S1C17W22/23

EPSON
EXCEED YOUR VISION

New series

16-bit Single Chip Microcontroller

- Low power operation from 1.2V with a single alkaline or silver oxide button battery.
- Low power consumption standby driving at HALT 0.3 µA . *super economy mode
- Built-in LCD Driver: 56 SEG x 24 COM (max.)
- Internal R/F converters enable to realize various sensing.

■ DESCRIPTIONS

The S1C17W22/W23 is a 16-bit MCU that features low-voltage operation from 1.2 V even though Flash memory is included. The embedded high-efficiency DC-DC converter generates the constant-voltage to drive the IC with lower power consumption than 4-bit MCUs. This IC includes a real-time clock, a stopwatch, an LCD driver, and a PWM timer capable of being used to generate drive waveforms for a motor driver as well as a high-performance 16-bit CPU. It is suitable for battery-driven applications that require an LCD display and timers.

■ FEATURES

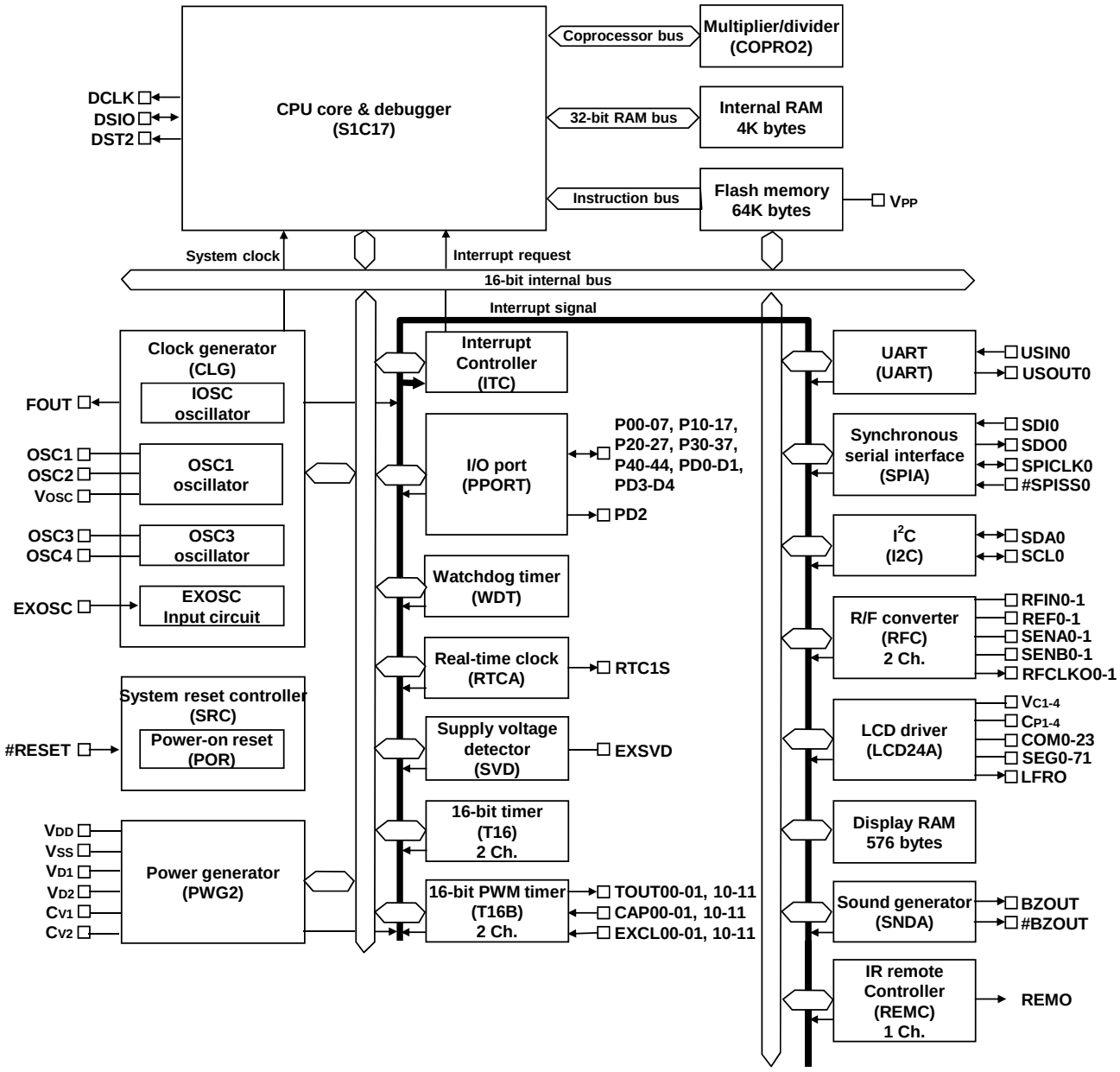
Model	S1C17W22	S1C17W23
CPU		
CPU core	Seiko Epson original 16-bit RISC CPU core S1C17	
Other	On-chip debugger	
Embedded Flash memory		
Capacity	64K bytes (for both instructions and data)	96K bytes (for both instructions and data)
Erase/program count	50 times (min.) * Programming by the debugging tool ICDmini	
Other	Security function to protect from reading/programming by ICDmini	
	On-board programming function using ICDmini	
Embedded RAM		
Capacity	4K bytes	8K bytes
Embedded display RAM		
Capacity	576 bytes	
Clock generator (CLG)		
System clock source	4 sources (IOSC/OSC1/OSC3/EXOSC)	
System clock frequency (operating frequency)	1.1 MHz (max.) VDD = 1.2 to 1.6 V 4.2 MHz (max.) VDD = 1.6 to 3.6 V	
IOSC oscillator circuit (boot clock source)	700 kHz (typ.) embedded oscillator	
	23 µs (max.) starting time (time from cancelation of SLEEP state to vector table read by the CPU)	
OSC1 oscillator circuit	32.768 kHz (typ.) crystal oscillator	
	Oscillation stop detection circuit included	
OSC3 oscillator circuit	4.2 MHz (max.) crystal/ceramic oscillator	
	500 kHz, 1, 2, and 4 MHz-switchable embedded oscillator	
	500 Hz to 2 MHz CR oscillator (an external R is required)	
EXOSC clock input	4.2 MHz (max.) square or sine wave input	
Other	Configurable system clock division ratio	
	Configurable system clock used at wake up from SLEEP state	
	Operating clock frequency for the CPU and all peripheral circuits is selectable.	
I/O port (PPORT)		
Number of general-purpose I/O ports	Input/output port: 41 bits (max.)	
	Output port: 1 bit (max.)	
	Pins are shared with the peripheral I/O.	
Number of input interrupt ports	37 bits	
Number of ports that support universal port multiplexer (UPMUX)	32 bits	
	A peripheral circuit I/O function selected via software can be assigned to each port.	
Timers		
Watchdog timer (WDT)	Generates NMI or watchdog timer reset.	
Real-time clock (RTCA)	128–1 Hz counter, second/minute/hour/day/day of the week/month/year counters	
	Theoretical regulation function for 1-second correction	

