

# R1EX25002ASA00I/R1EX25002ATA00I R1EX25004ASA00I/R1EX25004ATA00I

Serial Peripheral Interface

2k EEPROM (256-word × 8-bit)

4k EEPROM (512-word × 8-bit)

R10DS0106EJ0200

Rev.2.00

Nov 12, 2013

## Description

R1EX25xxx Series is the Serial Peripheral Interface compatible (SPI) EEPROM (Electrically Erasable and Programmable ROM). It realizes high speed, low power consumption and a high level of reliability by employing advanced MONOS memory technology and CMOS process and low voltage circuitry technology. It also has a 16-byte page programming function to make it's write operation faster.

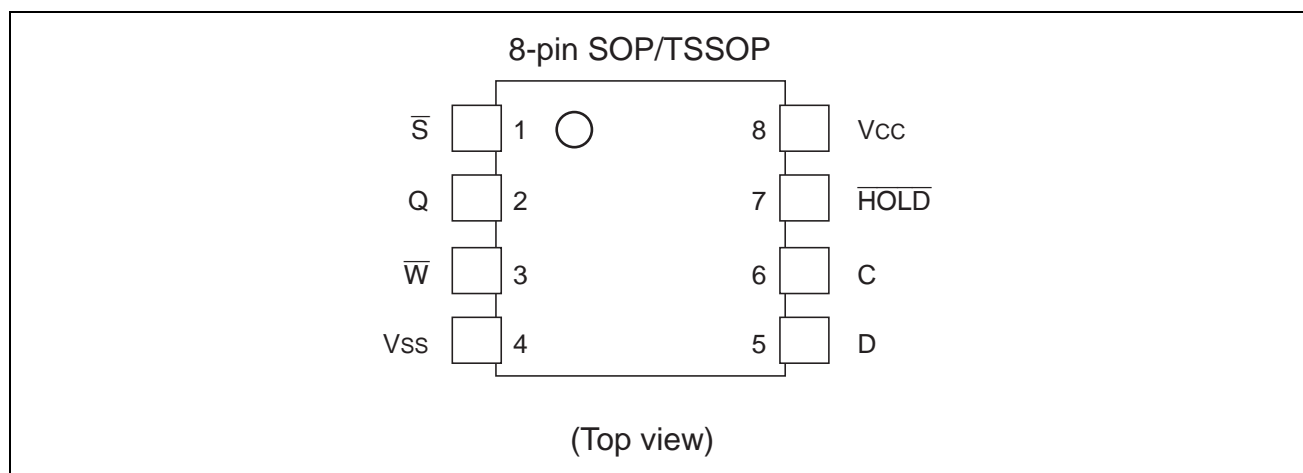
## Features

- Single supply: 1.8 V to 5.5 V
- Serial Peripheral Interface compatible (SPI bus)
  - SPI mode 0 (0,0), 3 (1,1)
- Clock frequency: 5 MHz (2.5 V to 5.5 V), 3 MHz (1.8 V to 5.5 V)
- Power dissipation:
  - Standby: 2.0  $\mu$ A (max)
  - Active (Read): 2.0 mA (max)
  - Active (Write): 2.5 mA (max)
- Automatic page write: 16-byte/page
- Write cycle time: 5 ms
- Endurance: 1,000k or more Cycles @25°C
- Data retention: 100 or more Years @25°C
- Small size packages: SOP-8pin, TSSOP-8pin
- Shipping tape and reel
  - TSSOP-8pin: 3,000 IC/reel
  - SOP-8pin : 2,500 IC/reel
- Temperature range: -40 to +85°C
- Lead free product. (#U0, #S0)
- Halogen free products. (#U0)

## Ordering Information

Orderable Part Numbers	Internal organization	Package		Shipping tape and reel
			Halogen free	
R1EX25002ASA00I#S0	2k bit (256 × 8-bit)	150 mil 8-pin plastic SOP PRSP0008DF-B (FP-8DBV) Lead free	—	2,500 IC/reel
R1EX25004ASA00I#S0	4k bit (512 × 8-bit)		—	
R1EX25002ATA00I#S0	2k bit (256 × 8-bit)	8-pin plastic TSSOP PTSP0008JC-B (TTP-8DAV) Lead free	—	3,000 IC/reel
R1EX25004ATA00I#U0	4k bit (512 × 8-bit)		<b>0</b>	
R1EX25004ATA00I#S0			—	

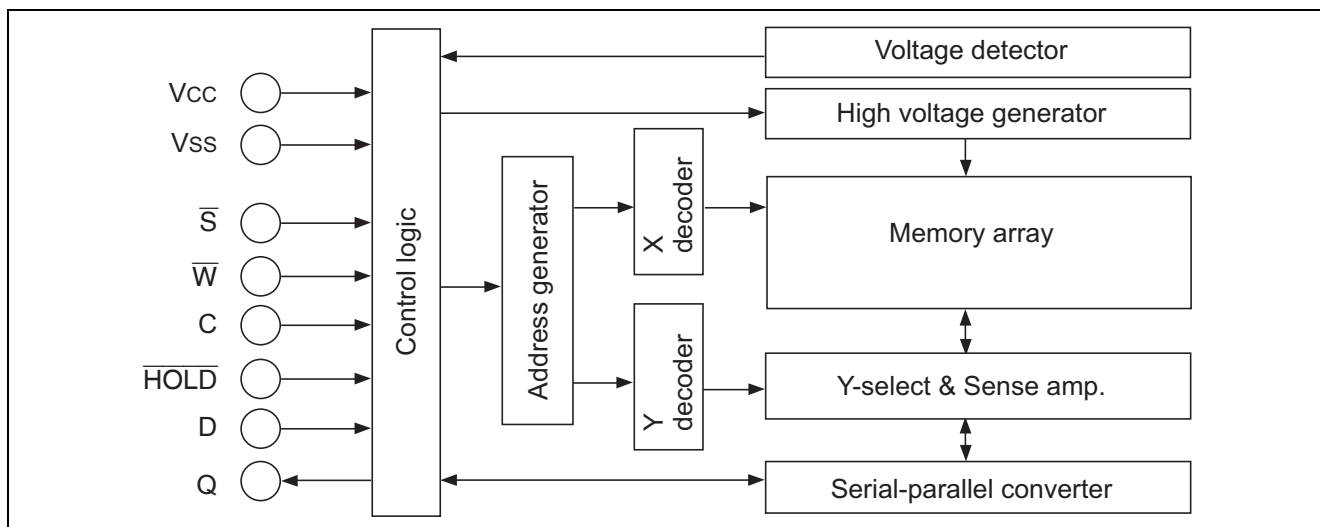
## Pin Arrangement



## Pin Description

Pin name	Function
C	Serial clock
D	Serial data input
Q	Serial data output
$\overline{S}$	Chip select
$\overline{W}$	Write protect
$\overline{HOLD}$	Hold
$V_{CC}$	Supply voltage
$V_{SS}$	Ground

## Block Diagram



## Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Supply voltage relative to V <sub>SS</sub>	V <sub>CC</sub>	−0.6 to +7.0	V
Input voltage relative to V <sub>SS</sub>	V <sub>in</sub>	−0.5* <sup>2</sup> to +7.0	V
Operating temperature range* <sup>1</sup>	T <sub>opr</sub>	−40 to +85	°C
Storage temperature range	T <sub>stg</sub>	−55 to +125	°C

Notes: 1. Including electrical characteristics and data retention.

2. V<sub>in</sub> (min): −3.0 V for pulse width ≤ 50 ns.

## DC Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	V <sub>CC</sub>	1.8	—	5.5	V
	V <sub>SS</sub>	0	0	0	V
Input voltage	V <sub>IH</sub>	V <sub>CC</sub> × 0.7	—	V <sub>CC</sub> + 0.5	V
	V <sub>IL</sub>	−0.3* <sup>1</sup>	—	V <sub>CC</sub> × 0.3	V
Operating temperature range	T <sub>opr</sub>	−40	—	+85	°C

Note: 1. V<sub>IL</sub> (min): −1.0 V for pulse width ≤ 50 ns.

## Capacitance

(T<sub>a</sub> = +25°C, f = 1 MHz)

Parameter	Symbol	Min	Typ	Max	Unit	Test conditions
Input capacitance (D, C, S, W, HOLD)	C <sub>in</sub> * <sup>1</sup>	—	—	6.0	pF	V <sub>in</sub> = 0 V
Output capacitance (Q)	C <sub>I/O</sub> * <sup>1</sup>	—	—	8.0	pF	V <sub>out</sub> = 0 V

Note: 1. Not 100% tested.

## Memory cell characteristics

(V<sub>CC</sub> = 1.8 V to 5.5 V)

	T <sub>a</sub> =25°C	T <sub>a</sub> =85°C	Notes
Endurance	1,000k Cycles min.	100k Cycles min	1
Data retention	100 Years min.	10 Years min.	1

Note: 1. Not 100% tested.

