

# Memory FRAM

## 256 K (32 K × 8) Bit SPI

# MB85RS256B

### ■ DESCRIPTION

MB85RS256B is a FRAM (Ferroelectric Random Access Memory) chip in a configuration of 32,768 words × 8 bits, using the ferroelectric process and silicon gate CMOS process technologies for forming the nonvolatile memory cells.

MB85RS256B adopts the Serial Peripheral Interface (SPI).

The MB85RS256B is able to retain data without using a back-up battery, as is needed for SRAM.

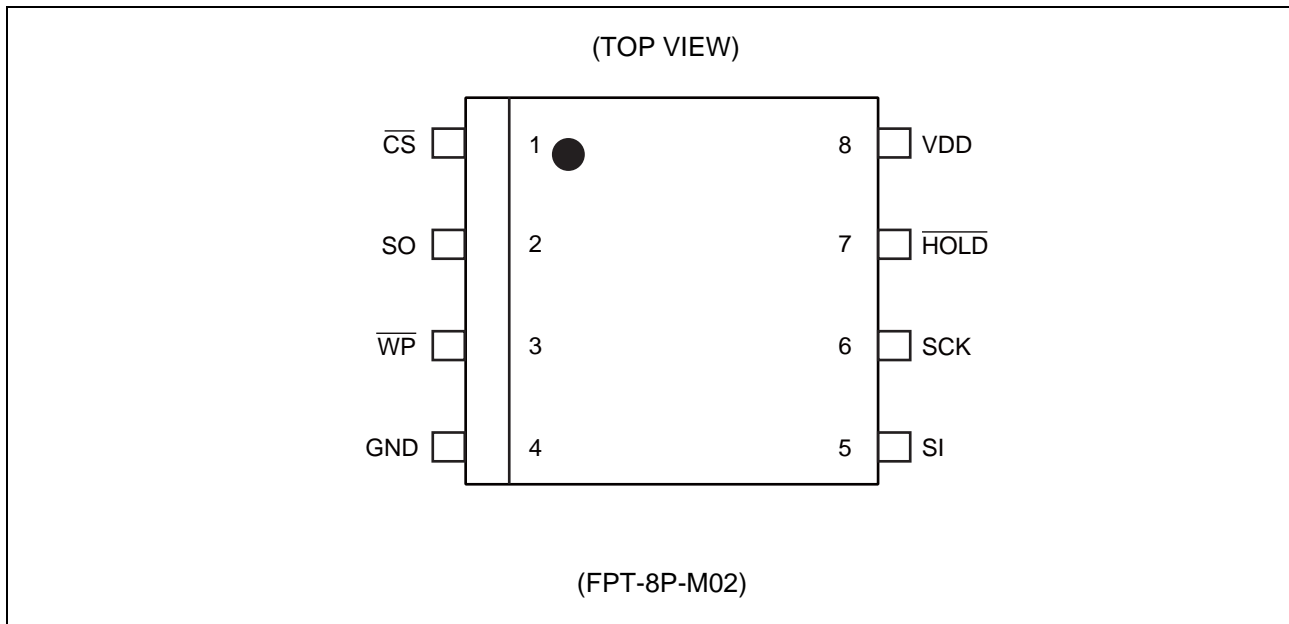
The memory cells used in the MB85RS256B can be used for  $10^{12}$  read/write operations, which is a significant improvement over the number of read and write operations supported by Flash memory and E<sup>2</sup>PROM.

MB85RS256B does not take long time to write data like Flash memories or E<sup>2</sup>PROM, and MB85RS256B takes no wait time.

### ■ FEATURES

- Bit configuration : 32,768 words × 8 bits
- Serial Peripheral Interface : SPI (Serial Peripheral Interface)  
Correspondent to SPI mode 0 (0, 0) and mode 3 (1, 1)
- Operating frequency : All commands except READ 33 MHz (Max)  
READ command 25 MHz (Max)
- High endurance :  $10^{12}$  times / byte
- Data retention : 10 years (+ 85 °C), 95 years (+ 55 °C), over 200 years (+ 35 °C)
- Operating power supply voltage : 2.7 V to 3.6 V
- Low power consumption : Operating power supply current 6 mA (Typ@33 MHz)  
Standby current 9 μA (Typ)
- Operation ambient temperature range : -40 °C to +85 °C
- Package : 8-pin plastic SOP (FPT-8P-M02)  
RoHS compliant

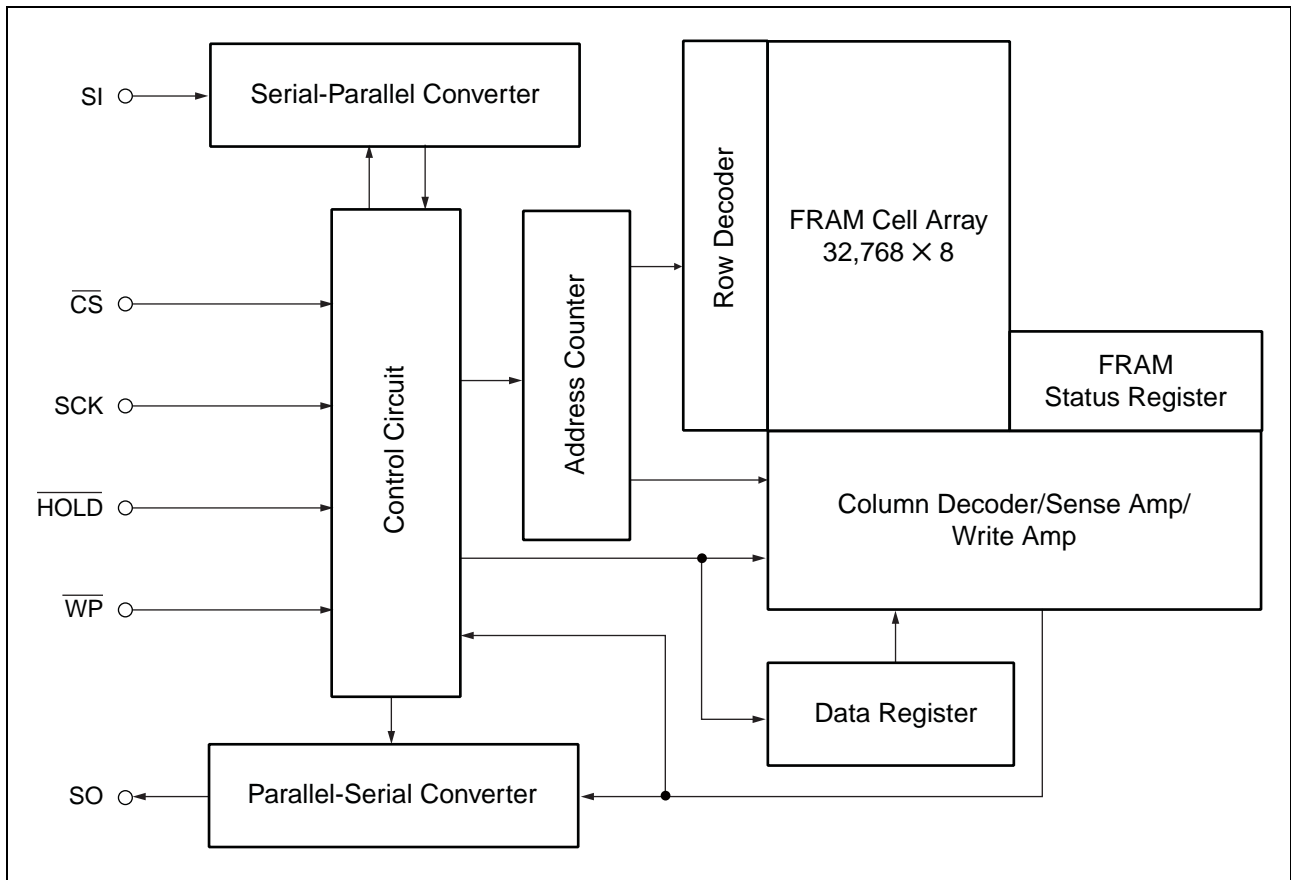
## ■ PIN ASSIGNMENT



## ■ 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 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. |
| 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, 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, 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       | 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       | GND               | Ground pin   |