	Alarm and stopwatch functions	
16-bit timer (T16)	2 channels	4 channels
	1 channel can generate the SPIA master clock.	Generates the SPIA master clocks and the ADC12A trigger signal.
16-bit PWM timer (T16B)	2 channels	3 channels
	Event counter/capture function	
	PWM waveform generation function	
	Number of PWM output or capture input ports: 2 ports/channel	
Supply voltage detector (SVD)		
Detection level	30 levels (1.2 to 3.6 V)	
Other	Intermittent operation mode	
	Generates an interrupt or reset according to the detection level evaluation.	
Serial interfaces		
UART (UART)	1 channel	2 channels
	Baud-rate generator included, IrDA1.0 supported	
Synchronous Serial Interface (SPIA)	1 channel	2 channels
	2 to 16-bit variable data length	
	The 16-bit timer (T16) can be used for the baud-rate generator in master mode.	
I2C (I2C)	1 channel	
	Baud-rate generator included	
Sound generator (SNDA)		
Buzzer output function	512 Hz to 16 kHz output frequencies	
	One-shot output function	
Melody generation function	Pitch: 128 Hz to 16 kHz ≈ C3 to C6	
	Duration: 7 notes/rests (Half note/rest to thirty-second note/rest)	
	Tempo: 16 tempos (30 to 480)	
	Tie may be specified.	
IR remote controller (REMC)		
Number of transmitter channels	-	1 channel
LCD driver (LCD24A)		
LCD output	72 SEG × 1–8 COM (max.), 64 SEG × 9–16 COM (max.), 56 SEG × 17–24 COM (max.)	
LCD contrast	32 levels (TBD to TBD V)	
Other	1/4 or 1/3 bias power supply included, external voltage can be applied.	
R/F converter (RFC)		
Conversion method	CR oscillation type with 24-bit counters	
Number of conversion channels	2 channels (Up to two sensors can be connected to each channel.)	
Supported sensors	DC-bias resistive sensors, AC-bias resistive sensors (Ch.0 only)	
12-bit A/D converter (ADC12A)		
Conversion method	-	Successive approximation type
Resolution	-	12 bits
Number of conversion channels	-	1 channel
Number of analog signal inputs	-	6 ports/channel
Operational amplifier/comparator (OPCMP)		
Number of channels	-	2 channels
Multiplier/divider (COPRO2)		
Arithmetic functions	16-bit × 16-bit multiplier	
	16-bit × 16-bit + 32-bit multiply and accumulation unit	
	32-bit ÷ 32-bit divider	
Reset		
#RESET pin	Reset when the reset pin is set to low.	
Power-on reset	Reset at power on.	
Key entry reset	Reset when the P00 to P01/P02/P03 keys are pressed simultaneously (can be enabled/ disabled using a register).	
Watchdog timer reset	Reset when the watchdog timer overflows (can be enabled/disabled using a register).	
Supply voltage detector reset	Reset when the supply voltage detector detects the set voltage level (can be enabled/ disabled using a register).	
Interrupt		

