

# Memory FRAM

## 2 M (256 K × 8) Bit SPI

# MB85RS2MT

### ■ DESCRIPTION

MB85RS2MT is a FRAM (Ferroelectric Random Access Memory) chip in a configuration of 262,144 words × 8 bits, using the ferroelectric process and silicon gate CMOS process technologies for forming the nonvolatile memory cells.

MB85RS2MT adopts the Serial Peripheral Interface (SPI).

The MB85RS2MT is able to retain data without using a back-up battery, as is needed for SRAM.

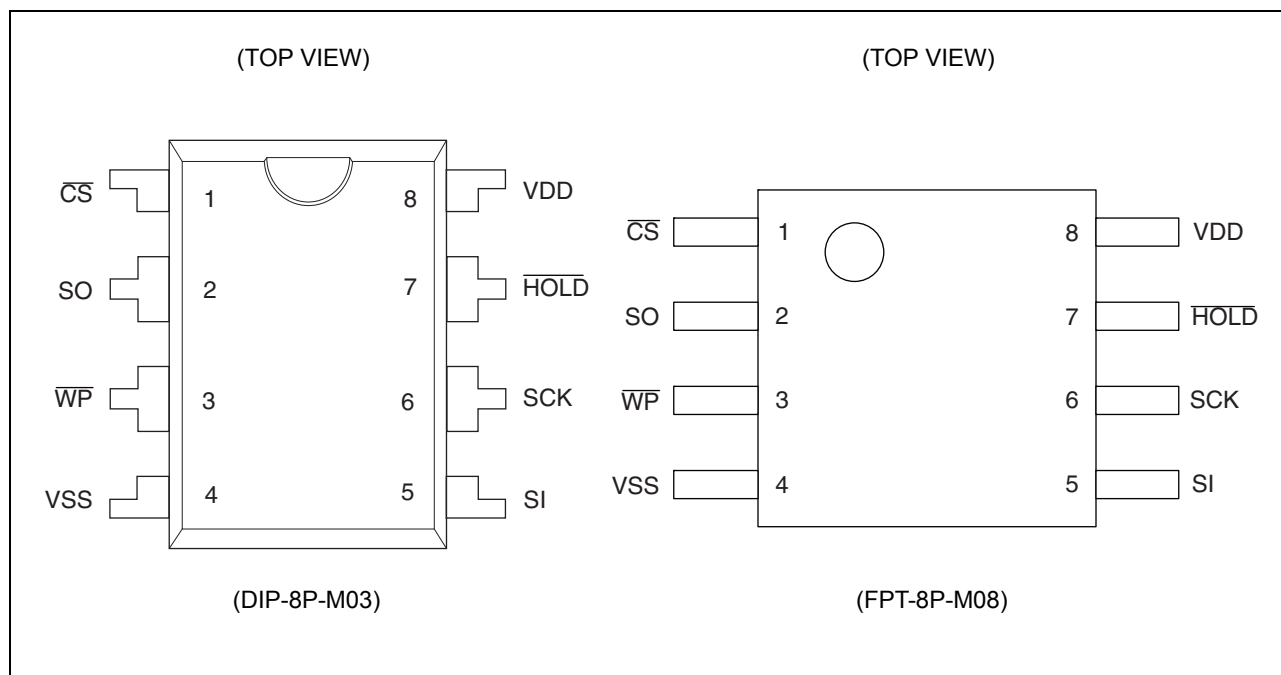
The memory cells used in the MB85RS2MT can be used for  $10^{13}$  read/write operations, which is a significant improvement over the number of read and write operations supported by Flash memory and E<sup>2</sup>PROM.

MB85RS2MT does not take long time to write data like Flash memories or E<sup>2</sup>PROM, and MB85RS2MT takes no wait time.

### ■ FEATURES

- Bit configuration : 262,144 words × 8 bits
- Serial Peripheral Interface : SPI (Serial Peripheral Interface)  
Correspondent to SPI mode 0 (0, 0) and mode 3 (1, 1)
- Operating frequency : 25 MHz (Max)  
For FSTRD command 2.7 V to 3.6 V, 40 MHz (Max)
- High endurance :  $10^{13}$  times / byte
- Data retention : 10 years (+85 °C), 95 years ( + 55 °C), over 200 years ( + 35 °C)
- Operating power supply voltage : 1.8 V to 3.6 V
- Low power consumption : Operating power supply current 10.6 mA (Max@25 MHz)  
Standby current 150 μA (Max)  
Sleep current 10 μA (Max)
- Operation ambient temperature range : -40 °C to +85 °C
- Package : 8-pin plastic SOP (FPT-8P-M08)  
8-pin plastic DIP (DIP-8P-M03)  
RoHS compliant

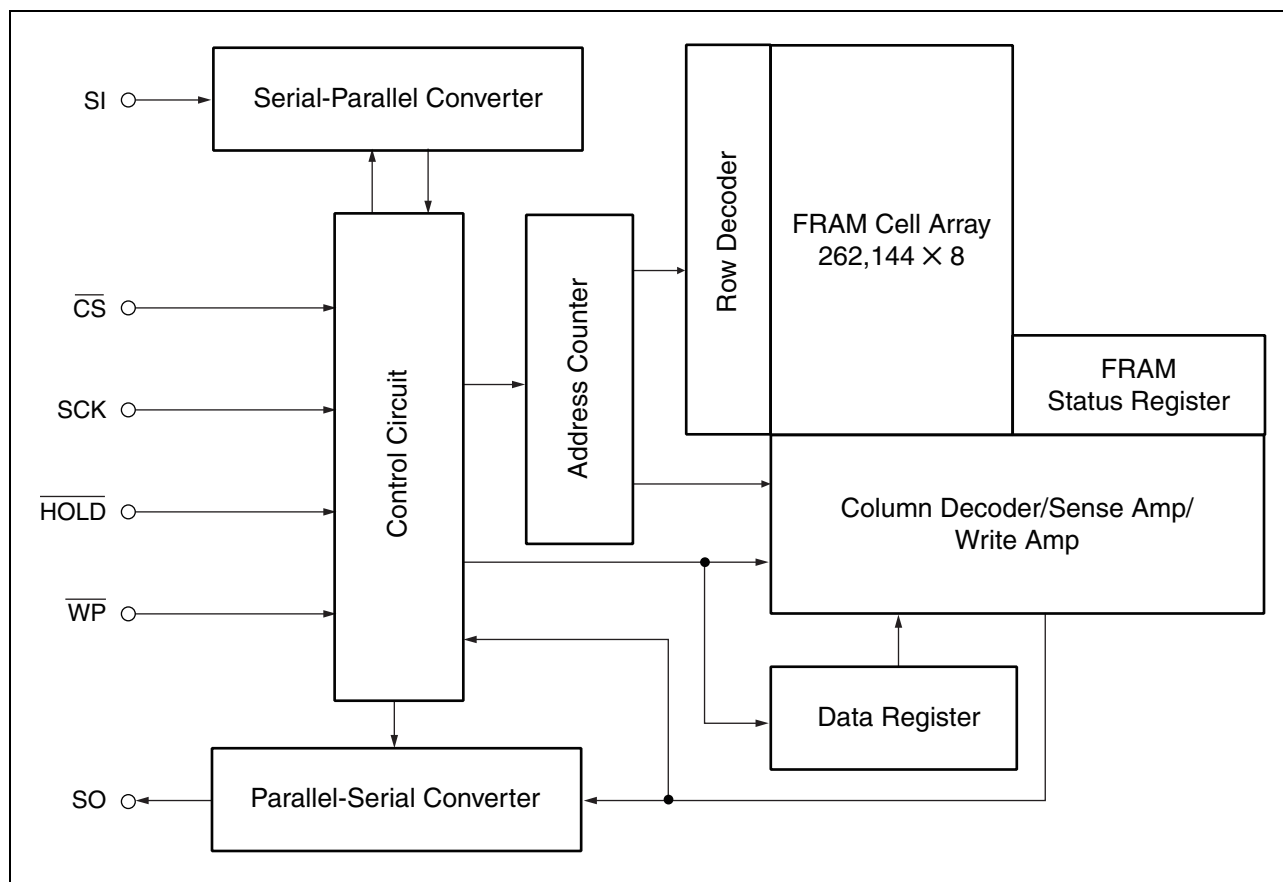
## ■ PIN ASSIGNMENT



## ■ PIN FUNCTIONAL DESCRIPTIONS

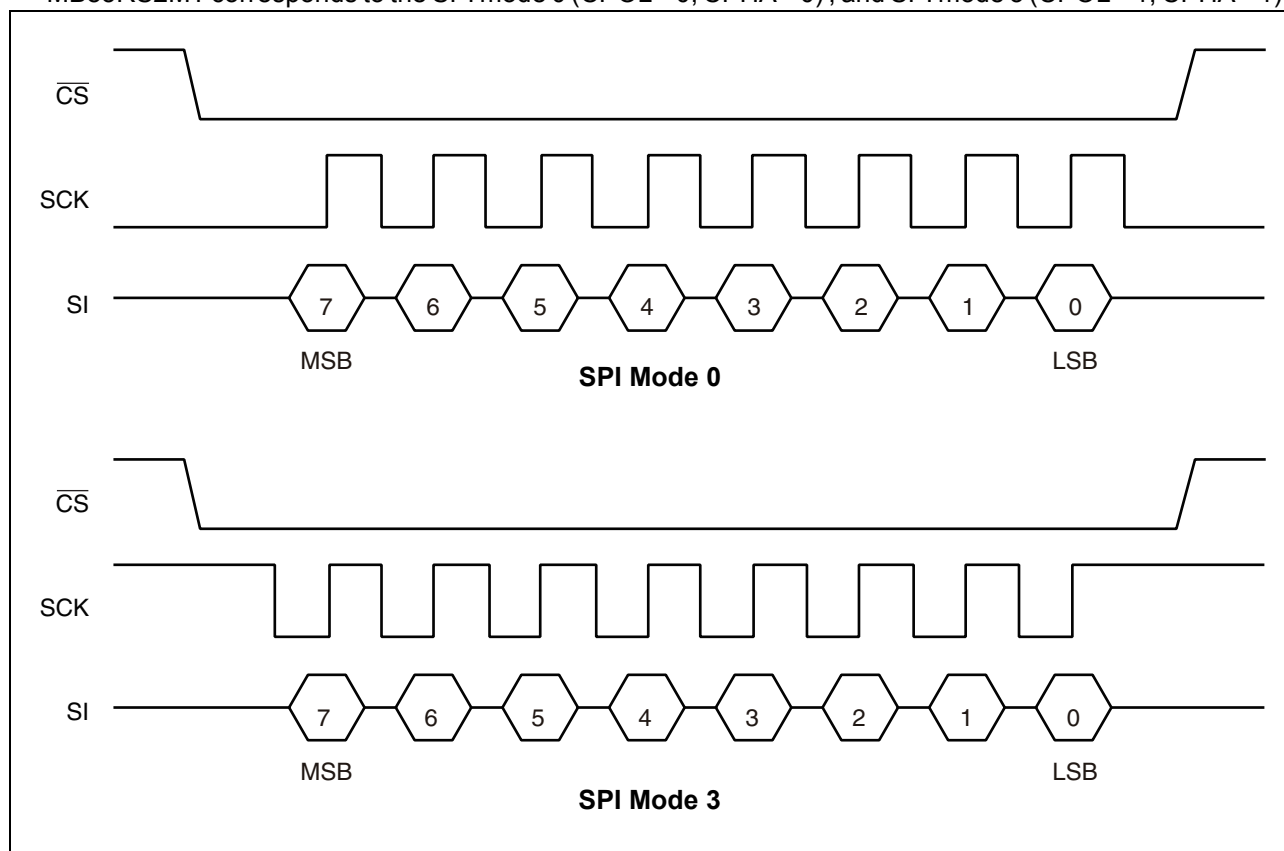
| Pin No. | Pin Name          | Functional description  |
|---------|-------------------|---|
| 1       | $\overline{CS}$   | Chip Select pin<br>This is an input pin to make chips select. When $\overline{CS}$ is "H" level, device is in deselect (standby) status and $\overline{SO}$ becomes High-Z. Inputs from other pins are ignored for this time. When $\overline{CS}$ is "L" level, device is in select (active) status. $\overline{CS}$ has to be "L" level before inputting op-code. The Chip Select pin is pulled up internally to the VDD pin. |
| 3       | $\overline{WP}$   | Write Protect pin<br>This is a pin to control writing to a status register. The writing of status register (see "■ STATUS REGISTER") is protected in related with $\overline{WP}$ and $WPEN$ . See "■ WRITING PROTECT" for detail.  |
| 7       | $\overline{HOLD}$ | Hold pin<br>This pin is used to interrupt serial input/output without making chips deselect. When $\overline{HOLD}$ is "L" level, hold operation is activated, $\overline{SO}$ becomes High-Z, $SCK$ and $SI$ become do not care. While the hold operation, $\overline{CS}$ has to be retained "L" level.   |
| 6       | $SCK$             | Serial Clock pin<br>This is a clock input pin to input/output serial data. $SI$ is loaded synchronously to a rising edge, $\overline{SO}$ is output synchronously to a falling edge.  |
| 5       | $SI$              | Serial Data Input pin<br>This is an input pin of serial data. This inputs op-code, address, and writing data.   |
| 2       | $\overline{SO}$   | Serial Data Output pin<br>This is an output pin of serial data. Reading data of FRAM memory cell array and status register data are output. This is High-Z during standby.  |
| 8       | $VDD$             | Supply Voltage pin  |
| 4       | $VSS$             | Ground pin  |