## DC Characteristics

Parameter		Symbol	Min	Typ	Max	Unit	Test conditions
Input leakage current		I <sub>LI</sub>	—	—	2.0	μA	V <sub>CC</sub> = 5.5 V, V <sub>IN</sub> = 0 to 5.5 V (S̄, D, C, HOLD, W)
Output leakage current		I <sub>LO</sub>	—	—	2.0	μA	V <sub>CC</sub> = 5.5 V, V <sub>OUT</sub> = 0 to 5.5 V (Q)
V <sub>CC</sub> current	Standby	I <sub>SB</sub>	—	0.5	—	μA	V <sub>IN</sub> = V <sub>SS</sub> or V <sub>CC</sub> , V <sub>CC</sub> = 3.6 V
			—	1.0	2.0	μA	V <sub>IN</sub> = V <sub>SS</sub> or V <sub>CC</sub> , V <sub>CC</sub> = 5.5 V
	Active	I <sub>CC1</sub>	—	0.2	1.5	mA	V <sub>CC</sub> = 3.6 V, Read at 5 MHz V <sub>IN</sub> = V <sub>CC</sub> × 0.1/V <sub>CC</sub> × 0.9 Q = OPEN
			—	—	2.0	mA	V <sub>CC</sub> = 5.5 V, Read at 5 MHz V <sub>IN</sub> = V <sub>CC</sub> × 0.1/V <sub>CC</sub> × 0.9 Q = OPEN
		I <sub>CC2</sub>	—	1.0	2.0	mA	V <sub>CC</sub> = 3.6 V, Write at 5 MHz V <sub>IN</sub> = V <sub>CC</sub> × 0.1/V <sub>CC</sub> × 0.9
			—	—	2.5	mA	V <sub>CC</sub> = 5.5 V, Write at 5 MHz V <sub>IN</sub> = V <sub>CC</sub> × 0.1/V <sub>CC</sub> × 0.9
Output voltage		V <sub>OL1</sub>	—	—	0.4	V	V <sub>CC</sub> = 5.5 V, I <sub>OL</sub> = 2 mA
		V <sub>OL2</sub>	—	—	0.4	V	V <sub>CC</sub> = 2.5 V, I <sub>OL</sub> = 1.5 mA
		V <sub>OH1</sub>	V <sub>CC</sub> × 0.8	—	—	V	V <sub>CC</sub> = 5.5 V, I <sub>OH</sub> = −2 mA
		V <sub>OH2</sub>	V <sub>CC</sub> × 0.8	—	—	V	V <sub>CC</sub> = 2.5 V, I <sub>OH</sub> = −0.4 mA

## AC Characteristics

### Test Conditions

- Input pulses levels:
  - $V_{IL} = V_{CC} \times 0.2$
  - $V_{IH} = V_{CC} \times 0.8$
- Input rise and fall time:  $\leq 10$  ns
- Input and output timing reference levels:  $V_{CC} \times 0.3$ ,  $V_{CC} \times 0.7$
- Output reference levels:  $V_{CC} \times 0.5$
- Output load: 100 pF

(Ta = -40 to +85°C, V<sub>CC</sub> = 2.5 V to 5.5 V)

Parameter	Symbol	Alt	Min	Max	Unit	Notes
Clock frequency	f <sub>C</sub>	f <sub>SCK</sub>	—	5	MHz	
$\overline{S}$ active setup time	t <sub>SLCH</sub>	t <sub>CSS1</sub>	90	—	ns	
$\overline{S}$ not active setup time	t <sub>SHCH</sub>	t <sub>CSS2</sub>	90	—	ns	
$\overline{S}$ deselect time	t <sub>SHSL</sub>	t <sub>CS</sub>	90	—	ns	
$\overline{S}$ active hold time	t <sub>CHSH</sub>	t <sub>CSH</sub>	90	—	ns	
$\overline{S}$ not active hold time	t <sub>CHSL</sub>	—	90	—	ns	
Clock high time	t <sub>CH</sub>	t <sub>CLH</sub>	90	—	ns	1
Clock low time	t <sub>CL</sub>	t <sub>CLL</sub>	90	—	ns	1
Clock rise time	t <sub>CLCH</sub>	t <sub>RC</sub>	—	1	μs	2
Clock fall time	t <sub>CHCL</sub>	t <sub>FC</sub>	—	1	μs	2
Data in setup time	t <sub>DVCH</sub>	t <sub>DSU</sub>	20	—	ns	
Data in hold time	t <sub>CHDX</sub>	t <sub>DH</sub>	30	—	ns	
Clock low hold time after $\overline{HOLD}$ not active	t <sub>HHCH</sub>	—	70	—	ns	
Clock low hold time after $\overline{HOLD}$ active	t <sub>HLCH</sub>	—	40	—	ns	
Clock high setup time before $\overline{HOLD}$ active	t <sub>CHHL</sub>	—	60	—	ns	
Clock high setup time before $\overline{HOLD}$ not active	t <sub>CHHH</sub>	—	60	—	ns	
Output disable time	t <sub>SHQZ</sub>	t <sub>DIS</sub>	—	100	ns	2
Clock low to output valid	t <sub>CLQV</sub>	t <sub>V</sub>	—	70	ns	
Output hold time	t <sub>CLQX</sub>	t <sub>HO</sub>	0	—	ns	
Output rise time	t <sub>QLQH</sub>	t <sub>RO</sub>	—	50	ns	2
Output fall time	t <sub>QHQL</sub>	t <sub>FO</sub>	—	50	ns	2
$\overline{HOLD}$ high to output low-Z	t <sub>HHQX</sub>	t <sub>LZ</sub>	—	50	ns	2
$\overline{HOLD}$ low to output high-Z	t <sub>HLQZ</sub>	t <sub>HZ</sub>	—	100	ns	2
Write time	t <sub>W</sub>	t <sub>WC</sub>	—	5	ms	

Notes: 1.  $t_{CH} + t_{CL} \geq 1/f_C$   
 2. Not 100% tested.

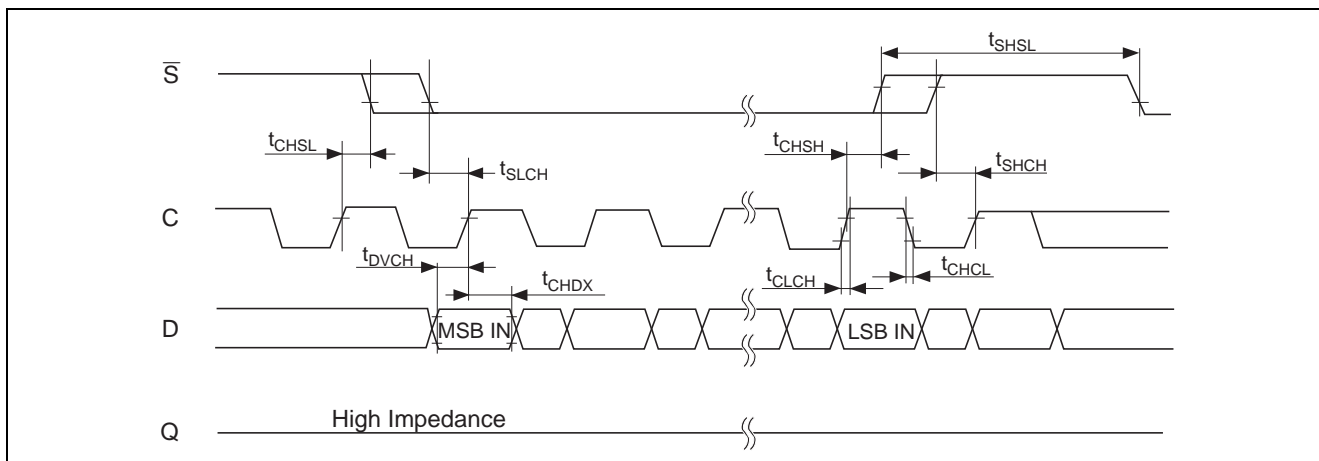
(Ta = -40 to +85°C, V<sub>CC</sub> = 1.8 V to 5.5 V)