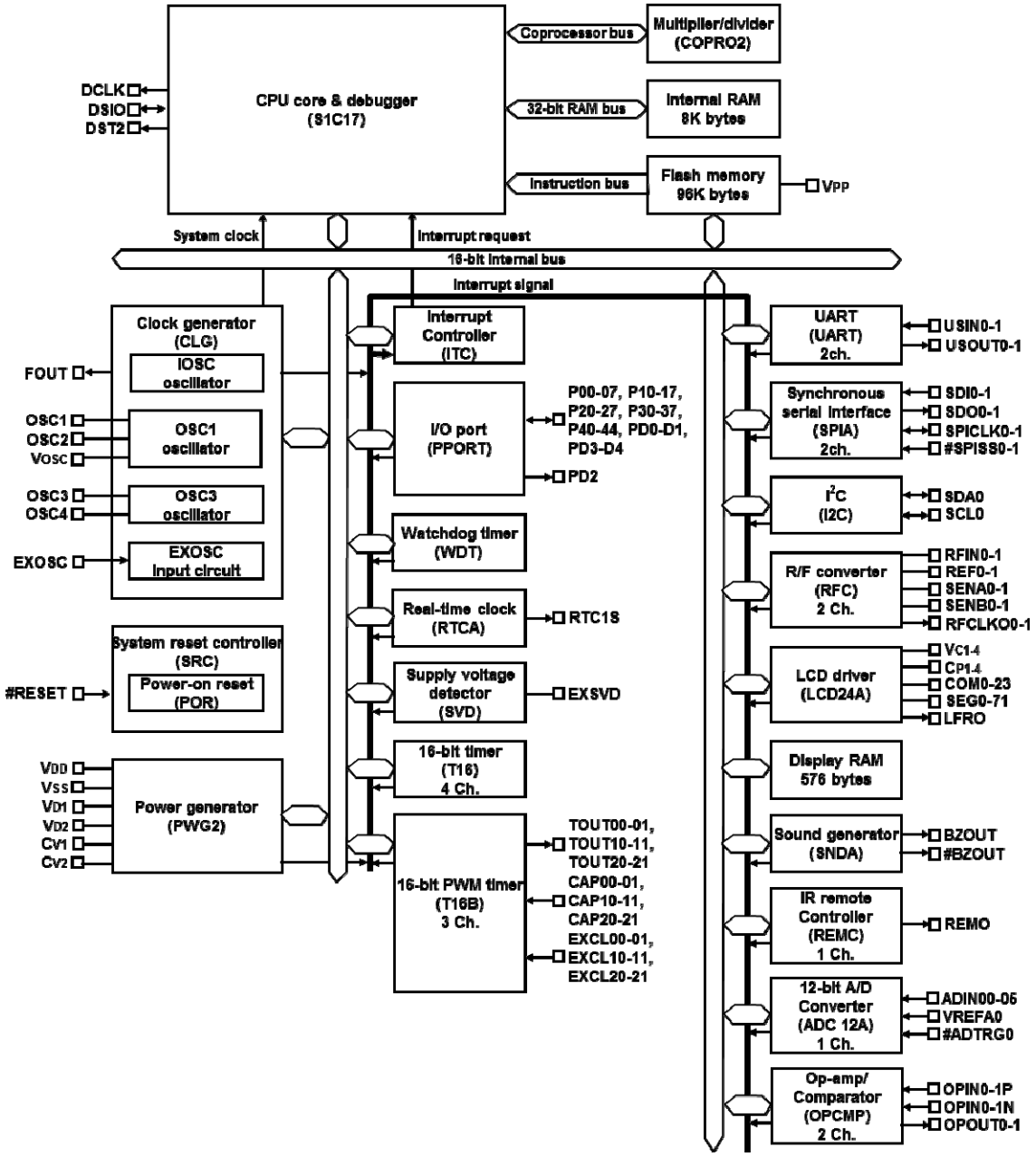
Non-maskable interrupt	4 systems (Reset, address misaligned interrupt, debug, NMI)	
Programmable interrupt	External interrupt: 1 system (8 levels)	
	Internal interrupt: 16 systems (8 levels)	Internal interrupt: 23 systems (8 levels)
Power supply voltage		
VDD operating voltage	1.2 to 3.6 V	
VDD operating voltage for Flash programming	1.8 to 3.6 V (VPP = 7.5 V external power supply is required.)	
VDD operating voltage for super economy mode	2.7 to 3.6 V	
Operating temperature		
Operating temperature range	-40 to 85 °C	
Current consumption		
SLEEP mode	0.15 µA (TBD) IOSC = OFF, OSC1 = OFF, OSC3 = OFF	
HALT mode	0.5 µA (TBD) OSC1 = 32 kHz, RTC = ON	
	0.3 µA (TBD) OSC1 = 32 kHz, RTC = ON, super economy mode	
	1.5 µA (TBD) OSC1 = 32 kHz, RTC = ON, CPU = OSC1, LCD = ON (no panel load, VC2 reference, 1/3 bias), super economy mode	
RUN mode	8 µA (TBD) OSC1 = 32 kHz, RTC = ON, CPU = OSC1, FLASHCWAIT.RDWAIT[1:0] bits = 0x1	
	4 µA (TBD) OSC1 = 32 kHz, RTC = ON, CPU = OSC1, super economy mode, FLASHCWAIT.RDWAIT[1:0] bits = 0x1	
	250 µA (TBD) OSC3 = 1 MHz (internal oscillator), OSC1 = 32 kHz, RTC = ON, CPU = OSC3, FLASHCWAIT.RDWAIT[1:0] bits = 0x1	
Shipping form		
1	TQFP15-128pin (Lead pitch: 0.4 mm)	
2	Die form (Pad pitch: 80 µm (min.))	