## ■ BLOCK DIAGRAM



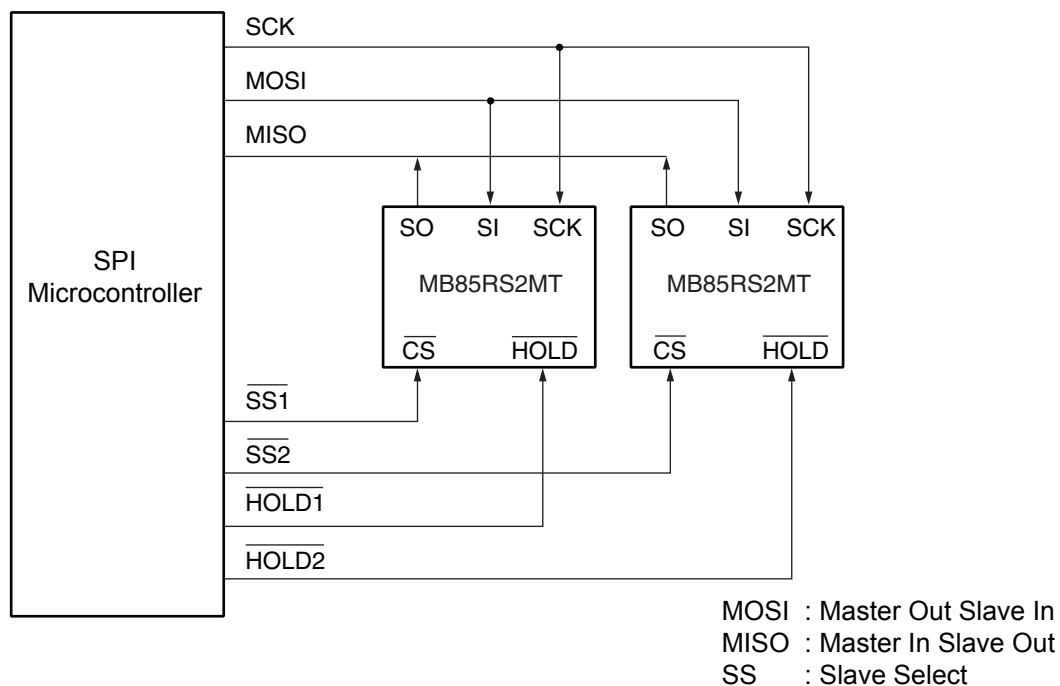
## ■ SPI MODE

MB85RS2MT corresponds to the SPI mode 0 (CPOL = 0, CPHA = 0), and SPI mode 3 (CPOL = 1, CPHA = 1).

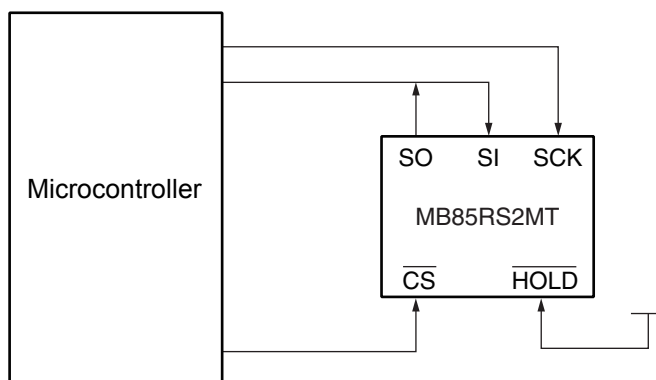


## ■ SERIAL PERIPHERAL INTERFACE (SPI)

MB85RS2MT works as a slave of SPI. More than 2 devices can be connected by using microcontroller equipped with SPI port. By using a microcontroller not equipped with SPI port, SI and SO can be bus connected to use.



**System Configuration with SPI Port**



**System Configuration without SPI Port**

## ■ STATUS REGISTER

| Bit No. | Bit Name | Function  |
|---------|----------|---|
| 7       | WPEN     | Status Register Write Protect<br>This is a bit composed of nonvolatile memories (FRAM). WPEN protects writing to a status register (refer to “■ WRITING PROTECT”) relating with $\overline{WP}$ input. Writing with the WRSR command and reading with the RDSR command are possible.  |
| 6 to 4  | —        | Not Used Bits<br>These are bits composed of nonvolatile memories, writing with the WRSR command is possible. These bits are not used but they are read with the RDSR command.   |
| 3       | BP1      | Block Protect<br>This is a bit composed of nonvolatile memory. This defines size of write protect block for the WRITE command (refer to “■ BLOCK PROTECT”). Writing with the WRSR command and reading with the RDSR command are possible.   |
| 2       | BP0      |   |
| 1       | WEL      | Write Enable Latch<br>This indicates FRAM Array and status register are writable. The WREN command is for setting, and the WRDI command is for resetting. With the RDSR command, reading is possible but writing is not possible with the WRSR command. WEL is reset after the following operations.<br>After power ON.<br>After WRDI command recognition.<br>The rising edge of $\overline{CS}$ after WRSR command recognition.<br>The rising edge of $\overline{CS}$ after WRITE command recognition. |
| 0       | 0        | This is a bit fixed to “0”.   |

## ■ OP-CODE

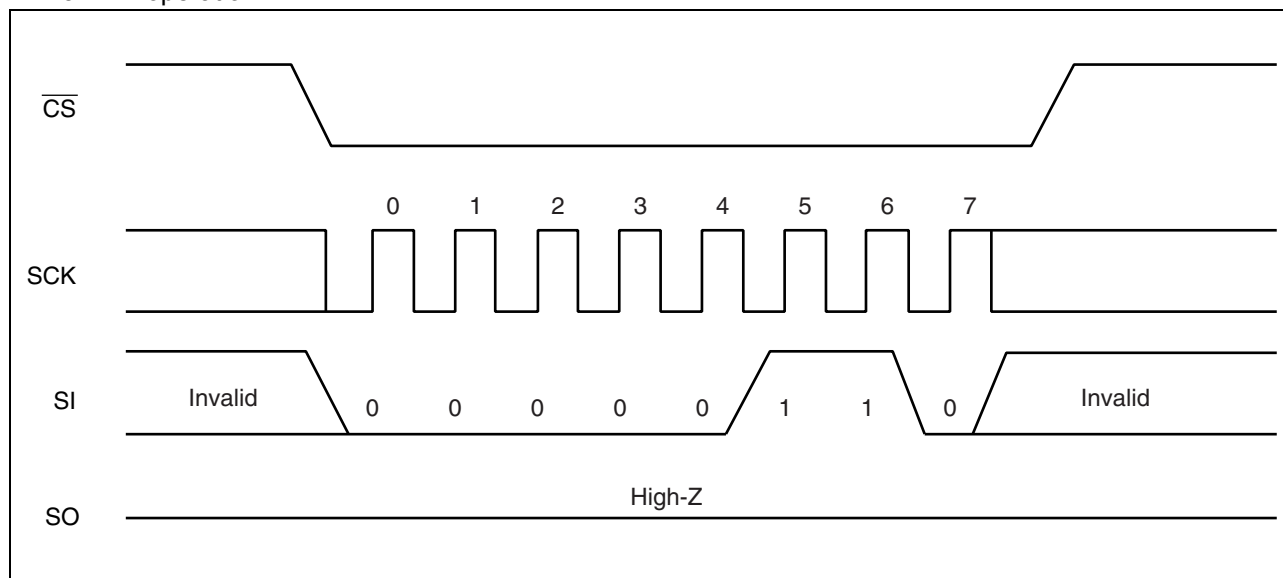
MB85RS2MT accepts 9 kinds of command specified in op-code. Op-code is a code composed of 8 bits shown in the table below. Do not input invalid codes other than those codes. If  $\overline{CS}$  is risen while inputting op-code, the command are not performed.

| Name  | Description              | Op-code                |
|-------|--------------------------|------------------------|
| WREN  | Set Write Enable Latch   | 0000 0110 <sub>B</sub> |
| WRDI  | Reset Write Enable Latch | 0000 0100 <sub>B</sub> |
| RDSR  | Read Status Register     | 0000 0101 <sub>B</sub> |
| WRSR  | Write Status Register    | 0000 0001 <sub>B</sub> |
| READ  | Read Memory Code         | 0000 0011 <sub>B</sub> |
| WRITE | Write Memory Code        | 0000 0010 <sub>B</sub> |
| RDID  | Read Device ID           | 1001 1111 <sub>B</sub> |
| FSTRD | Fast Read Memory Code    | 0000 1011 <sub>B</sub> |
| SLEEP | Sleep Mode               | 1011 1001 <sub>B</sub> |

## ■ COMMAND

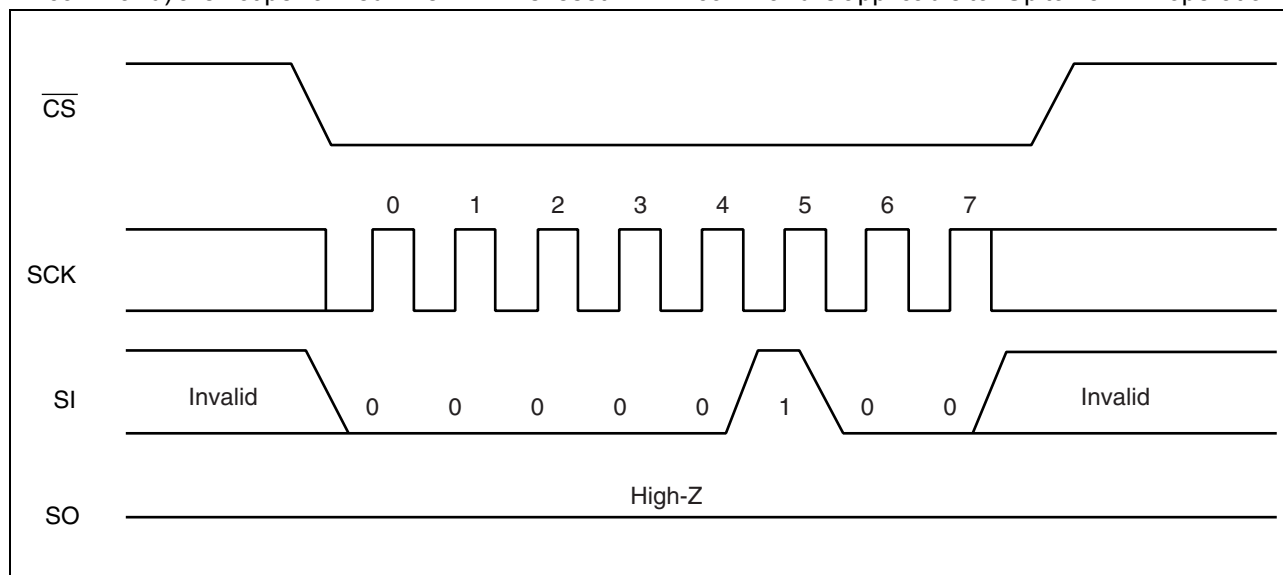
### • WREN

The WREN command sets WEL (Write Enable Latch) . WEL has to be set with the WREN command before writing operation (WRSR command and WRITE command) . WREN command is applicable to “Up to 25 MHz operation”.



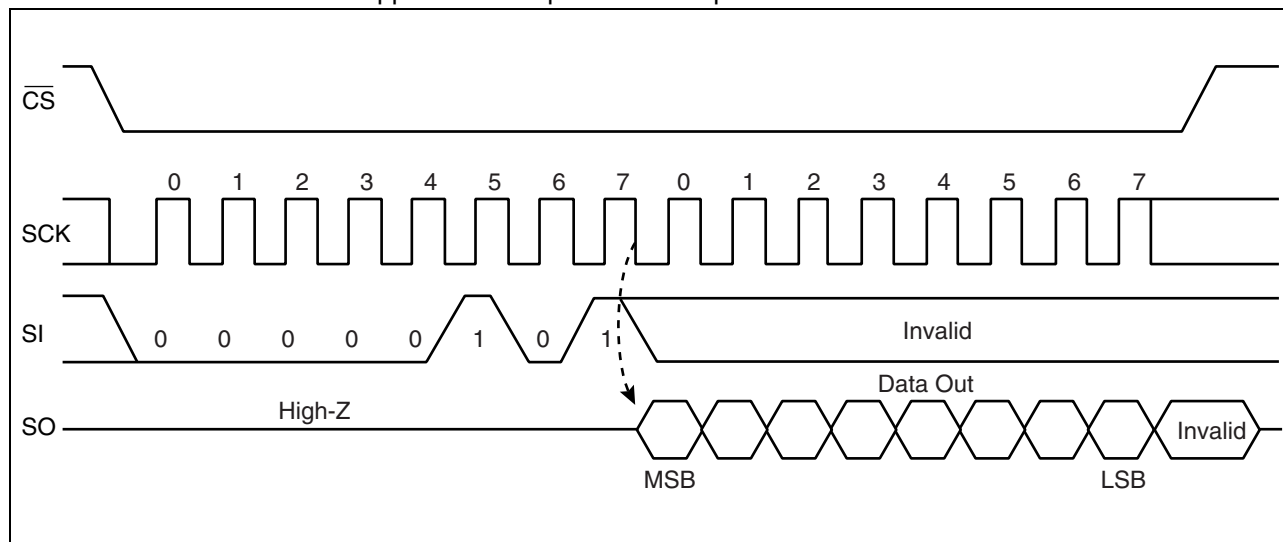
### • WRDI

The WRDI command resets WEL (Write Enable Latch) . Writing operation (WRSR command and WRITE command) are not performed when WEL is reset. WRDI command is applicable to “Up to 25 MHz operation”.