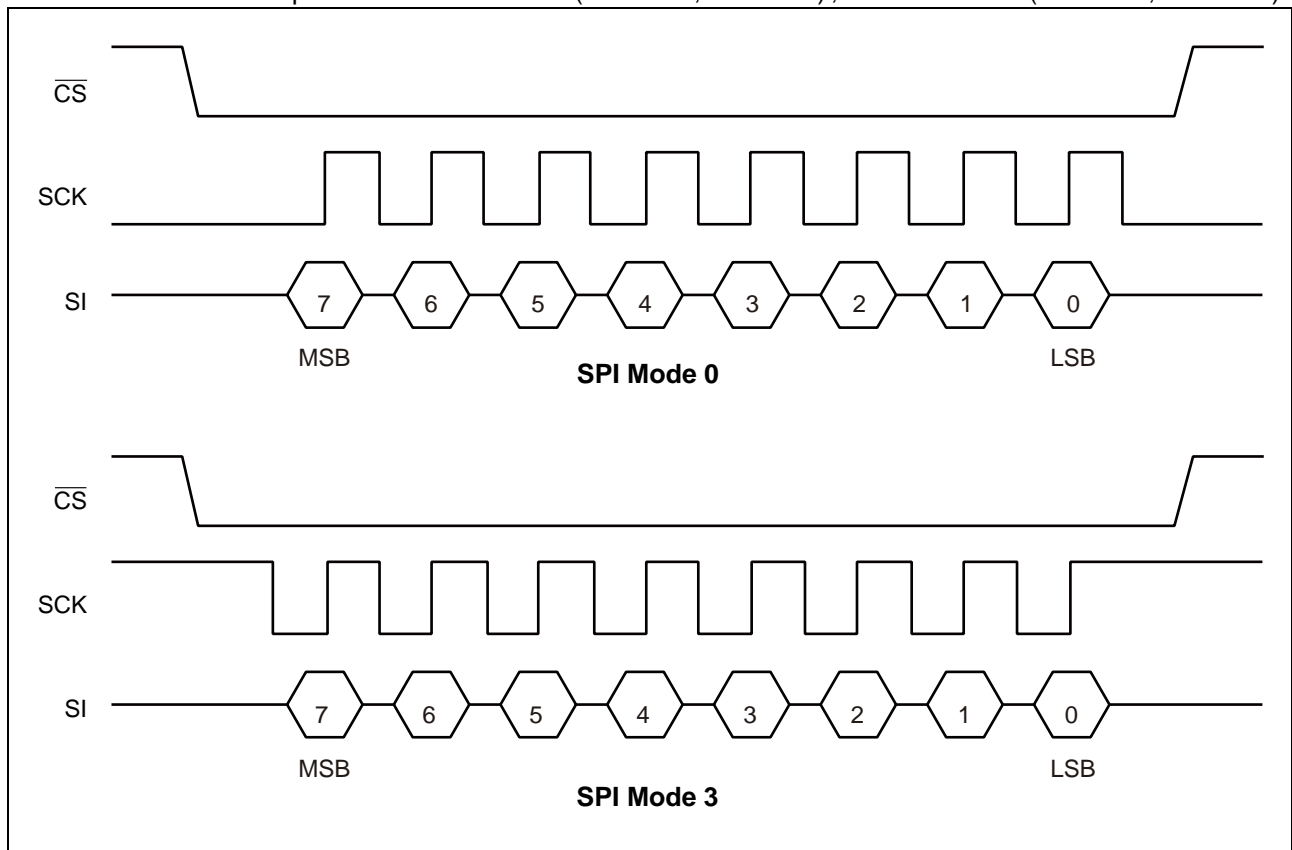
## ■ BLOCK DIAGRAM



# MB85RS256B

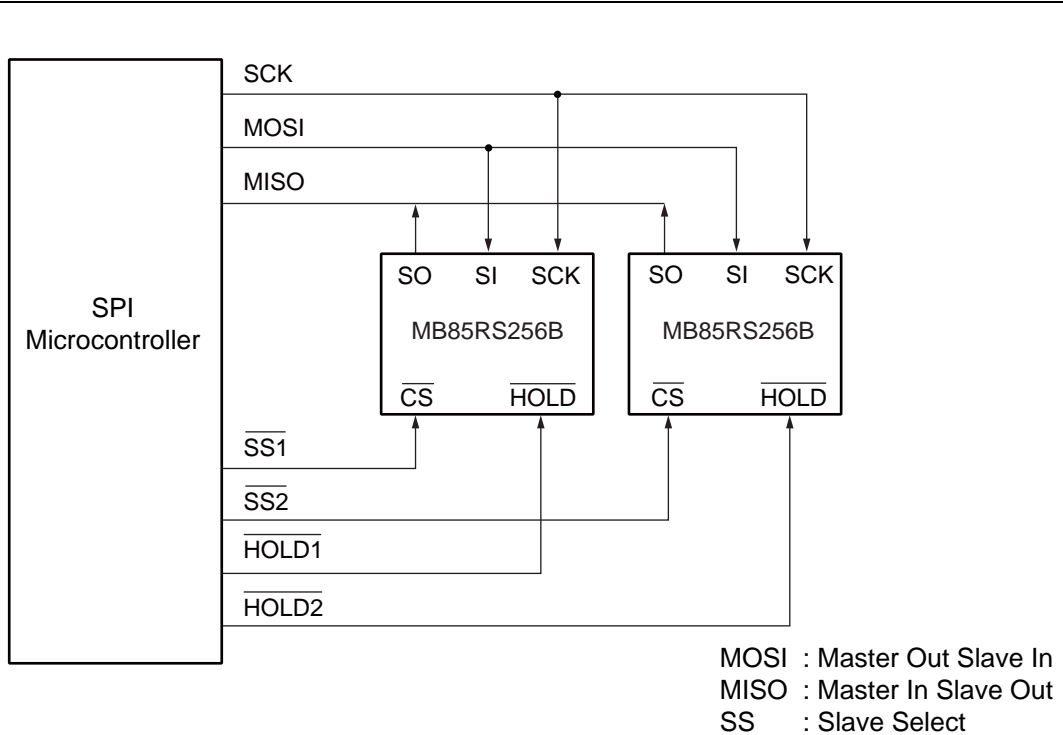
## ■ SPI MODE

MB85RS256B corresponds to the SPI mode 0 (CPOL = 0, CPHA = 0), and SPI mode 3 (CPOL = 1, CPHA = 1).

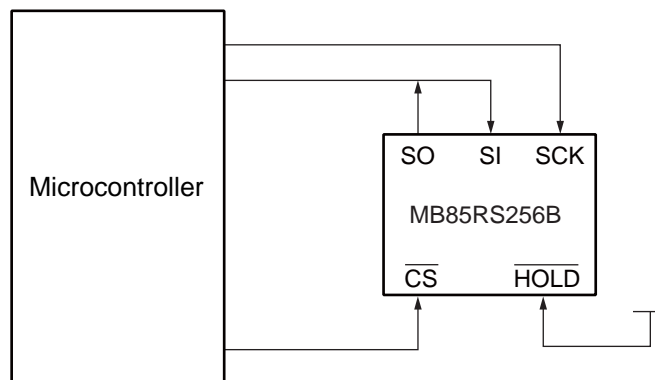


## ■ SERIAL PERIPHERAL INTERFACE (SPI)

MB85RS256B 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 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, and "000" is written before shipment. 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

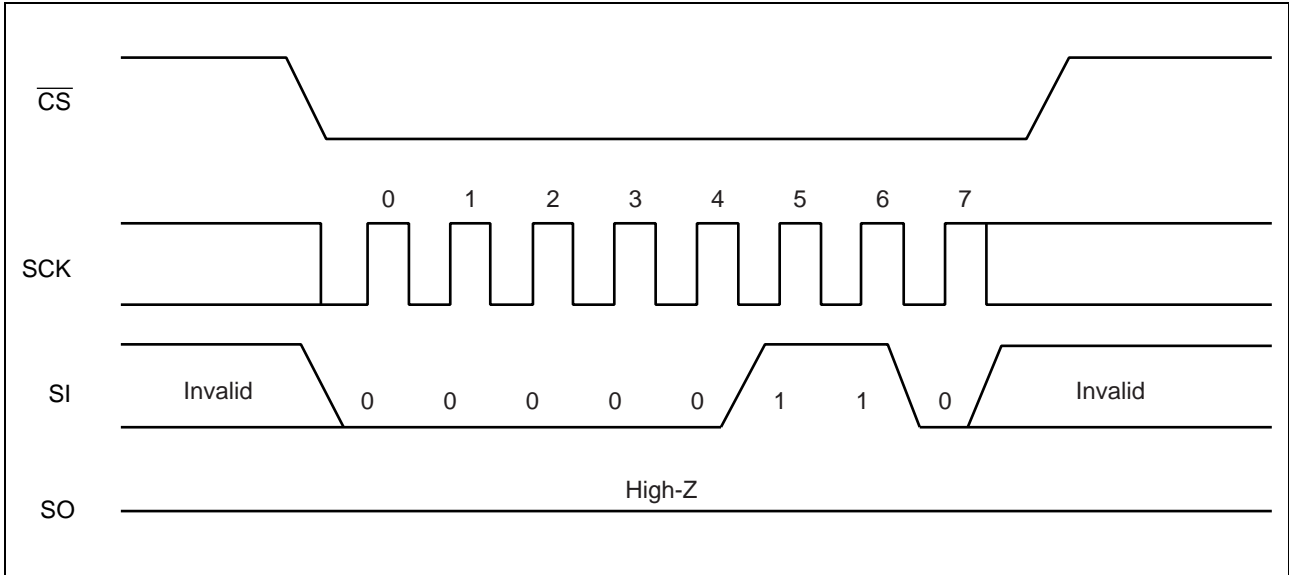
MB85RS256B accepts 8 kinds of command specified in op-code. Op-code is a code composed of 8 bits shown in the table below. Do not input invalid codes other than those codes. If  $\overline{CS}$  is risen while inputting op-code, the command are not performed.

