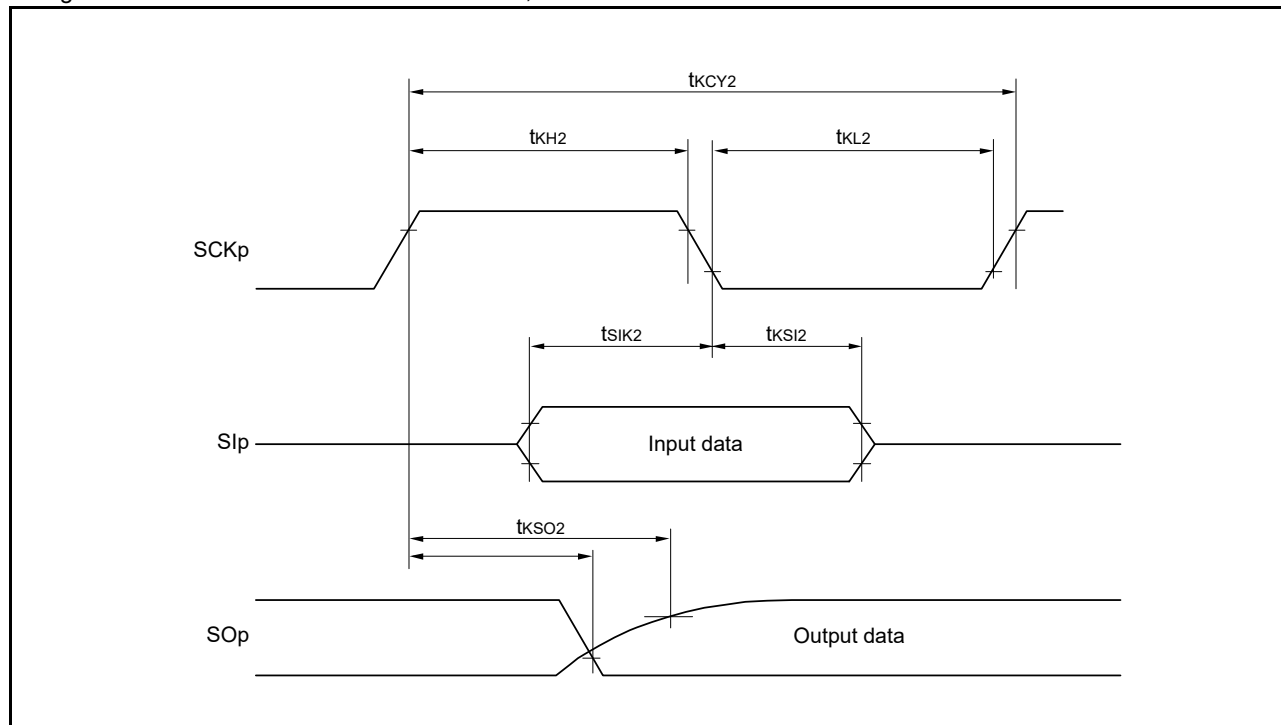
**Remark 3.** f<sub>MCK</sub>: Serial array unit operation clock frequency  
(To set this operating clock, use the CKSmn bit in the serial mode register mn (SMRmn) (m: Unit number, n: Channel number = 00, 01, 02, 10, 12 and 13).)

**Remark 4.** Communications by using CSI01 of 48-, 52-, and 64-pin products, and CSI11 and CSI21 with devices operating at different voltage levels are not possible. Use other CSI channels to handle such communications.

Timing of serial transfer in the simplified SPI (CSI) communications in the slave mode with devices operating at different voltage levels when DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1



Timing of serial transfer in the simplified SPI (CSI) communications in the slave mode with devices operating at different voltage levels when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0



**Remark 1.** p: CSI number (p = 00, 01, 10, 20, 30, 31), m: Unit number, n: Channel number (mn = 00, 01, 02, 10, 12, 13), g: PIM and POM number (g = 0, 1, 4, 5, 8, 14)

**Remark 2.** Communications by using CSI01 of 48-, 52-, and 64-pin products, and CSI11 and CSI21 with devices operating at different voltage levels are not possible. Use other CSI channels to handle such communications.

10. Simplified I<sup>2</sup>C communications with devices operating at different voltage levels (1.8 V, 2.5 V, or 3 V)(T<sub>A</sub> = -40 to +105°C, 1.8 V ≤ EV<sub>DD0</sub> = EV<sub>DD1</sub> ≤ V<sub>DD</sub> ≤ 5.5 V, V<sub>SS</sub> = EV<sub>SS0</sub> = EV<sub>SS1</sub> = 0 V)

(1/2)

| Item                        | Symbol            | Conditions                                                                                                                                   | HS<br>(High-Speed Main)<br>Mode |                | LS<br>(Low-Speed Main)<br>Mode |                | LP<br>(Low-Power Main)<br>Mode |               | Unit |
|-----------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----------------|--------------------------------|----------------|--------------------------------|---------------|------|
|                             |                   |                                                                                                                                              | Min.                            | Max.           | Min.                           | Max.           | Min.                           | Max.          |      |
| SCLr clock frequency        | f <sub>SCL</sub>  | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     |                                 | 1000<br>Note 1 |                                | 1000<br>Note 1 |                                | 300<br>Note 1 | kHz  |
|                             |                   | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     |                                 | 1000<br>Note 1 |                                | 1000<br>Note 1 |                                | 300<br>Note 1 | kHz  |
|                             |                   | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 2.8 kΩ                    |                                 | 400<br>Note 1  |                                | 400<br>Note 1  |                                | 300<br>Note 1 | kHz  |
|                             |                   | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 2.7 kΩ                    |                                 | 400<br>Note 1  |                                | 400<br>Note 1  |                                | 300<br>Note 1 | kHz  |
|                             |                   | 1.8 V ≤ EV <sub>DD0</sub> < 3.3 V,<br>1.6 V ≤ V <sub>b</sub> ≤ 2.0 V <sup>Note 2</sup> ,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5.5 kΩ |                                 | 300<br>Note 1  |                                | 300<br>Note 1  |                                | 300<br>Note 1 | kHz  |
| Hold time when SCLr is low  | t <sub>LOW</sub>  | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     | 475                             |                | 475                            |                | 1550                           |               | ns   |
|                             |                   | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     | 475                             |                | 475                            |                | 1550                           |               | ns   |
|                             |                   | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 2.8 kΩ                    | 1150                            |                | 1550                           |                | 1550                           |               | ns   |
|                             |                   | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 2.7 kΩ                    | 1150                            |                | 1550                           |                | 1550                           |               | ns   |
|                             |                   | 1.8 V ≤ EV <sub>DD0</sub> < 3.3 V,<br>1.6 V ≤ V <sub>b</sub> ≤ 2.0 V <sup>Note 2</sup> ,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5.5 kΩ | 1550                            |                | 1550                           |                | 1550                           |               | ns   |
| Hold time when SCLr is high | t <sub>HIGH</sub> | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     | 245                             |                | 245                            |                | 610                            |               | ns   |
|                             |                   | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     | 200                             |                | 200                            |                | 610                            |               | ns   |
|                             |                   | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 2.8 kΩ                    | 675                             |                | 675                            |                | 610                            |               | ns   |
|                             |                   | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 2.7 kΩ                    | 600                             |                | 600                            |                | 610                            |               | ns   |
|                             |                   | 1.8 V ≤ EV <sub>DD0</sub> < 3.3 V,<br>1.6 V ≤ V <sub>b</sub> ≤ 2.0 V <sup>Note 2</sup> ,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5.5 kΩ | 610                             |                | 610                            |                | 610                            |               | ns   |

10. Simplified I<sup>2</sup>C communications with devices operating at different voltage levels (1.8 V, 2.5 V, and 3 V)(T<sub>A</sub> = -40 to +105°C, 1.8 V ≤ EV<sub>DD0</sub> = EV<sub>DD1</sub> ≤ V<sub>DD</sub> ≤ 5.5 V, V<sub>SS</sub> = EV<sub>SS0</sub> = EV<sub>SS1</sub> = 0 V)

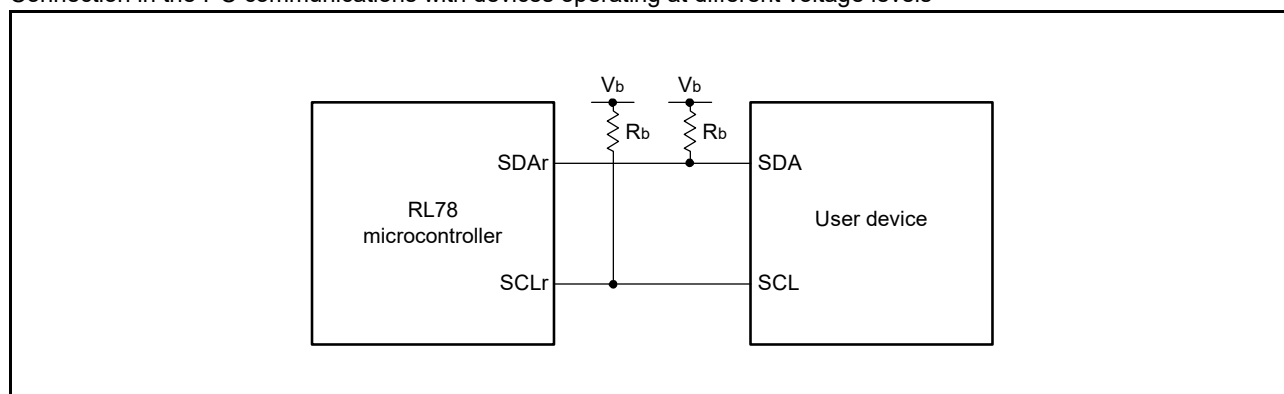
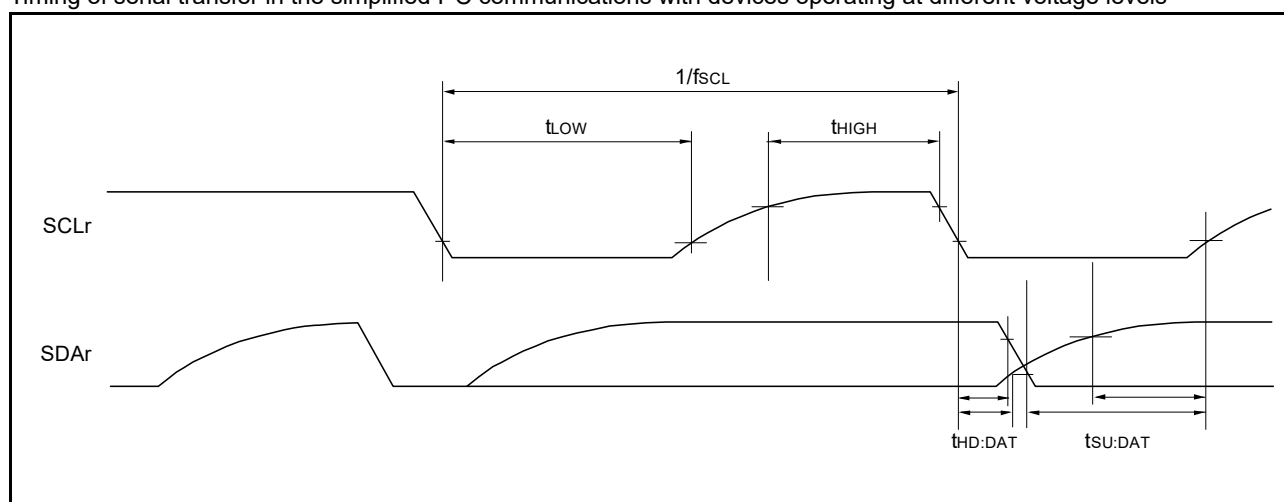
(2/2)

| Item                             | Symbol               | Conditions                                                                                                                                   | HS<br>(High-Speed Main)<br>Mode       |      | LS<br>(Low-Speed Main)<br>Mode        |      | LP<br>(Low-Power Main)<br>Mode        |      | Unit |
|----------------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|------|---------------------------------------|------|---------------------------------------|------|------|
|                                  |                      |                                                                                                                                              | Min.                                  | Max. | Min.                                  | Max. | Min.                                  | Max. |      |
| Data setup time<br>(reception)   | tsu:DAT              | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     | 1/f <sub>MCK</sub><br>+ 135<br>Note 3 |      | 1/f <sub>MCK</sub><br>+ 135<br>Note 3 |      | 1/f <sub>MCK</sub><br>+ 190<br>Note 3 |      | ns   |
|                                  |                      | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     | 1/f <sub>MCK</sub><br>+ 135<br>Note 3 |      | 1/f <sub>MCK</sub><br>+ 135<br>Note 3 |      | 1/f <sub>MCK</sub><br>+ 190<br>Note 3 |      | ns   |
|                                  |                      | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 2.8 kΩ                    | 1/f <sub>MCK</sub><br>+ 190<br>Note 3 |      | 1/f <sub>MCK</sub><br>+ 190<br>Note 3 |      | 1/f <sub>MCK</sub><br>+ 190<br>Note 3 |      | ns   |
|                                  |                      | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 2.7 kΩ                    | 1/f <sub>MCK</sub><br>+ 190<br>Note 3 |      | 1/f <sub>MCK</sub><br>+ 190<br>Note 3 |      | 1/f <sub>MCK</sub><br>+ 190<br>Note 3 |      | ns   |
|                                  |                      | 1.8 V ≤ EV <sub>DD0</sub> < 3.3 V,<br>1.6 V ≤ V <sub>b</sub> ≤ 2.0 V <sup>Note 2</sup> ,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5.5 kΩ | 1/f <sub>MCK</sub><br>+ 190<br>Note 3 |      | 1/f <sub>MCK</sub><br>+ 190<br>Note 3 |      | 1/f <sub>MCK</sub><br>+ 190<br>Note 3 |      | ns   |
| Data hold time<br>(transmission) | t <sub>HD</sub> :DAT | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     | 0                                     | 305  | 0                                     | 305  | 0                                     | 305  | ns   |
|                                  |                      | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     | 0                                     | 305  | 0                                     | 305  | 0                                     | 305  | ns   |
|                                  |                      | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 2.8 kΩ                    | 0                                     | 355  | 0                                     | 355  | 0                                     | 355  | ns   |
|                                  |                      | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 2.7 kΩ                    | 0                                     | 355  | 0                                     | 355  | 0                                     | 355  | ns   |
|                                  |                      | 1.8 V ≤ EV <sub>DD0</sub> < 3.3 V,<br>1.6 V ≤ V <sub>b</sub> ≤ 2.0 V <sup>Note 2</sup> ,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5.5 kΩ | 0                                     | 405  | 0                                     | 405  | 0                                     | 405  | ns   |

**Note 1.** The listed times must be no greater than f<sub>MCK</sub>/4.**Note 2.** Use this setting with EV<sub>DD0</sub> ≥ V<sub>b</sub>.**Note 3.** Set f<sub>MCK</sub> so that it will not exceed the hold time when SCL<sub>r</sub> is low or high.

**Caution** Select the TTL input buffer and the N-ch open drain output (withstand voltage of V<sub>DD</sub> (for the 30- to 52-pin products)/withstand voltage of EV<sub>DD</sub> (for the 64- to 128-pin products)) mode for the SDA<sub>r</sub> pin and the N-ch open drain output (withstand voltage of V<sub>DD</sub> (for the 30- to 52-pin products)/withstand voltage of EV<sub>DD</sub> (for the 64- to 128-pin products)) mode for the SCL<sub>r</sub> pin by using port input mode register g (PIMg) and port output mode register g (POMg). For V<sub>IH</sub> and V<sub>IL</sub>, see the DC characteristics with TTL input buffer selected.

(Remarks are listed on the next page.)

Connection in the I<sup>2</sup>C communications with devices operating at different voltage levelsTiming of serial transfer in the simplified I<sup>2</sup>C communications with devices operating at different voltage levels

- Remark 1.**  $R_b[\Omega]$ : Communication line (SDAr, SCLr) pull-up resistance,  $C_b[F]$ : Communication line (SDAr, SCLr) load capacitance,  $V_b[V]$ : Communication line voltage
- Remark 2.** r: IIC number (r = 00, 01, 10, 20, 30, 31), g: PIM and POM number (g = 0, 1, 4, 5, 8, 14)
- Remark 3.**  $f_{MCK}$ : Serial array unit operation clock frequency  
(To set this operating clock, use the CKSmn bit in the serial mode register mn (SMRmn) (m: Unit number, n: Channel number = 00, 01, 02, 10, 12 and 13).)

## 2.5.2 Serial interface UARTA

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.6\text{ V} \leq \text{EVDD0} = \text{EVDD1} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = \text{EVSS1} = 0\text{ V}$ )

| Item          | Symbol | Conditions | Min. | Typ. | Max.   | Unit |
|---------------|--------|------------|------|------|--------|------|
| Transfer rate |        |            | 200  | 0    | 153600 | bps  |

**Caution** Select the normal input buffer for the RxDq pin and the normal output mode for the TxDq pin by using port input mode register g (PIMg) and port output mode register g (POMg).

**Remark** g: PIM number (g = 3, 4, 7, 8), h: POM number (h = 3, 4, 7, 8, 12)

### 2.5.3 Serial interface IICA

#### 1. I<sup>2</sup>C standard mode

(TA = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

| Item                                            | Symbol  | Conditions                  | Min. | Typ. | Max. | Unit |
|-------------------------------------------------|---------|-----------------------------|------|------|------|------|
| SCLA0 clock frequency                           | fSCL    | Standard mode: fCLK ≥ 1 MHz | 0    |      | 100  | kHz  |
| Setup time of restart condition                 | tSU:STA |                             | 4.7  |      |      | μs   |
| Hold time <sup>Note 1</sup>                     | tHD:STA |                             | 4.0  |      |      | μs   |
| Hold time when SCLA0 is low                     | tLOW    |                             | 4.7  |      |      | μs   |
| Hold time when SCLA0 is high                    | tHIGH   |                             | 4.0  |      |      | μs   |
| Data setup time (reception)                     | tSU:DAT |                             | 250  |      |      | ns   |
| Data hold time (transmission) <sup>Note 2</sup> | tHD:DAT |                             | 0    |      | 3.45 | μs   |
| Setup time of stop condition                    | tSU:STO |                             | 4.0  |      |      | μs   |
| Bus-free time                                   | tBUF    |                             | 4.7  |      |      | μs   |

**Note 1.** The first clock pulse is generated after this period when the start or restart condition is detected.

**Note 2.** The maximum value of tHD:DAT applies to normal transfer. The clock stretching will be inserted on reception of an acknowledgment (ACK) signal.

**Caution** The listed frequency and times apply even when bit 2 (PIOR2) in the peripheral I/O redirection register (PIOR) is 1. In such cases, the pin characteristics (IOH1, IOL1, VOH1, VOL1) must satisfy the values in the redirect destination.