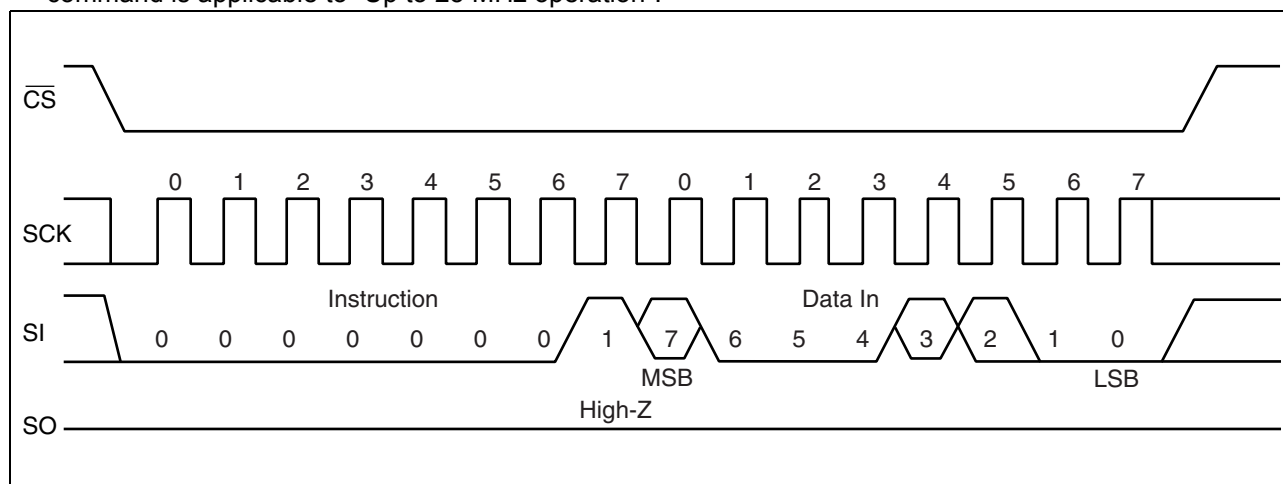
## • RDSR

The RDSR command reads status register data. After op-code of RDSR is input to SI, 8-cycle clock is input to SCK. The SI value is invalid for this time. SO is output synchronously to a falling edge of SCK. In the RDSR command, repeated reading of status register is enabled by sending SCK continuously before rising of  $\overline{CS}$ . RDSR command is applicable to "Up to 25 MHz operation".



## • WRSR

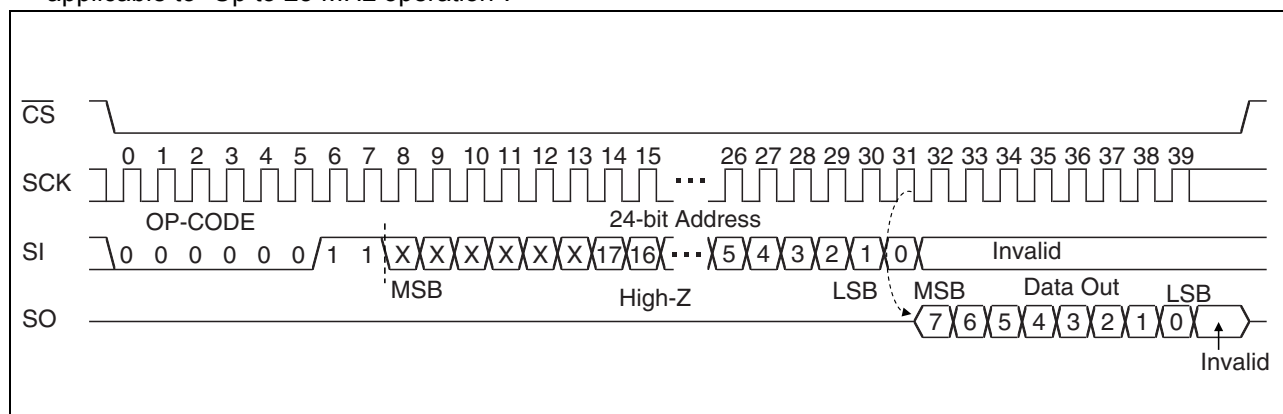
The WRSR command writes data to the nonvolatile memory bit of status register. After performing WRSR op-code to a SI pin, 8 bits writing data is input. WEL (Write Enable Latch) is not able to be written with WRSR command. A SI value correspondent to bit 1 is ignored. Bit 0 of the status register is fixed to "0" and cannot be written. The SI value corresponding to bit 0 is ignored.  $\overline{WP}$  signal level shall be fixed before performing WRSR command, and do not change the  $\overline{WP}$  signal level until the end of command sequence. WRSR command is applicable to "Up to 25 MHz operation".





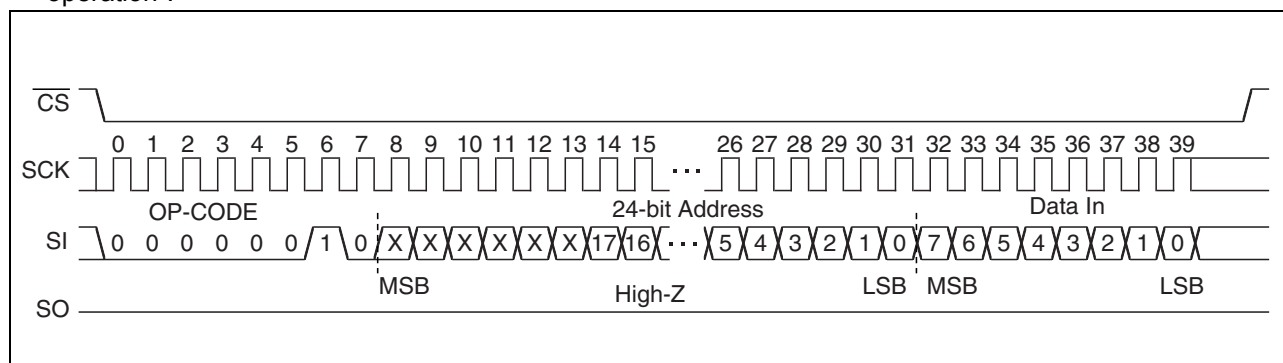
## • READ

The READ command reads FRAM memory cell array data. Arbitrary 24 bits address and op-code of READ are input to SI. The 6-bit upper address bit is invalid. Then, 8-cycle clock is input to SCK. SO is output synchronously to the falling edge of SCK. While reading, the SI value is invalid. When  $\overline{CS}$  is risen, the READ command is completed, but keeps on reading with automatic address increment which is enabled by continuously sending clocks to SCK in unit of 8 cycles before  $\overline{CS}$  rising. When it reaches the most significant address, it rolls over to the starting address, and reading cycle keeps on infinitely. READ command is applicable to "Up to 25 MHz operation".



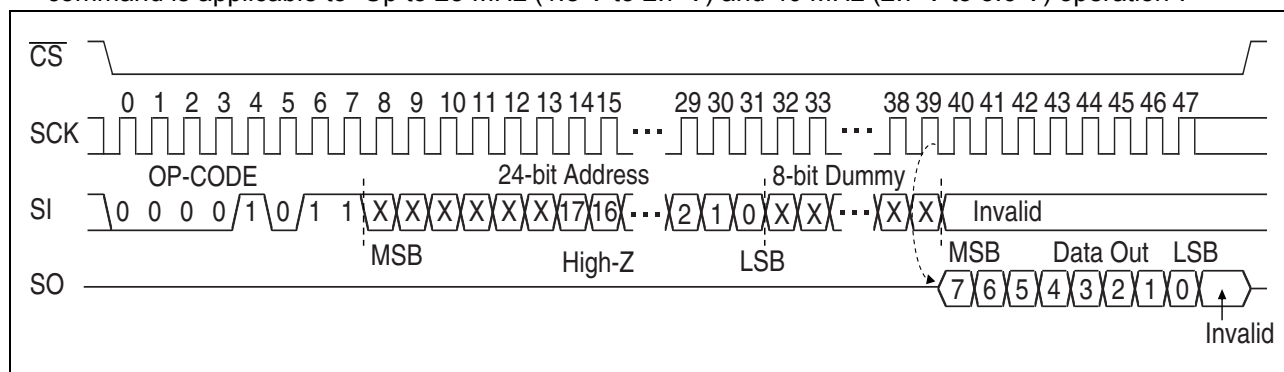
## • WRITE

The WRITE command writes data to FRAM memory cell array. WRITE op-code, arbitrary 24 bits of address and 8 bits of writing data are input to SI. The 6-bit upper address bit is invalid. When 8 bits of writing data is input, data is written to FRAM memory cell array. Risen  $\overline{CS}$  will terminate the WRITE command, but if you continue sending the writing data for 8 bits each before  $\overline{CS}$  rising, it is possible to continue writing with automatic address increment. When it reaches the most significant address, it rolls over to the starting address, and writing cycle can be continued infinitely. WRITE command is applicable to "Up to 25 MHz operation".



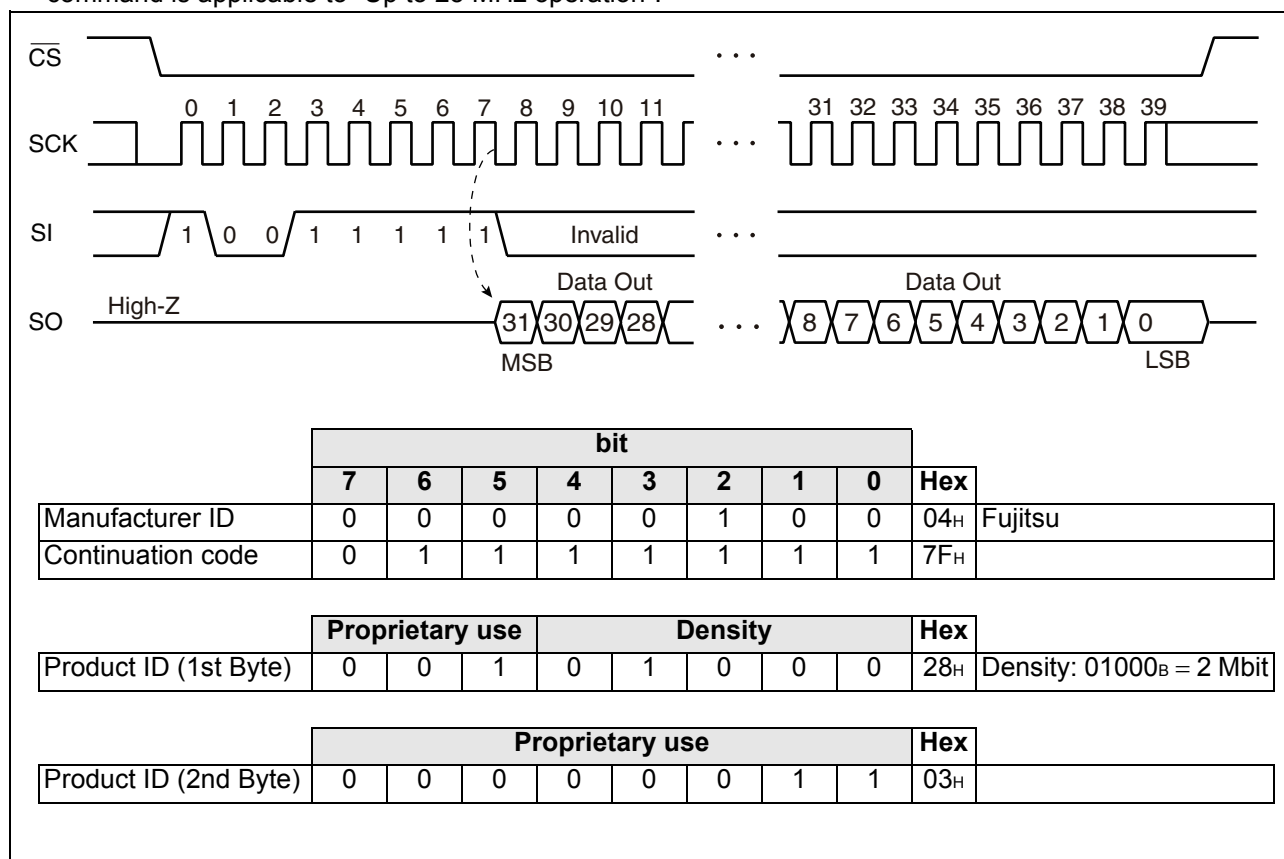
## • FSTRD

The FSTRD command reads FRAM memory cell array data. Arbitrary 24 bits address and op-code of FSTRD are input to SI followed by 8 bits dummy. The 6-bit upper address bit is invalid. Then, 8-cycle clock is input to SCK. SO is output synchronously to the falling edge of SCK. While reading, the SI value is invalid. When  $\overline{CS}$  is risen, the FSTRD command is completed, but keeps on reading with automatic address increment which is enabled by continuously sending clocks to SCK in unit of 8 cycles before  $\overline{CS}$  rising. When it reaches the most significant address, it rolls over to the starting address, and reading cycle keeps on infinitely. FSTRD command is applicable to “Up to 25 MHz (1.8 V to 2.7 V) and 40 MHz (2.7 V to 3.6 V) operation”.