| 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> |

## ■ COMMAND

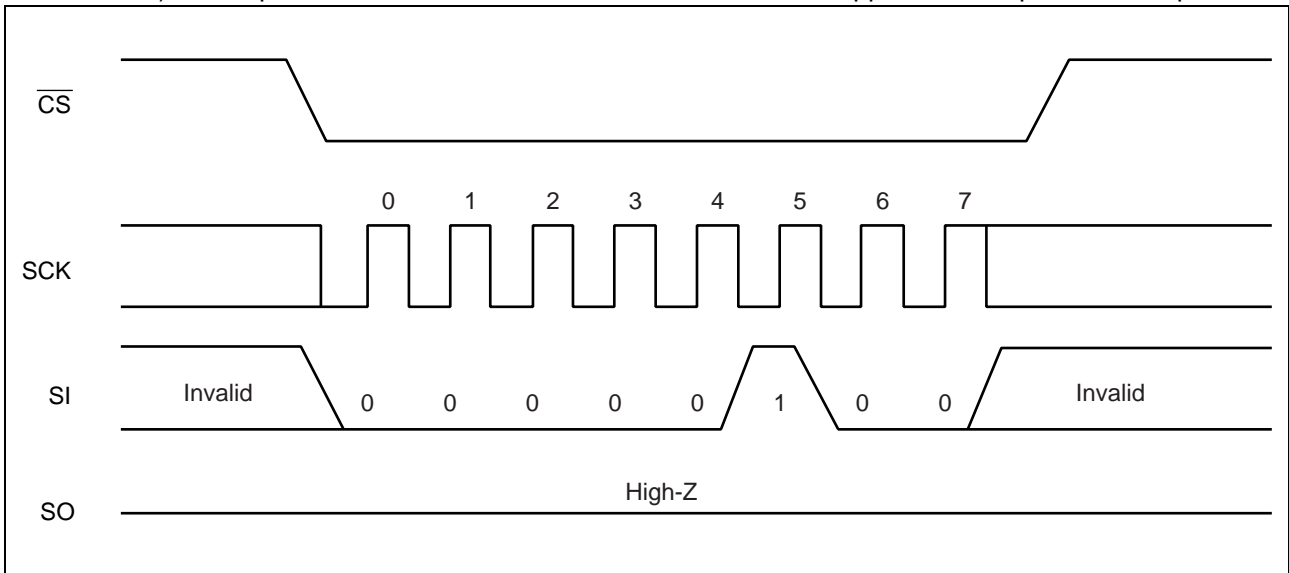
### • WREN

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 33 MHz operation".



### • WRDI

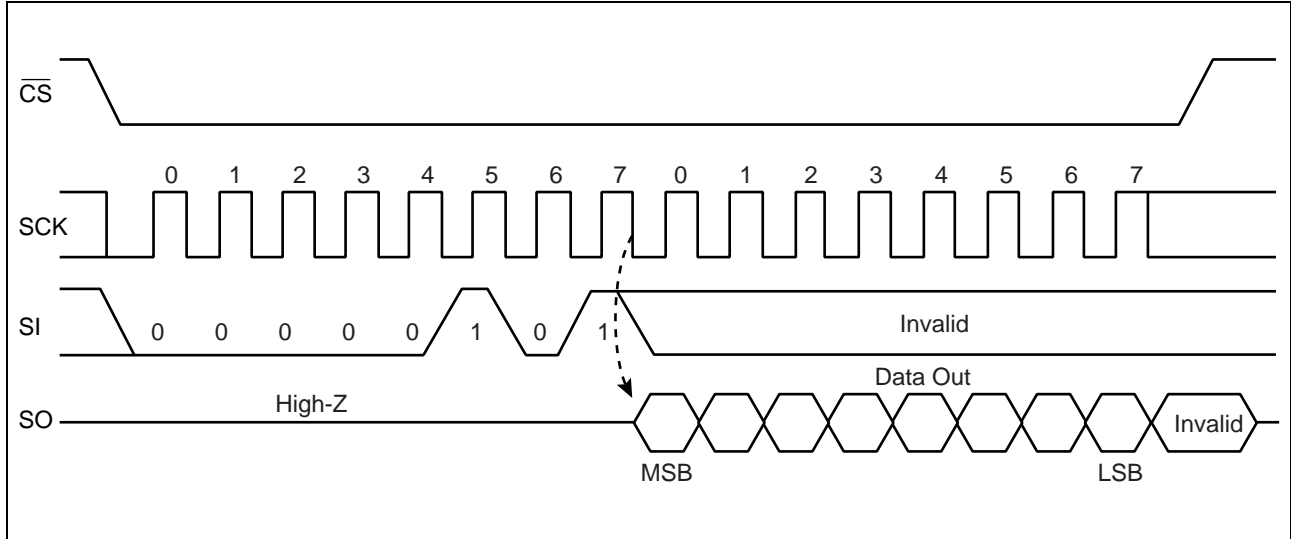
The WRDI command resets WEL (Write Enable Latch) . Writing operation (WRSR command and WRITE command) are not performed when WEL is reset. WRDI command is applicable to "Up to 33 MHz operation".



# MB85RS256B

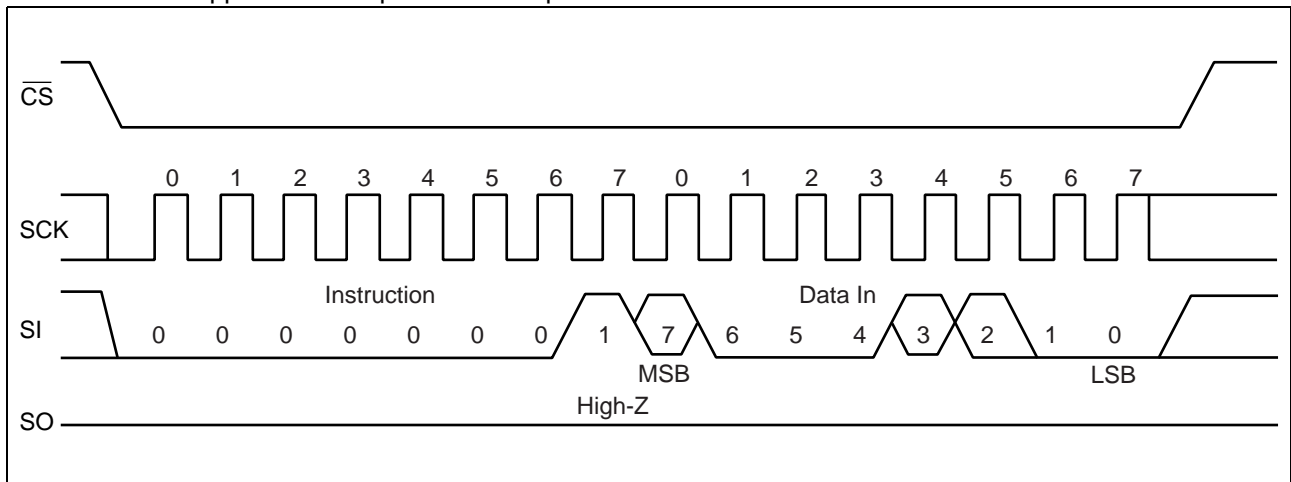
## • RDSR

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 33 MHz operation".



## • WRSR

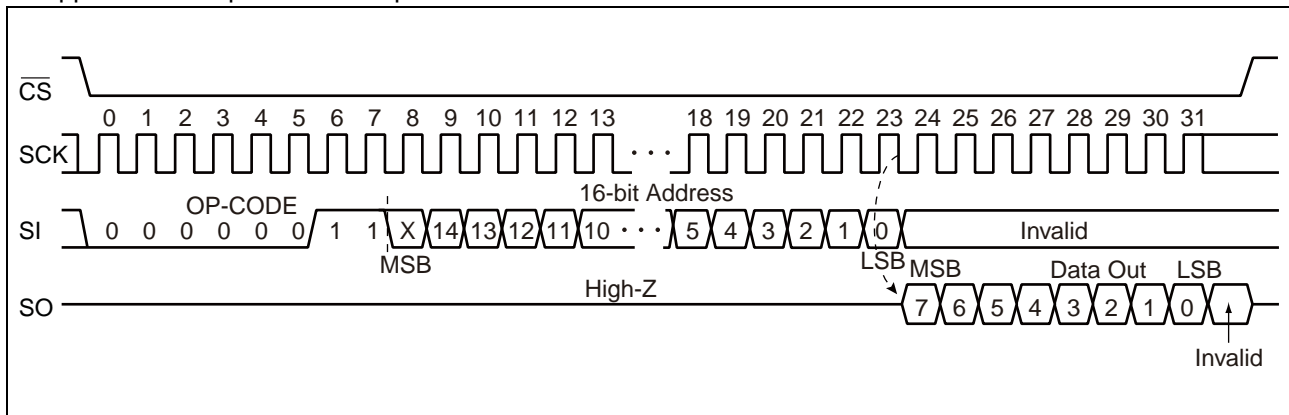
The WRSR command writes data to the nonvolatile memory bit of status register. After performing WRSR op-code to a SI pin, 8 bits writing data is input. WEL (Write Enable Latch) is not able to be written with WRSR command. A SI value correspondent to bit 1 is ignored. Bit 0 of the status register is fixed 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 33 MHz operation".