**Remark** The maximum value of communication line capacitance (Cb) and communication line pull-up resistor (Rb) are as follows.  
Cb = 400 pF, Rb = 2.7 kΩ

2. I<sup>2</sup>C fast mode(T<sub>A</sub> = -40 to +105°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

| Item                                            | Symbol  | Conditions                                         | Min. | Typ. | Max. | Unit |
|-------------------------------------------------|---------|----------------------------------------------------|------|------|------|------|
| SCLA0 clock frequency                           | fSCL    | Fast mode: fCLK ≥ 3.5 MHz<br>1.8 V ≤ EVDD0 ≤ 5.5 V | 0    |      | 400  | kHz  |
| Setup time of restart condition                 | tSU:STA | 1.8 V ≤ EVDD0 ≤ 5.5 V                              | 0.6  |      |      | μs   |
| Hold time <sup>Note 1</sup>                     | tHD:STA | 1.8 V ≤ EVDD0 ≤ 5.5 V                              | 0.6  |      |      | μs   |
| Hold time when SCLA0 is low                     | tLOW    | 1.8 V ≤ EVDD0 ≤ 5.5 V                              | 1.3  |      |      | μs   |
| Hold time when SCLA0 is high                    | tHIGH   | 1.8 V ≤ EVDD0 ≤ 5.5 V                              | 0.6  |      |      | μs   |
| Data setup time (reception)                     | tSU:DAT | 1.8 V ≤ EVDD0 ≤ 5.5 V                              | 100  |      |      | ns   |
| Data hold time (transmission) <sup>Note 2</sup> | tHD:DAT | 1.8 V ≤ EVDD0 ≤ 5.5 V                              | 0    |      | 0.9  | μs   |
| Setup time of stop condition                    | tSU:STO | 1.8 V ≤ EVDD0 ≤ 5.5 V                              | 0.6  |      |      | μs   |
| Bus-free time                                   | tBUF    | 1.8 V ≤ EVDD0 ≤ 5.5 V                              | 1.3  |      |      | μs   |

**Note 1.** The first clock pulse is generated after this period when the start or restart condition is detected.**Note 2.** The maximum value of tHD:DAT applies to normal transfer. The clock stretching will be inserted on reception of an acknowledgment (ACK) signal.**Caution** The values in the above table apply even when bit 2 (PIOR2) in the peripheral I/O redirection register (PIOR) is 1. In such cases, the pin characteristics (IOH1, IOL1, VOH1, VOL1) must satisfy the values in the redirect destination.**Remark** The maximum value of communication line capacitance (C<sub>b</sub>) and communication line pull-up resistor (R<sub>b</sub>) are as follows.  
C<sub>b</sub> = 320 pF, R<sub>b</sub> = 1.1 kΩ

3. I<sup>2</sup>C fast mode plus

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.6\text{ V} \leq \text{EVDD0} = \text{EVDD1} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = \text{EVSS1} = 0\text{ V}$ )

| Item                                            | Symbol  | Conditions                                                                                      | Min. | Typ. | Max. | Unit          |
|-------------------------------------------------|---------|-------------------------------------------------------------------------------------------------|------|------|------|---------------|
| SCLA0 clock frequency                           | fSCL    | Fast mode plus: fCLK $\geq 10\text{ MHz}$<br>$2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$ | 0    |      | 1000 | kHz           |
| Setup time of restart condition                 | tSU:STA | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$                                              | 0.26 |      |      | $\mu\text{s}$ |
| Hold time <sup>Note 1</sup>                     | tHD:STA | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$                                              | 0.26 |      |      | $\mu\text{s}$ |
| Hold time when SCLA0 is low                     | tLOW    | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$                                              | 0.5  |      |      | $\mu\text{s}$ |
| Hold time when SCLA0 is high                    | tHIGH   | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$                                              | 0.26 |      |      | $\mu\text{s}$ |
| Data setup time (reception)                     | tSU:DAT | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$                                              | 50   |      |      | ns            |
| Data hold time (transmission) <sup>Note 2</sup> | tHD:DAT | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$                                              | 0    |      | 0.45 | $\mu\text{s}$ |
| Setup time of stop condition                    | tSU:STO | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$                                              | 0.26 |      |      | $\mu\text{s}$ |
| Bus-free time                                   | tBUF    | $2.7\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$                                              | 0.5  |      |      | $\mu\text{s}$ |

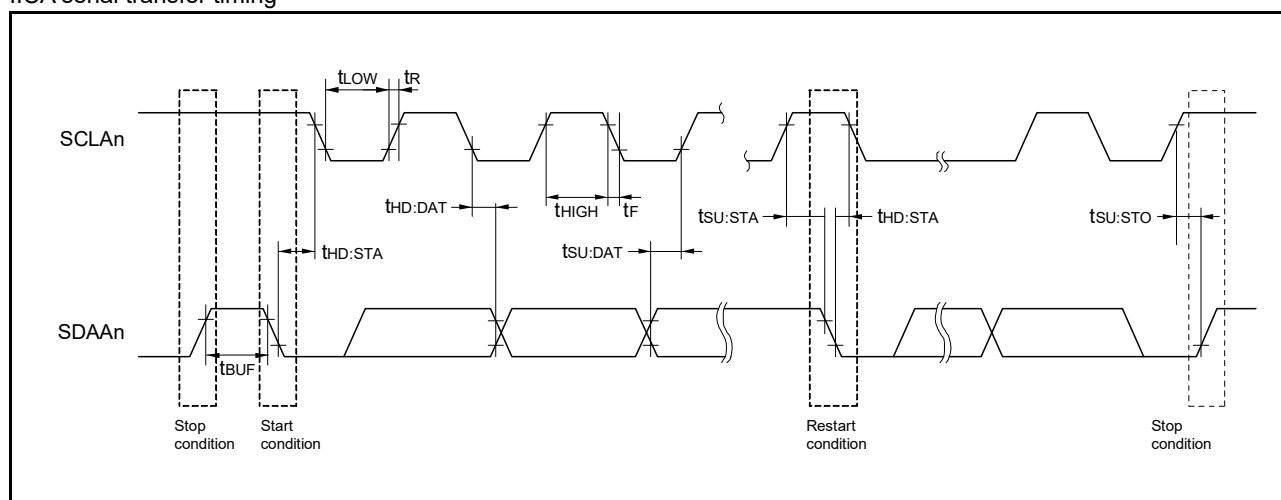
**Note 1.** The first clock pulse is generated after this period when the start or restart condition is detected.

**Note 2.** The maximum value of tHD:DAT applies to normal transfer. The clock stretching will be inserted on reception of an acknowledgment (ACK) signal.

**Caution** The values in the above table apply even when bit 2 (PIOR2) in the peripheral I/O redirection register (PIOR) is 1. In such cases, the pin characteristics (IOH1, IOL1, VOH1, VOL1) must satisfy the values in the redirect destination.

**Remark** The maximum value of communication line capacitance ( $C_b$ ) and communication line pull-up resistor ( $R_b$ ) are as follows.  
 $C_b = 120\text{ pF}$ ,  $R_b = 1.1\text{ k}\Omega$

## IICA serial transfer timing



**Remark** n = 0, 1

## 2.6 Analog Characteristics

### 2.6.1 A/D converter characteristics

#### 1. Normal modes 1 and 2

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $2.4\text{ V} \leq \text{AVREFP} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = 0\text{ V}$ ,  
reference voltage (+) =  $\text{AVREFP}$  ( $\text{ADREFP1} = 0$ ,  $\text{ADREFP0} = 1$ ), reference voltage (-) =  $\text{AVREFM}$  ( $\text{ADREFM} = 1$ ),  
target pins: ANI2 to ANI14, internal reference voltage, and temperature sensor output voltage)

| Item                                               | Symbol            | Conditions                                                       | Min. | Typ.       | Max.       | Unit          |
|----------------------------------------------------|-------------------|------------------------------------------------------------------|------|------------|------------|---------------|
| Resolution                                         | RES               |                                                                  |      |            | 12         | bit           |
| Conversion clock                                   | $f_{\text{AD}}$   |                                                                  | 1    |            | 32         | MHz           |
| Overall error <sup>Notes 1, 2, 3, 4, 5</sup>       | AINL              | $4.5\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 2.4$  | $\pm 4.5$  | LSB           |
|                                                    |                   | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 2.9$  | $\pm 5.7$  | LSB           |
|                                                    |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 3.0$  | $\pm 5.8$  | LSB           |
| Conversion time <sup>Notes 5, 6</sup>              | $t_{\text{CONV}}$ | $4.5\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ | 2.0  |            |            | $\mu\text{s}$ |
|                                                    |                   | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ | 2.0  |            |            | $\mu\text{s}$ |
|                                                    |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ | 2.0  |            |            | $\mu\text{s}$ |
| Zero-scale error <sup>Notes 1, 2, 3, 4, 5, 7</sup> | EzS               | $4.5\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 0.01$ | $\pm 0.08$ | %FSR          |
|                                                    |                   | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 0.01$ | $\pm 0.09$ | %FSR          |
|                                                    |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 0.03$ | $\pm 0.13$ | %FSR          |
| Full-scale error <sup>Notes 1, 2, 3, 4, 5, 7</sup> | EFS               | $4.5\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 0.03$ | $\pm 0.09$ | %FSR          |
|                                                    |                   | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 0.05$ | $\pm 0.13$ | %FSR          |
|                                                    |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 0.05$ | $\pm 0.13$ | %FSR          |
| Analog input voltage                               | VAIN              |                                                                  | 0    |            | AVREFP     | V             |

**Note 1.** This value does not include the quantization error ( $\pm 1/2$  LSB).

**Note 2.** The values in the column Max. only apply in the case of a normal distribution with  $\pm 3\sigma$  variation from the mean.

**Note 3.** We do not inspect the characteristics of the A/D converter before shipment. The listed values are only results of evaluation.

**Note 4.** When  $\text{AVREFP} < \text{VDD}$ , the maximum values are as follows.

Overall error/zero-scale error/full-scale error: Add ( $\pm 0.75\text{ LSB} \times (\text{VDD voltage (V)} - \text{AVREFP voltage (V)})$ ) to the maximum value.

Integral linearity error: Add ( $\pm 0.2\text{ LSB} \times (\text{VDD voltage (V)} - \text{AVREFP voltage (V)})$ ) to the maximum value.

**Note 5.** The listed values apply when the conversion resolution is set to 12 bits.

**Note 6.** When the internal reference voltage or the temperature sensor output voltage is selected as the target for conversion, the sampling time must be at least  $5\text{ }\mu\text{s}$ . Accordingly, use standard mode 2 with the longer sampling time.

**Note 7.** This value is indicated as a ratio (%FSR) to the full-scale value.

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $2.4\text{ V} \leq \text{AVREFP} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = 0\text{ V}$ ,  
reference voltage (+) = AVREFP (ADREFP1 = 0, ADREFP0 = 1), reference voltage (-) = AVREFM (ADREFM = 1),  
target pins: ANI2 to ANI14, internal reference voltage, and temperature sensor output voltage)

| Item                                              | Symbol | Conditions        |                                                                  | Min. | Typ.      | Max.       | Unit          |
|---------------------------------------------------|--------|-------------------|------------------------------------------------------------------|------|-----------|------------|---------------|
| Resolution                                        | RES    |                   |                                                                  | 8    |           | 12         | Bit           |
| Conversion clock                                  | fAD    |                   |                                                                  | 1    |           | 32         | MHz           |
| Overall error <sup>Notes 1, 2, 3, 4</sup>         | AINL   | 12-bit resolution | $4.5\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 7.5$  | LSB           |
|                                                   |        |                   | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 9.0$  | LSB           |
|                                                   |        |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 9.0$  | LSB           |
| Conversion time <sup>Note 5</sup>                 | tCONV  | 12-bit resolution | $4.5\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ | 2.0  |           |            | $\mu\text{s}$ |
|                                                   |        |                   | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ | 2.0  |           |            | $\mu\text{s}$ |
|                                                   |        |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ | 2.0  |           |            | $\mu\text{s}$ |
| Zero-scale error <sup>Notes 1, 2, 3, 4, 6</sup>   | Ezs    | 12-bit resolution | $4.5\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 0.17$ | %FSR          |
|                                                   |        |                   | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 0.21$ | %FSR          |
|                                                   |        |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 0.21$ | %FSR          |
| Full-scale error <sup>Notes 1, 2, 3, 4, 6</sup>   | Efs    | 12-bit resolution | $4.5\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 0.17$ | %FSR          |
|                                                   |        |                   | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 0.21$ | %FSR          |
|                                                   |        |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 0.21$ | %FSR          |
| Integral linearity error <sup>Notes 1, 3, 4</sup> | ILE    | 12-bit resolution | $4.5\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 3.0$  | LSB           |
|                                                   |        |                   | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 3.0$  | LSB           |
|                                                   |        |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 3.0$  | LSB           |
| Differential linearity error <sup>Note 1</sup>    | DLE    | 12-bit resolution | $4.5\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 1.0$ |            | LSB           |
|                                                   |        |                   | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 1.0$ |            | LSB           |
|                                                   |        |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 1.0$ |            | LSB           |
| Analog input voltage                              | VAIN   |                   |                                                                  | 0    |           | AVREFP     | V             |

**Note 1.** This value does not include the quantization error ( $\pm 1/2$  LSB).

**Note 2.** When pins ANI16 to ANI31 are selected as the target pins for conversion, the maximum values are as follows.

Overall error: Add  $\pm 3$  LSB to the maximum value.

Zero-scale/full-scale error: Add  $\pm 0.04\%$ FSR to the maximum value.

**Note 3.** When reference voltage (+) = VDD and reference voltage (-) = VSS, the maximum values are as follows.

Overall error: Add  $\pm 10$  LSB to the maximum value.

Zero-scale/full-scale error: Add  $\pm 0.25\%$ FSR to the maximum value.

Integral linearity error: Add  $\pm 4$  LSB to the maximum value.

**Note 4.** When AVREFP < VDD, the maximum values are as follows.

Overall error/zero-scale error/full-scale error: Add  $(\pm 0.75\text{ LSB} \times (\text{VDD voltage (V)} - \text{AVREFP voltage (V)}))$  to the maximum value.

Integral linearity error: Add  $(\pm 0.2\text{ LSB} \times (\text{VDD voltage (V)} - \text{AVREFP voltage (V)}))$  to the maximum value.

**Note 5.** When the internal reference voltage or the temperature sensor output voltage is selected as the target for conversion, the sampling time must be at least  $5\text{ }\mu\text{s}$ . Accordingly, use standard mode 2 with the longer sampling time.

**Note 6.** This value is indicated as a ratio (%FSR) to the full-scale value.

## 2. Low-voltage modes 1 and 2

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.6\text{ V} \leq \text{AVREFP} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = 0\text{ V}$ ,  
reference voltage (+) =  $\text{AVREFP}$  ( $\text{ADREFP1} = 0$ ,  $\text{ADREFP0} = 1$ ), reference voltage (-) =  $\text{AVREFM}$  ( $\text{ADREFM} = 1$ ),  
target pins ANI2 to ANI14, internal reference voltage<sup>Note 1</sup>, and temperature sensor output voltage<sup>Note 1</sup>)

| Item                                              | Symbol | Conditions        |                                                                  | Min. | Typ.      | Max.       | Unit          |
|---------------------------------------------------|--------|-------------------|------------------------------------------------------------------|------|-----------|------------|---------------|
| Resolution                                        | RES    |                   |                                                                  | 8    |           | 12         | Bit           |
| Conversion clock                                  | fAD    |                   |                                                                  | 1    |           | 24         | MHz           |
| Overall error <sup>Notes 2, 3, 4, 5</sup>         | AINL   | 12-bit resolution | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 9$    | LSB           |
|                                                   |        |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 9$    | LSB           |
|                                                   |        |                   | $1.8\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 11.5$ | LSB           |
|                                                   |        |                   | $1.6\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 12.0$ | LSB           |
| Conversion time <sup>Note 6</sup>                 | tCONV  | 12-bit resolution | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ | 3.33 |           |            | $\mu\text{s}$ |
|                                                   |        |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ | 5.0  |           |            | $\mu\text{s}$ |
|                                                   |        |                   | $1.8\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ | 10.0 |           |            | $\mu\text{s}$ |
|                                                   |        |                   | $1.6\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ | 20.0 |           |            | $\mu\text{s}$ |
| Zero-scale error <sup>Notes 2, 3, 4, 5, 7</sup>   | Ezs    | 12-bit resolution | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 0.21$ | %FSR          |
|                                                   |        |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 0.21$ | %FSR          |
|                                                   |        |                   | $1.8\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 0.27$ | %FSR          |
|                                                   |        |                   | $1.6\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 0.28$ | %FSR          |
| Full-scale error <sup>Notes 2, 3, 4, 5, 7</sup>   | EFS    | 12-bit resolution | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 0.21$ | %FSR          |
|                                                   |        |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 0.21$ | %FSR          |
|                                                   |        |                   | $1.8\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 0.27$ | %FSR          |
|                                                   |        |                   | $1.6\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 0.28$ | %FSR          |
| Integral linearity error <sup>Notes 2, 4, 5</sup> | ILE    | 12-bit resolution | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 4.0$  | LSB           |
|                                                   |        |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 4.0$  | LSB           |
|                                                   |        |                   | $1.8\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 4.5$  | LSB           |
|                                                   |        |                   | $1.6\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      |           | $\pm 4.5$  | LSB           |
| Differential linearity error <sup>Note 2</sup>    | DLE    | 12-bit resolution | $2.7\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 1.5$ |            | LSB           |
|                                                   |        |                   | $2.4\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 1.5$ |            | LSB           |
|                                                   |        |                   | $1.8\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 2.0$ |            | LSB           |
|                                                   |        |                   | $1.6\text{ V} \leq \text{AVREFP} = \text{VDD} \leq 5.5\text{ V}$ |      | $\pm 2.0$ |            | LSB           |
| Analog input voltage                              | VAIN   |                   |                                                                  | 0    |           | AVREFP     | V             |

**Note 1.** If the internal reference voltage or temperature sensor output voltage is to be A/D converted,  $\text{VDD}$  must be at least 1.8 V.

**Note 2.** This value does not include the quantization error ( $\pm 1/2$  LSB).

**Note 3.** When pins ANI16 to ANI31 are selected as the target pins for conversion, the maximum values are as follows.

Overall error: Add  $\pm 3$  LSB to the maximum value.

Zero-scale/full-scale error: Add  $\pm 0.04\%$ FSR to the maximum value.

**Note 4.** When reference voltage (+) =  $\text{VDD}$  and reference voltage (-) =  $\text{VSS}$ , the maximum values are as follows.

Overall error: Add  $\pm 10$  LSB to the maximum value.

Zero-scale/full-scale error: Add  $\pm 0.25\%$ FSR to the maximum value.

Integral linearity error: Add  $\pm 4$  LSB to the maximum value.

**Note 5.** When  $\text{AVREFP} < \text{VDD}$ , the maximum values are as follows.

Overall error/zero-scale error/full-scale error: Add  $(\pm 0.75 \text{ LSB} \times (\text{VDD voltage (V)} - \text{AVREFP voltage (V)}))$  to the maximum value.

Integral linearity error: Add  $(\pm 0.2 \text{ LSB} \times (\text{VDD voltage (V)} - \text{AVREFP voltage (V)}))$  to the maximum value.

- Note 6.** When the internal reference voltage or the temperature sensor output voltage is selected as the target for conversion, the sampling time must be at least 5  $\mu$ s. Accordingly, use standard mode 2 with the longer sampling time, and use the conversion clock (f<sub>AD</sub>) of no more than 16 MHz.
- Note 7.** This value is indicated as a ratio (%FSR) to the full-scale value.

## 3. When the internal reference voltage is selected as reference voltage (+)

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.8\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ ,  $V_{SS} = 0\text{ V}$ , low-voltage modes 1 and 2,  
 reference voltage (+) = internal reference voltage (ADREFP1 = 1, ADREFP0 = 0),  
 reference voltage (-) = AVREFM (ADREFM = 1))

| Item                                           | Symbol           | Conditions                                   | Min. | Typ. | Max.                       | Unit |
|------------------------------------------------|------------------|----------------------------------------------|------|------|----------------------------|------|
| Resolution                                     | RES              |                                              | 8    |      |                            | Bit  |
| Conversion clock                               | f <sub>AD</sub>  | $1.6\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ | 1    |      | 2                          | MHz  |
| Zero-scale error <sup>Notes 1, 2, 3</sup>      | E <sub>ZS</sub>  | $1.6\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ |      |      | ±0.6                       | %FSR |
| Integral linearity error <sup>Notes 1, 3</sup> | I <sub>LE</sub>  | $1.6\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ |      |      | ±2.0                       | LSB  |
| Differential linearity error <sup>Note 1</sup> | D <sub>LE</sub>  | $1.6\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ |      | ±1.0 |                            | LSB  |
| Analog input voltage                           | V <sub>AIN</sub> |                                              | 0    |      | V <sub>BGR</sub><br>Note 4 | V    |

**Note 1.** This value does not include the quantization error ( $\pm 1/2$  LSB).

**Note 2.** This value is indicated as a ratio (%FSR) to the full-scale value.

**Note 3.** When reference voltage (-) is selected as  $V_{SS}$ , the maximum values are as follows.

Zero-scale error: Add  $\pm 0.35\%$ FSR to the maximum value.