Parameter	Symbol	Alt	Min	Max	Unit	Notes
Clock frequency	f <sub>C</sub>	f <sub>SCK</sub>	—	3	MHz	
$\overline{S}$ active setup time	t <sub>SLCH</sub>	t <sub>CSS1</sub>	100	—	ns	
$\overline{S}$ not active setup time	t <sub>SHCH</sub>	t <sub>CSS2</sub>	100	—	ns	
$\overline{S}$ deselect time	t <sub>SHSL</sub>	t <sub>CS</sub>	150	—	ns	
$\overline{S}$ active hold time	t <sub>CHSH</sub>	t <sub>CSH</sub>	100	—	ns	
$\overline{S}$ not active hold time	t <sub>CHSL</sub>	—	100	—	ns	
Clock high time	t <sub>CH</sub>	t <sub>CLH</sub>	150	—	ns	1
Clock low time	t <sub>CL</sub>	t <sub>CLL</sub>	150	—	ns	1
Clock rise time	t <sub>CLCH</sub>	t <sub>RC</sub>	—	1	μs	2
Clock fall time	t <sub>CHCL</sub>	t <sub>FC</sub>	—	1	μs	2
Data in setup time	t <sub>DVCH</sub>	t <sub>DSU</sub>	30	—	ns	
Data in hold time	t <sub>CHDX</sub>	t <sub>DH</sub>	50	—	ns	
Clock low hold time after $\overline{HOLD}$ not active	t <sub>HHCH</sub>	—	140	—	ns	
Clock low hold time after $\overline{HOLD}$ active	t <sub>HLCH</sub>	—	90	—	ns	
Clock high setup time before $\overline{HOLD}$ active	t <sub>CHHL</sub>	—	120	—	ns	
Clock high setup time before $\overline{HOLD}$ not active	t <sub>CHHH</sub>	—	120	—	ns	
Output disable time	t <sub>SHQZ</sub>	t <sub>DIS</sub>	—	200	ns	2
Clock low to output valid	t <sub>CLQV</sub>	t <sub>V</sub>	—	120	ns	
Output hold time	t <sub>CLQX</sub>	t <sub>HO</sub>	0	—	ns	
Output rise time	t <sub>QLQH</sub>	t <sub>RO</sub>	—	100	ns	2
Output fall time	t <sub>QHQL</sub>	t <sub>FO</sub>	—	100	ns	2
$\overline{HOLD}$ high to output low-Z	t <sub>HHQX</sub>	t <sub>LZ</sub>	—	100	ns	2
$\overline{HOLD}$ low to output high-Z	t <sub>HLQZ</sub>	t <sub>HZ</sub>	—	100	ns	2
Write time	t <sub>W</sub>	t <sub>WC</sub>	—	5	ms	

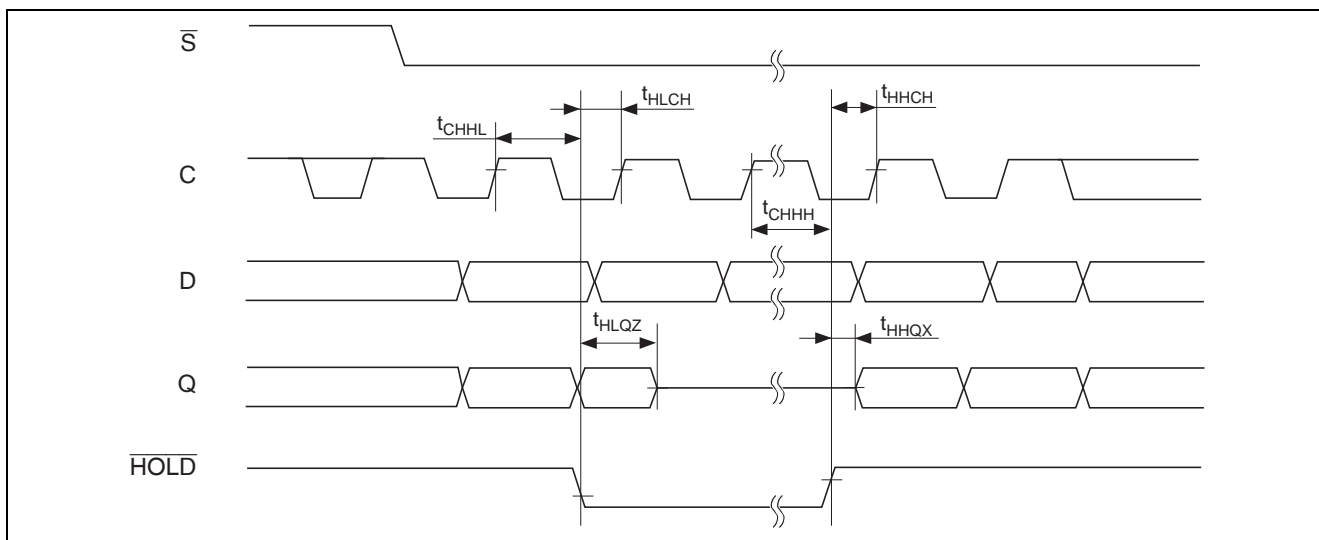
Notes: 1. t<sub>CH</sub> + t<sub>CL</sub> ≥ 1/f<sub>C</sub>  
2. Not 100% tested.

## Timing Waveforms

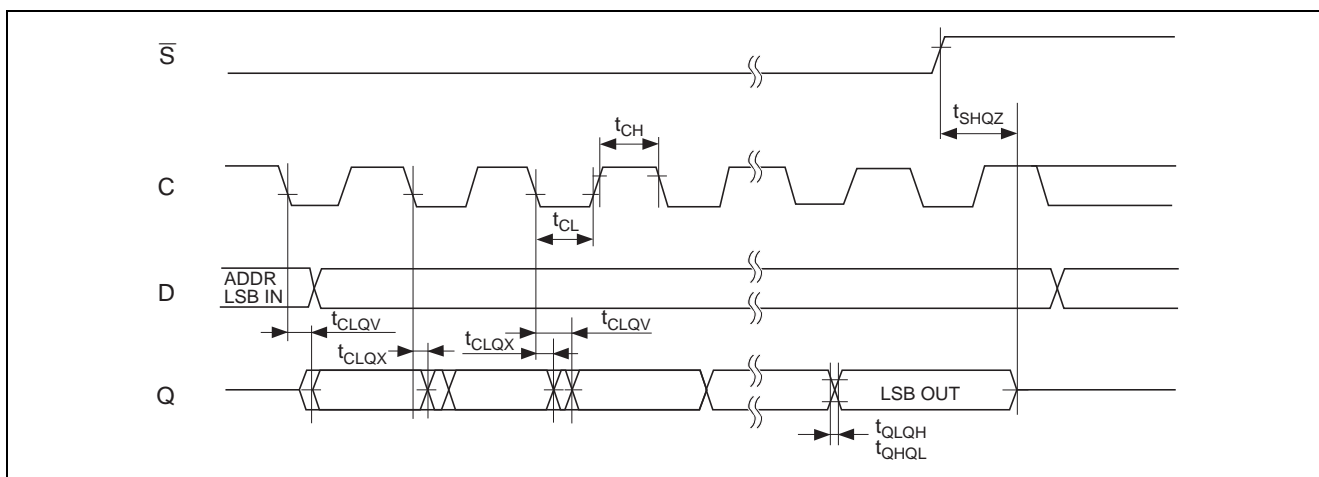
### Serial Input Timing



### Hold Timing



### Output Timing



## Pin Function

### Serial data output (Q)

This output signal is used to transfer data serially out of the device. Data is shifted out on the falling edge of serial clock (C).

### Serial data input (D)

This input signal is used to transfer data serially into the device. It receives instructions, addresses, and the data to be written. Values are latched on the rising edge of serial clock (C).

### Serial clock (C)

This input signal provides the timing of the serial interface. Instructions, addresses, or data present at serial data input (D) are latched on the rising edge of serial clock (C). Data on serial data output (Q) changes after the falling edge of serial clock (C).

### Chip select ( $\overline{S}$ )

When this input signal is high, the device is deselected and serial data output (Q) is at high impedance. Unless an internal write cycle is in progress, the device will be in the standby mode. Driving chip select ( $\overline{S}$ ) low enables the device, placing it in the active power mode. After power-up, a falling edge on chip select ( $\overline{S}$ ) is required prior to the start of any instruction.

### Hold ( $\overline{HOLD}$ )

The hold ( $\overline{HOLD}$ ) signal is used to pause any serial communications with the device without deselecting the device. During the hold condition, the serial data output (Q) is high impedance, and serial data input (D) and serial clock (C) are don't care. To start the hold condition, the device must be selected, with chip select ( $\overline{S}$ ) driven low.

### Write protect ( $\overline{W}$ )

This input signal is used to protect the memory against write instructions. When write protect ( $\overline{W}$ ) is held low, write instructions (WRSR, WRITE) are ignored. No action on this signal can interrupt a write cycle that has already started.