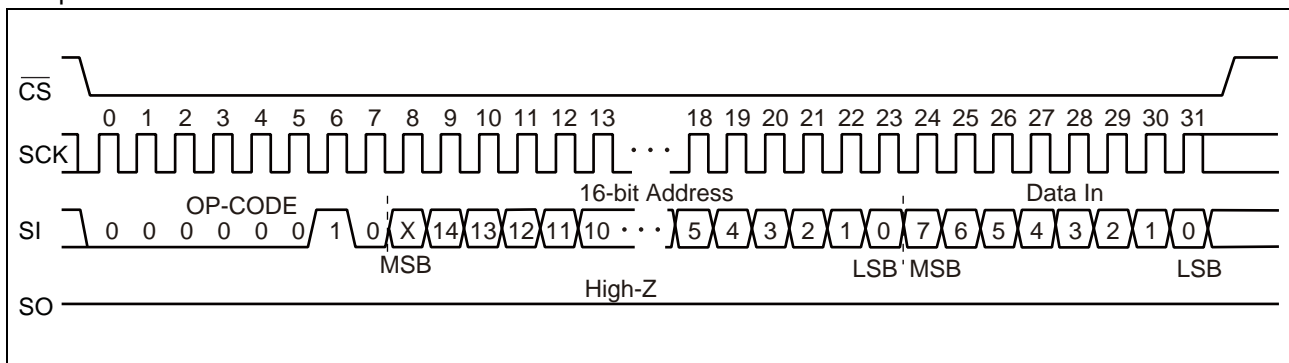
## • READ

The READ command reads FRAM memory cell array data. Arbitrary 16 bits address and op-code of READ are input to SI. The most significant 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

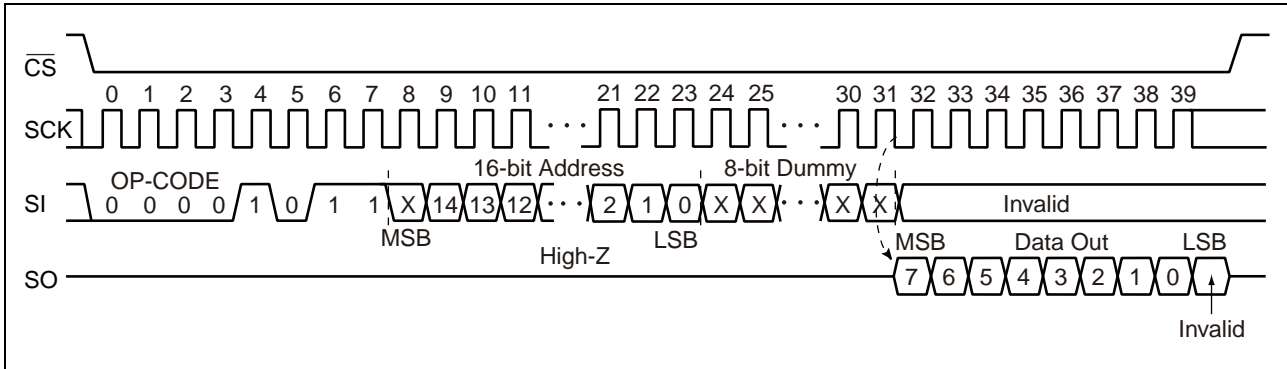
The WRITE command writes data to FRAM memory cell array. WRITE op-code, arbitrary 16 bits of address and 8 bits of writing data are input to SI. The most significant address bit is invalid. When 8 bits of writing data is input, data is written to FRAM memory cell array. Risen  $\overline{CS}$  will terminate 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 33MHz operation".



# MB85RS256B

## • FSTRD

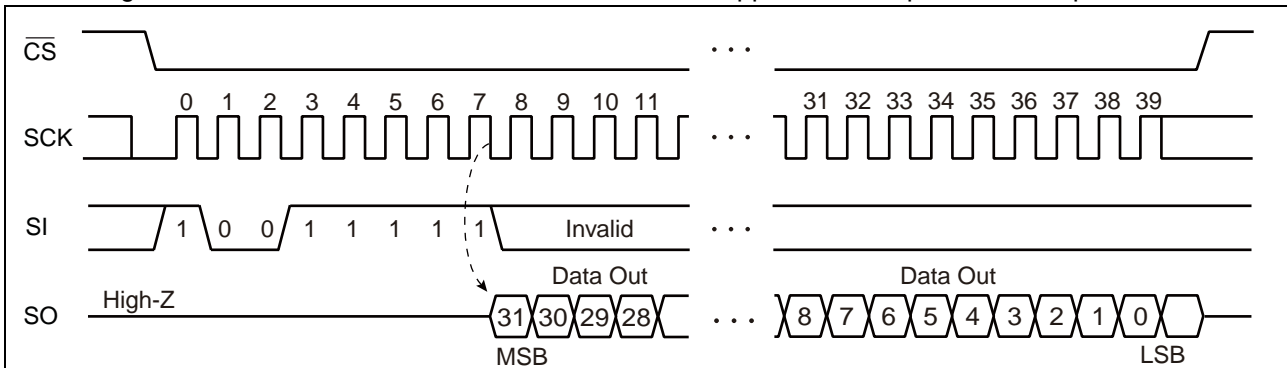
The FSTRD command reads FRAM memory cell array data. Arbitrary 16 bits address and op-code of FSTRD are input to SI followed by 8 bits dummy. The most significant address bit is invalid. Then, 8-cycle clock is input to SCK. SO is output synchronously to the falling edge of SCK. While reading, the SI 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 33 MHz 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). RDID command is applicable to “Up to 33 MHz operation”.

In the RDID command, SO holds the output state of the last bit after 32-bit Device ID output by continuously sending SCK clock before CS is risen. RDID command is applicable to “Up to 33 MHz operation”.



|                   | bit |   |   |   |   |   |   |   | Hex             |         |
|-------------------|-----|---|---|---|---|---|---|---|-----------------|---------|
|                   | 7   | 6 | 5 | 4 | 3 | 2 | 1 | 0 |                 |         |
| Manufacturer ID   | 0   | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 04 <sub>H</sub> | Fujitsu |
| Continuation code | 0   | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7F <sub>H</sub> |         |

|                       | Proprietary use |   |   |   | Density |   |   |   | Hex             |                                       |
|-----------------------|-----------------|---|---|---|---------|---|---|---|-----------------|---------------------------------------|
|                       | 7               | 6 | 5 | 4 | 3       | 2 | 1 | 0 |                 |                                       |
| Product ID (1st Byte) | 0               | 0 | 0 | 0 | 0       | 1 | 0 | 1 | 05 <sub>H</sub> | Density: 00101 <sub>B</sub> = 256kbit |

|                       | Proprietary use |   |   |   |   |   |   |   | Hex             |
|-----------------------|-----------------|---|---|---|---|---|---|---|-----------------|
| Product ID (2nd Byte) | 0               | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 09 <sub>H</sub> |

## ■ 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   | 6000 <sub>H</sub> to 7FFF <sub>H</sub> (upper 1/4) |
| 1   | 0   | 4000 <sub>H</sub> to 7FFF <sub>H</sub> (upper 1/2) |
| 1   | 1   | 0000 <sub>H</sub> to 7FFF <sub>H</sub> (all)       |