Integral linearity error: Add  $\pm 0.5$  LSB to the maximum value.

**Note 4.** Refer to **2.6.2 Temperature sensor/internal reference voltage characteristics**.

### 2.6.2 Temperature sensor/internal reference voltage characteristics

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.8\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ ,  $V_{SS} = 0\text{ V}$ )

| Item                              | Symbol  | Conditions                                               | Min. | Typ. | Max. | Unit                 |
|-----------------------------------|---------|----------------------------------------------------------|------|------|------|----------------------|
| Temperature sensor output voltage | VTMPS25 | Setting ADS register = 80H, $T_A = +25^\circ\text{C}$    |      | 1.05 |      | V                    |
| Internal reference voltage        | VBGR    | Setting ADS register = 81H                               | 1.42 | 1.48 | 1.54 | V                    |
| Temperature coefficient           | FVTMPS  | Temperature dependency of the temperature sensor voltage |      | -3.3 |      | mV/ $^\circ\text{C}$ |
| Operation stabilization wait time | tAMP    |                                                          | 5    |      |      | $\mu\text{s}$        |

### 2.6.3 D/A converter characteristics

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.6\text{ V} \leq EV_{DD0} = EV_{DD1} \leq V_{DD} \leq 5.5\text{ V}$ ,  $V_{SS} = EV_{SS0} = EV_{SS1} = 0\text{ V}$ )

| Item          | Symbol | Conditions                                                          | Min. | Typ. | Max.      | Unit          |
|---------------|--------|---------------------------------------------------------------------|------|------|-----------|---------------|
| Resolution    | RES    |                                                                     |      |      | 8         | Bit           |
| Overall error | AINL   | Rload = 8 M $\Omega$ , $1.8\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ |      |      | $\pm 2.5$ | LSB           |
|               |        | Rload = 4 M $\Omega$ , $1.8\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ |      |      | $\pm 2.5$ | LSB           |
| Settling time | tSET   | Cload = 20 pF, $2.7\text{ V} \leq V_{DD} \leq 5.5\text{ V}$         |      |      | 3         | $\mu\text{s}$ |
|               |        | $1.6\text{ V} \leq V_{DD} \leq 5.5\text{ V}$                        |      |      | 6         | $\mu\text{s}$ |

### 2.6.4 Comparator characteristics

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.6\text{ V} \leq EV_{DD0} = EV_{DD1} \leq V_{DD} \leq 5.5\text{ V}$ ,  $V_{SS} = EV_{SS0} = EV_{SS1} = 0\text{ V}$ )

| Item                                       | Symbol | Conditions                                                              | Min.            | Typ. | Max.                                | Unit          |
|--------------------------------------------|--------|-------------------------------------------------------------------------|-----------------|------|-------------------------------------|---------------|
| Input voltage range                        | IVREF  | Input to the IVREF0 and IVREF1 pins<br>C0LVL = 0, C1LVL = 0             | 0               |      | $V_{DD} - 1.4$<br>and<br>$EV_{DD0}$ | V             |
|                                            |        | Input to the IVREF0 and IVREF1 pins<br>C0LVL = 1, C1LVL = 1             | 1.4             |      | $EV_{DD0}$                          | V             |
|                                            | IVCMP  | Input to the IVCMP0 and IVCMP1 pins                                     | -0.3            |      | $EV_{DD0} + 0.3$                    | V             |
| Output delay                               | td     | $V_{DD} = 3.0\text{ V}$ ,<br>Input slew rate $> 1\text{ V}/\mu\text{s}$ | High-speed mode |      | 1.5                                 | $\mu\text{s}$ |
|                                            |        |                                                                         | Low-speed mode  | 3.0  |                                     | $\mu\text{s}$ |
| Offset voltage                             | —      | High-speed mode                                                         |                 |      | 50                                  | mV            |
|                                            |        | Low-speed mode                                                          |                 |      | 40                                  | mV            |
| Operation stabilization wait time          | tCMP   |                                                                         | 30              |      |                                     | $\mu\text{s}$ |
| Internal reference voltage <sup>Note</sup> | VBGR2  |                                                                         | 1.4             |      | 1.6                                 | V             |

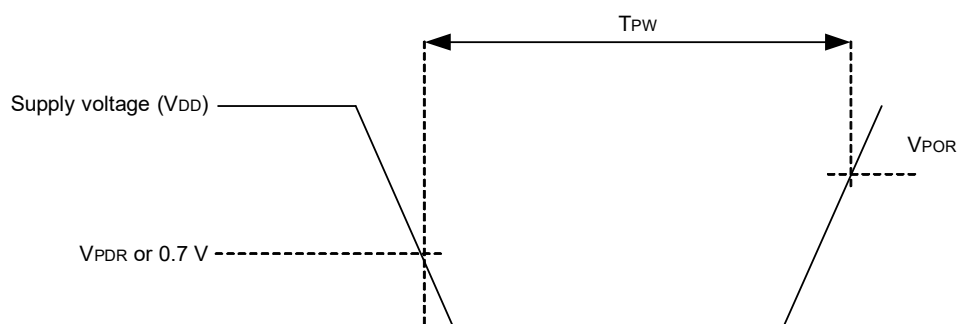
<R> **Note** The internal reference voltage can be selected as comparator reference voltage only when  $1.8\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ .

## 2.6.5 POR circuit characteristics

(TA = -40 to +105°C, VSS = 0 V)

| Item                                | Symbol     | Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|------------|------------|------|------|------|------|
| Detection voltage                   | VPOR, VPDR |            | 1.43 | 1.50 | 1.57 | V    |
| Minimum pulse width <sup>Note</sup> | TPW        |            | 300  |      |      | μs   |

**Note** This width is the minimum time required for a POR reset when VDD falls below VPDR. This width is also the minimum time required for a POR reset from when VDD falls below 0.7 V to when VDD exceeds VPOR in the STOP mode or while the main system clock is stopped through setting bit 0 (HIOSTOP) and bit 7 (MSTOP) in the clock operation status control register (CSC).



## 2.6.6 LVD circuit characteristics

### 1. LVD0 Detection Voltage in the Reset Mode and Interrupt Mode

( $T_A = -40$  to  $+105^{\circ}\text{C}$ ,  $V_{PDR} \leq V_{DD} \leq 5.5\text{ V}$ ,  $V_{SS} = 0\text{ V}$ )

| Item                 |                      | Symbol | Conditions                           | Min. | Typ. | Max. | Unit |
|----------------------|----------------------|--------|--------------------------------------|------|------|------|------|
| Detection voltage    | Supply voltage level | VLVD00 | The power supply voltage is rising.  | 3.84 | 3.96 | 4.08 | V    |
|                      |                      |        | The power supply voltage is falling. | 3.76 | 3.88 | 4.00 | V    |
|                      |                      | VLVD01 | The power supply voltage is rising.  | 2.88 | 2.97 | 3.06 | V    |
|                      |                      |        | The power supply voltage is falling. | 2.82 | 2.91 | 3.00 | V    |
|                      |                      | VLVD02 | The power supply voltage is rising.  | 2.59 | 2.67 | 2.75 | V    |
|                      |                      |        | The power supply voltage is falling. | 2.54 | 2.62 | 2.70 | V    |
|                      |                      | VLVD03 | The power supply voltage is rising.  | 2.31 | 2.38 | 2.45 | V    |
|                      |                      |        | The power supply voltage is falling. | 2.26 | 2.33 | 2.40 | V    |
|                      |                      | VLVD04 | The power supply voltage is rising.  | 1.84 | 1.90 | 1.95 | V    |
|                      |                      |        | The power supply voltage is falling. | 1.80 | 1.86 | 1.91 | V    |
|                      |                      | VLVD05 | The power supply voltage is rising.  | 1.64 | 1.69 | 1.74 | V    |
|                      |                      |        | The power supply voltage is falling. | 1.60 | 1.65 | 1.70 | V    |
| Minimum pulse width  |                      | tLW    |                                      | 500  |      |      | μs   |
| Detection delay time |                      |        |                                      |      |      | 500  | μs   |

## 2. LVD1 Detection Voltage of Reset Mode and Interrupt Mode

(TA = -40 to +105°C, VPDR ≤ VDD ≤ 5.5 V, VSS = 0 V)

| Item                 |                      | Symbol          | Conditions                           | Min. | Typ. | Max. | Unit |
|----------------------|----------------------|-----------------|--------------------------------------|------|------|------|------|
| Detection voltage    | Supply voltage level | VLVD10          | The power supply voltage is rising.  | 4.08 | 4.16 | 4.24 | V    |
|                      |                      |                 | The power supply voltage is falling. | 4.00 | 4.08 | 4.16 | V    |
|                      |                      | VLVD11          | The power supply voltage is rising.  | 3.88 | 3.96 | 4.04 | V    |
|                      |                      |                 | The power supply voltage is falling. | 3.80 | 3.88 | 3.96 | V    |
|                      |                      | VLVD12          | The power supply voltage is rising.  | 3.68 | 3.75 | 3.82 | V    |
|                      |                      |                 | The power supply voltage is falling. | 3.60 | 3.67 | 3.74 | V    |
|                      |                      | VLVD13          | The power supply voltage is rising.  | 3.48 | 3.55 | 3.62 | V    |
|                      |                      |                 | The power supply voltage is falling. | 3.40 | 3.47 | 3.54 | V    |
|                      |                      | VLVD14          | The power supply voltage is rising.  | 3.28 | 3.35 | 3.42 | V    |
|                      |                      |                 | The power supply voltage is falling. | 3.20 | 3.27 | 3.34 | V    |
|                      |                      | VLVD15          | The power supply voltage is rising.  | 3.07 | 3.13 | 3.19 | V    |
|                      |                      |                 | The power supply voltage is falling. | 3.00 | 3.06 | 3.12 | V    |
|                      |                      | VLVD16          | The power supply voltage is rising.  | 2.91 | 2.97 | 3.03 | V    |
|                      |                      |                 | The power supply voltage is falling. | 2.85 | 2.91 | 2.97 | V    |
|                      |                      | VLVD17          | The power supply voltage is rising.  | 2.76 | 2.82 | 2.87 | V    |
|                      |                      |                 | The power supply voltage is falling. | 2.70 | 2.76 | 2.81 | V    |
|                      |                      | VLVD18          | The power supply voltage is rising.  | 2.61 | 2.66 | 2.71 | V    |
|                      |                      |                 | The power supply voltage is falling. | 2.55 | 2.60 | 2.65 | V    |
|                      |                      | VLVD19          | The power supply voltage is rising.  | 2.45 | 2.50 | 2.55 | V    |
|                      |                      |                 | The power supply voltage is falling. | 2.40 | 2.45 | 2.50 | V    |
|                      |                      | VLVD110         | The power supply voltage is rising.  | 2.35 | 2.40 | 2.45 | V    |
|                      |                      |                 | The power supply voltage is falling. | 2.30 | 2.35 | 2.40 | V    |
|                      |                      | VLVD111         | The power supply voltage is rising.  | 2.25 | 2.30 | 2.34 | V    |
|                      |                      |                 | The power supply voltage is falling. | 2.20 | 2.25 | 2.29 | V    |
|                      |                      | VLVD112         | The power supply voltage is rising.  | 2.15 | 2.20 | 2.24 | V    |
|                      |                      |                 | The power supply voltage is falling. | 2.10 | 2.15 | 2.19 | V    |
|                      |                      | VLVD113         | The power supply voltage is rising.  | 2.05 | 2.09 | 2.13 | V    |
|                      |                      |                 | The power supply voltage is falling. | 2.00 | 2.04 | 2.08 | V    |
|                      |                      | VLVD114         | The power supply voltage is rising.  | 1.94 | 1.98 | 2.02 | V    |
|                      |                      |                 | The power supply voltage is falling. | 1.90 | 1.94 | 1.98 | V    |
|                      |                      | VLVD115<br>Note | The power supply voltage is rising.  | 1.84 | 1.88 | 1.91 | V    |
|                      |                      |                 | The power supply voltage is falling. | 1.80 | 1.84 | 1.87 | V    |
|                      |                      | VLVD116<br>Note | The power supply voltage is rising.  | 1.74 | 1.78 | 1.81 | V    |
|                      |                      |                 | The power supply voltage is falling. | 1.70 | 1.74 | 1.77 | V    |
|                      |                      | VLVD117<br>Note | The power supply voltage is rising.  | 1.64 | 1.67 | 1.70 | V    |
|                      |                      |                 | The power supply voltage is falling. | 1.60 | 1.63 | 1.66 | V    |
| Minimum pulse width  |                      | tlW             |                                      | 500  |      |      | μs   |
| Detection delay time |                      |                 |                                      |      |      | 500  | μs   |

**Note** This setting can only be used when LVD0 is disabled.

### 2.6.7 Power supply voltage rising slope characteristics

(TA = -40 to +105°C, VSS = 0 V)

| Item                              | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|--------|------------|------|------|------|------|
| Power supply voltage rising slope | SVDD   |            |      |      | 54   | V/ms |

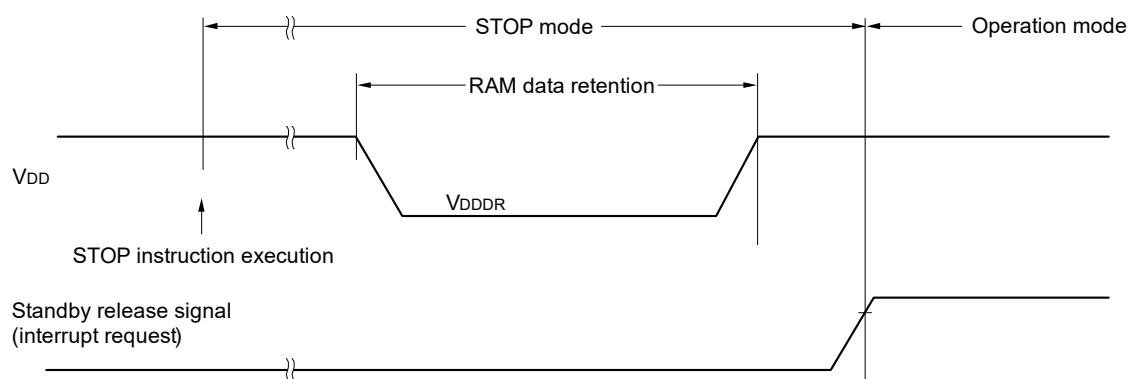
**Caution** Make sure to keep the internal reset state by the LVD0 circuit or an external reset until VDD reaches the operating voltage range shown in AC characteristics.

## 2.7 RAM Data Retention Characteristics

(TA = -40 to +105°C, VSS = 0V)

| Item                          | Symbol | Conditions | Min.                 | Typ. | Max. | Unit |
|-------------------------------|--------|------------|----------------------|------|------|------|
| Data retention supply voltage | VDDDR  |            | 1.43 <sup>Note</sup> |      | 5.5  | V    |

**Note** This voltage depends on the POR detection voltage. When the voltage drops, the data in RAM are retained until a POR is applied, but are not retained following a POR.



## 2.8 Flash Memory Programming Characteristics

(TA = -40 to +105°C, 1.6 V ≤ VDD ≤ 5.5 V, VSS = 0 V)

| Item                                               | Symbol            | Conditions                                      | Min.    | Typ.      | Max. | Unit  |
|----------------------------------------------------|-------------------|-------------------------------------------------|---------|-----------|------|-------|
| CPU/peripheral hardware clock frequency            | fCLK              |                                                 | 1       |           | 32   | MHz   |
| Number of code flash rewrites <b>Notes 1, 2, 3</b> | C <sub>erwr</sub> | Retained for 20 years<br>T <sub>A</sub> = +85°C | 1,000   |           |      | Times |
| Number of data flash rewrites <b>Notes 1, 2, 3</b> |                   | Retained for 1 year<br>T <sub>A</sub> = +25°C   |         | 1,000,000 |      |       |
|                                                    |                   | Retained for 5 years<br>T <sub>A</sub> = +85°C  | 100,000 |           |      |       |
|                                                    |                   | Retained for 20 years<br>T <sub>A</sub> = +85°C | 10,000  |           |      |       |

**Note 1.** 1 erase + 1 write after the erase is regarded as 1 rewrite. The retaining years are until next rewrite after the rewrite.

**Note 2.** The listed numbers of times apply when using flash memory programmer and Renesas Electronics self programming library.

**Note 3.** These are the characteristics of the flash memory and the results obtained from reliability testing by Renesas Electronics Corporation.

## 1. Code flash memory

(TA = -40 to +105°C, 1.6 V ≤ VDD ≤ 5.5 V, VSS = 0 V)

| Item                                                                         |          | Symbol  | fCLK = 1 MHz |      |        | fCLK = 2 MHz, 3 MHz |      |        | 4 MHz ≤ fCLK < 8 MHz |      |       | 8 MHz ≤ fCLK < 32 MHz |      |       | fCLK = 32 MHz |      |       | Unit |
|------------------------------------------------------------------------------|----------|---------|--------------|------|--------|---------------------|------|--------|----------------------|------|-------|-----------------------|------|-------|---------------|------|-------|------|
|                                                                              |          |         | Min.         | Typ. | Max.   | Min.                | Typ. | Max.   | Min.                 | Typ. | Max.  | Min.                  | Typ. | Max.  | Min.          | Typ. | Max.  |      |
| Programming time                                                             | 4 bytes  | tP4     | —            | 74.7 | 656.5  | —                   | 51.0 | 464.6  | —                    | 41.7 | 384.8 | —                     | 37.1 | 346.2 | —             | 34.2 | 321.9 | μs   |
| Erase time                                                                   | 2 Kbytes | tE2K    | —            | 10.4 | 312.2  | —                   | 7.7  | 258.5  | —                    | 6.4  | 231.8 | —                     | 5.8  | 218.4 | —             | 5.6  | 214.4 | ms   |
| Blank checking time                                                          | 4 bytes  | tBC4    | —            | —    | 38.4   | —                   | —    | 19.2   | —                    | —    | 13.1  | —                     | —    | 10.2  | —             | —    | 8.3   | μs   |
|                                                                              | 2 Kbytes | tBC2K   | —            | —    | 2618.9 | —                   | —    | 1309.5 | —                    | —    | 658.3 | —                     | —    | 332.8 | —             | —    | 234.1 | μs   |
| Time taken to forcibly stop the erasure                                      |          | tSED    | —            | —    | 18.0   | —                   | —    | 14.0   | —                    | —    | 12.0  | —                     | —    | 11.0  | —             | —    | 10.3  | μs   |
| Security setting time                                                        |          | tAWSSAS | —            | 18.2 | 526.2  | —                   | 14.4 | 469.2  | —                    | 12.5 | 441.1 | —                     | 11.6 | 427.1 | —             | 11.3 | 422.6 | ms   |
| Time until programming starts following cancellation of the STOP instruction |          | —       | 20           | —    | —      | 20                  | —    | —      | 20                   | —    | —     | 20                    | —    | —     | 20            | —    | —     | μs   |

**Caution** The listed values do not include the time until the operations of the flash memory start following execution of an instruction by software.