## • RDID

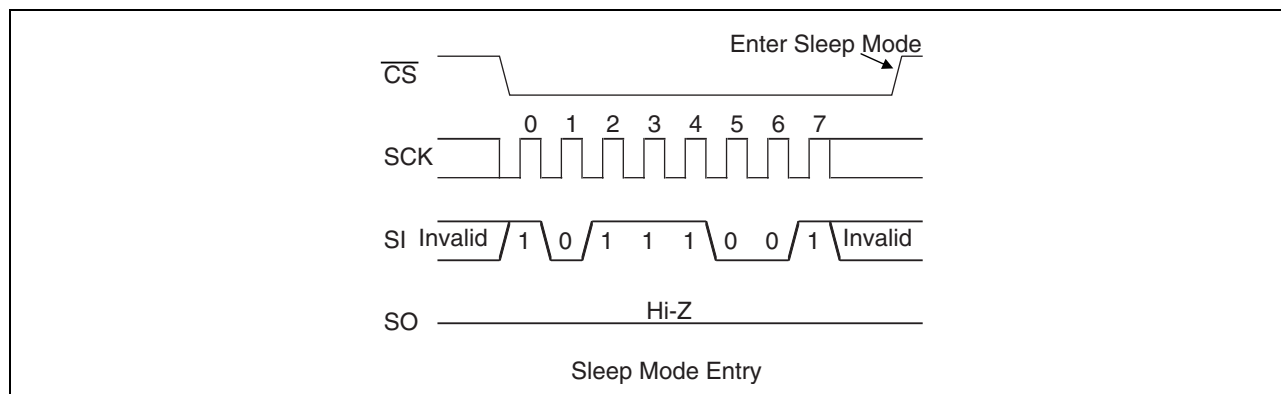
The RDID command reads fixed Device ID. After performing RDID op-code to SI, 32-cycle clock is input to SCK. The SI value is invalid for this time. SO is output synchronously to a falling edge of SCK. The output is in order of Manufacturer ID (8bit)/Continuation code (8bit)/Product ID (1st Byte)/Product ID (2nd Byte). In the RDID command, SO holds the output state of the last bit in 32-bit Device ID until  $\overline{CS}$  is risen. RDID command is applicable to “Up to 25 MHz operation”.



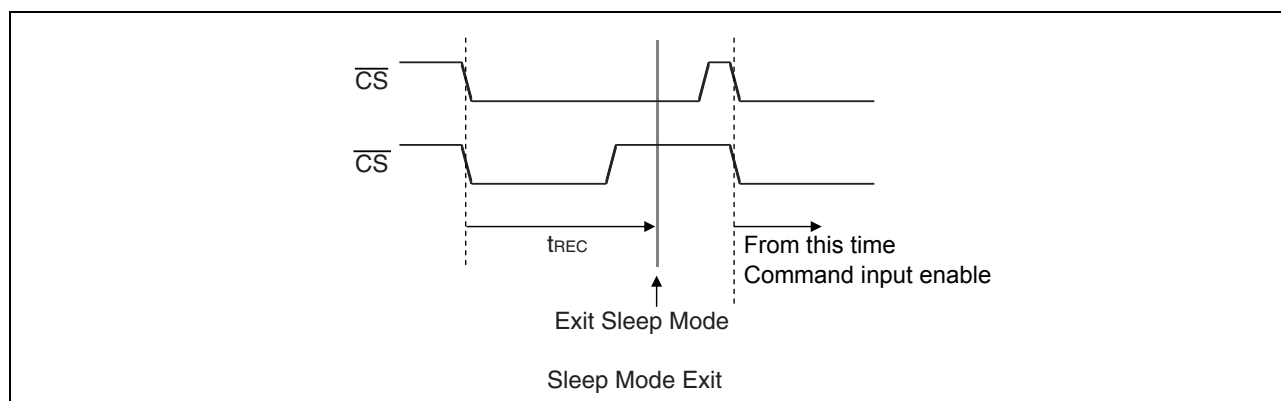
## • SLEEP

The SLEEP command shifts the LSI to a low power mode called “SLEEP mode”. The transition to the SLEEP mode is carried out at the rising edge of  $\overline{CS}$  after operation code in the SLEEP command. However, when at least one SCK clock is inputted before the rising edge of  $\overline{CS}$  after operation code in the SLEEP command, this SLEEP command is canceled.

After the SLEEP mode transition, SCK and SI inputs are ignored and SO changes to a Hi-Z state.



Returning to an normal operation from the SLEEP mode is carried out after  $t_{REC}$  (Max 400  $\mu$ s) time from the falling edge of  $\overline{CS}$  (see the figure below). It is possible to return  $\overline{CS}$  to H level before  $t_{REC}$  time. However, it is prohibited to bring down  $\overline{CS}$  to L level again during  $t_{REC}$  period.



## ■ BLOCK PROTECT

Writing protect block for WRITE command is configured by the value of BP0 and BP1 in the status register.

| BP1 | BP0 | Protected Block                                      |
|-----|-----|--|
| 0   | 0   | None   |
| 0   | 1   | 30000 <sub>H</sub> to 3FFFF <sub>H</sub> (upper 1/4) |
| 1   | 0   | 20000 <sub>H</sub> to 3FFFF <sub>H</sub> (upper 1/2) |
| 1   | 1   | 00000 <sub>H</sub> to 3FFFF <sub>H</sub> (all)       |

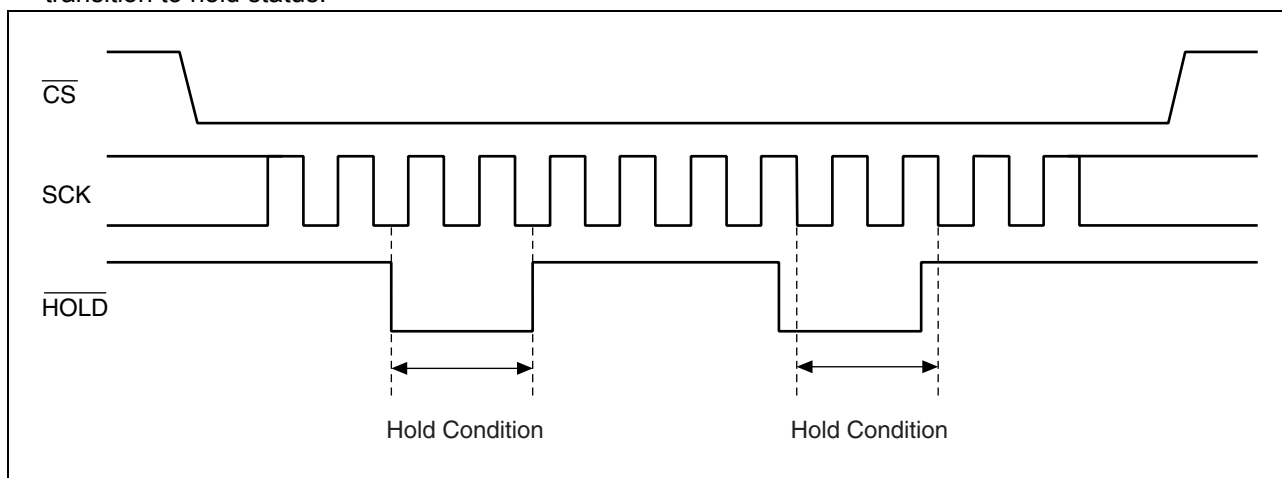
## ■ WRITING PROTECT

Writing operation of the WRITE command and the WRSR command are protected with the value of WEL, WPEN, WP as shown in the table.

| WEL | WPEN | WP | Protected Blocks | Unprotected Blocks | Status Register |
|-----|------|----|------------------|--------------------|-----------------|
| 0   | X    | X  | Protected        | Protected          | Protected       |
| 1   | 0    | X  | Protected        | Unprotected        | Unprotected     |
| 1   | 1    | 0  | Protected        | Unprotected        | Protected       |
| 1   | 1    | 1  | Protected        | Unprotected        | Unprotected     |

## ■ HOLD OPERATION

Hold status is retained without aborting a command if  $\overline{\text{HOLD}}$  is "L" level while  $\overline{\text{CS}}$  is "L" level. The timing for starting and ending hold status depends on the SCK to be "H" level or "L" level when a  $\overline{\text{HOLD}}$  pin input is transited to the hold condition as shown in the diagram below. In case the  $\overline{\text{HOLD}}$  pin transited to "L" level when SCK is "L" level, return the  $\overline{\text{HOLD}}$  pin to "H" level at SCK being "L" level. In the same manner, in case the  $\overline{\text{HOLD}}$  pin transited to "L" level when SCK is "H" level, return the  $\overline{\text{HOLD}}$  pin to "H" level at SCK being "H" level. Arbitrary command operation is interrupted in hold status, SCK and SI inputs become do not care. And, SO becomes High-Z while reading command (RDSR, READ). If  $\overline{\text{CS}}$  is rising during hold status, a command is aborted. In case the command is aborted before its recognition, WEL holds the value before transition to hold status.



## ■ ABSOLUTE MAXIMUM RATINGS

| Parameter                     | Symbol    | Rating |                | Unit |
|-------------------------------|-----------|--------|----------------|------|
|                               |           | Min    | Max            |      |
| Power supply voltage*         | $V_{DD}$  | − 0.5  | + 4.0          | V    |
| Input voltage*                | $V_{IN}$  | − 0.5  | $V_{DD} + 0.5$ | V    |
| Output voltage*               | $V_{OUT}$ | − 0.5  | $V_{DD} + 0.5$ | V    |
| Operation ambient temperature | $T_A$     | − 40   | + 85           | °C   |
| Storage temperature           | $T_{stg}$ | − 55   | + 125          | °C   |

\*:These parameters are based on the condition that  $V_{SS}$  is 0 V.

**WARNING:** Semiconductor devices may be permanently damaged by application of stress (including, without limitation, voltage, current or temperature) in excess of absolute maximum ratings.  
Do not exceed any of these ratings.

## ■ RECOMMENDED OPERATING CONDITIONS

| Parameter                                   | Symbol   | Value |     |      | Unit |
|---|----------|-------|-----|------|------|
|   |          | Min   | Typ | Max  |      |
| Power supply voltage <sup>*1</sup>          | $V_{DD}$ | 1.8   | 3.3 | 3.6  | V    |
| Operation ambient temperature <sup>*2</sup> | $T_A$    | − 40  | —   | + 85 | °C   |

\*1: These parameters are based on the condition that  $V_{SS}$  is 0 V.

\*2: Ambient temperature when only this device is working. Please consider it to be the almost same as the package surface temperature.

**WARNING:** The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated under these conditions.

Any use of semiconductor devices will be under their recommended operating condition.  
Operation under any conditions other than these conditions may adversely affect reliability of device and could result in device failure.

No warranty is made with respect to any use, operating conditions or combinations not represented on this data sheet. If you are considering application under any conditions other than listed herein, please contact sales representatives beforehand.

## ■ ELECTRICAL CHARACTERISTICS

### 1. DC Characteristics

(within recommended operating conditions)

| Parameter                              | Symbol     | Condition   | Value               |     |                     | Unit      |
|--|------------|---|---------------------|-----|---------------------|-----------|
|  |            |   | Min                 | Typ | Max                 |           |
| Input leakage current*1                | $ I_{LI} $ | $0 \leq \overline{CS} < V_{DD}$                                       | —                   | —   | 200                 | $\mu A$   |
|  |            | $\overline{CS} = V_{DD}$  | —                   | —   | 1                   |           |
|  |            | $\overline{WP}$ , $\overline{HOLD}$ , $SCK$<br>$SI = 0 V$ to $V_{DD}$ | —                   | —   | 1                   |           |
| Output leakage current*2               | $ I_{LO} $ | $SO = 0 V$ to $V_{DD}$  | —                   | —   | 1                   | $\mu A$   |
| Operating power supply current         | $I_{DD}$   | $SCK = 1 MHz$   | —                   | 0.8 | —                   | mA        |
|  |            | $SCK = 10 MHz$  | —                   | 2.6 | —                   | mA        |
|  |            | $SCK = 25 MHz$  | —                   | 5.6 | 10.6                | mA        |
| Standby current                        | $I_{SB}$   | $SCK = SI = \overline{CS} = V_{DD}$                                   | —                   | 35  | 150                 | $\mu A$   |
| Sleep current                          | $I_{ZZ}$   | $\overline{CS} = V_{DD}$<br>All inputs $V_{SS}$ or $V_{DD}$           | —                   | —   | 10                  | $\mu A$   |
| Input high voltage                     | $V_{IH}$   | $V_{DD} = 1.8 V$ to $3.6 V$   | $V_{DD} \times 0.7$ | —   | $V_{DD} + 0.5$      | V         |
| Input low voltage                      | $V_{IL}$   | $V_{DD} = 1.8 V$ to $3.6 V$   | $-0.5$              | —   | $V_{DD} \times 0.3$ | V         |
| Output high voltage                    | $V_{OH}$   | $I_{OH} = -2 mA$  | $V_{DD} - 0.5$      | —   | —                   | V         |
| Output low voltage                     | $V_{OL}$   | $I_{OL} = 2 mA$   | —                   | —   | 0.4                 | V         |
| Pull up resistance for $\overline{CS}$ | $R_P$      | —   | 18                  | 33  | 80                  | $k\Omega$ |

\*1 : Applicable pin :  $\overline{CS}$ ,  $\overline{WP}$ ,  $\overline{HOLD}$ ,  $SCK$ ,  $SI$