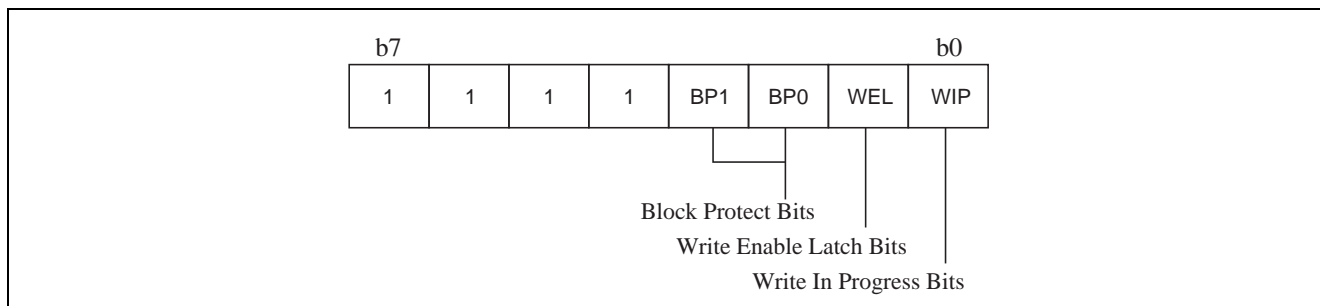


## Functional Description

### Status Register

The following figure shows the Status Register Format. The Status Register contains a number of status and control bits that can be read or set (as appropriate) by specific instructions.

#### Status Register Format



**WIP bit:** The Write In Progress (WIP) bit indicates whether the memory is busy with a Write or Write Status Register cycle.

**WEL bit:** The Write Enable Latch (WEL) bit indicates the status of the internal Write Enable Latch.

**BP1, BP0 bits:** The Block Protect (BP1, BP0) bits are non-volatile. They define the size of the area to be protected against Write instructions.

### Instructions

Each instruction starts with a single-byte code, as summarized in the following table. If an invalid instruction is sent (one not contained in the following table), the device automatically deselects itself.

#### Instruction Set

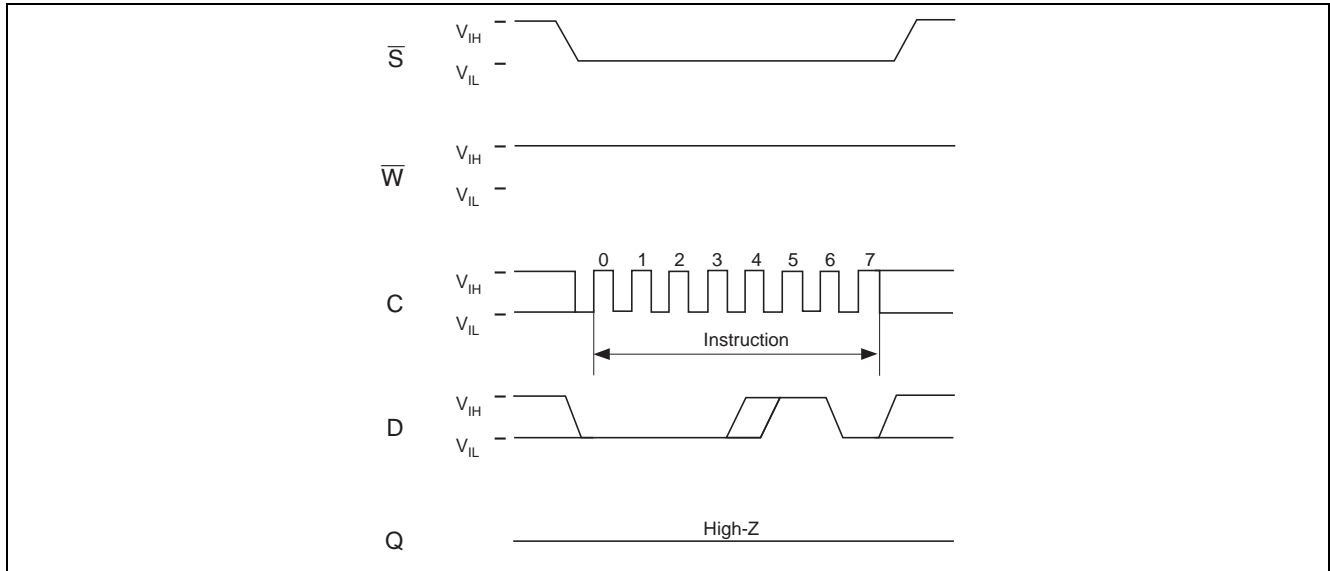
Instruction	Description	Instruction Format
WREN	Write Enable	0000 ×110
WRDI	Write Disable	0000 ×100
RDSR	Read Status Register	0000 ×101
WRSR	Write Status Register	0000 ×001
READ	Read from Memory Array	0000 A011
WRITE	Write to Memory Array	0000 A010

Notes: 1. "×" is Don't care.

2. "A" is A<sub>8</sub> address on the R1EX25004A, and Don't care on the R1EX25002A.

**Write Enable (WREN):**

The Write Enable Latch (WEL) bit must be set prior to each WRITE and WRSR instruction. The only way to do this is to send a Write Enable instruction to the device. As shown in the following figure, to send this instruction to the device, chip select ( $\overline{S}$ ) is driven low, and the bits of the instruction byte are shifted in, on serial data input (D). The device then enters a wait state. It waits for the device to be deselected, by chip select ( $\overline{S}$ ) being driven high.

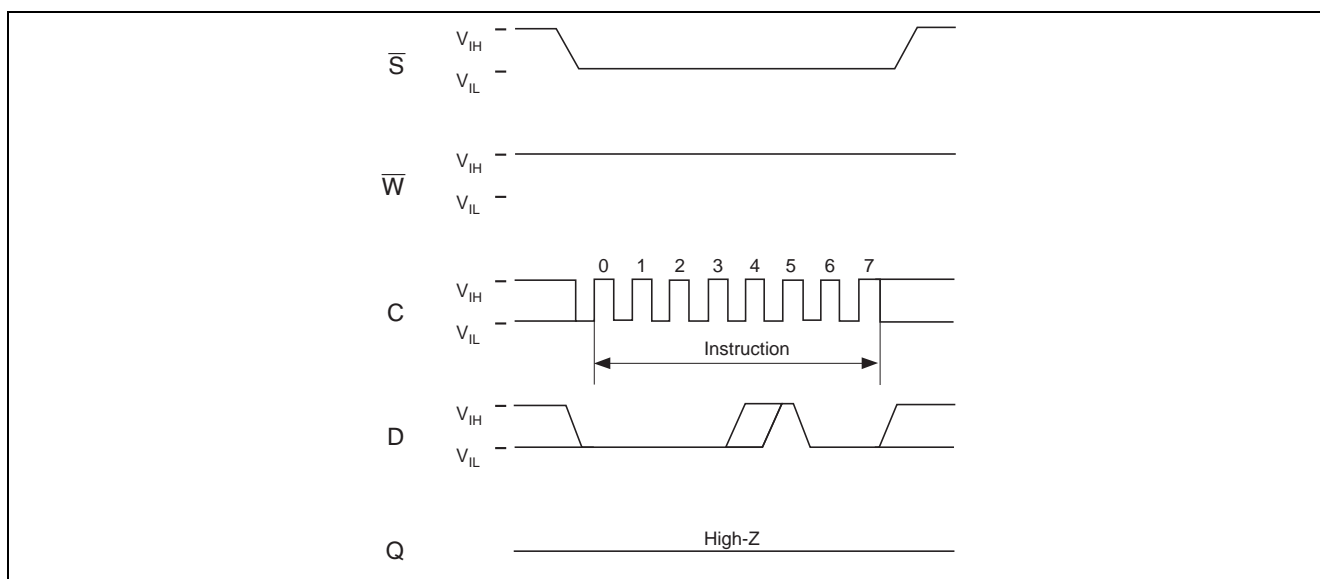
**Write Enable (WREN) Sequence**

**Write Disable (WRDI):**

One way of resetting the Write Enable Latch (WEL) bit is to send a Write Disable instruction to the device. As shown in the following figure, to send this instruction to the device, chip select ( $\overline{S}$ ) is driven low, and the bits of the instruction byte are shifted in, on serial data input (D).