## 2. Data flash memory

(TA = -40 to +105°C, 1.6 V ≤ VDD ≤ 5.5 V, VSS = 0 V)

| Item                                                                         |           | Symbol | fCLK = 1 MHz |      |        | fCLK = 2 MHz, 3 MHz |      |       | 4 MHz ≤ fCLK < 8 MHz |      |       | 8 MHz ≤ fCLK < 32 MHz |      |       | fCLK = 32 MHz |      |       | Unit |
|------------------------------------------------------------------------------|-----------|--------|--------------|------|--------|---------------------|------|-------|----------------------|------|-------|-----------------------|------|-------|---------------|------|-------|------|
|                                                                              |           |        | Min.         | Typ. | Max.   | Min.                | Typ. | Max.  | Min.                 | Typ. | Max.  | Min.                  | Typ. | Max.  | Min.          | Typ. | Max.  |      |
| Programming time                                                             | 1 byte    | tP4    | —            | 74.7 | 656.5  | —                   | 51.0 | 464.6 | —                    | 41.7 | 384.8 | —                     | 37.1 | 346.2 | —             | 34.2 | 321.9 | μs   |
| Erase time                                                                   | 256 bytes | tE2K   | —            | 7.8  | 259.2  | —                   | 6.4  | 232.0 | —                    | 5.8  | 218.5 | —                     | 5.5  | 211.8 | —             | 5.4  | 209.7 | ms   |
| Blank checking time                                                          | 1 byte    | tBC4   | —            | —    | 38.4   | —                   | —    | 19.2  | —                    | —    | 13.1  | —                     | —    | 10.2  | —             | —    | 8.3   | μs   |
|                                                                              | 256 bytes | tBC2K  | —            | —    | 1326.1 | —                   | —    | 663.1 | —                    | —    | 335.1 | —                     | —    | 171.2 | —             | —    | 121.0 | μs   |
| Time taken to forcibly stop the erasure                                      |           | tSED   | —            | —    | 18.0   | —                   | —    | 14.0  | —                    | —    | 12.0  | —                     | —    | 11.0  | —             | —    | 10.3  | μs   |
| Time until programming starts following cancellation of the STOP instruction |           | —      | 20           | —    | —      | 20                  | —    | —     | 20                   | —    | —     | 20                    | —    | —     | 20            | —    | —     | μs   |
| Time until reading starts following setting DFLEN to 1                       |           | —      | 0.25         | —    | —      | 0.25                | —    | —     | 0.25                 | —    | —     | 0.25                  | —    | —     | 0.25          | —    | —     | μs   |

**Caution** The listed values do not include the time until the operations of the flash memory start following execution of an instruction by software.

## 2.9 Dedicated Flash Memory Programmer Communication (UART)

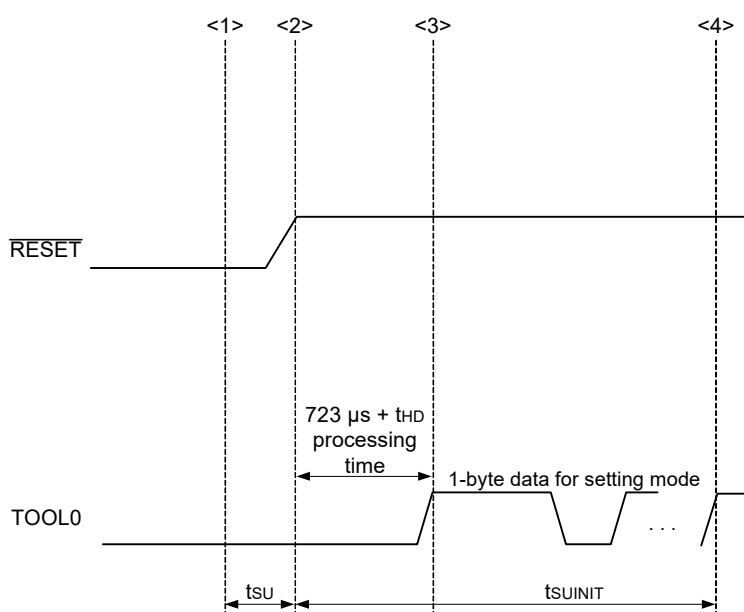
( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.8\text{ V} \leq \text{EVDD0} = \text{EVDD1} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = \text{EVSS1} = 0\text{ V}$ )

| Item          | Symbol | Conditions                | Min.    | Typ. | Max.      | Unit |
|---------------|--------|---------------------------|---------|------|-----------|------|
| Transfer rate |        | During serial programming | 115,200 |      | 1,000,000 | bps  |

## 2.10 Timing of Entry to Flash Memory Programming Modes

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $1.8\text{ V} \leq \text{EVDD0} = \text{EVDD1} \leq \text{VDD} \leq 5.5\text{ V}$ ,  $\text{VSS} = \text{EVSS0} = \text{EVSS1} = 0\text{ V}$ )

| Item                                                                                                                                                               | Symbol  | Conditions                                                                | Min. | Typ. | Max. | Unit          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------------------------------------------------------------------------|------|------|------|---------------|
| Time to complete the communication for the initial setting after the external reset is released                                                                    | tsuINIT | POR and LVD reset must be released before the external reset is released. |      |      | 100  | ms            |
| Time to release the external reset after the TOOL0 pin is set to the low level                                                                                     | tsu     | POR and LVD reset must be released before the external reset is released. | 10   |      |      | $\mu\text{s}$ |
| Time to hold the TOOL0 pin at the low level after the external reset is released (the processing time of the firmware to control the flash memory is not included) | tHD     | POR and LVD reset must be released before the external reset is released. | 1    |      |      | ms            |



<1> The low level is input to the TOOL0 pin.

<2> The external reset is released. Note that the POR and LVD reset must be released before the external reset is released.

<3> The TOOL0 pin is set to the high level.

<4> Setting of the flash memory programming mode by UART reception and complete the baud rate setting.

**Remark**  $t_{\text{suINIT}}$  : The time during which the communications for the initial setting must be completed within 100 ms after the external reset is released.

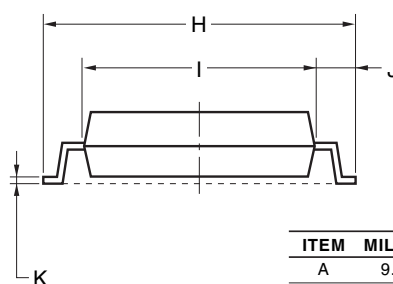
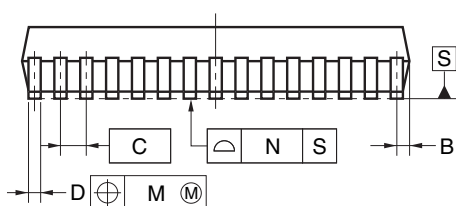
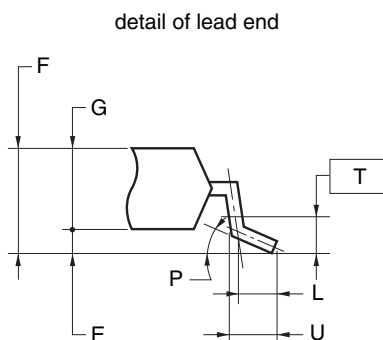
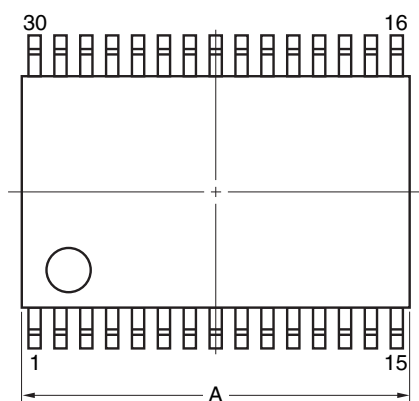
$t_{\text{su}}$  : Time to release the external reset after the TOOL0 pin is set to the low level

$t_{\text{HD}}$  : Time to hold the TOOL0 pin at the low level after the external reset is released. It does not include the processing time of the firmware to control the flash memory.

### 3. Package Drawings

#### 3.1 30-pin Products

| JEITA Package Code  | RENESAS Code | Previous Code  | MASS (TYP.) [g] |
|---------------------|--------------|----------------|-----------------|
| P-LSSOP30-0300-0.65 | PLSP0030JB-B | S30MC-65-5A4-3 | 0.18            |



#### NOTE

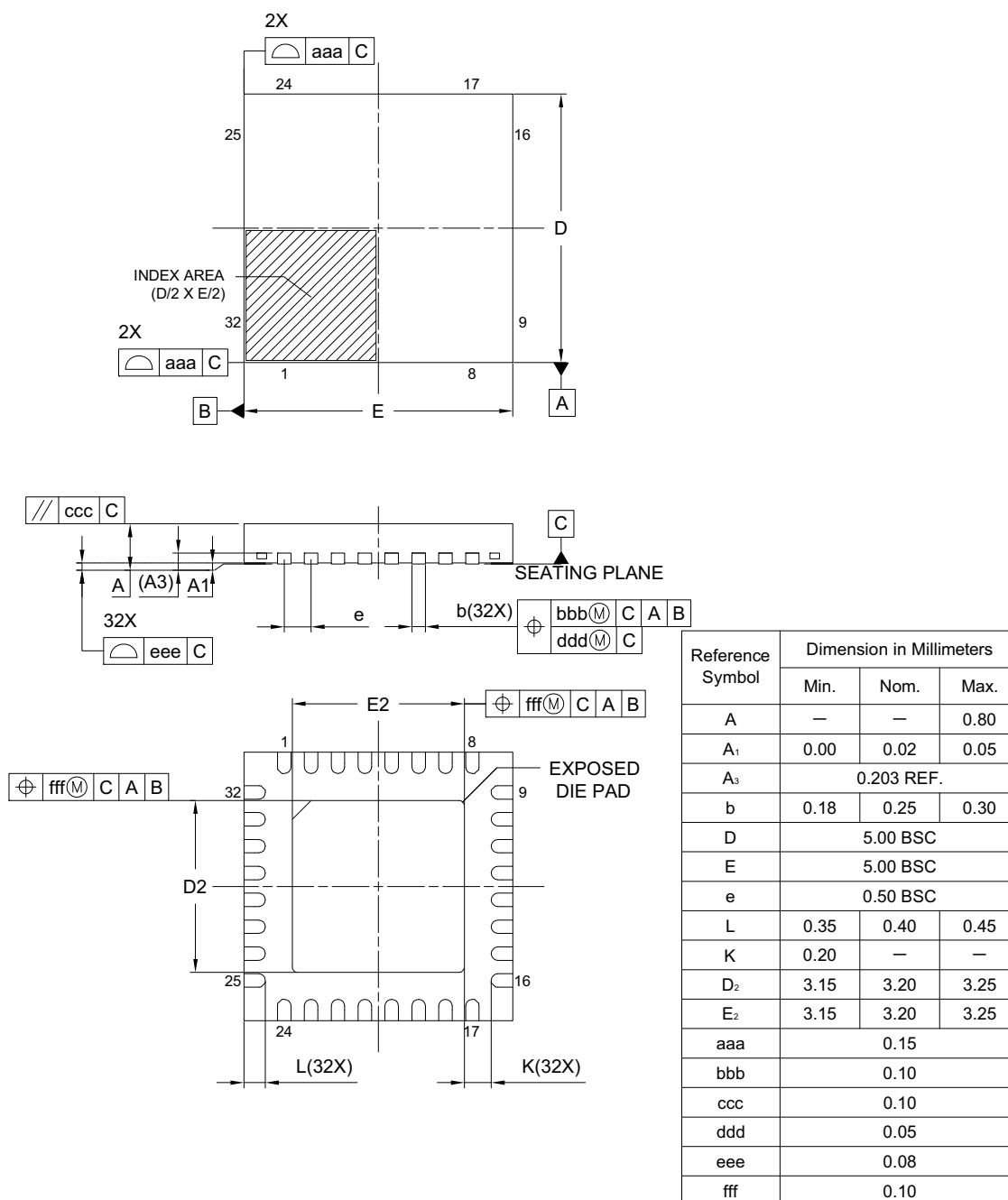
Each lead centerline is located within 0.13 mm of its true position (T.P.) at maximum material condition.

| ITEM | MILLIMETERS                            |
|------|----------------------------------------|
| A    | 9.85±0.15                              |
| B    | 0.45 MAX.                              |
| C    | 0.65 (T.P.)                            |
| D    | 0.24 <sup>+0.08</sup> <sub>-0.07</sub> |
| E    | 0.1±0.05                               |
| F    | 1.3±0.1                                |
| G    | 1.2                                    |
| H    | 8.1±0.2                                |
| I    | 6.1±0.2                                |
| J    | 1.0±0.2                                |
| K    | 0.17±0.03                              |
| L    | 0.5                                    |
| M    | 0.13                                   |
| N    | 0.10                                   |
| P    | 3° <sup>+5°</sup> <sub>-3°</sub>       |
| T    | 0.25                                   |
| U    | 0.6±0.15                               |

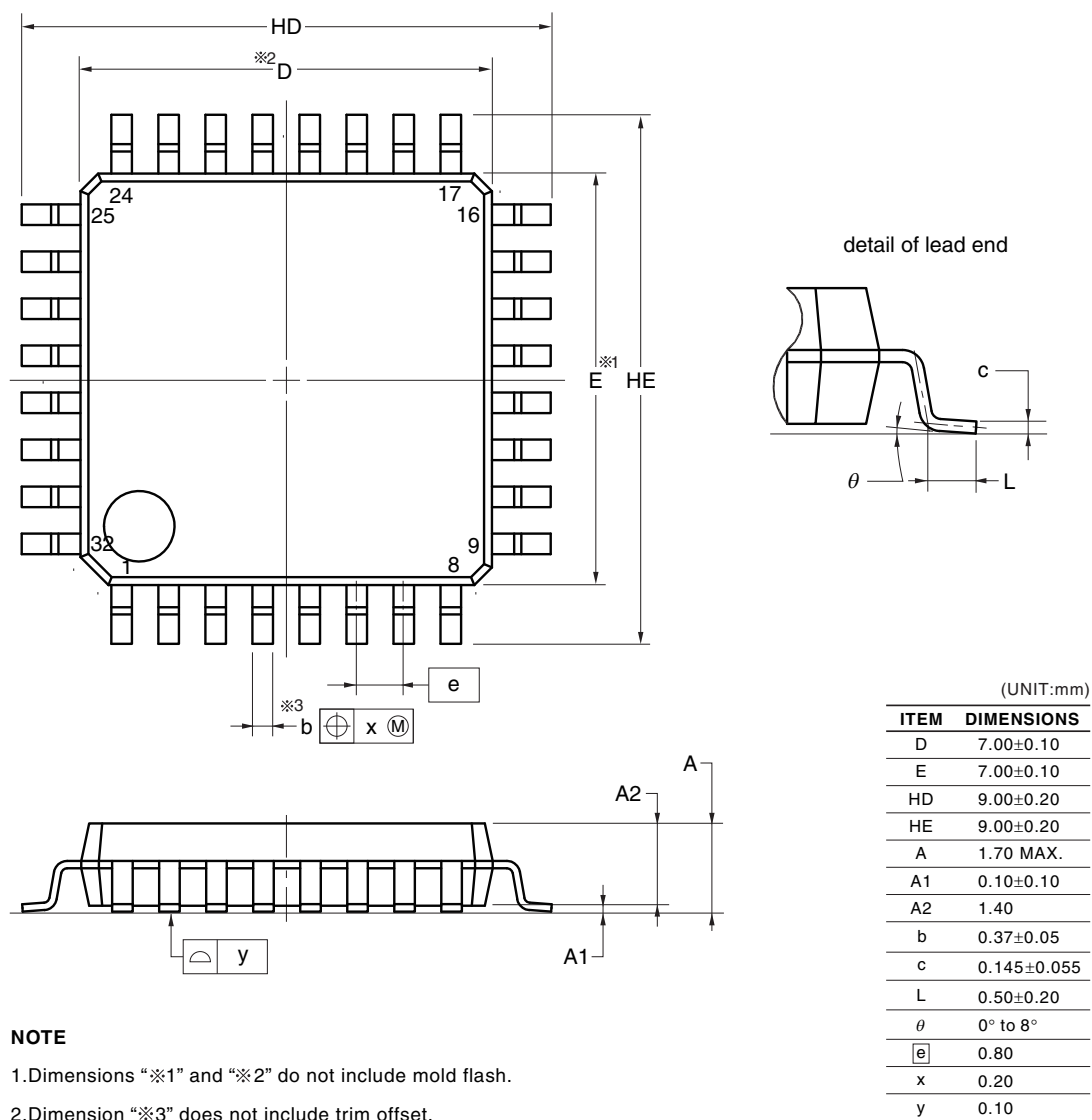
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## 3.2 32-pin Products

| JEITA Package code  | RENESAS code | MASS(TYP.)[g] |
|---------------------|--------------|---------------|
| P-HWQFN032-5x5-0.50 | PWQN0032KE-A | 0.06          |



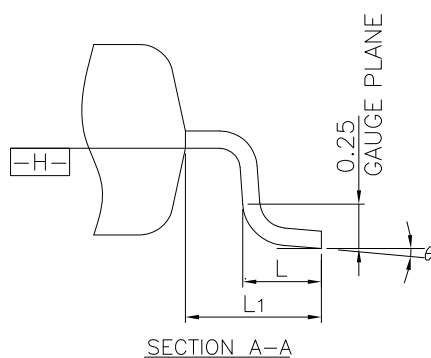
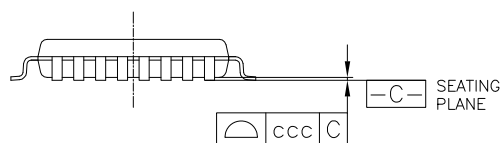
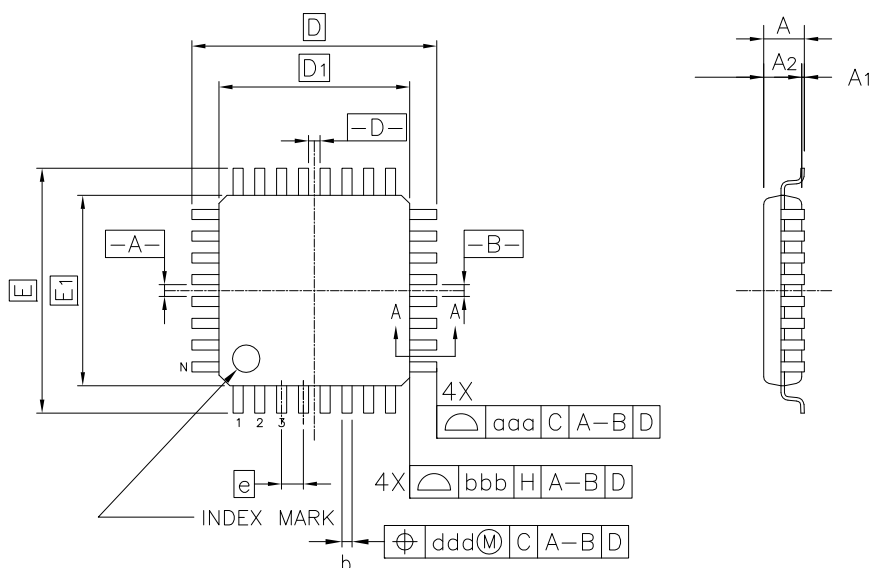
| JEITA Package Code | RENESAS Code | Previous Code  | MASS (TYP.) [g] |
|--------------------|--------------|----------------|-----------------|
| P-LQFP32-7x7-0.80  | PLQP0032GB-A | P32GA-80-GBT-1 | 0.2             |