\*2 : Applicable pin :  $SO$

## 2. AC Characteristics

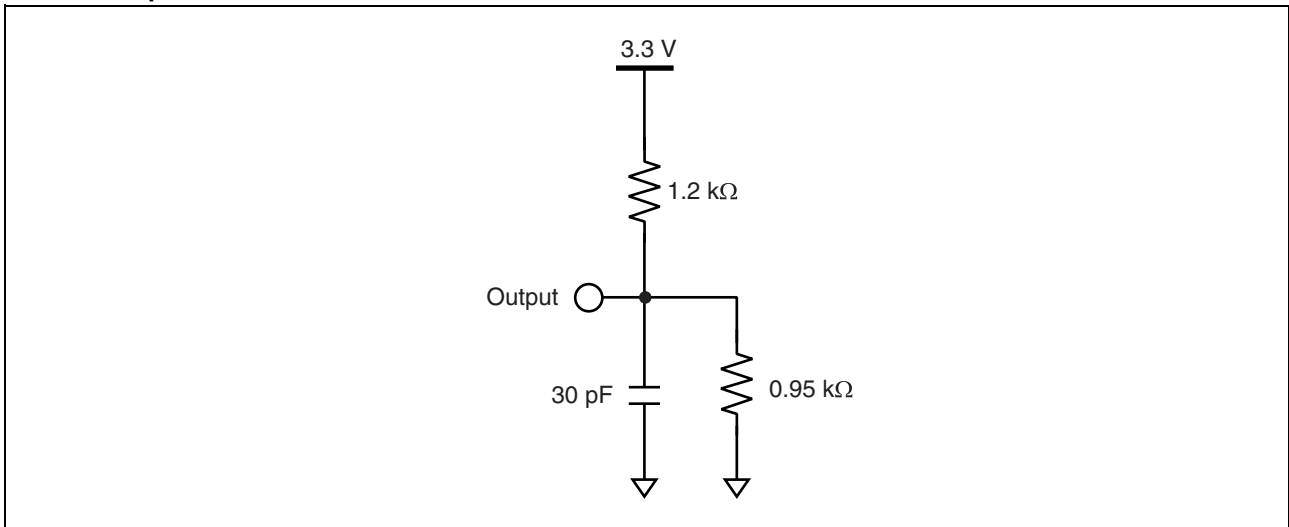
| Parameter   | Symbol           | Value                            |     |                                  |     | Unit |
|---|------------------|----------------------------------|-----|----------------------------------|-----|------|
|   |                  | Up to 25 MHz operation*          |     |                                  |     |      |
|   |                  | V <sub>DD</sub> = 1.8 V to 2.7 V |     | V <sub>DD</sub> = 2.7 V to 3.6 V |     |      |
|   |                  | Min                              | Max | Min                              | Max |      |
| SCK clock frequency<br>(All commands except FST-<br>RD command) | f <sub>CK</sub>  | 0                                | 25  | 0                                | 25  | MHz  |
| SCK clock frequency<br>(for FSTRD command)                      | f <sub>CK</sub>  | 0                                | 25  | 0                                | 40  | MHz  |
| Clock high time   | t <sub>CH</sub>  | 15                               | —   | 11                               | —   | ns   |
| Clock low time  | t <sub>CL</sub>  | 15                               | —   | 11                               | —   | ns   |
| Chip select set up time   | t <sub>CSU</sub> | 10                               | —   | 10                               | —   | ns   |
| Chip select hold time   | t <sub>CSH</sub> | 10                               | —   | 10                               | —   | ns   |
| Output disable time   | t <sub>OD</sub>  | —                                | 12  | -                                | 12  | ns   |
| Output data valid time  | t <sub>ODV</sub> | —                                | 18  | -                                | 9   | ns   |
| Output hold time  | t <sub>OH</sub>  | 0                                | —   | 0                                | —   | ns   |
| Deselect time   | t <sub>D</sub>   | 40                               | —   | 40                               | —   | ns   |
| Data in rising time   | t <sub>R</sub>   | —                                | 50  | -                                | 50  | ns   |
| Data falling time   | t <sub>F</sub>   | —                                | 50  | -                                | 50  | ns   |
| Data set up time  | t <sub>SU</sub>  | 5                                | —   | 5                                | —   | ns   |
| Data hold time  | t <sub>H</sub>   | 5                                | —   | 5                                | —   | ns   |
| HOLD set uptime   | t <sub>HS</sub>  | 10                               | —   | 10                               | —   | ns   |
| HOLD hold time  | t <sub>HH</sub>  | 10                               | —   | 10                               | —   | ns   |
| HOLD output floating time                                       | t <sub>HZ</sub>  | —                                | 20  | —                                | 20  | ns   |
| HOLD output active time   | t <sub>LZ</sub>  | —                                | 20  | —                                | 20  | ns   |
| SLEEP recovery time   | t <sub>REC</sub> | —                                | 400 | —                                | 400 | μs   |

\* : All commands except FSTRD are applicable to “Up to 25 MHz operation”.

### AC Test Condition

|                               |   |
|-------------------------------|---|
| Power supply voltage          | : 1.8 V to 3.6 V  |
| Operation ambient temperature | : - 40 °C to + 85 °C  |
| Input voltage magnitude       | : $V_{DD} \times 0.7 \leq V_{IH} \leq V_{DD}$<br>$0 \leq V_{IL} \leq V_{DD} \times 0.3$ |
| Input rising time             | : 5 ns  |
| Input falling time            | : 5 ns  |
| Input judge level             | : $V_{DD}/2$  |
| Output judge level            | : $V_{DD}/2$  |

## AC Load Equivalent Circuit



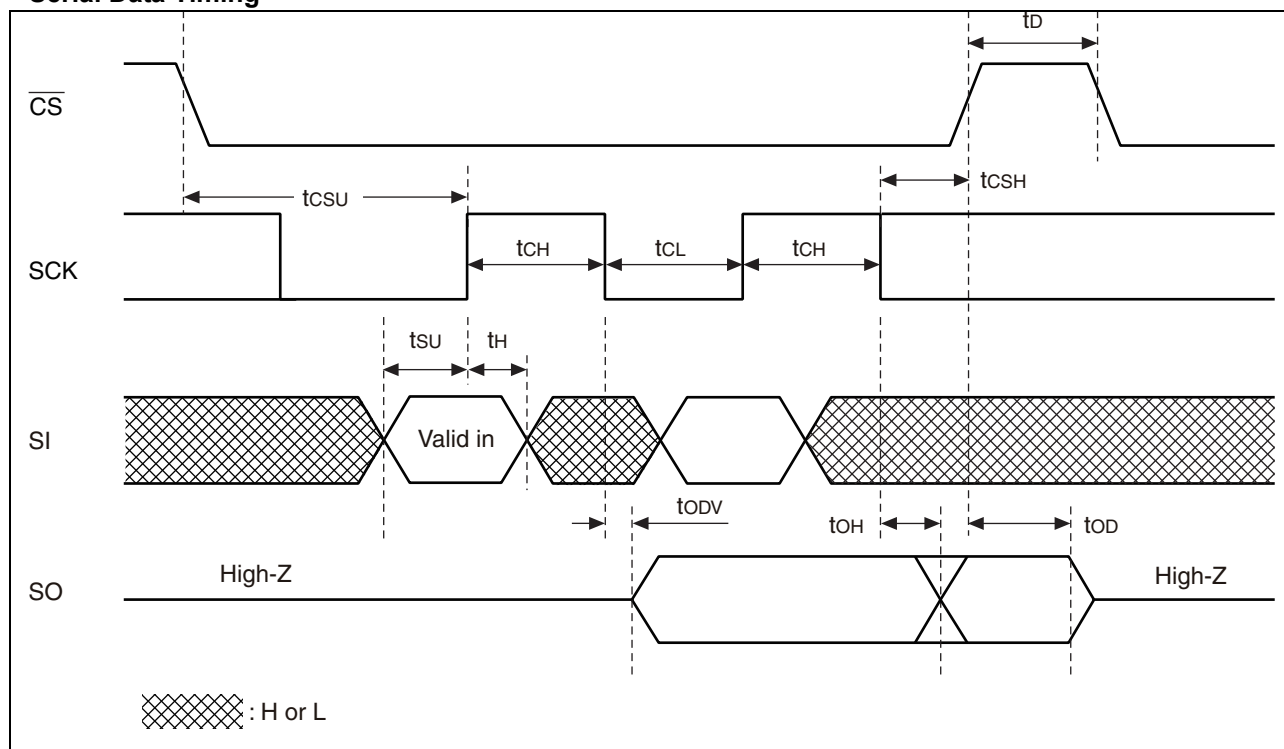
## 3. Pin Capacitance

| Parameter          | Symbol | Condition  | Value |     | Unit |
|--------------------|--------|--|-------|-----|------|
|                    |        |  | Min   | Max |      |
| Output capacitance | $C_o$  | $V_{DD} = V_{IN} = V_{OUT} = 0\text{ V}$ ,<br>$f = 1\text{ MHz}$ , $T_A = +25\text{ }^{\circ}\text{C}$ | —     | 6   | pF   |
| Input capacitance  | $C_i$  |  | —     | 8   | pF   |