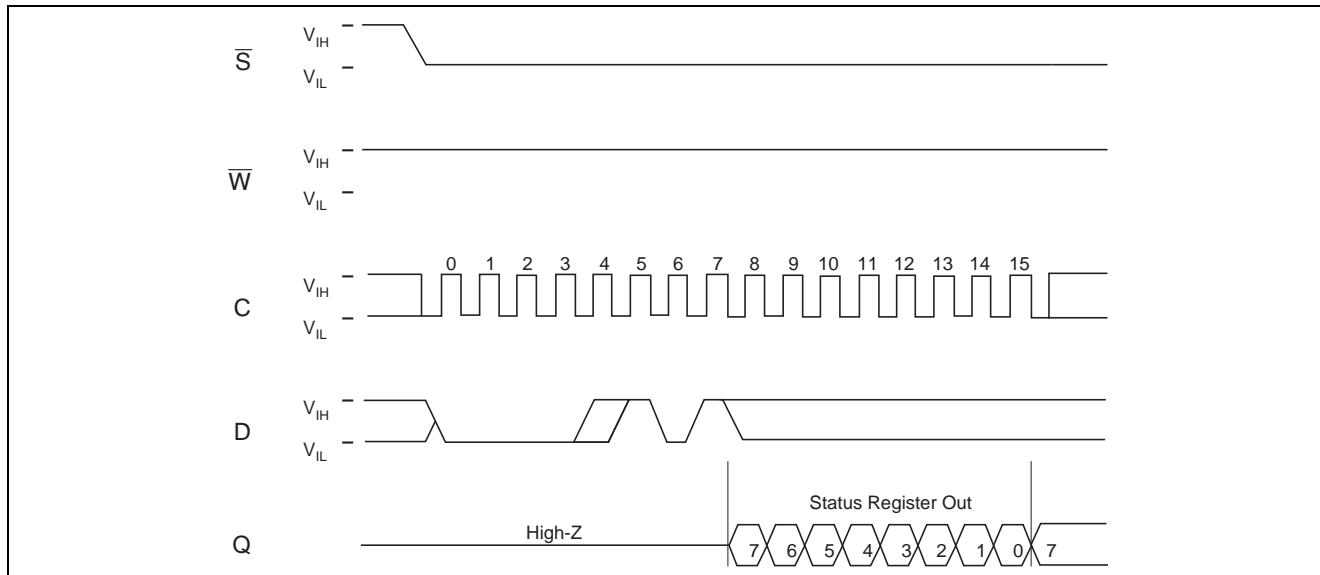
The device then enters a wait state. It waits for the device to be deselected, by chip select ( $\overline{S}$ ) being driven high. The Write Enable Latch (WEL) bit, in fact, becomes reset by any of the following events:

- Power-up
- WRDI instruction execution
- WRSR instruction completion
- WRITE instruction completion
- WRITE protect ( $\overline{W}$ ) is driven low

**Write Disable (WRDI) Sequence**

**Read Status Register (RDSR):**

The Read Status Register (RDSR) instruction allows the Status Register to be read. The Status Register may be read at any time, even while a Write or Write Status Register cycle is in progress. When one of these cycles is in progress, it is recommended to check the Write In Progress (WIP) bit before sending a new instruction to the device. It is also possible to read the Status Register continuously, as shown in the following figure.

**Read Status Register (RDSR) Sequence**

The status and control bits of the Status Register are as follows:

**WIP bit:** The Write In Progress (WIP) bit indicates whether the memory is busy with a Write or Write Status Register cycle. When set to 1, such a cycle is in progress. When reset to 0, no such cycles are in progress.

**WEL bit:** The Write Enable Latch (WEL) bit indicates the status of the internal Write Enable Latch. When set to 1, the internal Write Enable Latch is set. When set to 0, the internal Write Enable Latch is reset and no Write or Write Status Register instructions are accepted.

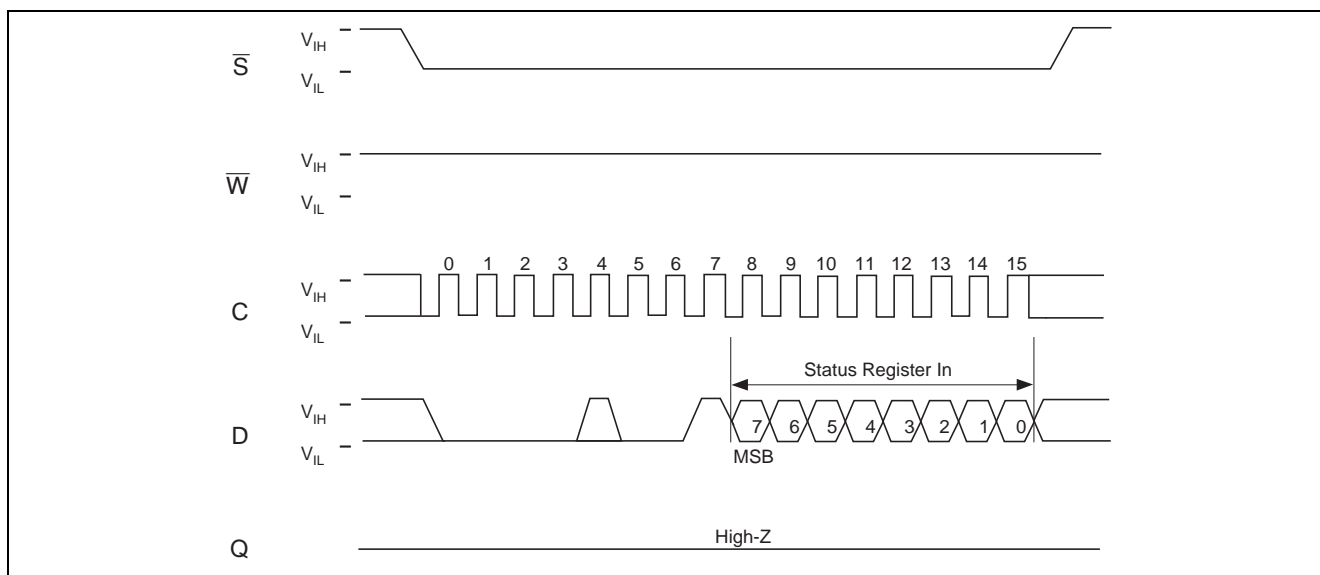
**BP1, BP0 bits:** The Block Protect (BP1, BP0) bits are non-volatile. They define the size of the area to be software protected against Write instructions. These bits are written with the Write Status Register (WRSR) instruction. When one or both of the Block Protect (BP1, BP0) bits are set to 1, the relevant memory area (as defined in the Status Register Format table) becomes protected against Write (WRITE) instructions. The Block Protect (BP1, BP0) bits can be written provided that the Hardware Protected mode has not been set.

### Write Status Register (WRSR):

The Write Status Register (WRSR) instruction allows new values to be written to the Status Register. Before it can be accepted, a Write Enable (WREN) instruction must previously have been executed. After the Write Enable (WREN) instruction has been decoded and executed, the device sets the Write Enable Latch(WEL). The instruction sequence is shown in the following figure. The Write Status Register (WRSR) instruction has no effect on b6, b5, b4, b1 and b0 of the Status Register. b6, b5 and b4 are always read as 0. Chip select ( $\overline{S}$ ) must be driven high after the rising edge of serial clock (C) that latches in the eighth bit of the data byte, and before the next rising edge of serial clock (C). Otherwise, the Write Status Register (WRSR) instruction is not executed. As soon as chip select ( $\overline{S}$ ) is driven high, the self-timed Write Status Register cycle (whose duration is  $t_w$ ) is initiated. While the Write Status Register cycle is in progress, the Status Register may still be read to check the value of the Write In Progress (WIP) bit. The Write In Progress (WIP) bit is 1 during the self-timed Write Status Register cycle, and is 0 when it is completed. When the cycle is completed, Write Enable Latch(WEL) is reset. The Write Status Register (WRSR) instruction allows the user to change the values of the Block Protect (BP1, BP0) bits, to define the size of the area that is to be treated as read-only, as defined in the Status Register Format table.

The contents of Block Protect (BP1, BP0) bits are frozen at their current values just before the start of the execution of the Write Status Register (WRSR) instruction. The new, updated values take effect at the moment of completion of the execution of Write Status Register (WRSR) instruction.

### Write Status Register (WRSR) Sequence



### Read from Memory Array (READ):

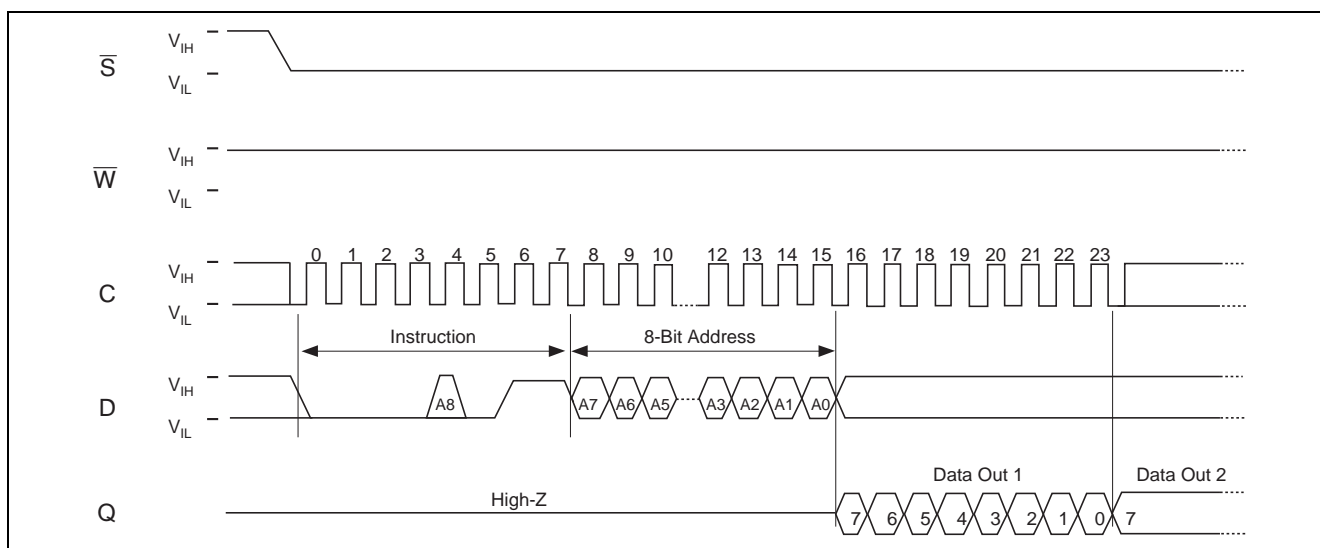
As shown in the following figure, to send this instruction to the device, chip select ( $\overline{S}$ ) is first driven low. The bits of the instruction byte and the address bytes are then shifted in, on serial data input (D). The addresses are loaded into an internal address register, and the byte of data at that address is shifted out, on serial data output (Q). The most significant address (A8) should be sent as fifth bit in the instruction byte.