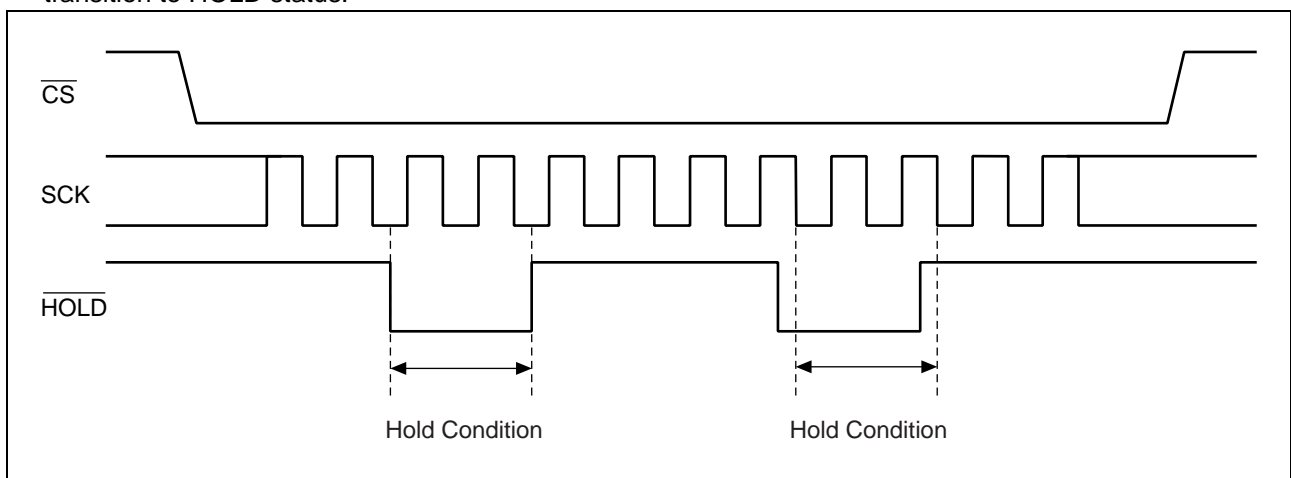
## ■ WRITING PROTECT

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

| WEL | WPEN | $\overline{WP}$ | 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  $\overline{HOLD}$  is "L" level while  $\overline{CS}$  is "L" level. The timing for starting and ending hold status depends on the SCK to be "H" level or "L" level when a  $\overline{HOLD}$  pin input is transitioned to the hold condition as shown in the diagram below. In case the  $\overline{HOLD}$  pin transitioned to "L" level when SCK is "L" level, return the  $\overline{HOLD}$  pin to "H" level at SCK being "L" level. In the same manner, in case the  $\overline{HOLD}$  pin transitioned to "L" level when SCK is "H" level, return the  $\overline{HOLD}$  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  $\overline{CS}$  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.



# MB85RS256B

## ■ 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 can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed these ratings.

## ■ RECOMMENDED OPERATING CONDITIONS

| Parameter                     | Symbol   | Value               |     |                | Unit |
|-------------------------------|----------|---------------------|-----|----------------|------|
|                               |          | Min                 | Typ | Max            |      |
| Power supply voltage*         | $V_{DD}$ | 2.7                 | 3.3 | 3.6            | V    |
| Input high voltage*           | $V_{IH}$ | $V_{DD} \times 0.8$ | —   | $V_{DD} + 0.5$ | V    |
| Input low voltage*            | $V_{IL}$ | - 0.5               | —   | + 0.6          | V    |
| Operation ambient temperature | $T_A$    | - 40                | —   | + 85           | °C   |

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

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 within these ranges.

Always use semiconductor devices within their recommended operating condition ranges. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their 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} $ | $V_{IN} = 0\text{ V to }V_{DD}$                               | —                   | —   | 10  | $\mu\text{A}$ |
| Output leakage current*2       | $ I_{LO} $ | $V_{OUT} = 0\text{ V to }V_{DD}$                              | —                   | —   | 10  | $\mu\text{A}$ |
| Operating power supply current | $I_{DD}$   | SCK = 25 MHz  | —                   | 4   | 5   | mA            |
|                                |            | SCK = 33 MHz  | —                   | 5   | 6   | mA            |
| Standby current                | $I_{SB}$   | All inputs $V_{SS}$ or<br>SCK = SI = $\overline{CS} = V_{DD}$ | —                   | 9   | 50  | $\mu\text{A}$ |
| Output high voltage            | $V_{OH}$   | $I_{OH} = -2\text{ mA}$                                       | $V_{DD} \times 0.8$ | —   | —   | V             |
| Output low voltage             | $V_{OL}$   | $I_{OL} = 2\text{ mA}$  | —                   | —   | 0.4 | V             |

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

\*2 : Applicable pin : SO

## 2. AC Characteristics

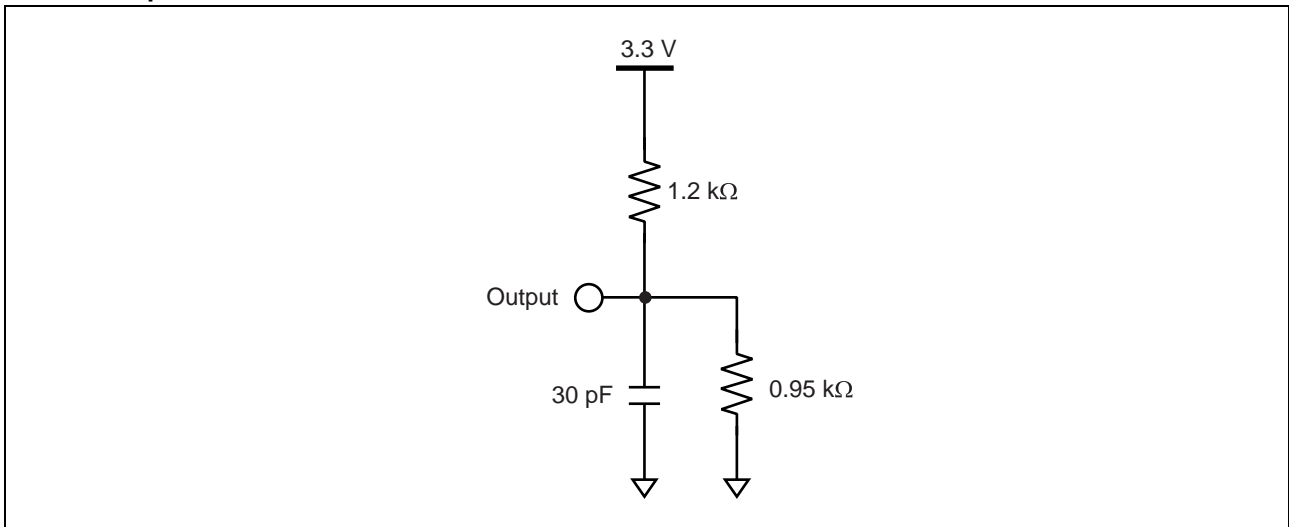
| Parameter                 | Symbol           | Value                 |     |                        |     | Unit |
|---------------------------|------------------|-----------------------|-----|------------------------|-----|------|
|                           |                  | Up to 25MHz operation |     | Up to 33MHz operation* |     |      |
|                           |                  | Min                   | Max | Min                    | Max |      |
| SCK clock frequency       | f <sub>CK</sub>  | 0                     | 25  | 0                      | 33  | MHz  |
| Clock high time           | t <sub>CH</sub>  | 20                    | —   | 15                     | —   | ns   |
| Clock low time            | t <sub>CL</sub>  | 20                    | —   | 15                     | —   | 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>  | —                     | 20  | —                      | 20  | ns   |
| Output data valid time    | t <sub>ODV</sub> | —                     | 18  | —                      | 13  | ns   |
| Output hold time          | t <sub>OH</sub>  | 0                     | —   | 0                      | —   | ns   |
| Deselect time             | t <sub>D</sub>   | 60                    | —   | 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 up time          | 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   |

\* : All commands except READ are applicable to “Up to 33 MHz operation”.  
 READ command is applicable to “Up to 25MHz operation”.

### AC Test Condition

|                               |                      |
|-------------------------------|----------------------|
| Power supply voltage          | : 2.7 V to 3.6 V     |
| Operation ambient temperature | : - 40 °C to + 85 °C |
| Input voltage magnitude       | : 0.3 V to 2.7 V     |
| Input rising time             | : 5 ns               |
| Input falling time            | : 5 ns               |
| Input judge level             | : V <sub>DD</sub> /2 |
| Output judge level            | : V <sub>DD</sub> /2 |