■ BLOCK DIAGRAM

S1C17W22

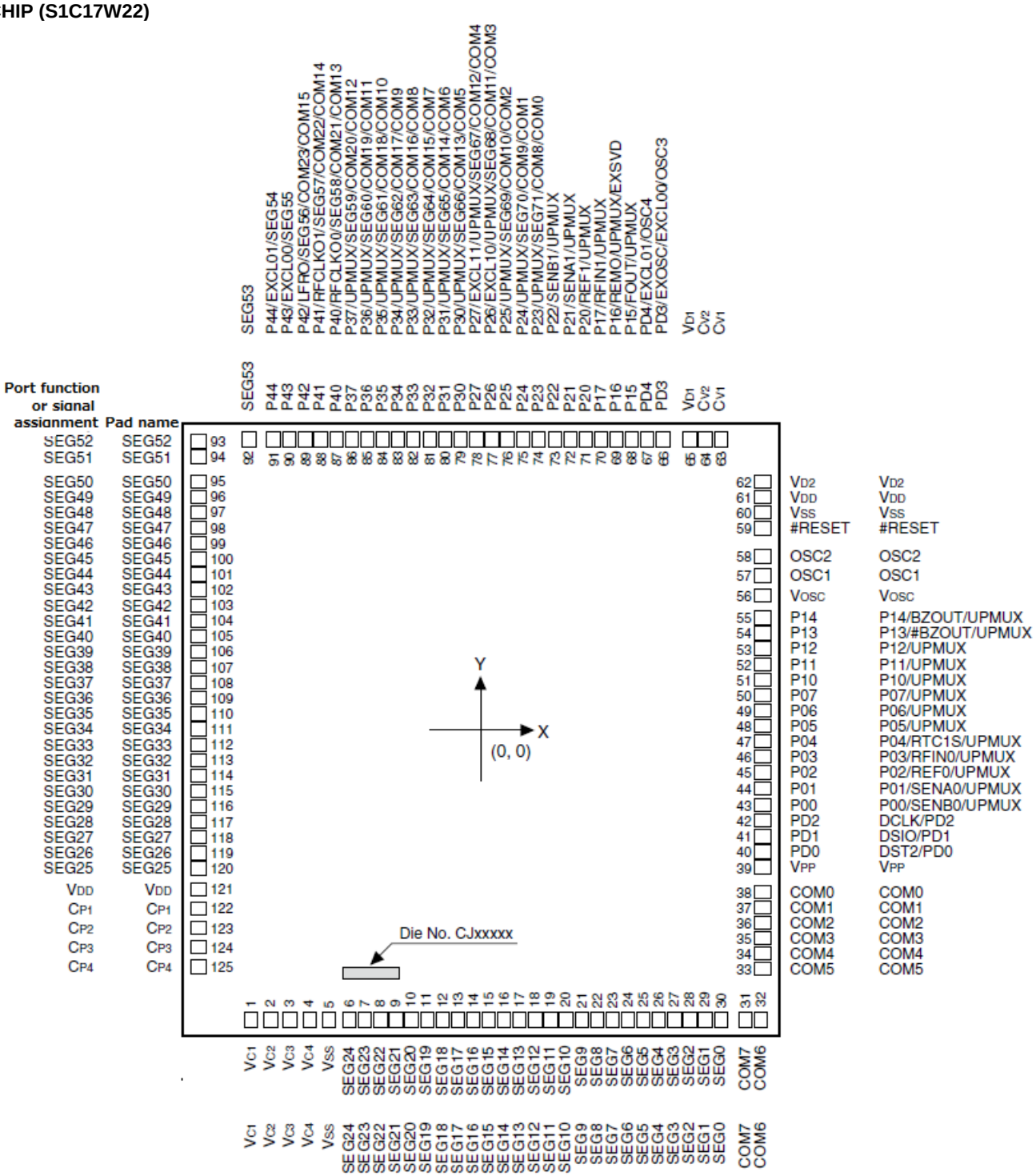


S1C17W23


CPU core & debugger
(S1C17)
DCLK
DSIO
DST2
Coprocessor bus
Multiplier/divider
(COPRO2)
32-bit RAM bus
Internal RAM
8K bytes
Instruction bus
Flash memory
96K bytes
VPP
System clock
Interrupt request
16-bit internal bus
Interrupt signal
Clock generator
(CLG)
IOSC
oscillator
OSC1
oscillator
OSC3
oscillator
EXOSC
Input circuit
FOUT
OSC1
OSC2
VOSC
OSC3
OSC4
EXOSC
System reset controller
(SRC)
Power-on reset
(POR)
#RESET
VDD
VSS
VD1
VD2
CV1
CV2
Power generator
(PWG2)
Interrupt
Controller
(ITC)
I/O port
(PPORT)
P00-07, P10-17,
P20-27, P30-37,
P40-44, PD0-D1,
PD3-D4
PD2
Watchdog timer
(WDT)
Real-time clock
(RTCA)
RTC1S
Supply voltage
detector
(SVD)
EXSVD
16-bit timer
(T16)
4 Ch.
16-bit PWM timer
(T16B)
3 Ch.
TOUT00-01,
TOUT10-11,
TOUT20-21
CAP00-01,
CAP10-11,
CAP20-21
EXCL00-01,
EXCL10-11,
EXCL20-21
UART
(UART)
2ch.
USIN0-1
USOUT0-1
Synchronous
serial interface
(SPIA)
2ch.
SDI0-1
SDO0-1
SPICLK0-1
#SPISS0-1
I2C
(I2C)
SDA0
SCL0
R/F converter
(RFC)
2 Ch.
RFIN0-1
REF0-1
SENA0-1
SENB0-1
RFCLKO0-1
LCD driver
(LCD24A)
VC1-4
CP1-4
COM0-23
SEG0-71
LFRO
Display RAM
576 bytes
Sound generator
(SNDA)
BZOUT
#BZOUT
IR remote
Controller
(REMC)
1 Ch.
REMO
12-bit A/D
Converter
(ADC 12A)
1 Ch.
ADIN00-06
VREFA0
#ADTRG0
Op-amp/
Comparator
(OPCMP)
2 Ch.
OPIN0-1P
OPIN0-1N
OPOUT0-1

■ Pin Configuration Diagram

CHIP (S1C17W22)