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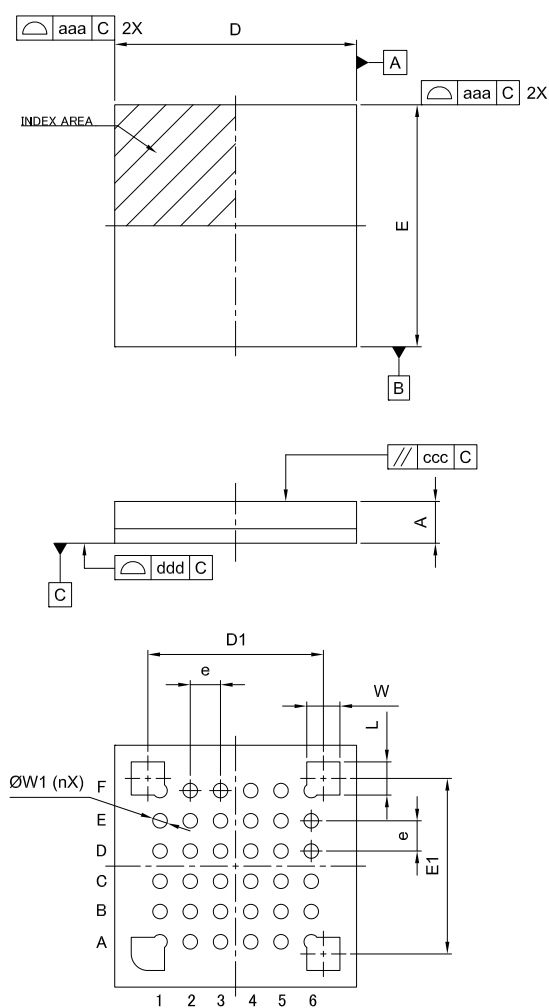
| JEITA Package code | RENESAS code | MASS(TYP.)[g] |
|--------------------|--------------|---------------|
| P-LQFP32-7x7-0.80  | PLQP0032GE-A | 0.18          |



| Reference Symbol | Dimension in Millimeters |      |      |
|------------------|--------------------------|------|------|
|                  | Min.                     | Nom. | Max. |
| A                | —                        | —    | 1.60 |
| A <sub>1</sub>   | 0.05                     | —    | 0.15 |
| A <sub>2</sub>   | 1.35                     | 1.40 | 1.45 |
| D                | —                        | 9.00 | —    |
| D <sub>1</sub>   | —                        | 7.00 | —    |
| E                | —                        | 9.00 | —    |
| E <sub>1</sub>   | —                        | 7.00 | —    |
| N                | —                        | 32   | —    |
| e                | —                        | 0.80 | —    |
| b                | 0.30                     | 0.37 | 0.45 |
| c                | 0.09                     | —    | 0.20 |
| θ                | 0°                       | 3.5° | 7°   |
| L                | 0.45                     | 0.60 | 0.75 |
| L <sub>1</sub>   | —                        | 1.00 | —    |
| aaa              | —                        | —    | 0.20 |
| bbb              | —                        | —    | 0.20 |
| ccc              | —                        | —    | 0.10 |
| ddd              | —                        | —    | 0.20 |

## 3.3 36-pin Products

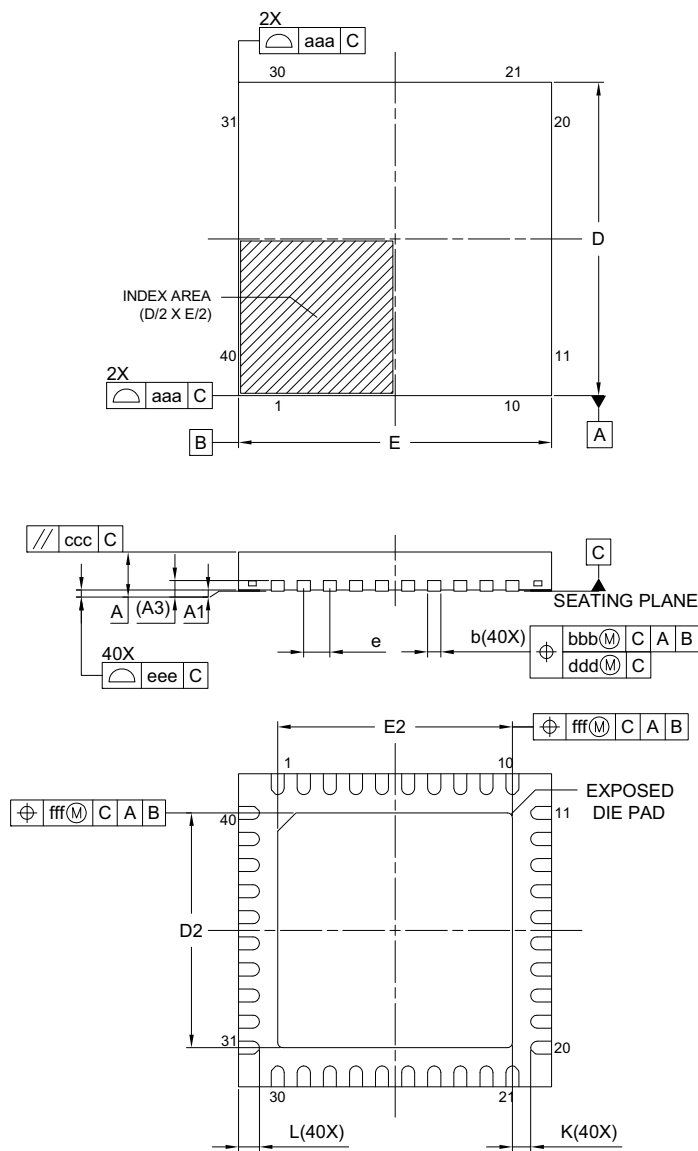
| JEITA Package Code   | RENESAS Code | MASS (Typ.) [g] |
|----------------------|--------------|-----------------|
| P-WFLGA36-4 × 4-0.50 | PWLG0036KB-A | 0.02            |



| Reference Symbol | Dimension in Millimeters |      |      |
|------------------|--------------------------|------|------|
|                  | Min.                     | Nom. | Max. |
| D                | —                        | 4.00 | —    |
| E                | —                        | 4.00 | —    |
| D1               | 2.90 BSC                 |      |      |
| E1               | 2.90 BSC                 |      |      |
| A                | —                        | —    | 0.76 |
| W1               | 0.19                     | 0.24 | 0.29 |
| W                | —                        | 0.55 | —    |
| L                | —                        | 0.55 | —    |
| e                | 0.50 BSC                 |      |      |
| aaa              | 0.10                     |      |      |
| ccc              | 0.20                     |      |      |
| ddd              | 0.08                     |      |      |
| n                | —                        | 36   | —    |

3.4 40-pin Products

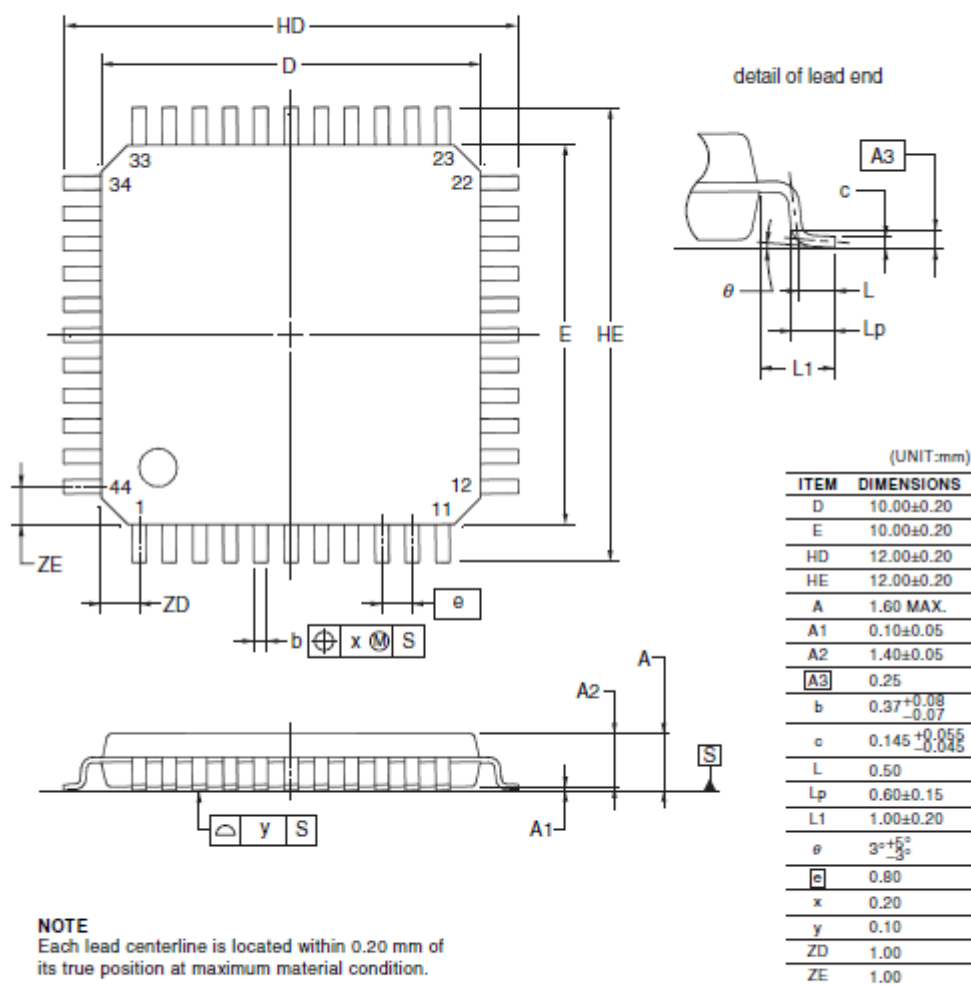
|                     |              |                |
|---------------------|--------------|----------------|
| JEITA Package code  | RENESAS code | MASS (TYP.)[g] |
| P-HWQFN040-6x6-0.50 | PWQN0040KD-A | 0.08           |



| Reference Symbol | Dimension in Millimeters |      |      |
|------------------|--------------------------|------|------|
|                  | Min.                     | Nom. | Max. |
| A                | —                        | —    | 0.80 |
| A <sub>1</sub>   | 0.00                     | 0.02 | 0.05 |
| A <sub>3</sub>   | 0.203 REF.               |      |      |
| b                | 0.18                     | 0.25 | 0.30 |
| D                | 6.00 BSC                 |      |      |
| E                | 6.00 BSC                 |      |      |
| e                | 0.50 BSC                 |      |      |
| L                | 0.30                     | 0.40 | 0.50 |
| K                | 0.20                     | —    | —    |
| D <sub>2</sub>   | 4.45                     | 4.50 | 4.55 |
| E <sub>2</sub>   | 4.45                     | 4.50 | 4.55 |
| aaa              | 0.15                     |      |      |
| bbb              | 0.10                     |      |      |
| ccc              | 0.10                     |      |      |
| ddd              | 0.05                     |      |      |
| eee              | 0.08                     |      |      |
| fff              | 0.10                     |      |      |

## 3.5 44-pin Products

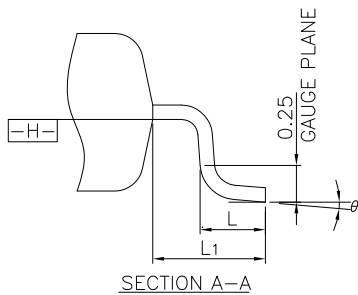
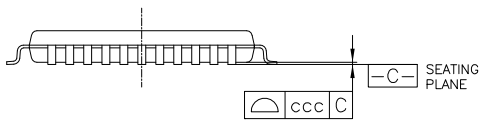
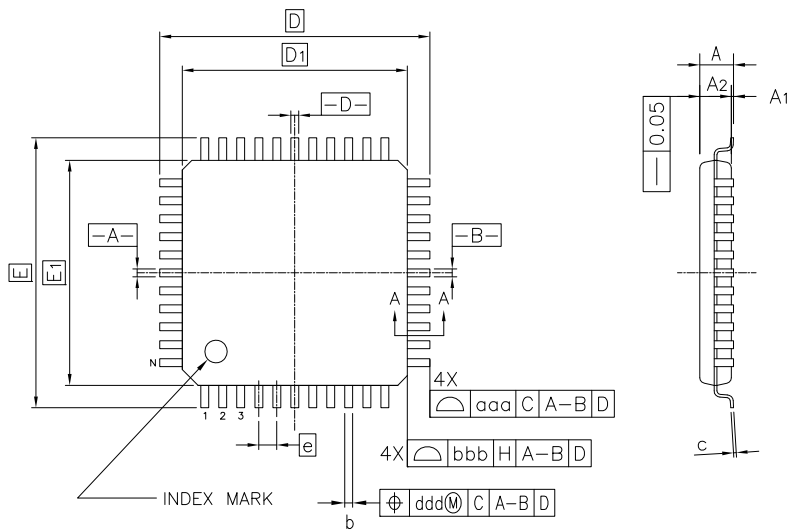
| JEITA Package Code  | RENESAS Code | Previous Code  | MASS (TYP.) [g] |
|---------------------|--------------|----------------|-----------------|
| P-LQFP44-10x10-0.80 | PLQP0044GC-A | P44GB-80-UES-2 | 0.36            |



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<R>

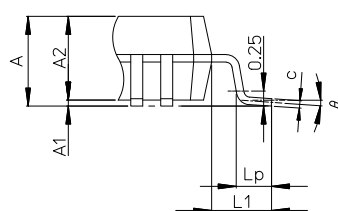
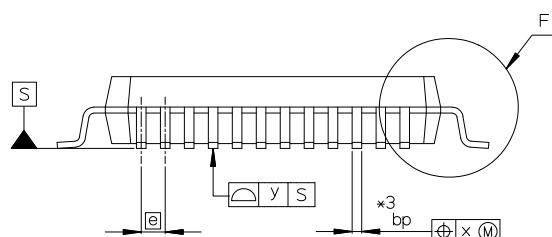
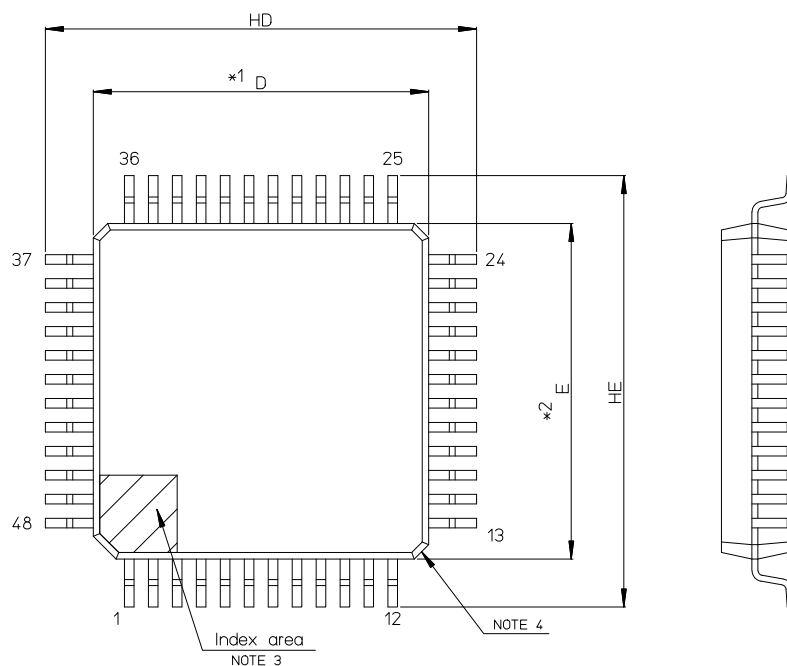
|                      |              |               |
|----------------------|--------------|---------------|
| JEITA Package code   | RENESAS code | MASS(TYP.)[g] |
| P-LQFP044-10x10-0.80 | PLQP0044GE-A | 0.34          |



| Reference Symbol | Dimension in Millimeters |       |      |
|------------------|--------------------------|-------|------|
|                  | Min.                     | Nom.  | Max. |
| A                | —                        | —     | 1.60 |
| A <sub>1</sub>   | 0.05                     | —     | 0.15 |
| A <sub>2</sub>   | 1.35                     | 1.40  | 1.45 |
| D                | —                        | 12.00 | —    |
| D <sub>1</sub>   | —                        | 10.00 | —    |
| E                | —                        | 12.00 | —    |
| E <sub>1</sub>   | —                        | 10.00 | —    |
| N                | —                        | 44    | —    |
| e                | —                        | 0.80  | —    |
| b                | 0.30                     | 0.37  | 0.45 |
| c                | 0.09                     | —     | 0.20 |
| θ                | 0°                       | 3.5°  | 7°   |
| L                | 0.45                     | 0.60  | 0.75 |
| L <sub>1</sub>   | —                        | 1.00  | —    |
| aaa              | —                        | —     | 0.20 |
| bbb              | —                        | —     | 0.20 |
| ccc              | —                        | —     | 0.10 |
| ddd              | —                        | —     | 0.20 |

## 3.6 48-pin Products

| JEITA Package Code | RENESAS Code | Previous Code | MASS[Typ.] |
|--------------------|--------------|---------------|------------|
| P-LFQFP48-7x7-0.50 | PLQP0048KB-B | —             | 0.2g       |



Detail F

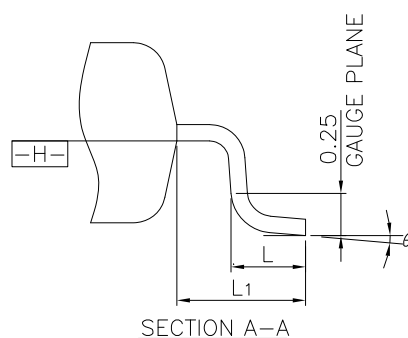
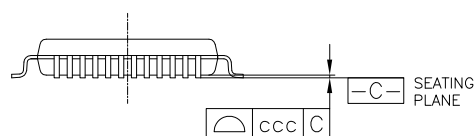
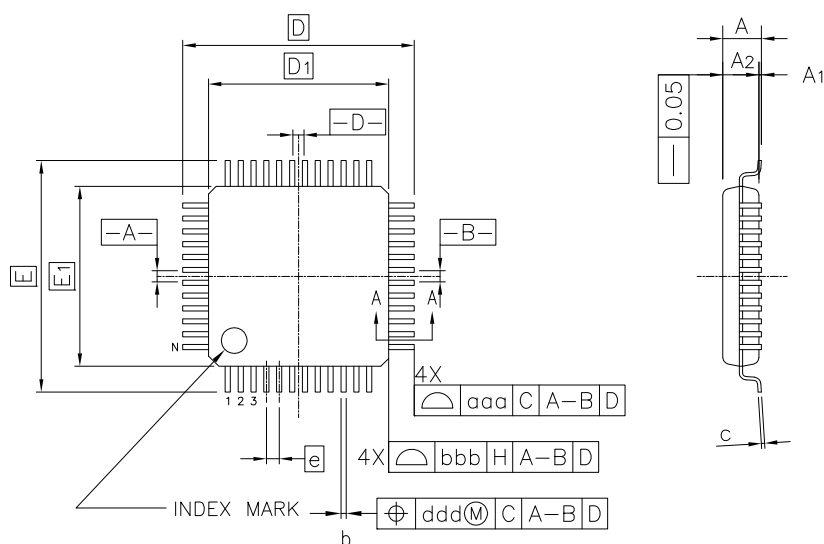
## NOTE)

1. DIMENSIONS \*1 AND \*2 DO NOT INCLUDE MOLD FLASH.
2. DIMENSION \*3 DOES NOT INCLUDE TRIM OFFSET.
3. PIN 1 VISUAL INDEX FEATURE MAY VARY, BUT MUST BE LOCATED WITHIN THE HATCHED AREA.
4. CHAMFERS AT CORNERS ARE OPTIONAL; SIZE MAY VARY.

| Reference Symbol | Dimension in Millimeters |      |      |
|------------------|--------------------------|------|------|
|                  | Min                      | Nom  | Max  |
| D                | 6.9                      | 7.0  | 7.1  |
| E                | 6.9                      | 7.0  | 7.1  |
| A2               | —                        | 1.4  | —    |
| HD               | 8.8                      | 9.0  | 9.2  |
| HE               | 8.8                      | 9.0  | 9.2  |
| A                | —                        | —    | 1.7  |
| A1               | 0.05                     | —    | 0.15 |
| bp               | 0.17                     | 0.20 | 0.27 |
| c                | 0.09                     | —    | 0.20 |
| $\theta$         | 0°                       | 3.5° | 8°   |
| e                | —                        | 0.5  | —    |
| x                | —                        | —    | 0.08 |
| y                | —                        | —    | 0.08 |
| Lp               | 0.45                     | 0.6  | 0.75 |
| L1               | —                        | 1.0  | —    |