## AC Load Equivalent Circuit

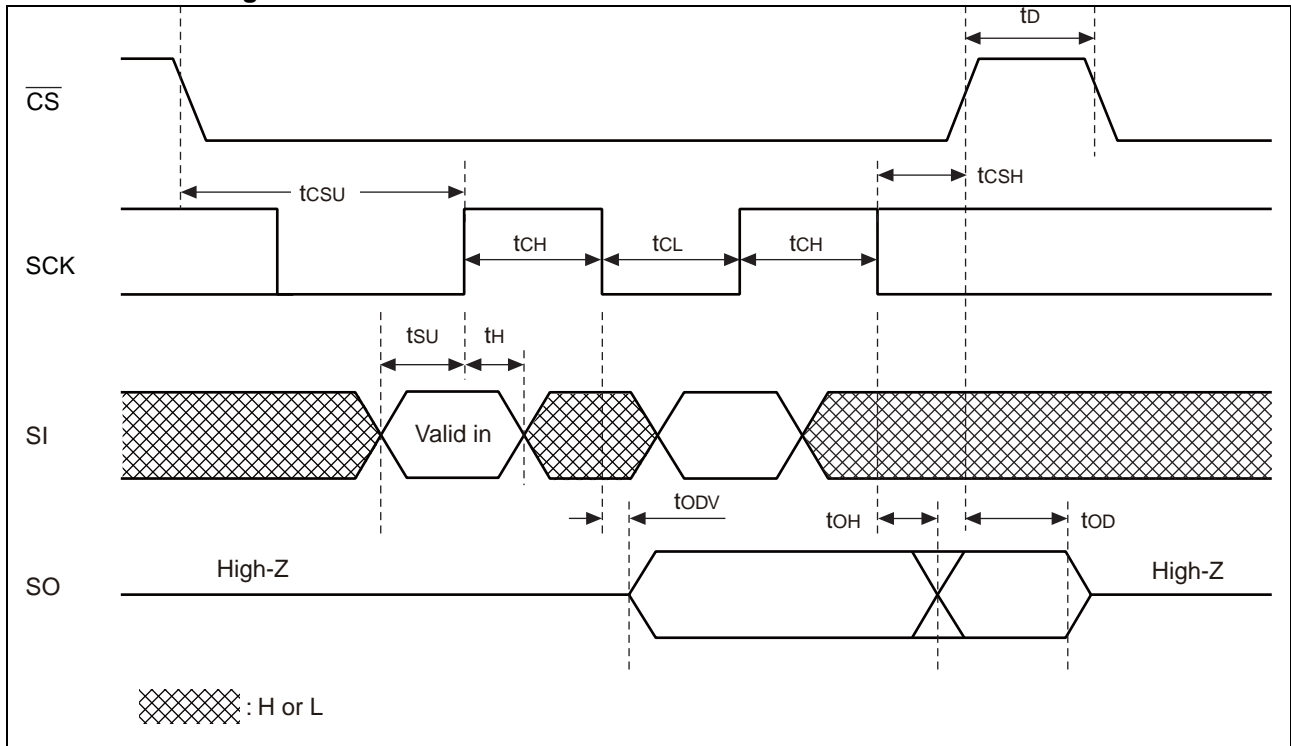


## 3. Pin Capacitance

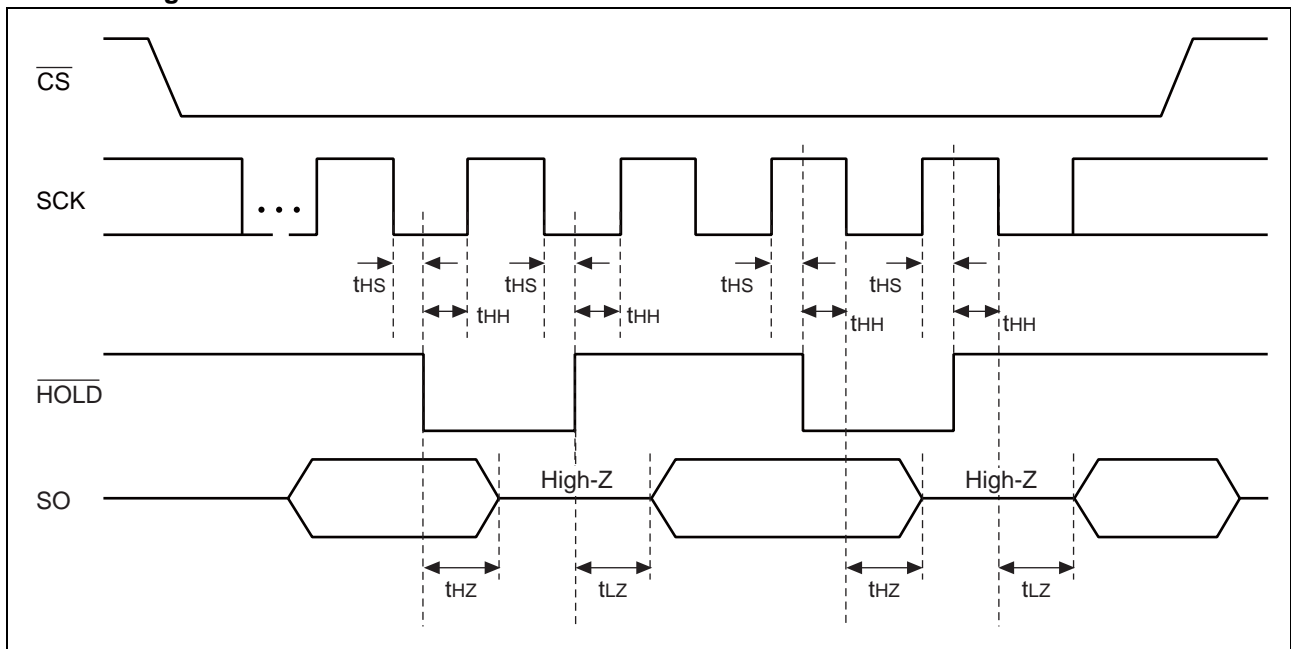
| Parameter          | Symbol | Condition  | Value |     | Unit |
|--------------------|--------|--|-------|-----|------|
|                    |        |  | Min   | Max |      |
| Output capacitance | $C_o$  | $V_{DD} = V_{IN} = V_{OUT} = 0\text{ V}$ ,<br>$f = 1\text{ MHz}$ , $T_A = +25\text{ °C}$ | —     | 10  | pF   |
| Input capacitance  | $C_i$  |  | —     | 10  | pF   |

## ■ TIMING DIAGRAM

### • Serial Data Timing



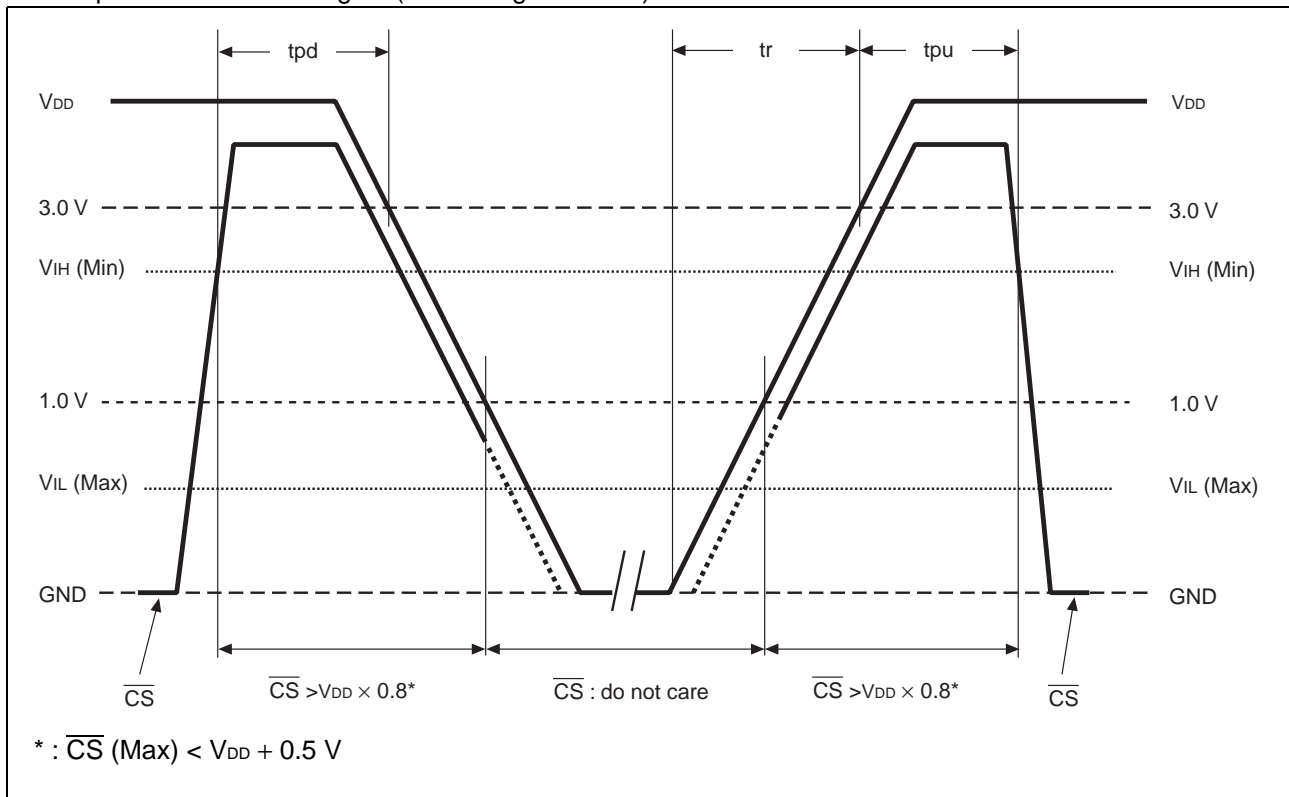
### • Hold Timing





## POWER ON/OFF SEQUENCE

If  $V_{DD}$  falls down below 2.0 V,  $V_{DD}$  is required to be started from 1.0 V or less to prevent malfunctions when the power is turned on again (see the figure below).



| Parameter                                    | Symbol | Value |     | Unit |
|--|--------|-------|-----|------|
|  |        | Min   | Max |      |
| $\overline{CS}$ level hold time at power OFF | tpd    | 200   | —   | ns   |
| $\overline{CS}$ level hold time at power ON  | tpu    | 85    | —   | ns   |
| Power supply rising time                     | tr     | 0.05  | 200 | ms   |

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 | $10^{12}$  | —   | Times/byte | Operation Ambient Temperature $T_A = +85 \text{ }^\circ\text{C}$ |
| Data Retention*2       | 10         | —   | Years      | Operation Ambient Temperature $T_A = +85 \text{ }^\circ\text{C}$ |
|                        | 95         | —   |            | Operation Ambient Temperature $T_A = +55 \text{ }^\circ\text{C}$ |
|                        | $\geq 200$ | —   |            | Operation Ambient Temperature $T_A = +35 \text{ }^\circ\text{C}$ |

\*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.