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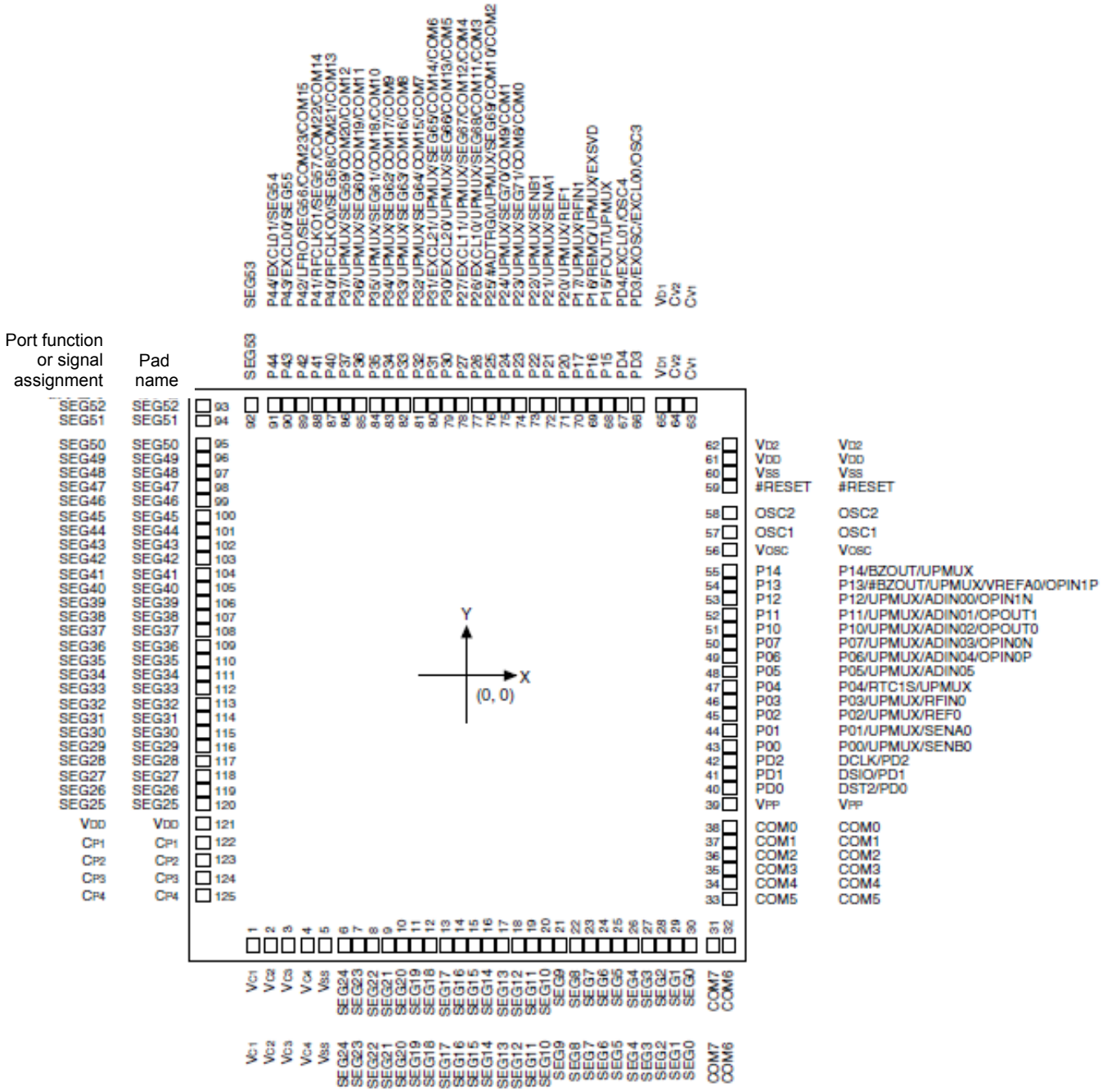