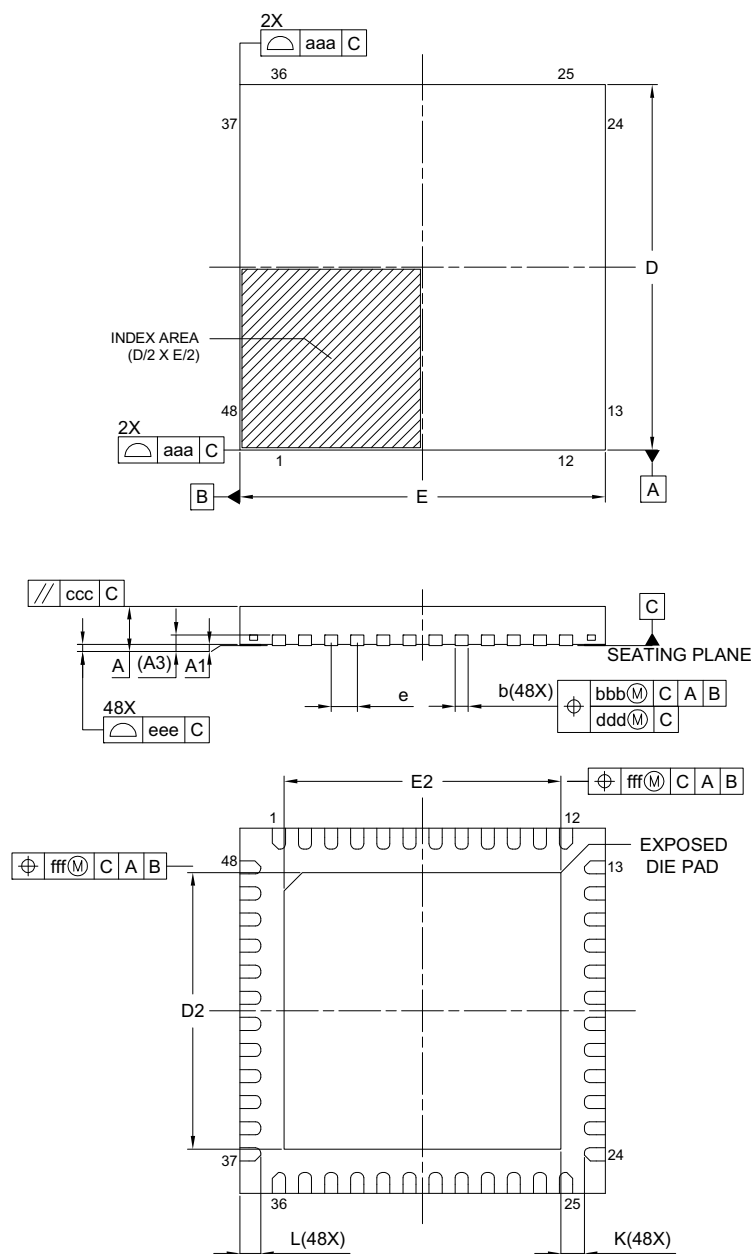
<R>

|                    |              |               |
|--------------------|--------------|---------------|
| JEITA Package code | RENESAS code | MASS(TYP.)[g] |
| P-LFQFP48-7x7-0.50 | PLQP0048KL-A | 0.18          |



| Reference Symbol | Dimension in Millimeters |      |      |
|------------------|--------------------------|------|------|
|                  | Min.                     | Nom. | Max. |
| A                | —                        | —    | 1.60 |
| A <sub>1</sub>   | 0.05                     | —    | 0.15 |
| A <sub>2</sub>   | 1.35                     | 1.40 | 1.45 |
| D                | —                        | 9.00 | —    |
| D <sub>1</sub>   | —                        | 7.00 | —    |
| E                | —                        | 9.00 | —    |
| E <sub>1</sub>   | —                        | 7.00 | —    |
| N                | —                        | 48   | —    |
| e                | —                        | 0.50 | —    |
| b                | 0.17                     | 0.22 | 0.27 |
| c                | 0.09                     | —    | 0.20 |
| θ                | 0°                       | 3.5° | 7°   |
| L                | 0.45                     | 0.60 | 0.75 |
| L <sub>1</sub>   | —                        | 1.00 | —    |
| aaa              | —                        | —    | 0.20 |
| bbb              | —                        | —    | 0.20 |
| ccc              | —                        | —    | 0.08 |
| ddd              | —                        | —    | 0.08 |

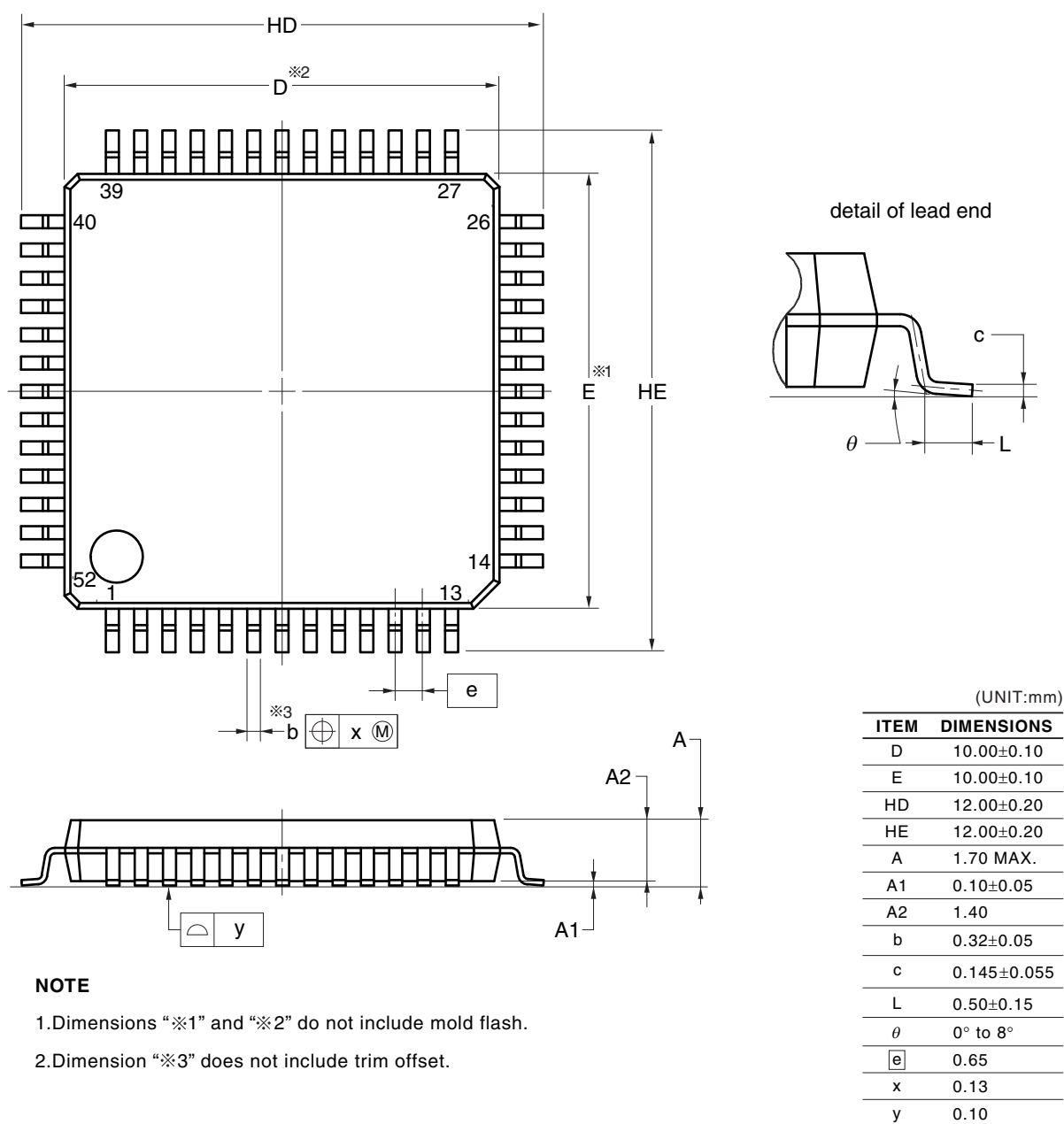
| JEITA Package code  | RENESAS code | MASS(TYP.)[g] |
|---------------------|--------------|---------------|
| P-HWQFN048-7x7-0.50 | PWQN0048KC-A | 0.13 g        |



| Reference Symbol | Dimension in Millimeters |      |      |
|------------------|--------------------------|------|------|
|                  | Min.                     | Nom. | Max. |
| A                | —                        | —    | 0.80 |
| A <sub>1</sub>   | 0.00                     | 0.02 | 0.05 |
| A <sub>3</sub>   | 0.203 REF.               |      |      |
| b                | 0.20                     | 0.25 | 0.30 |
| D                | 7.00 BSC                 |      |      |
| E                | 7.00 BSC                 |      |      |
| e                | 0.50 BSC                 |      |      |
| L                | 0.30                     | 0.40 | 0.50 |
| K                | 0.20                     | —    | —    |
| D <sub>2</sub>   | 5.25                     | 5.30 | 5.35 |
| E <sub>2</sub>   | 5.25                     | 5.30 | 5.35 |
| aaa              | 0.15                     |      |      |
| bbb              | 0.10                     |      |      |
| ccc              | 0.10                     |      |      |
| ddd              | 0.05                     |      |      |
| eee              | 0.08                     |      |      |
| fff              | 0.10                     |      |      |

## 3.7 52-pin Products

| JEITA Package Code  | RENESAS Code | Previous Code  | MASS (TYP.) [g] |
|---------------------|--------------|----------------|-----------------|
| P-LQFP52-10x10-0.65 | PLQP0052JA-A | P52GB-65-GBS-1 | 0.3             |

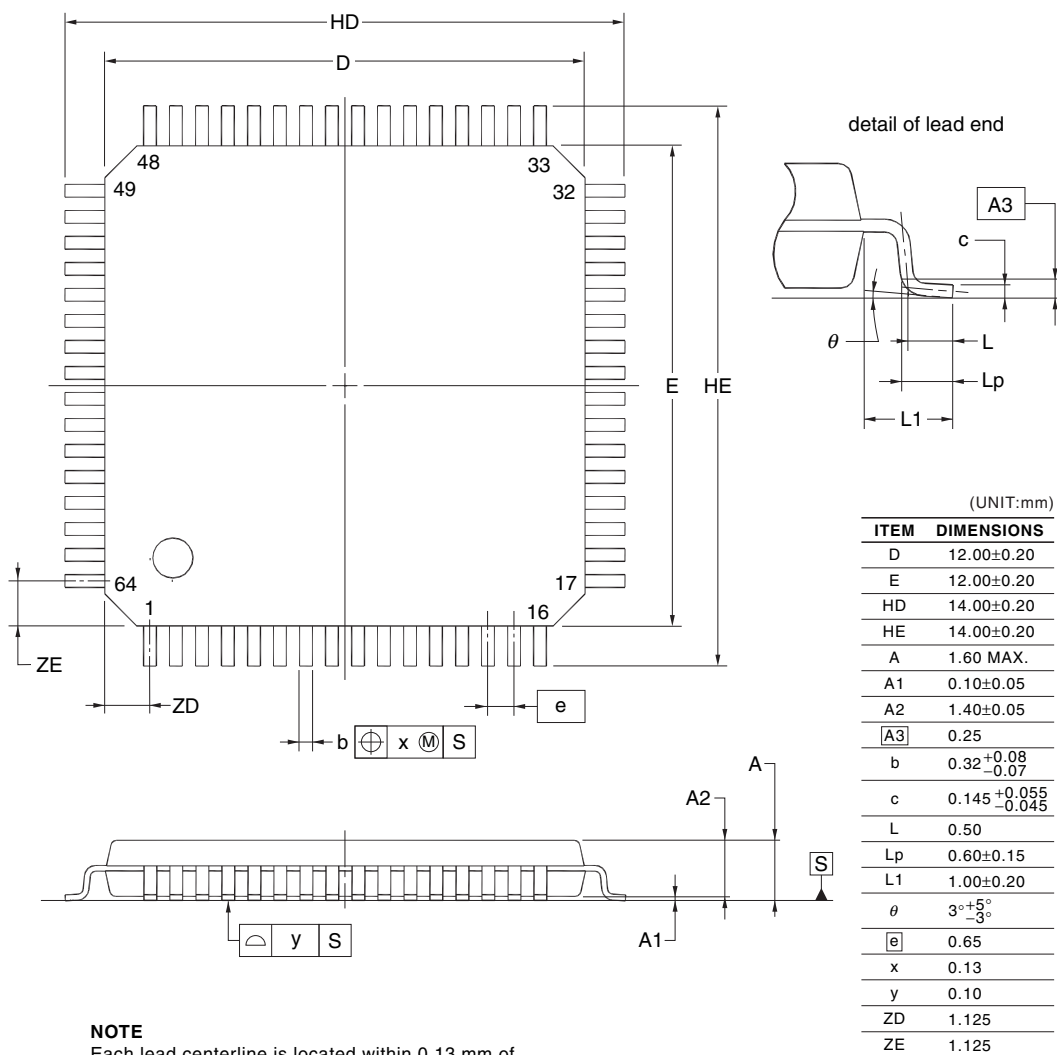
**NOTE**

1. Dimensions "※1" and "※2" do not include mold flash.
2. Dimension "※3" does not include trim offset.

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## 3.8 64-pin Products

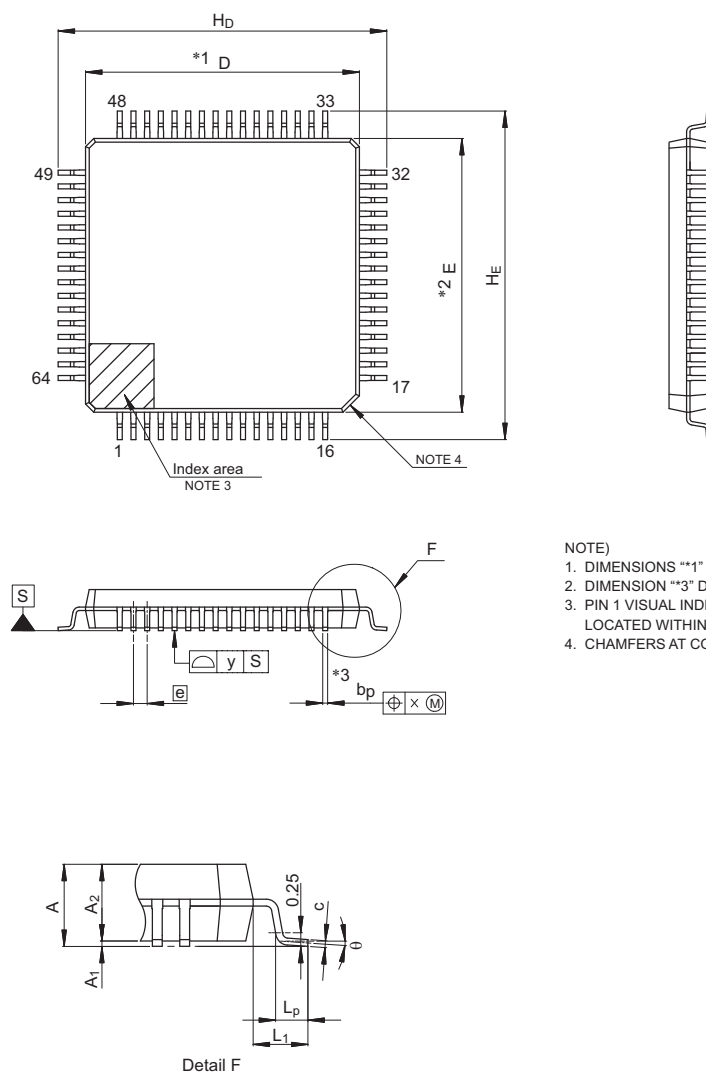
| JEITA Package Code  | RENESAS Code | Previous Code  | MASS (TYP.) [g] |
|---------------------|--------------|----------------|-----------------|
| P-LQFP64-12x12-0.65 | PLQP0064JA-A | P64GK-65-UET-2 | 0.51            |



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| JEITA Package Code   | RENESAS Code | Previous Code | MASS (Typ) [g] |
|----------------------|--------------|---------------|----------------|
| P-LFQFP64-10x10-0.50 | PLQP0064KB-C | —             | 0.3            |

Unit: mm



NOTE)

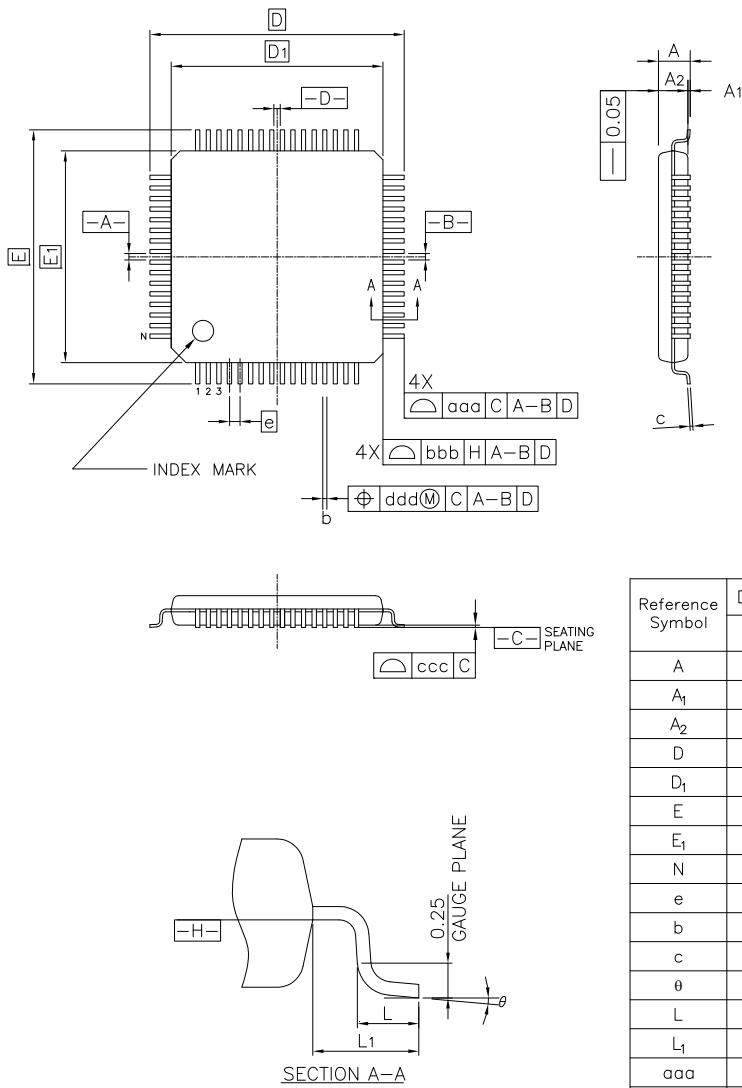
1. DIMENSIONS "\*\*1" AND "\*\*2" DO NOT INCLUDE MOLD FLASH.
2. DIMENSION "\*\*3" DOES NOT INCLUDE TRIM OFFSET.
3. PIN 1 VISUAL INDEX FEATURE MAY VARY, BUT MUST BE LOCATED WITHIN THE HATCHED AREA.
4. CHAMFERS AT CORNERS ARE OPTIONAL, SIZE MAY VARY.