If chip select ( $\overline{S}$ ) continues to be driven low, the internal address register is automatically incremented, and the byte of data at the new address is shifted out.

When the highest address is reached, the address counter rolls over to zero, allowing the Read cycle to be continued indefinitely. The whole memory can, therefore, be read with a single READ instruction.

The Read cycle is terminated by driving chip select ( $\overline{S}$ ) high. The rising edge of the chip select ( $\overline{S}$ ) signal can occur at any time during the cycle. The addressed first byte can be any byte within any page. The instruction is not accepted, and is not executed, if a Write cycle is currently in progress.

### Read from Memory Array (READ) Sequence



Note: 1. Depending on the memory size, as shown in the following table, the most significant address bits are don't care.

### Address Range Bits

Device	R1EX25004A	R1EX25002A
Address bits	A8 to A0	A7 to A0

Note: 1. A8 is don't care on the R1EX25002A.

**Write to Memory Array (WRITE):**

As shown in the following figure, to send this instruction to the device, chip select ( $\overline{S}$ ) is first driven low. The bits of the instruction byte, address byte, and at least one data byte are then shifted in, on serial data input (D).

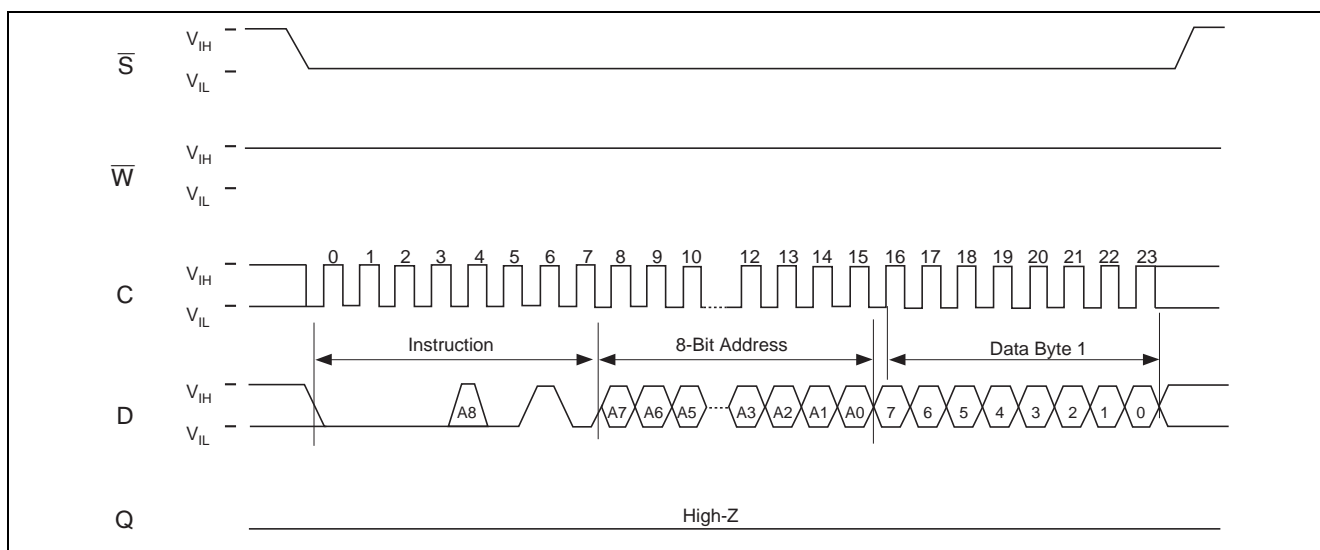
The instruction is terminated by driving chip select ( $\overline{S}$ ) high at a byte boundary of the input data. In the case of the following figure, this occurs after the eighth bit of the data byte has been latched in, indicating that the instruction is being used to write a single byte. The self-timed Write cycle starts, and continues for a period  $t_{WC}$  (as specified in AC Characteristics). At the end of the cycle, the Write In Progress (WIP) bit is reset to 0.

If, though, chip select ( $\overline{S}$ ) continues to be driven low, as shown in the following figure, the next byte of the input data is shifted in, so that more than a single byte, starting from the given address towards the end of the same page, can be written in a single internal Write cycle.

Each time a new data byte is shifted in, the least significant bits of the internal address counter are incremented. If the number of data bytes sent to the device exceeds the page boundary, the internal address counter rolls over to the beginning of the page, and the previous data there are overwritten with the incoming data. (The page size of these device is 32 bytes).

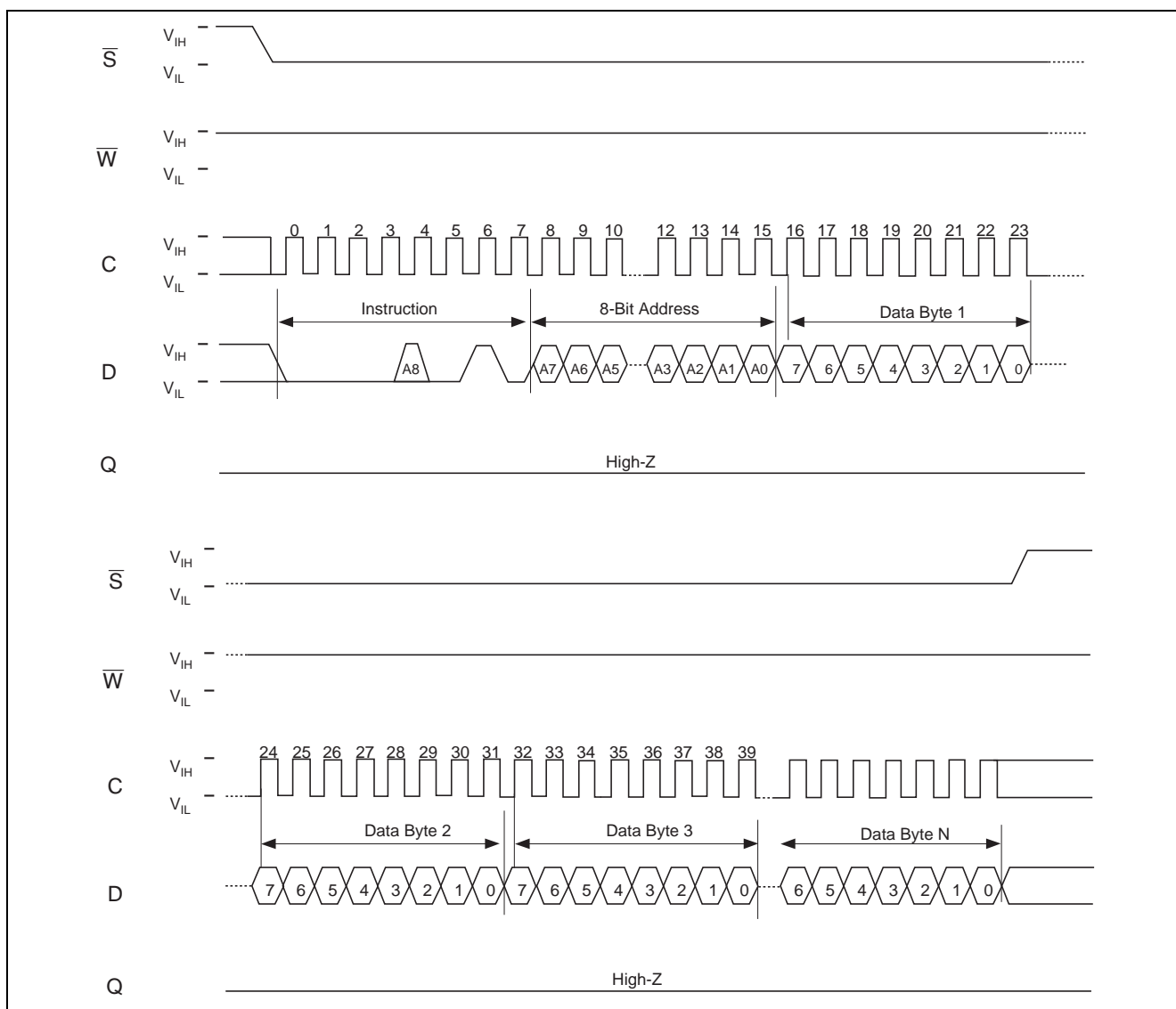
The instruction is not accepted, and is not executed, under the following conditions:

- If the Write Enable Latch (WEL) bit has not been set to 1 (by executing a Write Enable instruction just before)
- If a Write cycle is already in progress
- If the addressed page is in the region protected by the Block Protect (BP1 and BP0) bits.
- If Write Protect ( $\overline{WP}$ ) is low

**Byte Write (WRITE) Sequence (1 Byte)**

Note: 1. Depending on the memory size, as shown in Address Range Bits table, the most significant address bit is don't care.