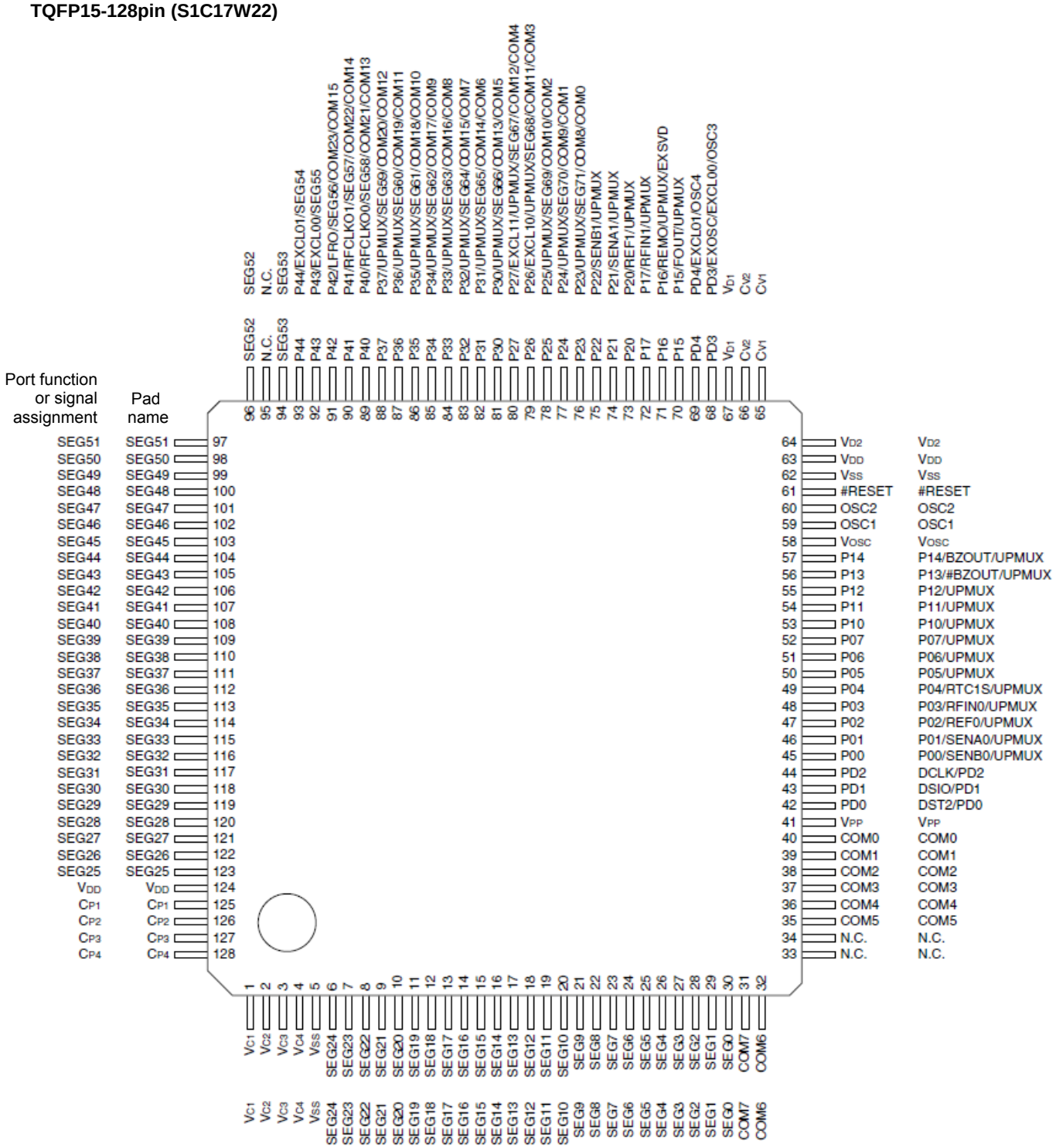
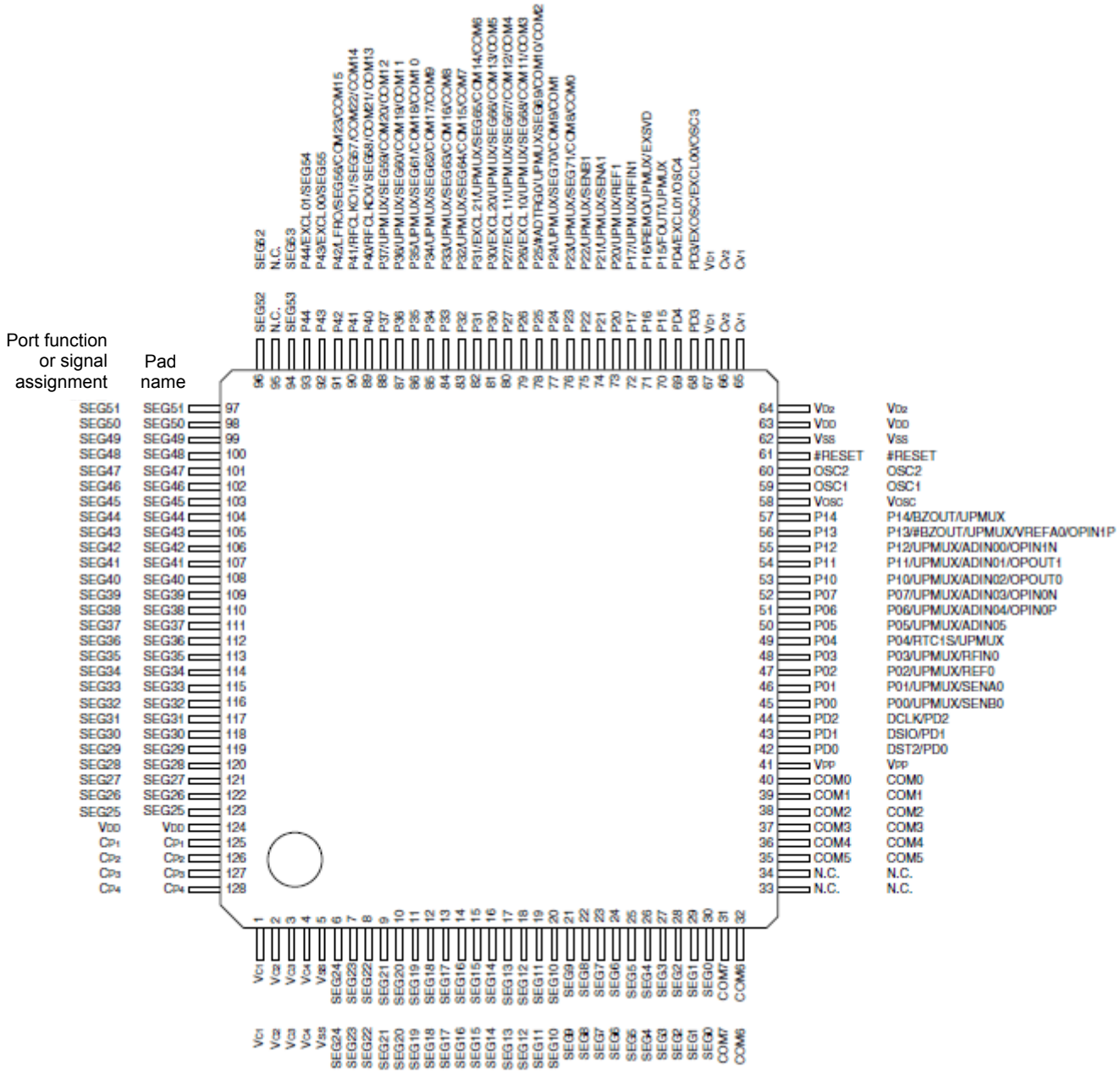