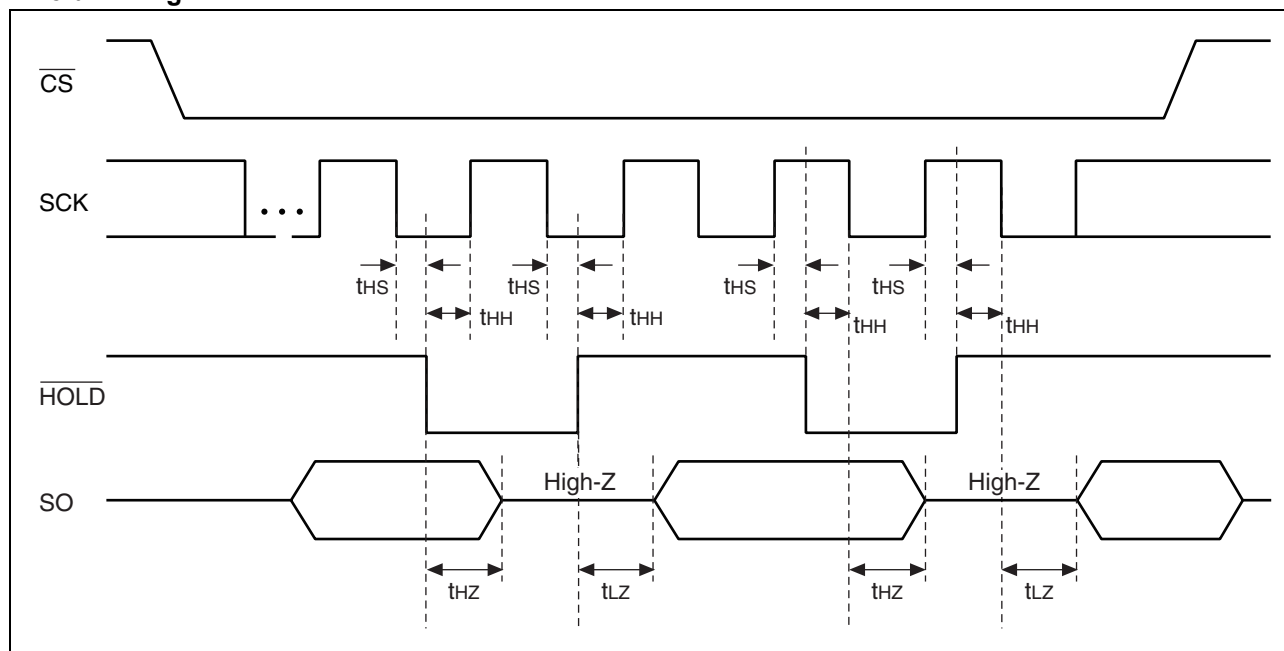


## ■ TIMING DIAGRAM

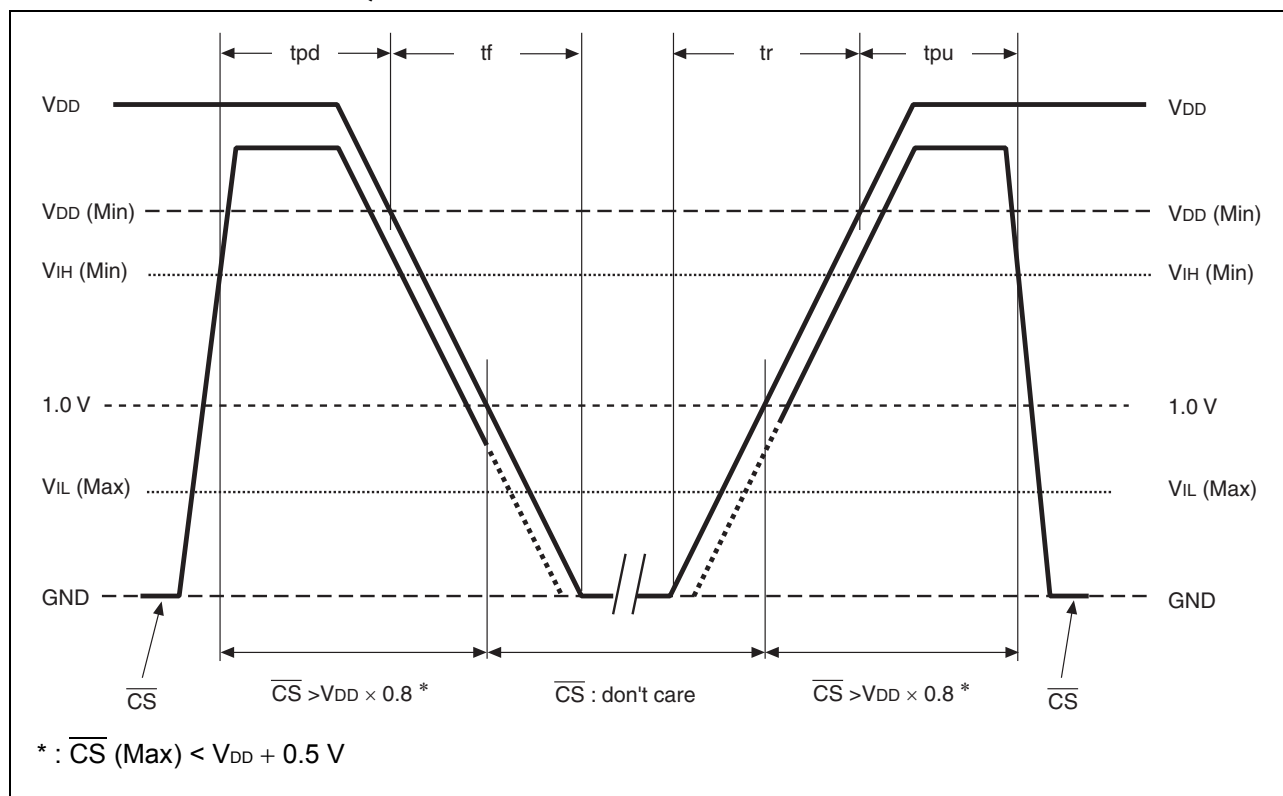
### • Serial Data Timing



### • Hold Timing



## ■ POWER ON/OFF SEQUENCE



| Parameter                                    | Symbol   | Value |     | Unit          |
|--|----------|-------|-----|---------------|
|  |          | Min   | Max |               |
| $\overline{CS}$ level hold time at power OFF | $t_{pd}$ | 400   | —   | ns            |
| $\overline{CS}$ level hold time at power ON  | $t_{pu}$ | 250   | —   | $\mu\text{s}$ |
| Power supply rising time                     | $t_r$    | 0.05  | —   | ms/V          |
| Power supply falling time                    | $t_f$    | 0.1   | —   | ms/V          |

If the device does not operate within the specified conditions of read cycle, write cycle or power on/off sequence, memory data can not be guaranteed.

## ■ FRAM CHARACTERISTICS

| Item                   | Min        | Max | Unit       | Parameter   |
|------------------------|------------|-----|------------|---|
| Read/Write Endurance*1 | $10^{13}$  | —   | Times/byte | Operation Ambient Temperature $T_A = +85^\circ\text{C}$ |
| Data Retention*2       | 10         | —   | Years      | Operation Ambient Temperature $T_A = +85^\circ\text{C}$ |
|                        | 95         | —   |            | Operation Ambient Temperature $T_A = +55^\circ\text{C}$ |
|                        | $\geq 200$ | —   |            | Operation Ambient Temperature $T_A = +35^\circ\text{C}$ |
|                        |            |     |            |   |

\*1 : Total number of reading and writing defines the minimum value of endurance, as an FRAM memory operates with destructive readout mechanism.

\*2 : Minimum values define retention time of the first reading/writing data right after shipment, and these values are calculated by qualification results.

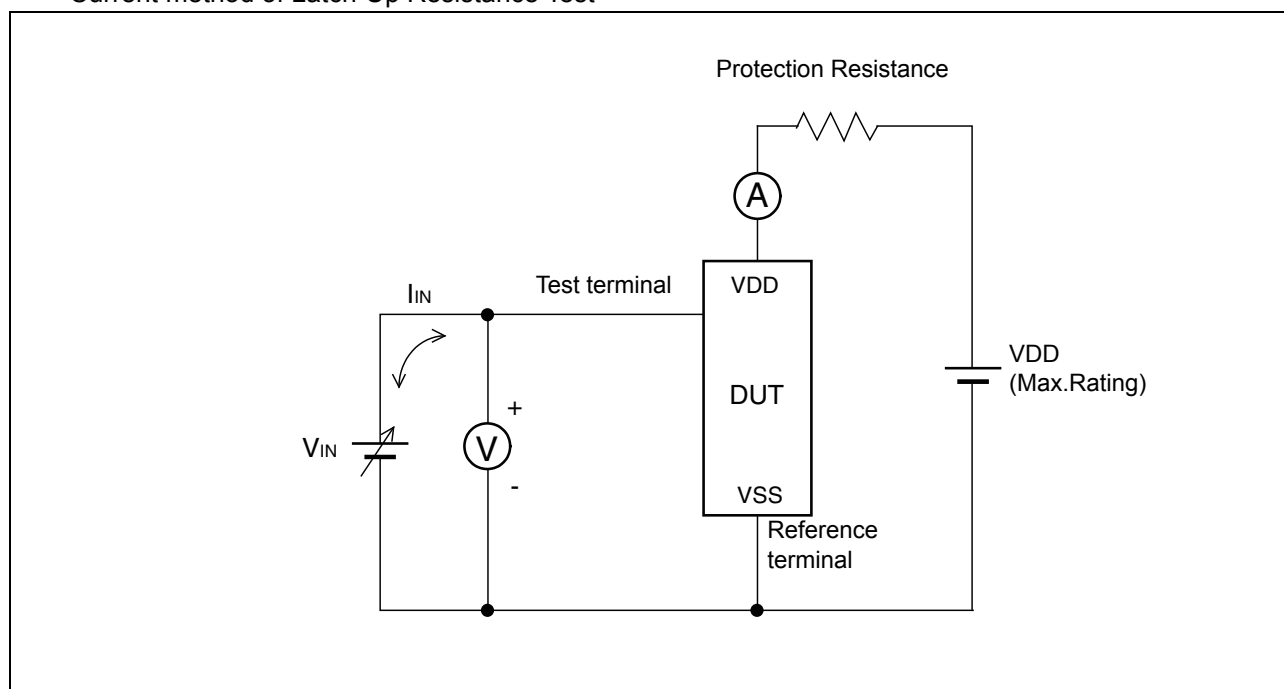
## ■ NOTE ON USE

We recommend programming of the device after reflow. Data written before reflow cannot be guaranteed.

## ■ ESD AND LATCH-UP

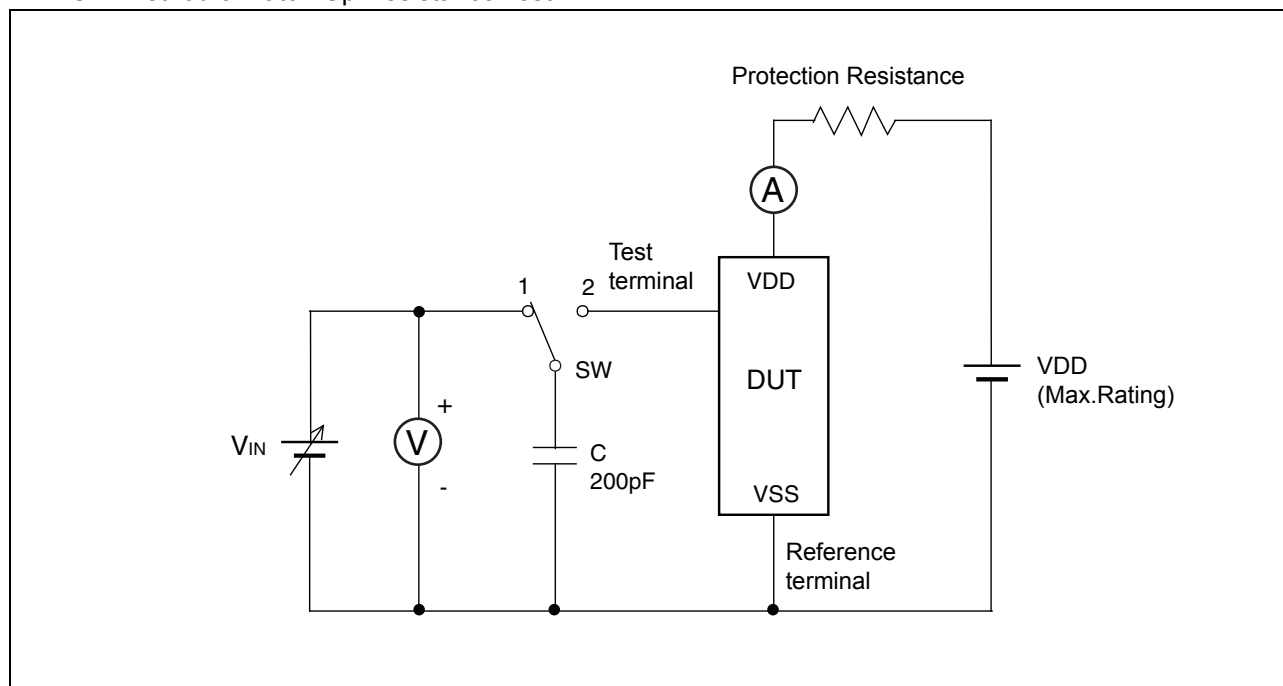
| Test   | DUT                                      | Value                   |
|--|--|-------------------------|
| ESD HBM (Human Body Model)<br>JESD22-A114 compliant                  | MB85RS2MTPF-G-JNE2<br>MB85RS2MTPH-G-JNE1 | $\geq  2000 \text{ V} $ |
| ESD MM (Machine Model)<br>JESD22-A115 compliant                      |  | $\geq  200 \text{ V} $  |
| ESD CDM (Charged Device Model)<br>JESD22-C101 compliant              |  | —                       |
| Latch-Up (I-test)<br>JESD78 compliant                                |  | —                       |
| Latch-Up ( $V_{\text{supply}}$ overvoltage test)<br>JESD78 compliant |  | —                       |
| Latch-Up (Current Method)<br>Proprietary method                      |  | —                       |
| Latch-Up (C-V Method)<br>Proprietary method                          |  | $\geq  200 \text{ V} $  |

### • Current method of Latch-Up Resistance Test



Note : The voltage  $V_{IN}$  is increased gradually and the current  $I_{IN}$  of 300 mA at maximum shall flow.  
 Confirm the latch up does not occur under  $I_{IN} = \pm 300 \text{ mA}$ .  
 In case the specific requirement is specified for I/O and  $I_{IN}$  cannot be 300 mA, the voltage shall be increased to the level that meets the specific requirement.

- C-V method of Latch-Up Resistance Test



Note : Charge voltage alternately switching 1 and 2 approximately 2 sec interval. This switching process is considered as one cycle. Repeat this process 5 times. However, if the latch-up condition occurs before completing 5times, this test must be stopped immediately.

## ■ REFLOW CONDITIONS AND FLOOR LIFE

[ JEDEC MSL ] : Moisture Sensitivity Level 3 (ISP/JEDEC J-STD-020D)

## ■ CURRENT STATUS ON CONTAINED RESTRICTED SUBSTANCES

This product complies with the regulations of REACH Regulations, EU RoHS Directive and China RoHS.

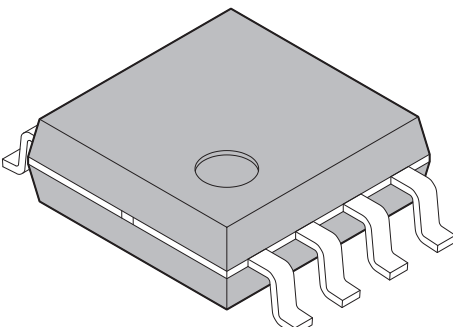
## ■ ORDERING INFORMATION

| Part number          | Package                           | Shipping form         | Minimum shipping quantity |
|----------------------|-----------------------------------|-----------------------|---------------------------|
| MB85RS2MTPF-G-JNE2   | 8-pin plastic SOP<br>(FPT-8P-M08) | Tube                  | — *                       |
| MB85RS2MTPF-G-JNERE2 | 8-pin plastic SOP<br>(FPT-8P-M08) | Embossed Carrier tape | 2000                      |
| MB85RS2MTPH-G-JNE1   | 8-pin plastic DIP<br>(DIP-8P-M03) | Tube                  | — *                       |

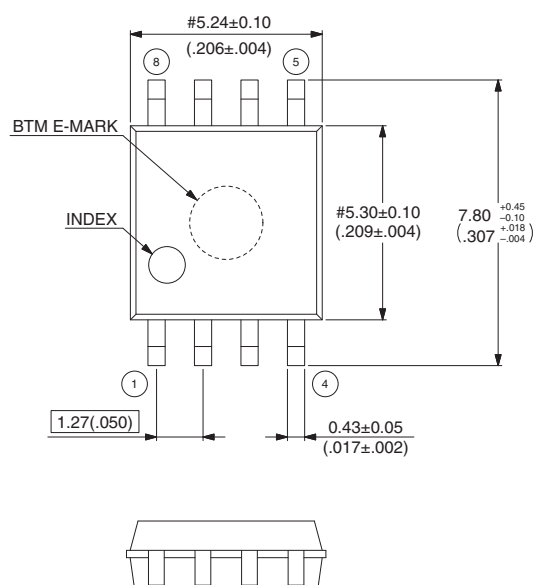
\* : Please contact our sales office about minimum shipping quantity.