## Byte Write (WRITE) Sequence (Page)



Note: 1. Depending on the memory size, as shown in Address Range Bits table, the most significant address bit is don't care.



## Data Protect

The Block Protect bits (BP1, BP0) define the area of memory that is protected against the execution of write cycle, as summarized in the following table.

When Write Protect ( $\overline{W}$ ) is driven low, write to memory array (WRITE) and write status register (WRSR) are disabled, and WEL bit is reset.

### Write Protected Block Size

Status register bits		Protected blocks	Array addresses protected	
BP1	BP0		R1EX25004A	R1EX25002A
0	0	None	None	None
0	1	Upper quarter	180h – 1FFh	C0h – FFh
1	0	Upper half	100h – 1FFh	80h – FFh
1	1	Whole memory	000h – 1FFh	00h – FFh

## Hold Condition

The hold ( $\overline{HOLD}$ ) signal is used to pause any serial communications with the device without resetting the clocking sequence.

During the hold condition, the serial data output (Q) is high impedance, and serial data input (D) and serial clock (C) are don't care.

To enter the hold condition, the device must be selected, with chip select ( $\overline{S}$ ) low.

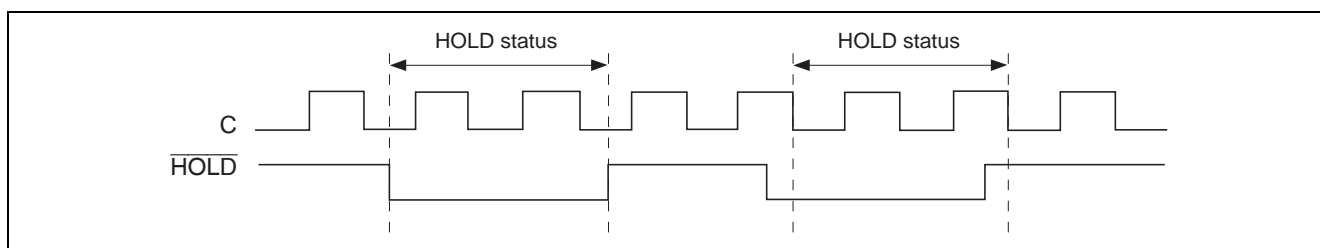
Normally, the device is kept selected, for the whole duration of the hold condition. Deselecting the device while it is in the hold condition, has the effect of resetting the state of the device, and this mechanism can be used if it is required to reset any processes that had been in progress.

The hold condition starts when the hold ( $\overline{HOLD}$ ) signal is driven low at the same time as serial clock (C) already being low (as shown in the following figure).

The hold condition ends when the hold ( $\overline{HOLD}$ ) signal is driven high at the same time as serial clock (C) already being low.

The following figure also shows what happens if the rising and falling edges are not timed to coincide with serial clock (C) being low.

### Hold Condition Activation



## Notes

### Data Protection at $V_{CC}$ On/Off

When  $V_{CC}$  is turned on or off, noise on  $\bar{S}$  inputs generated by external circuits (CPU, etc) may act as a trigger and turn the EEPROM to unintentional program mode. To prevent this unintentional programming, this EEPROM have a power on reset function. Be careful of the notices described below in order for the power on reset function to operate correctly.

- $\bar{S}$  should be fixed to  $V_{CC}$  during  $V_{CC}$  on/off. Low to high or high to low transition during  $V_{CC}$  on/off may cause the trigger for the unintentional programming.
- $V_{CC}$  should be turned on/off after the EEPROM is placed in a standby state.
- $V_{CC}$  should be turned on from the ground level ( $V_{SS}$ ) in order for the EEPROM not to enter the unintentional programming mode.
- $V_{CC}$  turn on rate should be slower than  $2\ \mu\text{s}/\text{V}$ .
- When WRSR or WRITE instruction is executed before  $V_{CC}$  turns off,  $V_{CC}$  should be turned off after waiting write cycle time ( $t_w$ ).

### Power Source Noise Countermeasures

In order to suppress power-source-noise which causes malfunction of the device, it is recommended to put  $0.1\ \mu\text{F}$  bypass-capacitor (such as a monolithic ceramic capacitor which has good high-frequency characteristics) between  $V_{CC}$  and  $V_{SS}$ , and shorten the wiring length between the capacitor and  $V_{CC}/V_{SS}$  terminals as much as possible.

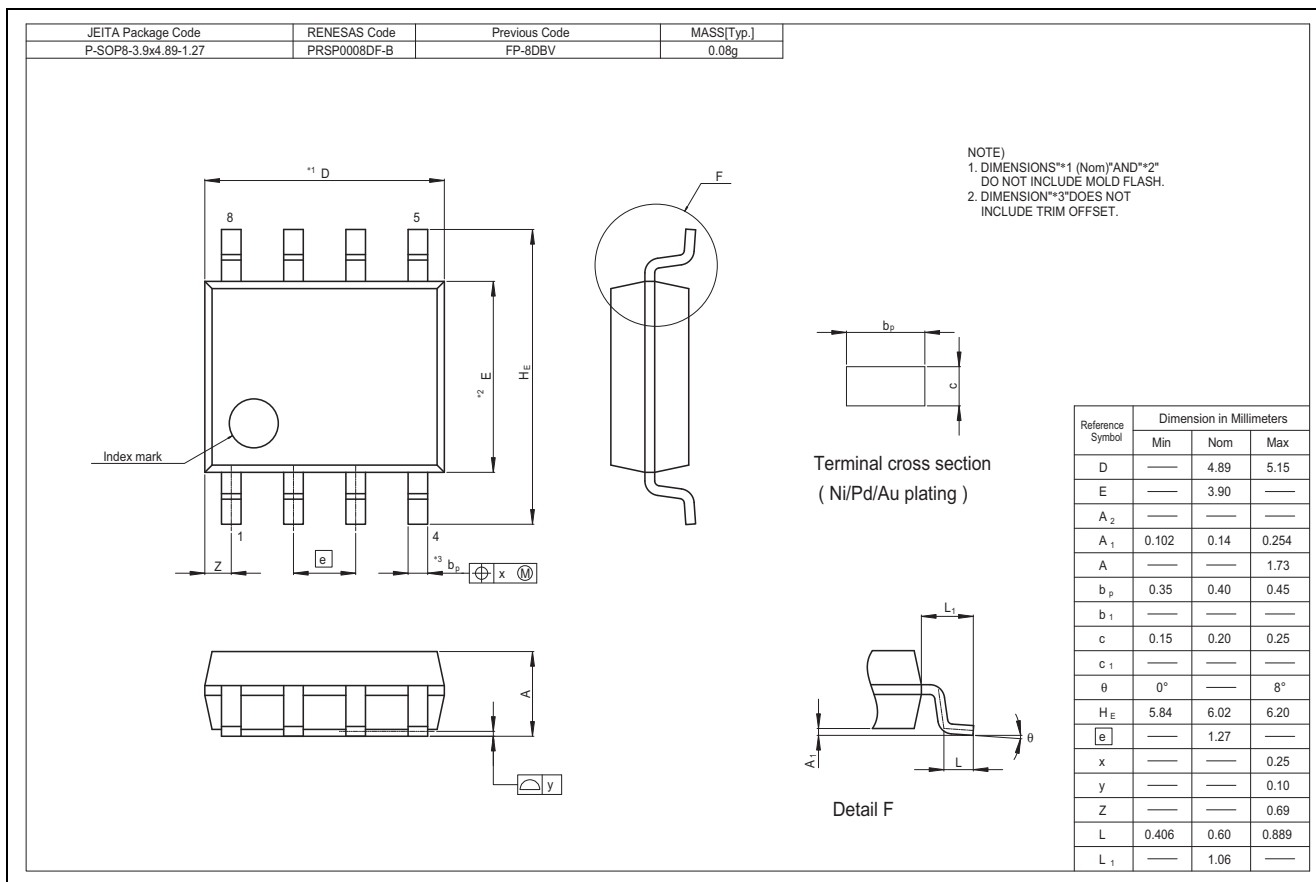
### Data of shipped sample

All bits of EEPROM are logical "1" (FF Hex).