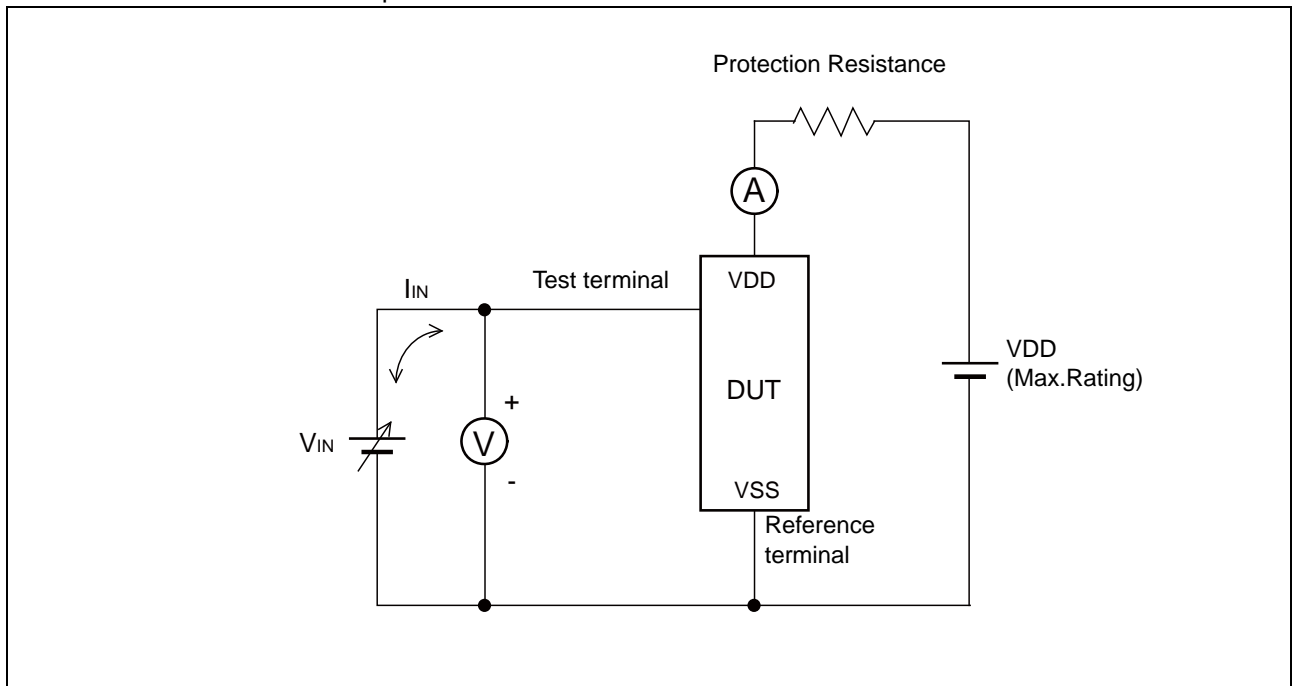
## NOTE ON USE

Data written before performing IR reflow is not guaranteed after IR reflow.

## ■ ESD AND LATCH-UP

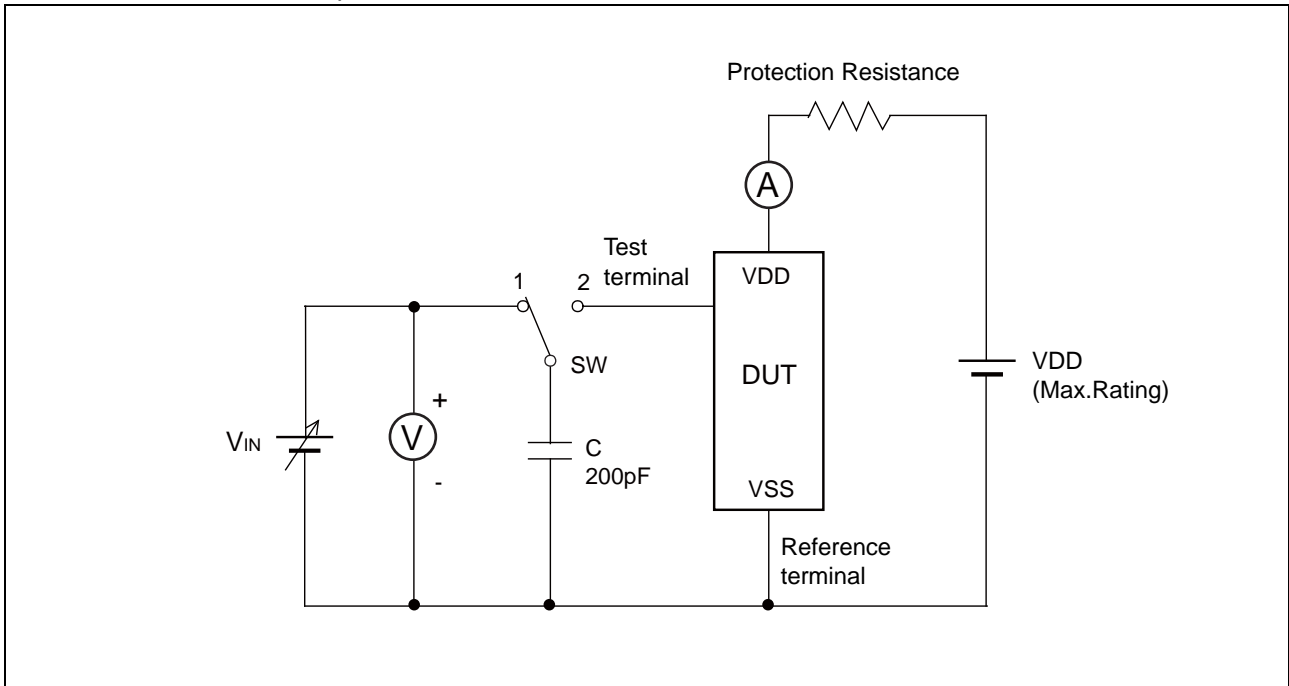
| Test   | DUT                  | Value                   |
|--|----------------------|-------------------------|
| ESD HBM (Human Body Model)<br>JESD22-A114 compliant                  | MB85RS256BPNF-G-JNE1 | $\geq  2000 \text{ V} $ |
| ESD MM (Machine Model)<br>JESD22-A115 compliant                      |                      | $\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                          |                      | —                       |

- Current method of Latch-Up Resistance Test



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



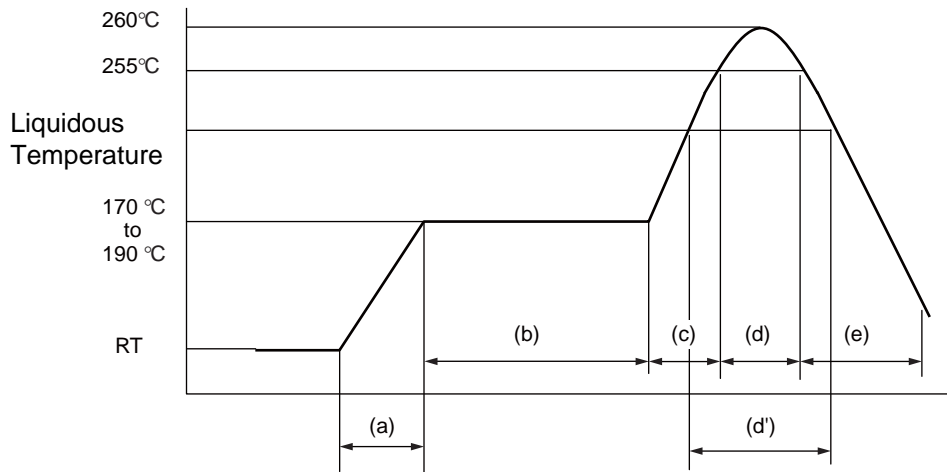
Note : Charge voltage alternately switching 1 and 2 approximately 2 sec interval. This switching process is considered as one cycle. Repeat this process 5 times. However, if the latch-up condition occurs before completing 5times, this test must be stopped immediately.