TQFP15-128pin (S1C17W22)



TQFP15-128pin (S1C17W23)



■ Pin Descriptions

Symbol meanings

Assigned signal: The signal listed at the top of each pin is assigned in the initial state. The pin function must be switched via software to assign another signal (see the "I/O Ports" chapter).

I/O:
- I = Input
- O = Output
- I/O = Input/output
- P = Power supply
- A = Analog signal
- Hi-Z = High impedance state

Initial state:
- I (Pull-up) = Input with pulled up
- I (Pull-down) = Input with pulled down
- Hi-Z = High impedance state
- O (H) = High level output
- O (L) = Low level output

Tolerant fail-safe structure:
- ✓ = Over voltage tolerant fail-safe type I/O cell included (see the "I/O Ports" chapter)

Pin/pad name	Assigned signal	I/O	Initial state	Tolerant fail-safe structure	Function
VDD	VDD	P	–	–	Power supply (+)
VSS	VSS	P	–	–	GND
VPP	VPP	P	–	–	Power supply for Flash programming
VD1	VD1	A	–	–	DC-DC converter output
VD2	VD2	A	–	–	DC-DC converter stabilization capacitor connect pin
CV1–2	CV1–2	A	–	–	DC-DC converter charge pump capacitor connect pins
VC1–4	VC1–4	P	–	–	LCD panel driver power supply
CP1–4	CP1–4	A	–	–	LCD power supply booster capacitor connect pins
VOSC	VOSC	A	–	–	OSC1 oscillator circuit voltage regulator output
OSC1	OSC1	A	–	–	OSC1 oscillator circuit input
OSC2	OSC2	A	–	–	OSC1 oscillator circuit output
#RESET	#RESET	I	I (Pull-up)	–	Reset input
P00	P00	I/O	Hi-Z	–	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SENB0	A			R/F converter Ch.0 sensor B oscillator pin
P01	P01	I/O	Hi-Z	–	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SENA0	A			R/F converter Ch.0 sensor A oscillator pin
P02	P02	I/O	Hi-Z	–	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	REF0	A			R/F converter Ch.0 reference oscillator pin
P03	P03	I/O	Hi-Z	–	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	RFIN0	A			R/F converter Ch.0 oscillation input
P04	P04	I/O	Hi-Z	✓	I/O port
	RTC1S	O			Real-time clock 1-second cycle pulse output
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
P05	P05	I/O	Hi-Z	–	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	ADIN05	A			12-bit A/D converter Ch.0 analog signal input 5 (S1C17W23 only)
P06	P06	I/O	Hi-Z	–	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	ADIN04	A			12-bit A/D converter Ch.0 analog signal input 4 (S1C17W23 only)
	OPIN0P	A			Operational amplifier/comparator Ch.0 analog signal input (+) (S1C17W23 only)
P07	P07	I/O	Hi-Z	–	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	ADIN03	A			12-bit A/D converter Ch.0 analog signal input 3 (S1C17W23 only)
	OPIN0N	A			Operational amplifier/comparator Ch.0 analog signal input (-) (S1C17W23 only)
P10	P10	I/O	Hi-Z	–	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	ADIN02	A			12-bit A/D converter Ch.0 analog signal input 2 (S1C17W23 only)
	OPOUT0	A			Operational amplifier/comparator Ch.0 analog signal output

					(S1C17W23 only)
P11	P11	I/O	Hi-Z	–	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	ADIN01	A			12-bit A/D converter Ch.0 analog signal input 1 (S1C17W23 only)
	OPIOUT1	A			Operational amplifier/comparator Ch.1 analog signal output (S1C17W23 only)
P12	P12	I/O	Hi-Z	–	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	ADIN00	A			12-bit A/D converter Ch.0 analog signal input 0 (S1C17W23 only)
	OPIN1N	A			Operational amplifier/comparator Ch.1 analog signal input (-) (S1C17W23 only)
P13	P13	I/O	Hi-Z	–	I/O port
	#BZOUT	O			Sound generator inverted output
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	VREFA0	A			12-bit A/D converter Ch.0 reference voltage input (S1C17W23 only)
	OPIN1P	A			Operational amplifier/comparator Ch.1 analog signal input (+) (S1C17W23 only)
P14	P14	I/O	Hi-Z	–	I/O port
	BZOUT	O			Sound generator output
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
P15	P15	I/O	Hi-Z	✓	I/O port
	FOUT	O			Clock external output
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
P16	P16	I/O	Hi-Z	–	I/O port
	REMO	O			IR remote controller transmit data output
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	EXSVD	A			External power supply voltage detection input
P17	P17	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	RFIN1	A			R/F converter Ch.1 oscillation input
P20	P20	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	REF1	A			R/F converter Ch.1 reference oscillator pin
P21	P21	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SENA1	A			R/F converter Ch.1 sensor A oscillator pin
P22	P22	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SENB1	A			R/F converter Ch.1 sensor B oscillator pin
P23	P23	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SEG71	A			LCD segment output
	COM8/COM0	A			LCD COMMON OUTPUT
P24	P24	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SEG70	A			LCD segment output
	COM9/COM1	A			LCD COMMON OUTPUT
P25	P25	I/O	Hi-Z	✓	I/O port
	#ADTRG0	I			12-bit A/D converter Ch.0 trigger input (S1C17W23 only)
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SEG69	A			LCD segment output
	COM10/COM2	A			LCD COMMON OUTPUT
P26	P26	I/O	Hi-Z	✓	I/O port
	EXCL10	I			16-bit PWM timer Ch.1 event counter input 0
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SEG68	A			LCD segment output
	COM11/COM3	A			LCD COMMON OUTPUT
P27	P27	I/O	Hi-Z	✓	I/O port
	EXCL11	I			16-bit PWM timer Ch.1 event counter input 1
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SEG67	A			LCD segment output
	COM12/COM4	A			LCD COMMON OUTPUT
P30	P30	I/O	Hi-Z	✓	I/O port
	EXCL20	I			16-bit PWM timer Ch.2 event counter input 0 (S1C17W23 only)
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SEG66	A			LCD segment output
	COM13/COM5	A			LCD COMMON OUTPUT
P31	P31	I/O	Hi-Z	✓	I/O port