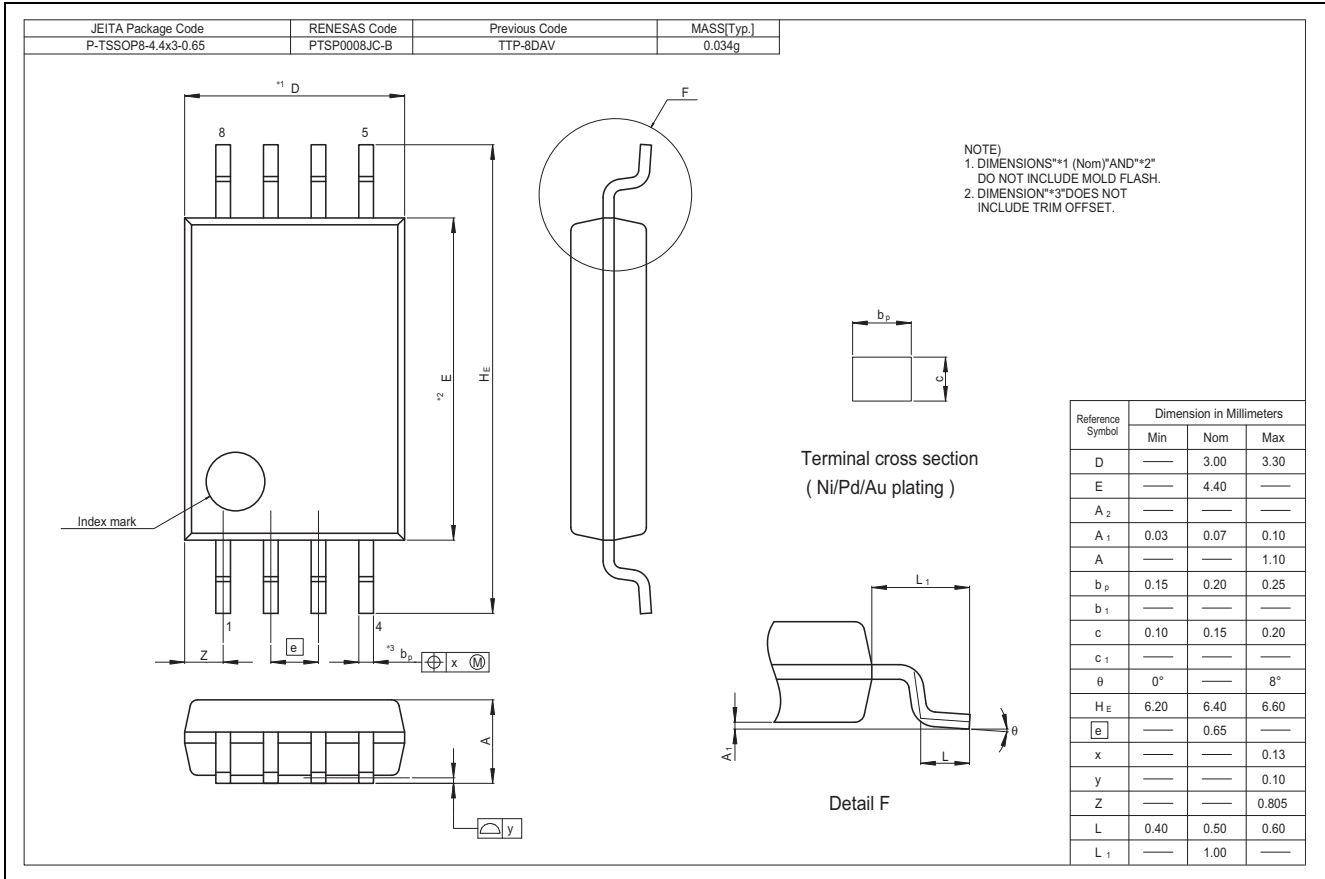
Block Protect bits (BP1, BP0) are "0" status at Shipment.

## Package Dimensions

R1EX25002ASA00I/R1EX25004ASA00I (PRSP0008DF-B / Previous Code: FP-8DBV)



R1EX25002ATA00I/R1EX25004ATA00I (PTSP0008JC-B / Previous Code: TTP-8DAV)



<b>Revision History</b>	<b>R1EX25002ASA00I/R1EX25002ATA00I/ R1EX25004ASA00I/R1EX25004ATA00I Data Sheet</b>
-------------------------	--

Rev.	Date	Description	
		Page	Summary
0.01	Feb 21, 2008	—	Initial issue
0.02	Jan 09, 2009	1	Features Endurance cycles change $10^6$ cycles to 1,000k cycles @25°C. Data retentions years change 10 years to 100years@25°C.
		3	Capacitance new is described. Memory cell characteristics new is described.
		4	DC characteristics Output voltage $V_{OH1}$ , $V_{OH2}$ test conditions changed $I_{OL}$ to $I_{OH}$ .
		5, 6	AC characteristics Erase/Write endurance is deleted. Notes1. change Not 100% tested. Notes3. deleted.
1.00	Jan 10, 2012	—	Delete Preliminary
2.00	Nov 12, 2013	2	Change Ordering Information Change Type No. to Orderable P/N. Addition Halogen free.
		3	Addition Voltage detector in Block Diagram.
		4	Addition DC characteristics $I_{SB} = 0.5\mu A(Typ)@3.3V$ , $I_{CC1} = 0.2mA(Typ)@3.3V$ , $I_{CC2} = 1.0mA(Typ)@3.3V$ Addition Data of shipped sample
		14	Change Note $V_{CC}$ turn on speed should be longer than $10\mu s/V$ . to $V_{CC}$ turn on rate should be slower than $2\mu s/V$ . Addition these items for Notes (Power Source Noise Countermeasures) , (Data of shipped sample)

All trademarks and registered trademarks are the property of their respective owners.

## Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
  2. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
  3. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
  4. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from such alteration, modification, copy or otherwise misappropriation of Renesas Electronics product.
  5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.

"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots etc.

"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; and safety equipment etc.

Renesas Electronics products are neither intended nor authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems, surgical implantations etc.), or may cause serious property damages (nuclear reactor control systems, military equipment etc.). You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application for which it is not intended. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for which the product is not intended by Renesas Electronics.
  6. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
  7. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or systems manufactured by you.
  8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
  9. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You should not use Renesas Electronics products or technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. When exporting the Renesas Electronics products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations.
  10. It is the responsibility of the buyer or distributor of Renesas Electronics products, who distributes, disposes of, or otherwise places the product with a third party, to notify such third party in advance of the contents and conditions set forth in this document, Renesas Electronics assumes no responsibility for any losses incurred by you or third parties as a result of unauthorized use of Renesas Electronics products.
  11. This document may not be reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
  12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.
- (Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.
- (Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.



### SALES OFFICES

### Renesas Electronics Corporation

<http://www.renesas.com>

Refer to "<http://www.renesas.com/>" for the latest and detailed information.

**Renesas Electronics America Inc.**  
2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.  
Tel: +1-408-588-6000, Fax: +1-408-588-6130

**Renesas Electronics Canada Limited**  
1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada  
Tel: +1-905-898-5441, Fax: +1-905-898-3220

**Renesas Electronics Europe Limited**  
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K  
Tel: +44-1628-651-700, Fax: +44-1628-651-804

**Renesas Electronics Europe GmbH**  
Arcadiastrasse 10, 40472 Düsseldorf, Germany  
Tel: +49-211-65030, Fax: +49-211-6503-1327

**Renesas Electronics (China) Co., Ltd.**  
7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, P.R.China  
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

**Renesas Electronics (Shanghai) Co., Ltd.**  
Unit 301, Tower A, Central Towers, 555 LanGao Rd., Putuo District, Shanghai, China  
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

**Renesas Electronics Hong Kong Limited**  
Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong  
Tel: +852-2886-9318, Fax: +852 2886-9022/9044

**Renesas Electronics Taiwan Co., Ltd.**  
13F, No. 363, Fu Shing North Road, Taipei, Taiwan  
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

**Renesas Electronics Singapore Pte. Ltd.**  
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre Singapore 339949  
Tel: +65-6213-0200, Fax: +65-6213-0300

**Renesas Electronics Malaysia Sdn.Bhd.**  
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia  
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

**Renesas Electronics Korea Co., Ltd.**  
12F., 234 Teheran-ro, Gangnam-Gu, Seoul, 135-080, Korea  
Tel: +82-2-558-3737, Fax: +82-2-558-5141

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Renesas Electronics:](#)

[R1EX25004ASA00I#S0](#) [R1EX25002ATA00I#S0](#) [R1EX25004ATA00I#S0](#) [R1EX25002ASA00I#S0](#)