# MB85RS2MT

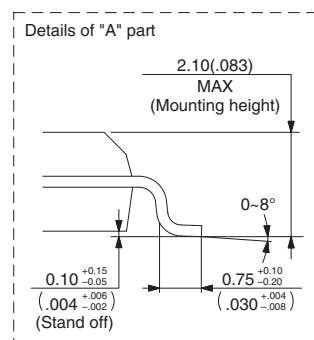
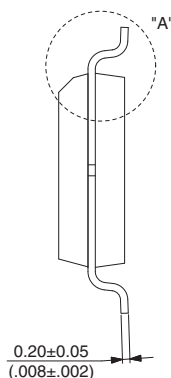
## ■ PACKAGE DIMENSION

|  |                                |                   |
|--|--------------------------------|-------------------|
|  <p>8-pin plastic SOP</p> <p>(FPT-8P-M08)</p> | Lead pitch                     | 1.27 mm           |
|  | Package width × package length | 5.30 mm × 5.24 mm |
|  | Lead shape                     | Gullwing          |
|  | Lead bend direction            | Normal bend       |
|  | Sealing method                 | Plastic mold      |
|  | Mounting height                | 2.10 mm Max       |
|  | Weight                         | 0.14 g            |

8-pin plastic SOP  
(FPT-8P-M08)



Note 1) Pins width and pins thickness include plating thickness.  
Note 2) Pins width do not include tie bar cutting remainder.  
Note 3) # : These dimensions do not include resin protrusion.

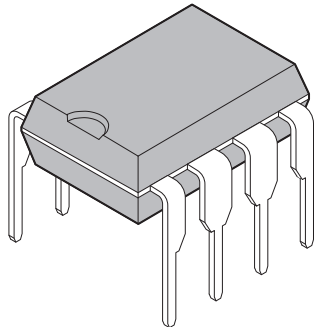


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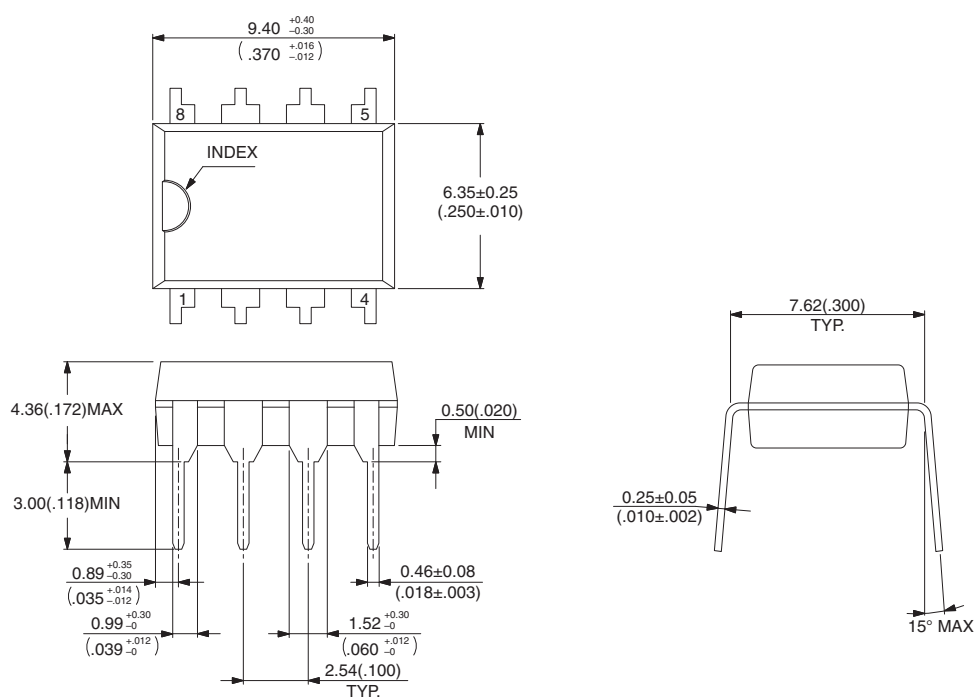
Dimensions in mm (inches).  
Note: The values in parentheses are reference values.

(Continued)

(Continued)

|  |                |              |
|--|----------------|--------------|
| <p>8-pin plastic DIP</p>  <p>(DIP-8P-M03)</p> | Lead pitch     | 2.54 mm      |
|  | Sealing method | Plastic mold |
|  | Weight         | 0.46 g       |
|  |                |              |
|  |                |              |
|  |                |              |
|  |                |              |

8-pin plastic DIP  
(DIP-8P-M03)

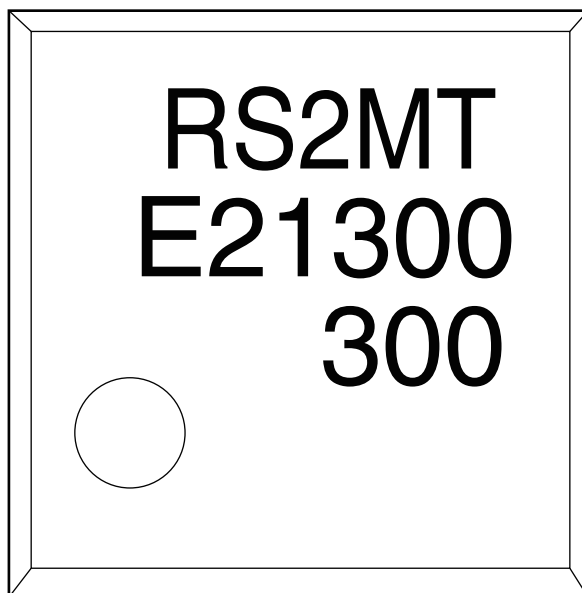


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Dimensions in mm (inches).  
Note: The values in parentheses are reference values

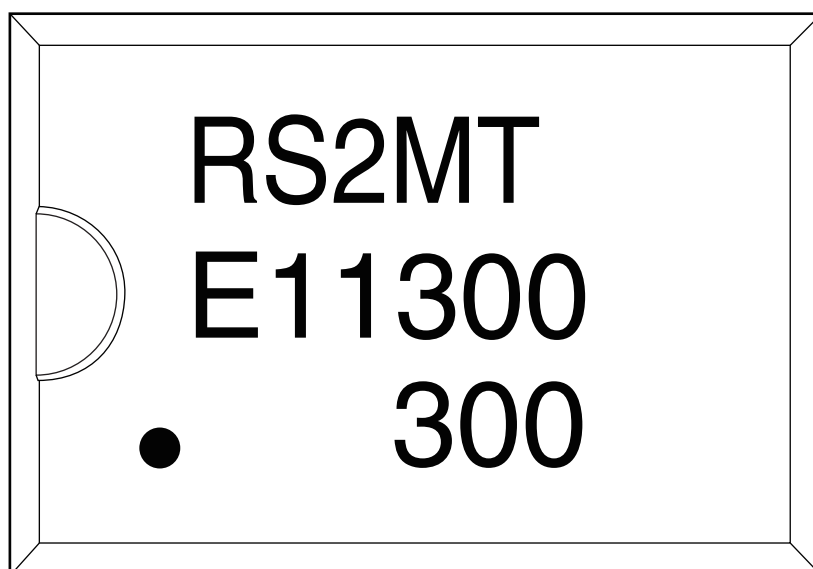
## ■ MARKING

[MB85RS2MTPF-G-JNE2]  
[MB85RS2MTPF-G-JNERE2]



[FPT-08P-M08]

[MB85RS2MTPH-G-JNE1]



[DIP-08P-M03]

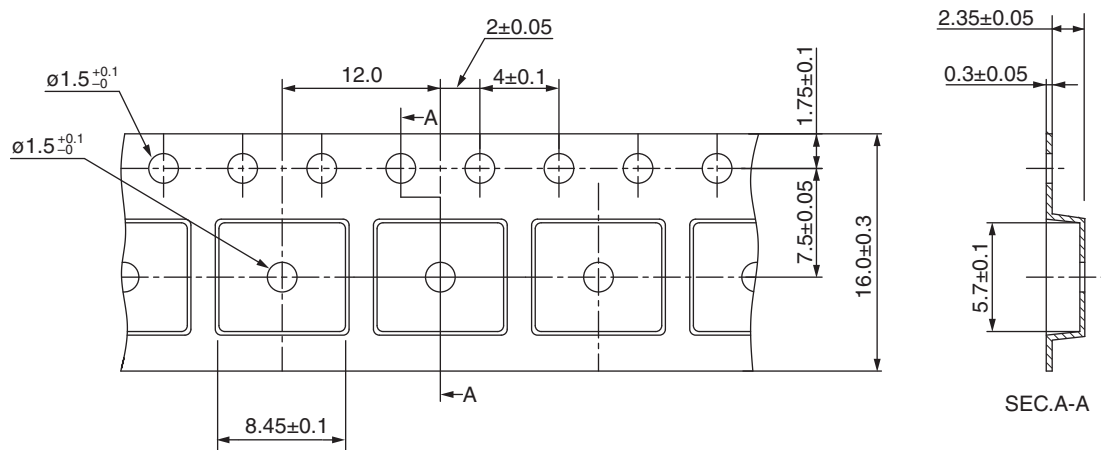


## ■ PACKING INFORMATION

### 1. Emboss Tape

#### 1.1 Tape Dimensions (FTP-8P-M08)

| PKG code   | Reel No | Maximum storage capacity |               |               |
|------------|---------|--------------------------|---------------|---------------|
|            |         | pcs/reel                 | pcs/inner box | pcs/outer box |
| FPT-8P-M08 | 5       | 2000                     | 2000          | 14000         |



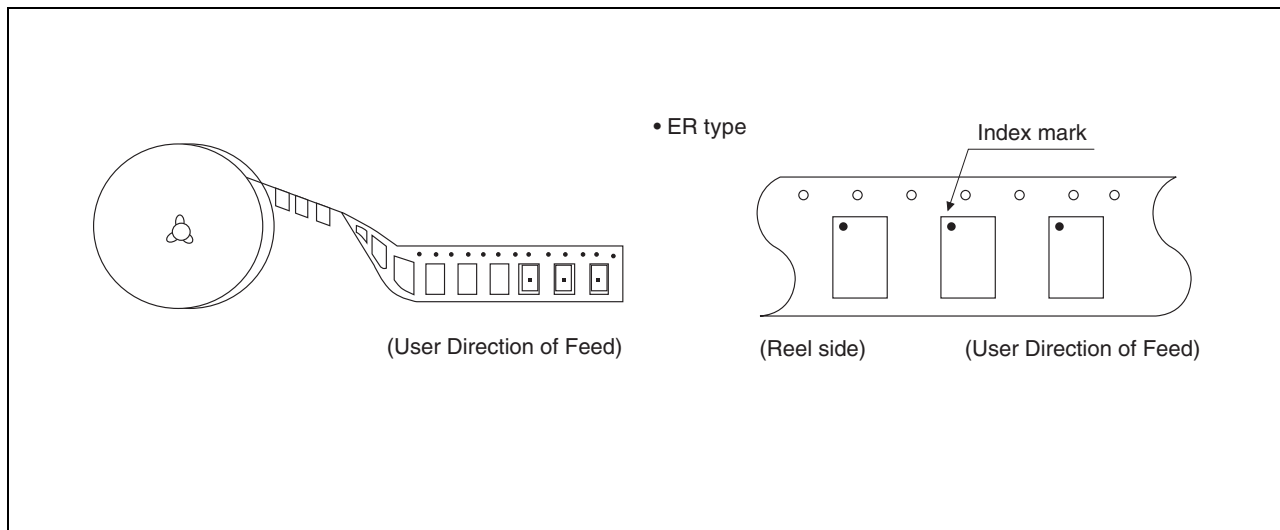
© 2012 FUJITSU SEMICONDUCTOR LIMITED SOL8-EMBOSSTAPE9 : NFME-EMB-X0084-1-P-1

(Dimensions in mm)

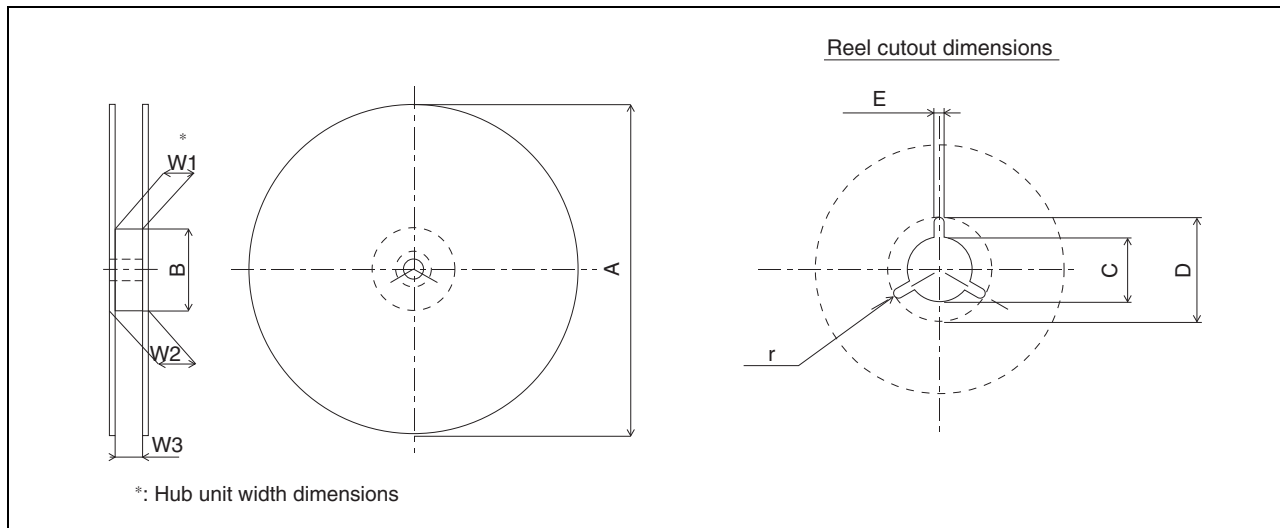
Material : Conductive polystyrene  
Heat proof temperature : No heat resistance. Package  
should not be baked by using tape and reel.