	EXCL21	I			16-bit PWM timer Ch.2 event counter input 1 (S1C17W23 only)
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SEG65	A			LCD segment output
	COM14/COM6	A			LCD COMMON OUTPUT
P32	P32	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SEG64	A			LCD segment output
	COM15/COM7	A			LCD COMMON OUTPUT
P33	P33	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SEG63	A			LCD segment output
	COM16/COM8	A			LCD COMMON OUTPUT
P34	P34	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SEG62	A			LCD segment output
	COM17/COM9	A			LCD COMMON OUTPUT
P35	P35	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SEG61	A			LCD SEGMENT OUTPUT
	COM18/COM10	A			LCD COMMON OUTPUT
P36	P36	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SEG60	A			LCD SEGMENT OUTPUT
	COM19/COM11	A			LCD COMMON OUTPUT
P37	P37	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			User-selected I/O (universal port multiplexer)
	SEG59	A			LCD SEGMENT OUTPUT
	COM20/COM12	A			LCD COMMON OUTPUT
P40	P40	I/O	Hi-Z	✓	I/O port
	RFCLKO0	O			R/F converter Ch.0 clock monitor output
	SEG58	A			LCD SEGMENT OUTPUT
	COM21/COM13	A			LCD COMMON OUTPUT
P41	P41	I/O	Hi-Z	✓	I/O port
	RFCLKO1	O			R/F converter Ch.1 clock monitor output
	SEG57	A			LCD SEGMENT OUTPUT
	COM22/COM14	A			LCD COMMON OUTPUT
P42	P42	I/O	Hi-Z	✓	I/O port
	LFRO	O			LCD frame signal monitor output
	SEG56	A			LCD SEGMENT OUTPUT
	COM23/COM15	A			LCD COMMON OUTPUT
P43	P43	I/O	Hi-Z	✓	I/O port
	EXCL00	I			16-bit PWM timer Ch.0 event counter input 0
	SEG55	A			LCD SEGMENT OUTPUT
P44	P44	I/O	Hi-Z	✓	I/O port
	EXCL01	I			16-bit PWM timer Ch.0 event counter input 1
	SEG54	A			LCD SEGMENT OUTPUT
PD0	DST2	O	O (L)	✓	On-chip debugger status output
	PD0	I/O			I/O port
PD1	DSIO	I/O	I (Pull-up)	✓	On-chip debugger status output
	PD1	I/O			I/O port
PD2	DCLK	O	O (H)	✓	On-chip debugger status output
	PD2	O			I/O port
PD3	PD3	I/O	Hi-Z	–	I/O port
	EXOSC	I			Clock generator external clock input
	EXCL00	I			16-bit PWM timer Ch.0 event counter input 0
	OSC3	A			OSC3 oscillator circuit input
PD4	PD4	I/O	Hi-Z	–	I/O port
	EXCL01	I			16-bit PWM timer Ch.0 event counter input 1
	OSC4	A			OSC3 oscillator circuit output
COM0–7	COM0–7	A	Hi-Z	–	LCD COMMON OUTPUT
SEG0–53	SEG0–53	A	Hi-Z	–	LCD SEGMENT OUTPUT

Notes: · In the peripheral circuit descriptions, the assigned signal name is used as the pin name.
· Both the S1C17W23 A/D converter and operational amplifier/comparator pins are assigned to the same pin function.

Universal port multiplexer (UPMUX)

The universal port multiplexer (UPMUX) allows software to select the peripheral circuit input/output function to be assigned to each pin from those listed below.

Peripheral circuit	Signal to be assigned	I/O	Channel number *n*	Function
Synchronous serial interface (SPIA)	SDI*n*	I	S1C17W22: *n* = 0 S1C17W23: *n* = 0, 1	SPIA Ch.*n* data input
	SDO*n*	O		SPIA Ch.*n* data output
	SPICLK*n*	I/O		SPIA Ch.*n* clock input/output
	#SPISS*n*	I		SPIA Ch.*n* slave-select input
I2C (I2C)	SCL*n*	I/O	S1C17W22: *n* = 0 S1C17W23: *n* = 0	I2C Ch.*n* clock input/output
	SDA*n*	I/O		I2C Ch.*n* data input/output
UART (UART)	USIN*n*	I	S1C17W22: *n* = 0 S1C17W23: *n* = 0, 1	UART Ch.*n* data input
	USOUT*n*	O		UART Ch.*n* data output
16-bit PWM timer (T16B)	TOUT*n*0/CAP*n*0	I/O	S1C17W22: *n* = 0, 1 S1C17W23: *n* = 0, 1, 2	T16B Ch.*n* PWM output/capture input 0
	TOUT*n*1/CAP*n*1	I/O		T16B Ch.*n* PWM output/capture input 1

Note: Do not assign a function to two or more pins simultaneously.

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