| Reference Symbol | Dimensions in millimeters |      |      |
|------------------|---------------------------|------|------|
|                  | Min                       | Nom  | Max  |
| D                | 9.9                       | 10.0 | 10.1 |
| E                | 9.9                       | 10.0 | 10.1 |
| A <sub>2</sub>   | —                         | 1.4  | —    |
| H <sub>D</sub>   | 11.8                      | 12.0 | 12.2 |
| H <sub>E</sub>   | 11.8                      | 12.0 | 12.2 |
| A                | —                         | —    | 1.7  |
| A <sub>1</sub>   | 0.05                      | —    | 0.15 |
| b <sub>p</sub>   | 0.15                      | 0.20 | 0.27 |
| c                | 0.09                      | —    | 0.20 |
| θ                | 0°                        | 3.5° | 8°   |
| e                | —                         | 0.5  | —    |
| x                | —                         | —    | 0.08 |
| y                | —                         | —    | 0.08 |
| L <sub>p</sub>   | 0.45                      | 0.6  | 0.75 |
| L <sub>1</sub>   | —                         | 1.0  | —    |

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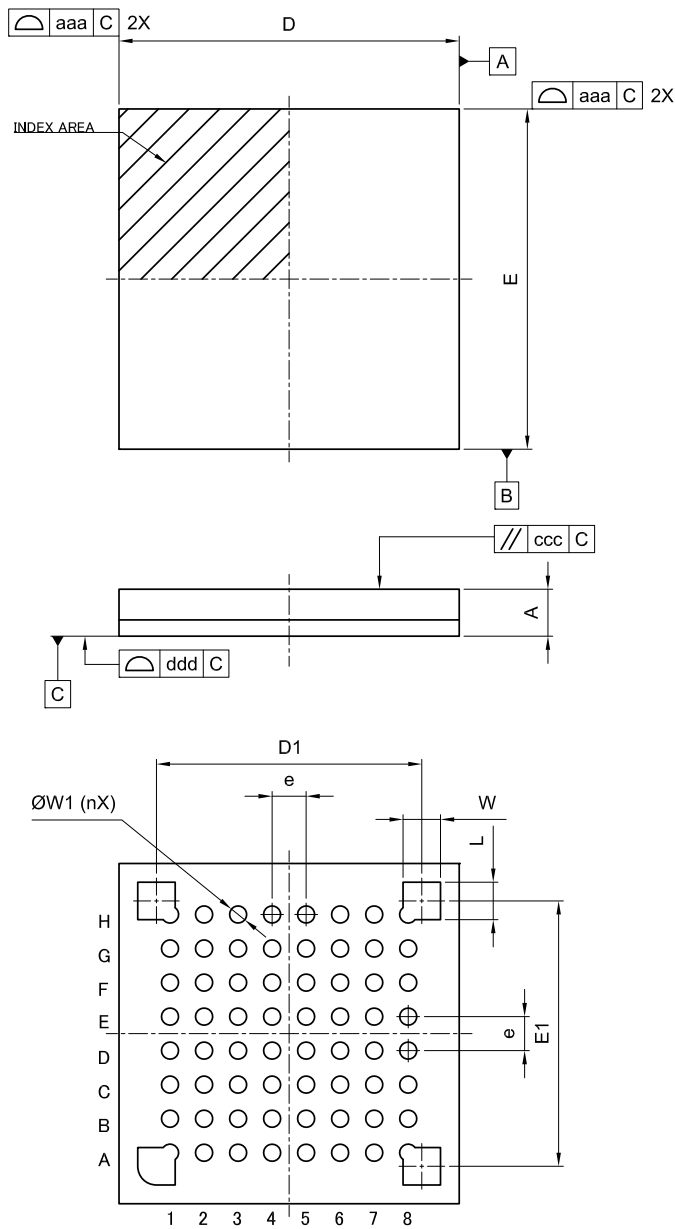
<R>

|                       |              |               |
|-----------------------|--------------|---------------|
| JEITA Package code    | RENESAS code | MASS(TYP.)[g] |
| P-LFQFP064-10x10-0.50 | PLQP0064KL-A | 0.36          |



| Reference Symbol | Dimension in Millimeters |       |      |
|------------------|--------------------------|-------|------|
|                  | Min.                     | Nom.  | Max. |
| A                | —                        | —     | 1.60 |
| A <sub>1</sub>   | 0.05                     | —     | 0.15 |
| A <sub>2</sub>   | 1.35                     | 1.40  | 1.45 |
| D                | —                        | 12.00 | —    |
| D <sub>1</sub>   | —                        | 10.00 | —    |
| E                | —                        | 12.00 | —    |
| E <sub>1</sub>   | —                        | 10.00 | —    |
| N                | —                        | 64    | —    |
| e                | —                        | 0.50  | —    |
| b                | 0.17                     | 0.22  | 0.27 |
| c                | 0.09                     | —     | 0.20 |
| θ                | 0°                       | 3.5°  | 7°   |
| L                | 0.45                     | 0.60  | 0.75 |
| L <sub>1</sub>   | —                        | 1.00  | —    |
| aaa              | —                        | —     | 0.20 |
| bbb              | —                        | —     | 0.20 |
| ccc              | —                        | —     | 0.08 |
| ddd              | —                        | —     | 0.08 |

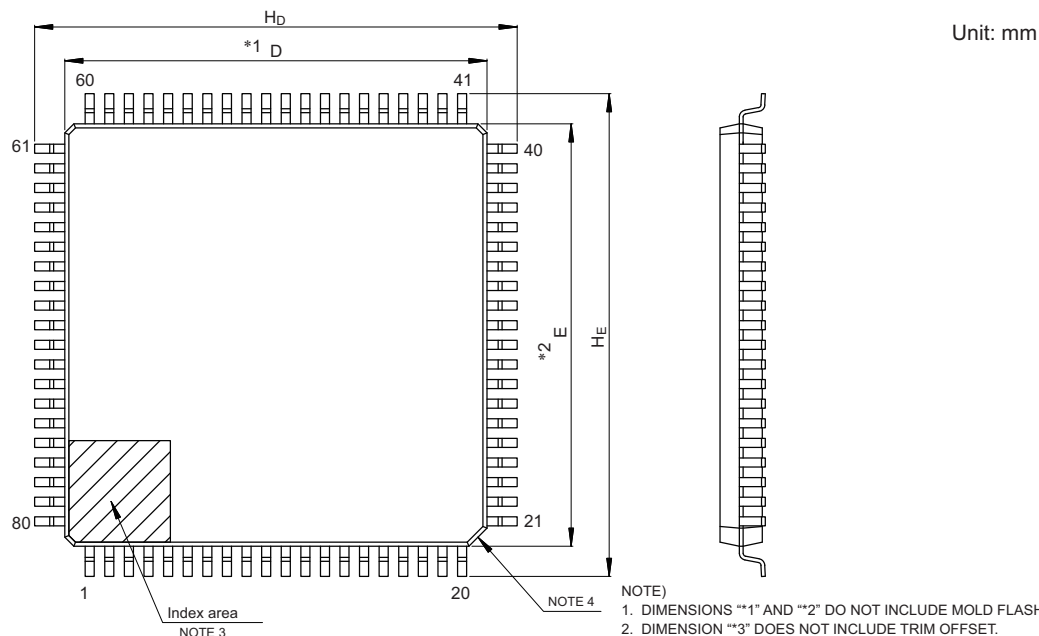
|                    |              |               |
|--------------------|--------------|---------------|
| JEITA Package code | RENESAS code | MASS(TYP.)[g] |
| P-WFLGA64-5x5-0.50 | PWLG0064KB-A | 0.035         |



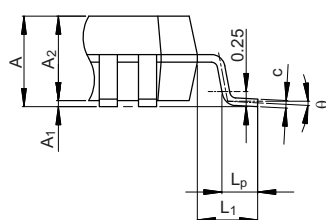
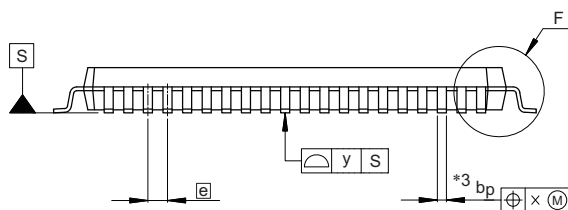
| Reference Symbol | Dimension in Millimeters |      |      |
|------------------|--------------------------|------|------|
|                  | Min.                     | Nom. | Max. |
| D                | —                        | 5.00 | —    |
| E                | —                        | 5.00 | —    |
| D1               | 3.90 BSC                 |      |      |
| E1               | 3.90 BSC                 |      |      |
| A                | —                        | —    | 0.76 |
| W1               | 0.21                     | 0.25 | 0.29 |
| W                | —                        | 0.55 | —    |
| L                | —                        | 0.55 | —    |
| e                | 0.50 BSC                 |      |      |
| aaa              | —                        | —    | 0.10 |
| ccc              | —                        | —    | 0.20 |
| ddd              | —                        | —    | 0.08 |
| n                | —                        | 64   | —    |

## 3.9 80-pin Products

| JEITA Package Code  | RENESAS Code | Previous Code | MASS (Typ) [g] |
|---------------------|--------------|---------------|----------------|
| P-LQFP80-14x14-0.65 | PLQP0080JA-B | —             | 0.6            |



- NOTE)
1. DIMENSIONS "\*\*1" AND "\*\*2" DO NOT INCLUDE MOLD FLASH.
  2. DIMENSION "\*\*3" DOES NOT INCLUDE TRIM OFFSET.
  3. PIN 1 VISUAL INDEX FEATURE MAY VARY, BUT MUST BE LOCATED WITHIN THE HATCHED AREA.
  4. CHAMFERS AT CORNERS ARE OPTIONAL, SIZE MAY VARY.

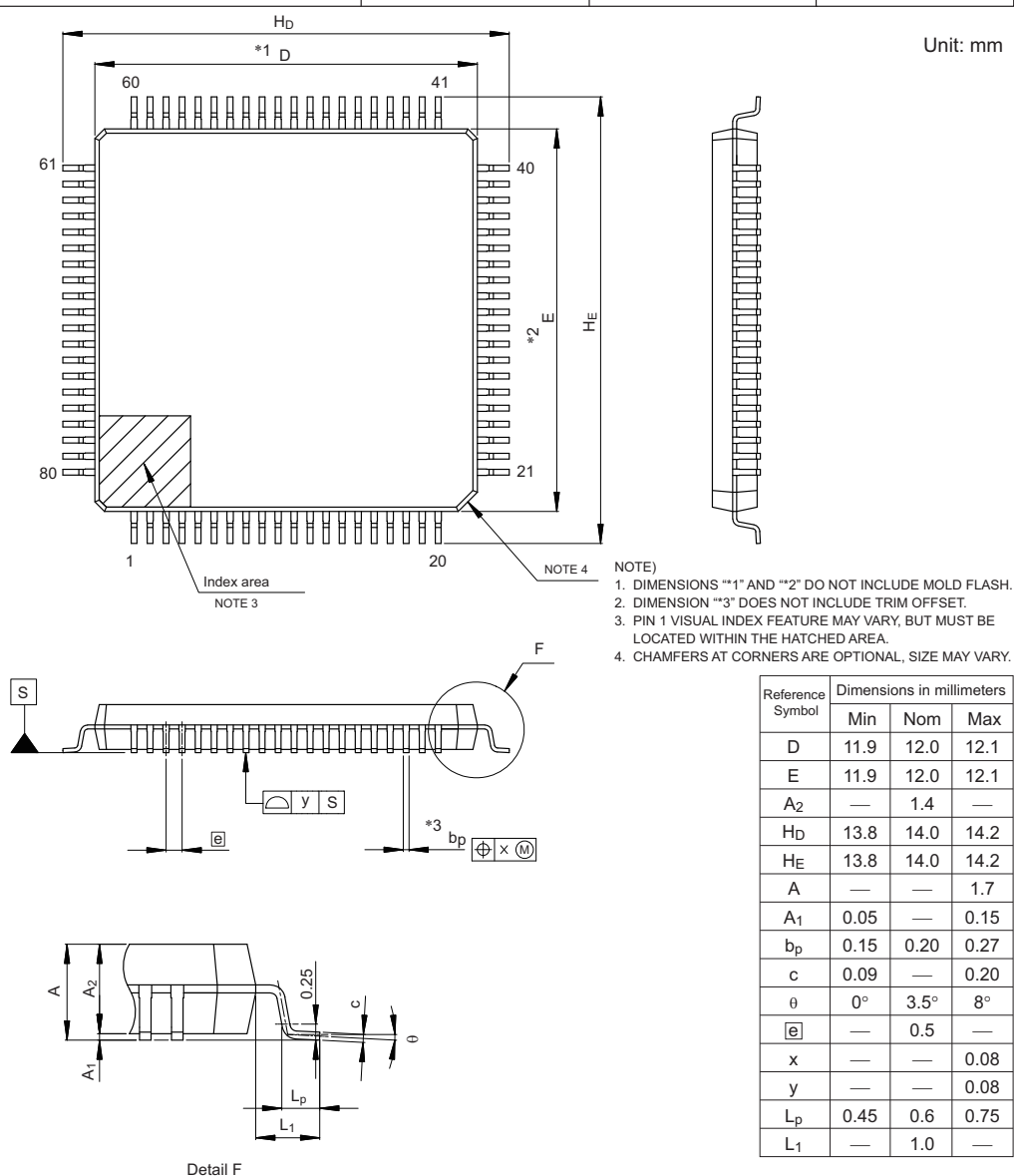


Detail F

| Reference Symbol | Dimensions in millimeters |      |      |
|------------------|---------------------------|------|------|
|                  | Min                       | Nom  | Max  |
| D                | 13.9                      | 14.0 | 14.1 |
| E                | 13.9                      | 14.0 | 14.1 |
| A <sub>2</sub>   | —                         | 1.4  | —    |
| H <sub>D</sub>   | 15.8                      | 16.0 | 16.2 |
| H <sub>E</sub>   | 15.8                      | 16.0 | 16.2 |
| A                | —                         | —    | 1.7  |
| A <sub>1</sub>   | 0.05                      | —    | 0.15 |
| b <sub>p</sub>   | 0.22                      | 0.30 | 0.38 |
| c                | 0.09                      | —    | 0.20 |
| θ                | 0°                        | 3.5° | 8°   |
| e                | —                         | 0.65 | —    |
| x                | —                         | —    | 0.13 |
| y                | —                         | —    | 0.10 |
| L <sub>p</sub>   | 0.45                      | 0.6  | 0.75 |
| L <sub>1</sub>   | —                         | 1.0  | —    |

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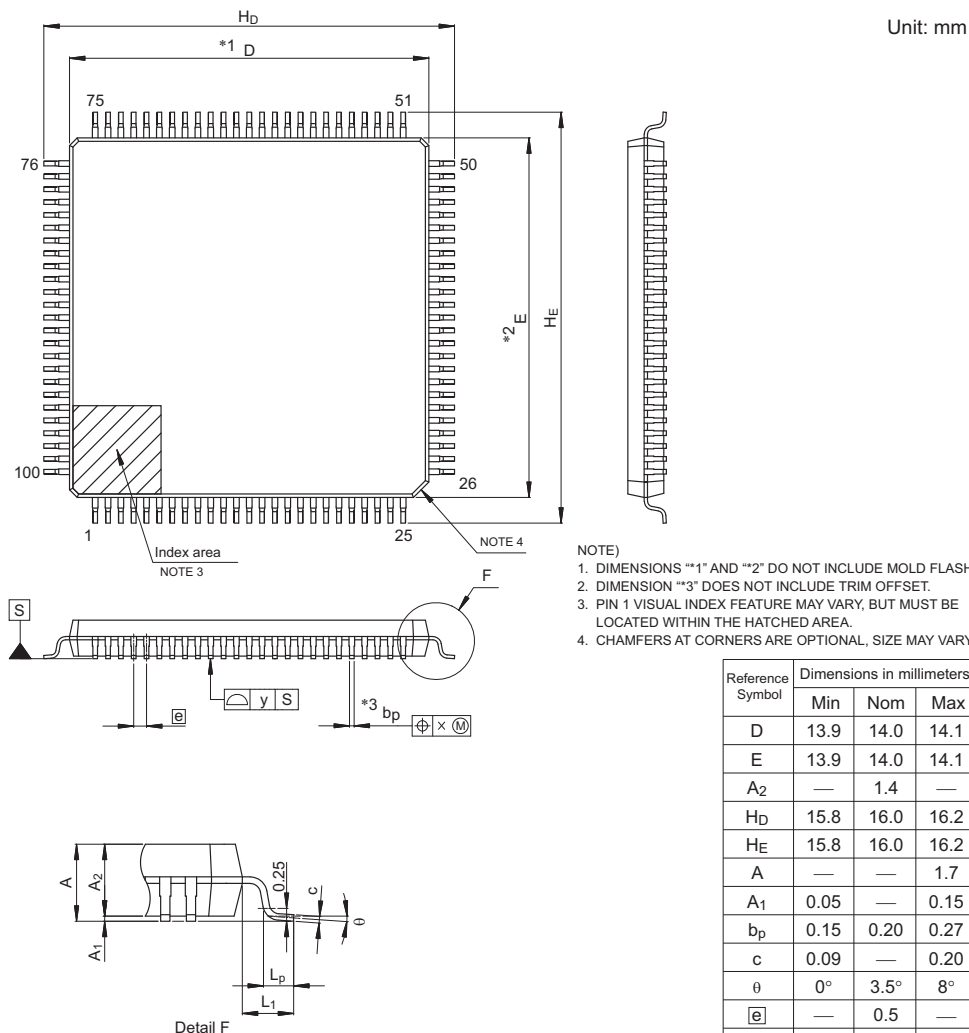
| JEITA Package Code   | RENESAS Code | Previous Code | MASS (Typ) [g] |
|----------------------|--------------|---------------|----------------|
| P-LFQFP80-12x12-0.50 | PLQP0080KB-B | —             | 0.5            |