# MB85RS2MT

## 1.2 IC orientation

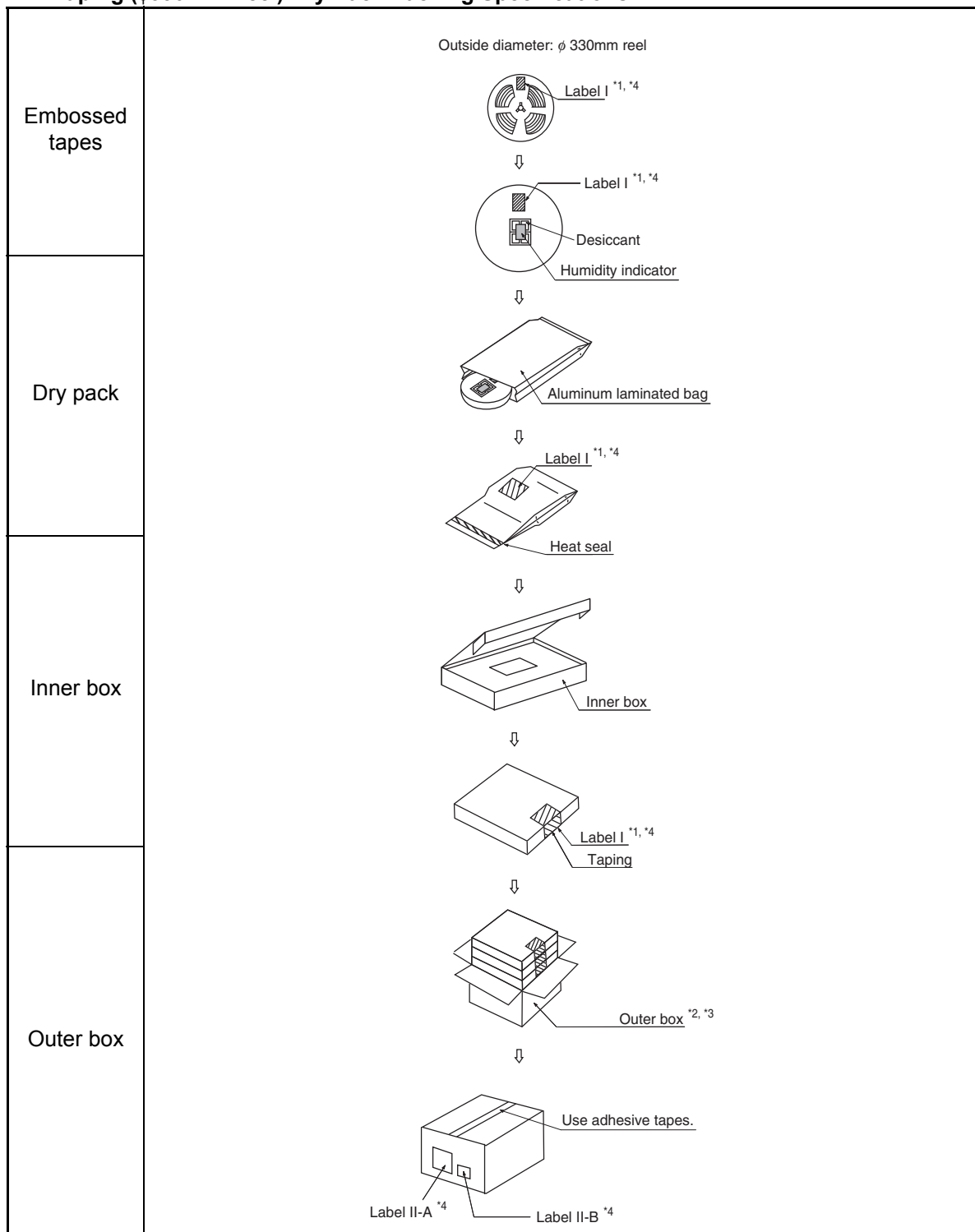


## 1.3 Reel dimensions



| Dimensions in mm     |                                 |                                  |         |                                  |         |                                  |         |                                  |                                 |                                  |     |                                  |                                    |                                  |                                    |
|----------------------|---------------------------------|----------------------------------|---------|----------------------------------|---------|----------------------------------|---------|----------------------------------|---------------------------------|----------------------------------|-----|----------------------------------|------------------------------------|----------------------------------|------------------------------------|
| Reel No              | 1                               | 2                                | 3       | 4                                | 5       | 6                                | 7       | 8                                | 9                               | 10                               | 11  | 12                               | 13                                 | 14                               | 15                                 |
| Tape width<br>Symbol | 8                               | 12                               |         | 16                               |         | 24                               |         | 32                               |                                 | 44                               |     | 56                               | 12                                 | 16                               | 24                                 |
| A                    | 254 ± 2                         | 254 ± 2                          | 330 ± 2 | 254 ± 2                          | 330 ± 2 | 254 ± 2                          | 330 ± 2 | 330 ± 2                          |                                 |                                  |     |                                  |                                    |                                  |                                    |
| B                    | 100 <sup>+2</sup> <sub>-0</sub> |                                  |         |                                  |         |                                  |         | 100 <sup>+2</sup> <sub>-0</sub>  | 150 <sup>+2</sup> <sub>-0</sub> | 100 <sup>+2</sup> <sub>-0</sub>  | 150 | 100 <sup>+2</sup> <sub>-0</sub>  | 100 ± 2                            |                                  |                                    |
| C                    | 13 ± 0.2                        |                                  |         |                                  |         |                                  |         |                                  |                                 |                                  |     |                                  | 13 <sup>+0.5</sup> <sub>-0.2</sub> |                                  |                                    |
| D                    | 21 ± 0.8                        |                                  |         |                                  |         |                                  |         |                                  |                                 |                                  |     |                                  | 20.5 <sup>+1</sup> <sub>-0.2</sub> |                                  |                                    |
| E                    | 2 ± 0.5                         |                                  |         |                                  |         |                                  |         |                                  |                                 |                                  |     |                                  |                                    |                                  |                                    |
| W1                   | 8.4 <sup>+2</sup> <sub>-0</sub> | 12.4 <sup>+2</sup> <sub>-0</sub> |         | 16.4 <sup>+2</sup> <sub>-0</sub> |         | 24.4 <sup>+2</sup> <sub>-0</sub> |         | 32.4 <sup>+2</sup> <sub>-0</sub> |                                 | 44.4 <sup>+2</sup> <sub>-0</sub> |     | 56.4 <sup>+2</sup> <sub>-0</sub> | 12.4 <sup>+1</sup> <sub>-0</sub>   | 16.4 <sup>+1</sup> <sub>-0</sub> | 24.4 <sup>+0.1</sup> <sub>-0</sub> |
| W2                   | less than 14.4                  | less than 18.4                   |         | less than 22.4                   |         | less than 30.4                   |         | less than 38.4                   |                                 | less than 50.4                   |     | less than 62.4                   | less than 18.4                     | less than 22.4                   | less than 30.4                     |
| W3                   | 7.9 ~ 10.9                      | 11.9 ~ 15.4                      |         | 15.9 ~ 19.4                      |         | 23.9 ~ 27.4                      |         | 31.9 ~ 35.4                      |                                 | 43.9 ~ 47.4                      |     | 55.9 ~ 59.4                      | 12.4 ~ 14.4                        | 16.4 ~ 18.4                      | 24.4 ~ 26.4                        |
| r                    | 1.0                             |                                  |         |                                  |         |                                  |         |                                  |                                 |                                  |     |                                  |                                    |                                  |                                    |

## 1.4 Taping (φ330mm Reel) Dry Pack Packing Specifications



\*1: For a product of witch part number is suffixed with “E1”, a “ ” marks is display to the moisture barrier bag and the inner boxes.

\*2: The size of the outer box may be changed depending on the quantity of inner boxes.

\*3: The space in the outer box will be filled with empty inner boxes, or cushions, etc.

\*4: Please refer to an attached sheet about the indication label.

: The packing specifications may not be applied when the product is delivered via a distributor.

## 1.5 Product label indicators

Label I: Label on Inner box/Moisture Barrier Bag/ (It sticks it on the reel for the emboss taping)  
[C-3 Label (50mm × 100mm) Supplemental Label (20mm × 100mm)]

|   |   |
|---|---|
| XXXXXXXXXXXXXXX (Customer part number or FJ part number)  | ← C-3 Label                               |
| (3N)1 XXXXXXXXXXXXXXX XXX (LEAD FREE mark)<br>XXXXXXXXXXXXXXXXXXXX (Part number and quantity)<br>QC PASS  |   |
| (3N)2 XXXXXXXXXXXXXXX XXXXXXX<br>XXXXXXXXXXXXXXXXXXXX (FJ control number)   |   |
| XXX pcs (Quantity)<br>XXXXXXXXXXXXXXXXXXXX (Customer part number or FJ part number)<br>XXXXXXXXXXXXXXXXXXXX (Customer part number or FJ part number bar code)<br>XXXX/XX/XX (Packed years/month/day) ASSEMBLED IN xxxx              |   |
| XXXXXXXXXXXXXXXXXXXX (Customer part number or FJ part number)<br>(FJ control number bar code)<br>XX/XX (Package count) XXXX-XXX XXX<br>XXXXXXXXXXXX (FJ control number) (Lot Number and quantity)<br>XXXXXXXXXXXXXXXXXXXX (Comment) | ← Perforated line<br>← Supplemental Label |

Label II-A: Label on Outer box [D Label] (100mm × 100mm)

|  |  |           |
|--|--|-----------|
| 発注者 XXXXXXXXXXXXXXX (Customer Name)<br>(CUST.)                               | 受注者 (VENDOR)<br>富士通  | ← D Label |
| 受渡場所名 XXXXXXXXXXX (Delivery Address)<br>(DELIVERY POINT)                     | セミコンダクター株式会社   |           |
| 納品キー番号 XXXXXXXXXXXXXXX<br>(TRANS.NO.) (FJ control number)                    | XXX (FJ control number)<br>XXX (FJ control number)<br>XXX (FJ control number)<br>XXXXXXXXXXXXXXXXXXXX<br>(Part number) |           |
| 品名コード XXXXXXXXXXXXXXX<br>(PART NO.) (Customer part number or FJ part number) |  |           |
| 品名 (PART NAME) XXXXXXXXXXXXXXX (Part number)                                 |  |           |
| 入数/納入数量 XXX/XXX<br>(Q'TY/TOTAL Q'TY)   | 単位 XX<br>(UNIT)  |           |
| 発注者用備考 (CUSTOMER'S REMARKS)<br>XXXXXXXXXXXXXXXXXXXX                          | 梱包個数 (PACKAGE COUNT)<br>XXX/XXX  |           |
| (3N)3 XXXXXXXXXXXXXXX XXX<br>XXXXXXXXXXXXXXXXXXXX                            | (FJ control number + Product quantity)<br>(FJ control number + Product quantity bar code)                              |           |
| (3N)4 XXXXXXXXXXXXXXX XXX<br>XXXXXXXXXXXXXXXXXXXX                            | (Part number + Product quantity)<br>(Part number + Product quantity bar code)  |           |
| (3N)5 XXXXXXXXXXXXXXX<br>XXXXXXXXXXXXXXXXXXXX                                | (FJ control number)<br>(FJ control number bar code)  |           |

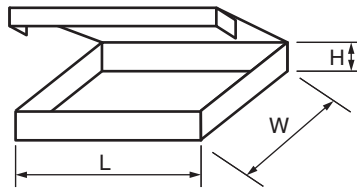
Label II-B: Outer boxes product indicate

|                               |         |            |
|-------------------------------|---------|------------|
| XXXXXXXXXXXXXXX (Part number) |         |            |
| (Lot Number)                  | (Count) | (Quantity) |
| XXXX-XXX                      | X 箱     | XXX 個      |
| XXXX-XXX                      | X 箱     | XXX 個      |
|                               | 計       | XXX 個      |

: Depending on shipment state, “Label II-A” and “Label II-B” on the external boxes might not be printed.

## 1.6 Dimensions for Containers

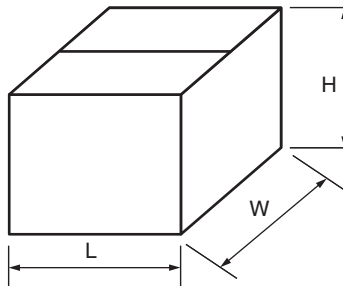
### (1) Dimensions for inner box



| Tape width | L   | W   | H  |
|------------|-----|-----|----|
| 16         | 365 | 345 | 40 |

(Dimensions in mm)

### (2) Dimensions for outer box



| L   | W   | H   |
|-----|-----|-----|
| 415 | 400 | 315 |

(Dimensions in mm)

## ■ MAJOR CHANGES IN THIS EDITION

A change on a page is indicated by a vertical line drawn on the left side of that page.

| Page | Section               | Change Results                           |
|------|-----------------------|--|
| 25   | ■ PACKING INFORMATION | Maximum storage capacity for FPT-8P-M08. |

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