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## 3.10 100-pin Products

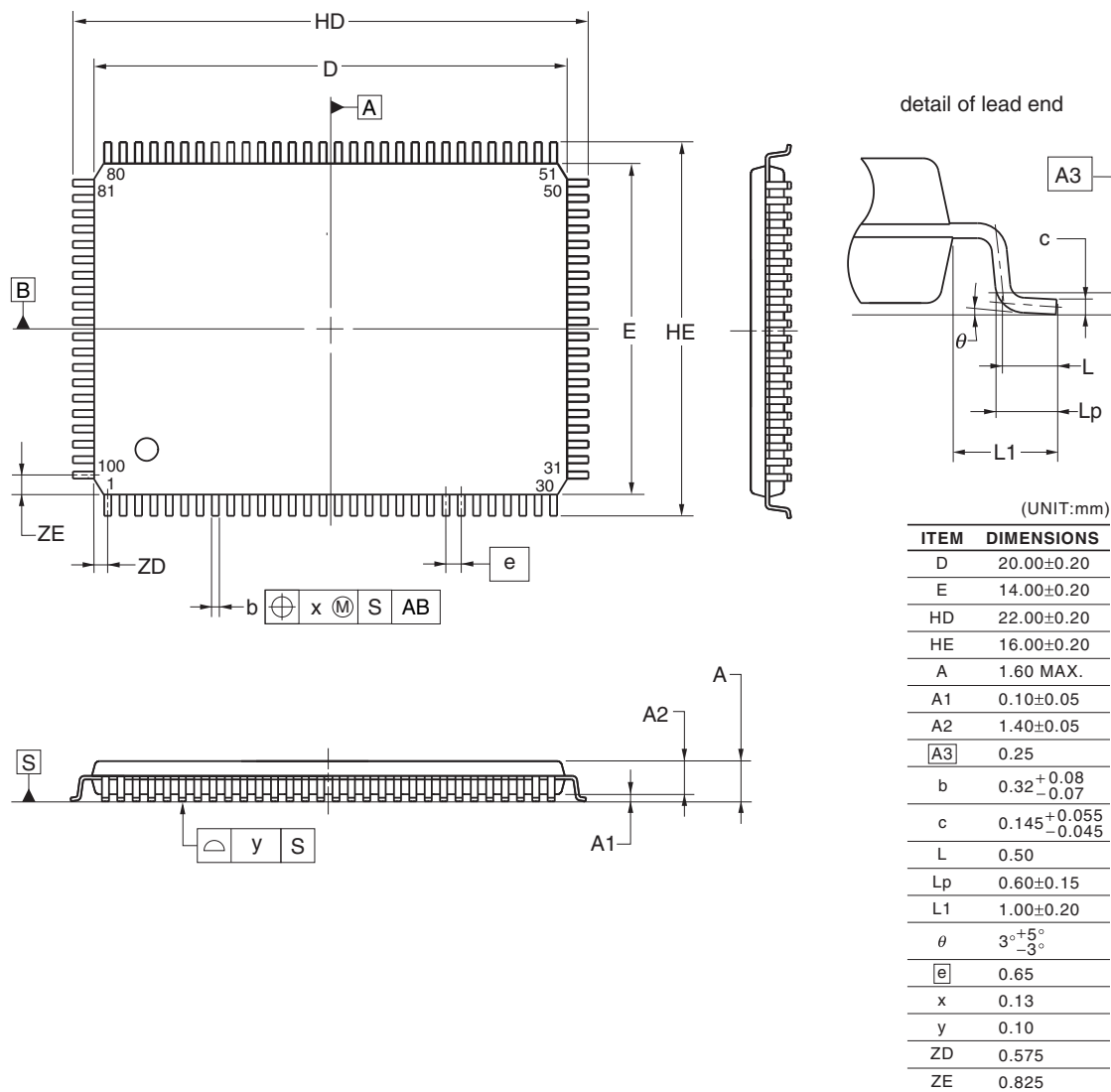
| JEITA Package Code    | RENESAS Code | Previous Code | MASS (Typ) [g] |
|-----------------------|--------------|---------------|----------------|
| P-LFQFP100-14x14-0.50 | PLQP0100KB-B | —             | 0.6            |



| Reference Symbol | Dimensions in millimeters |      |      |
|------------------|---------------------------|------|------|
|                  | Min                       | Nom  | Max  |
| D                | 13.9                      | 14.0 | 14.1 |
| E                | 13.9                      | 14.0 | 14.1 |
| $A_2$            | —                         | 1.4  | —    |
| $H_D$            | 15.8                      | 16.0 | 16.2 |
| $H_E$            | 15.8                      | 16.0 | 16.2 |
| A                | —                         | —    | 1.7  |
| $A_1$            | 0.05                      | —    | 0.15 |
| $b_p$            | 0.15                      | 0.20 | 0.27 |
| c                | 0.09                      | —    | 0.20 |
| $\theta$         | 0°                        | 3.5° | 8°   |
| $e$              | —                         | 0.5  | —    |
| x                | —                         | —    | 0.08 |
| y                | —                         | —    | 0.08 |
| $L_p$            | 0.45                      | 0.6  | 0.75 |
| $L_1$            | —                         | 1.0  | —    |

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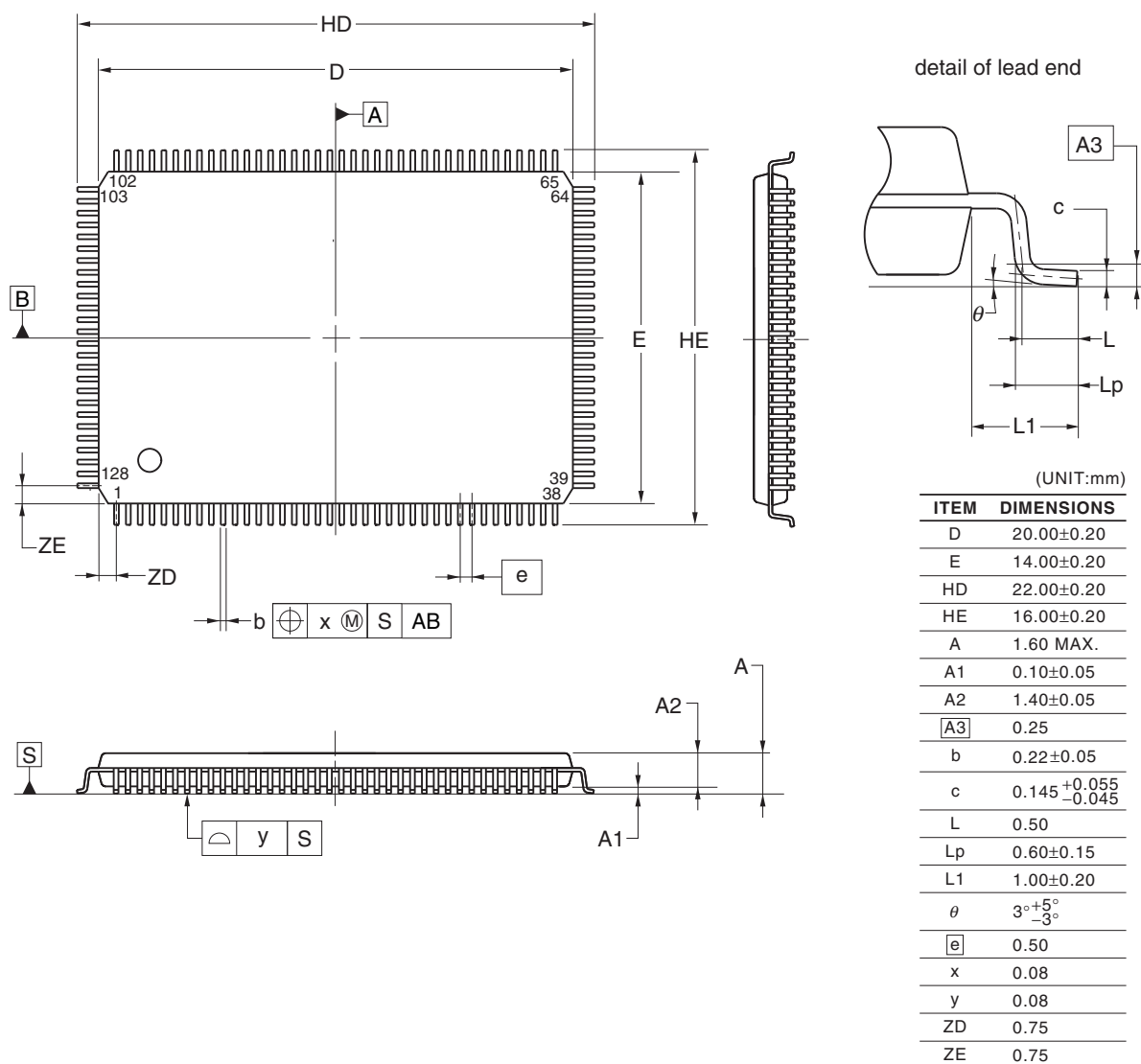
| JEITA Package Code   | RENESAS Code | Previous Code   | MASS (TYP.) [g] |
|----------------------|--------------|-----------------|-----------------|
| P-LQFP100-14x20-0.65 | PLQP0100JC-A | P100GF-65-GBN-1 | 0.92            |



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## 3.11 128-pin Products

| JEITA Package Code    | RENESAS Code | Previous Code   | MASS (TYP.) [g] |
|-----------------------|--------------|-----------------|-----------------|
| P-LFQFP128-14x20-0.50 | PLQP0128KD-A | P128GF-50-GBP-1 | 0.92            |



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|                  |                    |
|------------------|--------------------|
| REVISION HISTORY | RL78/G23 Datasheet |
|------------------|--------------------|

| Rev. | Date         | Description  |                                                                                                                                                                                               |
|------|--------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      |              | Page         | Summary                                                                                                                                                                                       |
| 1.00 | Apr 13, 2021 | —            | First edition issued                                                                                                                                                                          |
| 1.10 | Nov 18, 2021 | All          | The module name for 3-wire SPI was changed to simplified SPI.                                                                                                                                 |
|      |              | All          | The module name for SPI was changed to simplified SPI.                                                                                                                                        |
|      |              | p.1          | The operating current in the title was modified.                                                                                                                                              |
|      |              | p.1          | 1.1 Features: The descriptions of Middle-speed on-chip oscillator were modified.                                                                                                              |
|      |              | p.2          | 1.1 Features: The descriptions of Timers were modified.                                                                                                                                       |
|      |              | p.4          | Figure 1 - 1 Part Number, Memory Size, and Package of RL78/G23 was modified.                                                                                                                  |
|      |              | p.11         | 1.3.4 40-pin products: Figure was modified.                                                                                                                                                   |
|      |              | p.12         | 1.3.5 44-pin products: Figure was modified.                                                                                                                                                   |
|      |              | p.13         | 1.3.6 48-pin products: Note 2 was modified.                                                                                                                                                   |
|      |              | p.13         | 1.3.6 48-pin products: Remark 3 was added.                                                                                                                                                    |
|      |              | p.23         | 1.5 Block Diagram was modified.                                                                                                                                                               |
|      |              | p.24 to p.26 | 1.6 Outline of Functions [30-, 32-, 36-, 40-, 44-, and 48-pin products]: The descriptions were modified.                                                                                      |
|      |              | p.27 to p.29 | 1.6 Outline of Functions [52-, 64-, 80-, 100-, and 128-pin products]: The descriptions were modified.                                                                                         |
|      |              | p.31         | 2.1 Absolute Maximum Ratings: Note was modified.                                                                                                                                              |
|      |              | p.32         | 2.2.1 Characteristics of the X1 and XT1 oscillators: Condition was modified.                                                                                                                  |
|      |              | p.35         | 2.3.1 Pin characteristics: Notes 4 to 6 were modified.                                                                                                                                        |
|      |              | p.36, p.37   | 2.3.1 Pin characteristics: Notes 3, 5, and 6 were modified.                                                                                                                                   |
|      |              | p.43 to p.49 | 2.3.2 Supply current characteristics, (1) 30- to 64-pin package products with 96- to 128-Kbyte flash ROM: The descriptions in the tables were modified.                                       |
|      |              | p.50 to p.56 | 2.3.2 Supply current characteristics, (2) 30- to 64-pin package products with 192- to 256-Kbyte flash ROM and 80-pin package product with 128- to 256-Kbyte flash ROM was added.              |
|      |              | p.57 to p.63 | 2.3.2 Supply current characteristics, (3) 44- to 80-pin package products with 384- to 768-Kbyte flash ROM and 100- to 128-pin package products was added.                                     |
|      |              | p.64 to p.66 | 2.3.2 Supply current characteristics, (4) Peripheral Functions (Common to all products): The descriptions in the tables were added. Notes 13, 14, and 16 were modified. Note 19 was modified. |
|      |              | p.102        | 2.5.2 Serial interface UARTA: The table was modified.                                                                                                                                         |
|      |              | p.106        | 2.6.1 A/D converter characteristics, (1) Normal modes 1 and 2: The descriptions in the table were modified.                                                                                   |
|      |              | p.108        | 2.6.1 A/D converter characteristics, (2) Low-voltage modes 1 and 2: The descriptions in the table were modified.                                                                              |
|      |              | P.110        | 2.6.1 A/D converter characteristics, (3) When the internal reference voltage is selected as reference voltage (+): The descriptions in the table were modified.                               |
|      |              | p.111        | 2.6.4 Comparator characteristics: The descriptions in the table were modified.                                                                                                                |
|      |              | p.114        | 2.6.6 LVD circuit characteristics, (2) LVD1 Detection Voltage of Reset Mode and Interrupt Mode: The table was modified.                                                                       |
|      |              | p.117        | 2.8 Flash Memory Programming Characteristics, (2) Data flash memory: The descriptions in the table were modified.                                                                             |
|      |              | p.123        | 3.4 40-Pin Products: The figure was added.                                                                                                                                                    |
|      |              | p.126        | 3.6 48-Pin Products: The figure was added.                                                                                                                                                    |

| Rev. | Date         | Description              |                                                                                                                                                  |
|------|--------------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
|      |              | Page                     | Summary                                                                                                                                          |
| 1.20 | Oct 12, 2022 | p.5, p.6                 | Table 1 - 1 List of Ordering Part Numbers was modified.                                                                                          |
|      |              | p.9, p.10                | Table 1 - 2 Multiplexed Pin Functions of the 30-pin Products was added.                                                                          |
|      |              | p.12, p.13               | Table 1 - 3 Multiplexed Pin Functions of the 32-pin Products was added.                                                                          |
|      |              | p.15, p.16               | Table 1 - 4 Multiplexed Pin Functions of the 36-pin Products was added.                                                                          |
|      |              | p.18, p.19               | Table 1 - 5 Multiplexed Pin Functions of the 40-pin Products was added.                                                                          |
|      |              | p.21, p.22               | Table 1 - 6 Multiplexed Pin Functions of the 44-pin Products was added.                                                                          |
|      |              | p.24, p.25               | Table 1 - 7 Multiplexed Pin Functions of the 48-pin Products was added.                                                                          |
|      |              | p.27, p.28               | Table 1 - 8 Multiplexed Pin Functions of the 52-pin Products was added.                                                                          |
|      |              | p.30 to p.32             | Table 1 - 9 Multiplexed Pin Functions of the 64-pin Products was added.                                                                          |
|      |              | p.35 to p.37             | Table 1 - 10 Multiplexed Pin Functions 2 of the 64-pin Products was added.                                                                       |
|      |              | p.39 to p.41             | Table 1 - 11 Multiplexed Pin Functions of the 80-pin Products was added.                                                                         |
|      |              | p.43 to p.46             | Table 1 - 12 Multiplexed Pin Functions of the 100-pin Products was added.                                                                        |
|      |              | p.48 to p.51             | Table 1 - 13 Multiplexed Pin Functions 2 of the 100-pin Products was added.                                                                      |
|      |              | p.53 to p.57             | Table 1 - 14 Multiplexed Pin Functions of the 128-pin Products was added.                                                                        |
|      |              | P.62                     | 1.6 Outline of Functions [30-, 32-, 36-, 40-, 44-, and 48-pin products] was modified.                                                            |
|      |              | P.65                     | 1.6 Outline of Functions [52-, 64-, 80-, 100-, and 128-pin products] was modified.                                                               |
|      |              | P.66                     | 2 The section title was modified, and the description and Cautions 1 to 4 were added to the beginning of the section.                            |
|      |              | p.67, p.68               | 2.1 Absolute Maximum Ratings was modified.                                                                                                       |
|      |              | p.69                     | 2.2.1 Characteristics of the X1 oscillator was modified.                                                                                         |
|      |              | p.69                     | 2.2.2 Characteristics of the XT1 oscillator was added.                                                                                           |
|      |              | p.72, p.75 to p.77, p.79 | 2.3.1 Pin characteristics, Note, and Cautions were modified.                                                                                     |
|      |              | p.85                     | 2.3.2 Supply current characteristics: 1. Notes 3 to 5 were modified.                                                                             |
|      |              | p.91                     | 2.3.2 Supply current characteristics: 2. Notes 3 to 5 were modified.                                                                             |
|      |              | p.97                     | 2.3.2 Supply current characteristics: 3. Notes 3 to 5 were modified.                                                                             |
|      |              | p.98 to p.100            | 2.3.2 Supply current characteristics: 4. Peripheral Functions (Common to all products) was modified, and Note 20 was added.                      |
|      |              | p.101                    | 2.4 AC Characteristics was modified.                                                                                                             |
|      |              | p.142, p.143             | 2.6.1 A/D converter characteristics: 2. Low-voltage modes 1 and 2 was modified, and Note 7 was added.                                            |
|      |              | p.156                    | 3.3 36-pin Products was modified.                                                                                                                |
|      |              | p.164                    | 3.8 64-pin Products was modified.                                                                                                                |
| 1.21 | Nov 15, 2022 | p.5                      | Table 1 - 1 List of Ordering Part Numbers was modified.                                                                                          |
| 1.30 | Jan 31, 2024 | p.4                      | Figure 1 - 1 Part Number, Memory Size, and Package of RL78/G23 was modified.                                                                     |
|      |              | p.5 to p.7               | Table 1 - 1 List of Ordering Part Numbers was modified.                                                                                          |
|      |              | p.80                     | 2.3.2 Supply current characteristics, 1. 30- to 64-pin package products with 96- to 128-Kbyte flash ROM (1/4): Note 1 was modified.              |
|      |              | p.82                     | 2.3.2 Supply current characteristics, 1. 30- to 64-pin package products with 96- to 128-Kbyte flash ROM (2/4): Notes 1 to 3 were modified.       |
|      |              | p.83                     | 2.3.2 Supply current characteristics, 1. 30- to 64-pin package products with 96- to 128-Kbyte flash ROM (3/4): Note 1 was modified.              |
|      |              | p.86                     | 2.3.2 Supply current characteristics, 1. 30- to 64-pin package products with 96- to 128-Kbyte flash ROM (4/4): Notes 1 and 3 to 8 were modified. |

| Rev. | Date         | Description |                                                                                                                                                                                                               |
|------|--------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      |              | Page        | Summary                                                                                                                                                                                                       |
| 1.30 | Jan 31, 2024 | p.87        | 2.3.2 Supply current characteristics, 2. 30- to 64-pin package products with 192- to 256-Kbyte flash ROM and 80-pin package product with 128- to 256-Kbyte flash ROM (1/4): Note 1 was modified.              |
|      |              | p.89        | 2.3.2 Supply current characteristics, 2. 30- to 64-pin package products with 192- to 256-Kbyte flash ROM and 80-pin package product with 128- to 256-Kbyte flash ROM (2/4): Notes 1 to 3 were modified.       |
|      |              | p.90        | 2.3.2 Supply current characteristics, 2. 30- to 64-pin package products with 192- to 256-Kbyte flash ROM and 80-pin package product with 128- to 256-Kbyte flash ROM (3/4): Note 1 was modified.              |
|      |              | p.93        | 2.3.2 Supply current characteristics, 2. 30- to 64-pin package products with 192- to 256-Kbyte flash ROM and 80-pin package product with 128- to 256-Kbyte flash ROM (4/4): Notes 1 and 3 to 8 were modified. |
|      |              | p.94        | 2.3.2 Supply current characteristics, 3. 44- to 80-pin package products with 384- to 768-Kbyte flash ROM and 100- to 128-pin package products (1/4) and Note 1 was modified.                                  |
|      |              | p.96        | 2.3.2 Supply current characteristics, 3. 44- to 80-pin package products with 384- to 768-Kbyte flash ROM and 100- to 128-pin package products (2/4) and Notes 1 to 3 were modified.                           |
|      |              | p.97        | 2.3.2 Supply current characteristics, 3. 44- to 80-pin package products with 384- to 768-Kbyte flash ROM and 100- to 128-pin package products (3/4) and Note 1 was modified.                                  |
|      |              | p.99, p.100 | 2.3.2 Supply current characteristics, 3. 44- to 80-pin package products with 384- to 768-Kbyte flash ROM and 100- to 128-pin package products (4/4), Notes 1, and 3 to 8 were modified.                       |
|      |              | p.104       | 2.4 AC Characteristics was modified.                                                                                                                                                                          |
|      |              | p.148       | 2.6.4 Comparator characteristics: Note was added.                                                                                                                                                             |
|      |              | p.159       | 3.2 32-pin Products: The figure was added.                                                                                                                                                                    |
|      |              | p.163       | 3.5 44-pin Products: The figure was added.                                                                                                                                                                    |
|      |              | p.165       | 3.6 48-pin Products: The figure was added.                                                                                                                                                                    |
|      |              | p.170       | 3.8 64-pin Products: The figure was added.                                                                                                                                                                    |

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## General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

### 1. Precaution against Electrostatic Discharge (ESD)

A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

### 2. Processing at power-on

The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.

### 3. Input of signal during power-off state

Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

### 4. Handling of unused pins

Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

### 5. Clock signals

After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

### 6. Voltage application waveform at input pin

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between  $V_{IL}$  (Max.) and  $V_{IH}$  (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between  $V_{IL}$  (Max.) and  $V_{IH}$  (Min.).

### 7. Prohibition of access to reserved addresses

Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

### 8. Differences between products

Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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