# MB85RS256B

## REFLOW CONDITIONS AND FLOOR LIFE

| Item                 | Condition  |   |
|----------------------|--|---|
| Method               | IR (infrared reflow) , Convection  |   |
| Times                | 2  |   |
| Floor life           | Before unpacking   | Please use within 2 years after production.   |
|                      | From unpacking to 2nd reflow   | Within 8 days   |
|                      | In case over period of floor life  | Baking with 125 °C+/-3 °C for 24hrs+2hrs-0hrs is required. Then please use within 8 days. (Please remember baking is up to 2 times) |
| Floor life condition | Between 5 °C and 30 °C and also below 70%RH required. (It is preferred lower humidity in the required temp range.) |   |

### Reflow Profile



- (a) Average ramp-up rate : 1 °C/s to 4 °C/s
- (b) Preheat & Soak : 170 °C to 190 °C, 60 s to 180 s
- (c) Average ramp-up rate : 1 °C/s to 4 °C/s
- (d) Peak temperature : Temperature 260 °C Max; 255 °C within 10 s
- (d') Liquidous temperature : Up to 230 °C within 40 s or  
Up to 225 °C within 60 s or  
Up to 220 °C within 80 s
- (e) Cooling : Natural cooling or forced cooling

Note : Temperature on the top of the package body is measured.

## ■ RESTRICTED SUBSTANCES

This product complies with the regulations below (Based on current knowledge as of November 2011).

- EU RoHS Directive (2002/95/EC)
- China RoHS (Administration on the Control of Pollution Caused by Electronic Information Products  
(电子信息产品污染控制管理办法))
- Vietnam RoHS (30/2011/TT-BCT)

Restricted substances in each regulation are as follows.

| Substances                            | Threshold | Contain status* |
|---------------------------------------|-----------|-----------------|
| Lead and its compounds                | 1,000 ppm | ○               |
| Mercury and its compounds             | 1,000 ppm | ○               |
| Cadmium and its compounds             | 100 ppm   | ○               |
| Hexavalent chromium compound          | 1,000 ppm | ○               |
| Polybrominated biphenyls (PBB)        | 1,000 ppm | ○               |
| Polybrominated diphenyl ethers (PBDE) | 1,000 ppm | ○               |

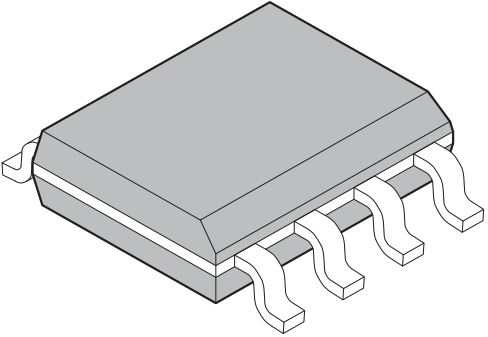
\* : The mark of "○" shows below a threshold value.

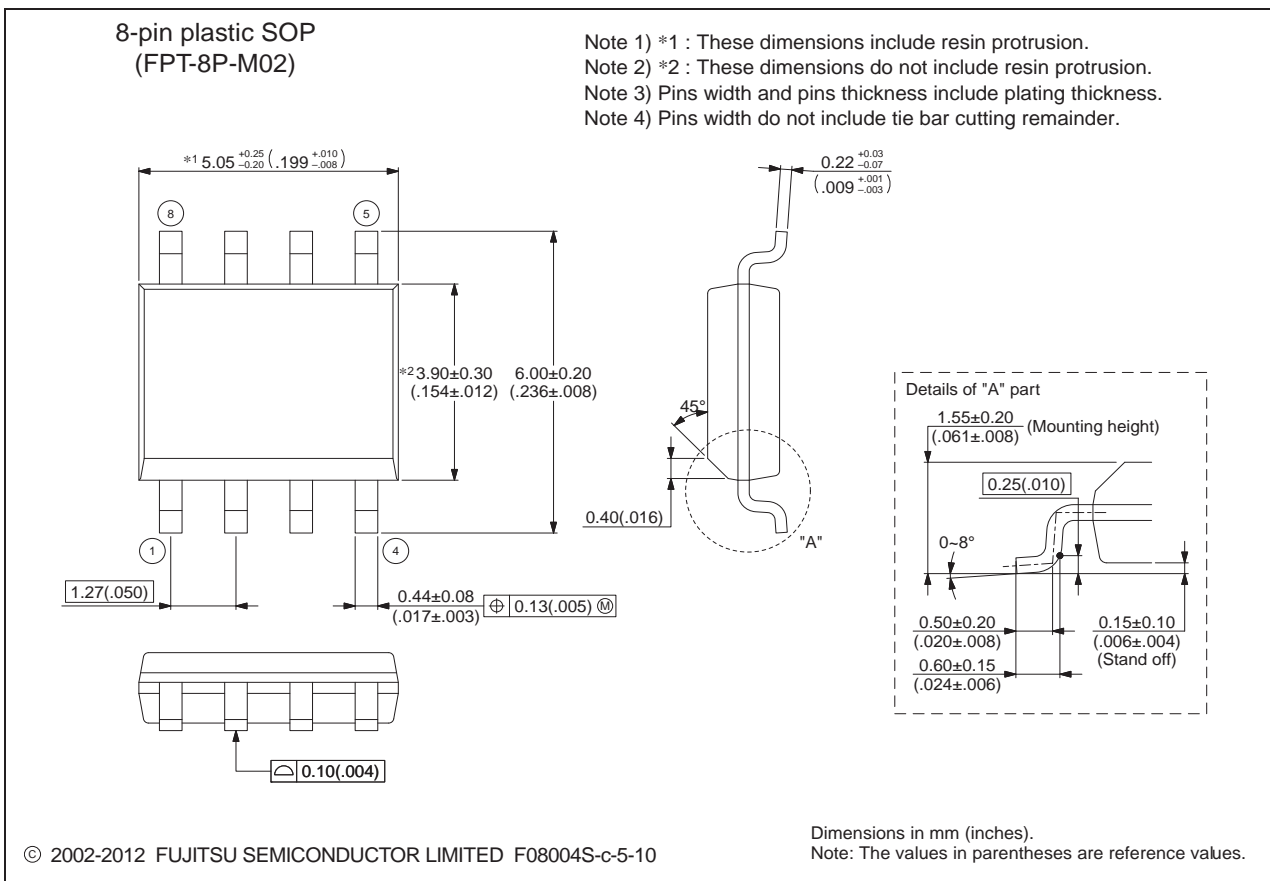
# MB85RS256B

## ■ ORDERING INFORMATION

| Part number            | Package                           | Shipping form         | Minimum shipping quantity |
|------------------------|-----------------------------------|-----------------------|---------------------------|
| MB85RS256BPNF-G-JNE1   | 8-pin plastic SOP<br>(FPT-8P-M02) | Tube                  | 1                         |
| MB85RS256BPNF-G-JNERE1 | 8-pin plastic SOP<br>(FPT-8P-M02) | Embossed Carrier tape | 1500                      |

## PACKAGE DIMENSION

|  |                                |                  |
|--|--------------------------------|------------------|
| <p>8-pin plastic SOP</p>  <p>(FPT-8P-M02)</p> | Lead pitch                     | 1.27 mm          |
|  | Package width × package length | 3.9 mm × 5.05 mm |
|  | Lead shape                     | Gullwing         |
|  | Sealing method                 | Plastic mold     |
|  | Mounting height                | 1.75 mm MAX      |
|  | Weight                         | 0.06 g           |
|  |                                |                  |



Please check the latest package dimension at the following URL.  
<http://edevice.fujitsu.com/package/en-search/>

## ■ MARKING

[MB85RS256BPNF-G-JNE1]  
[MB85RS256BPNF-G-JNERE1]



[FPT-8P-M02]

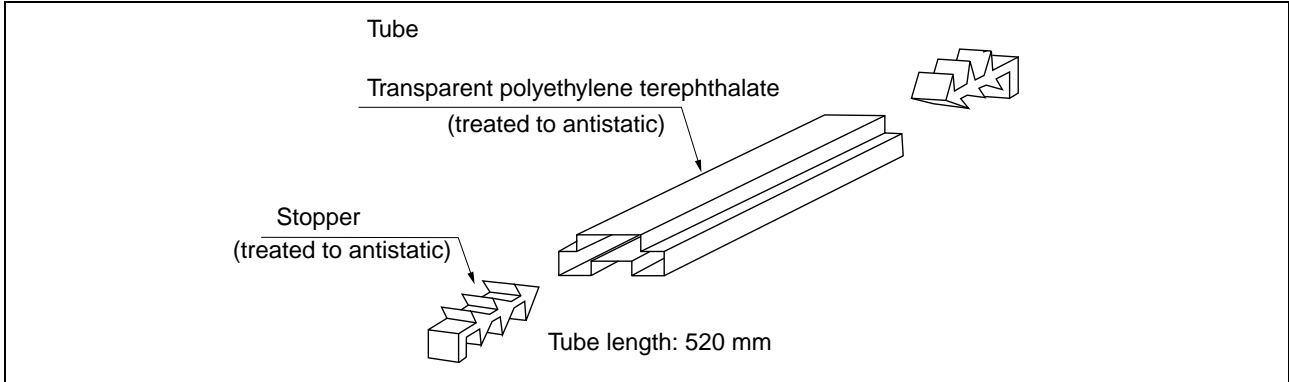


## ■ PACKING INFORMATION

### 1. Tube

#### 1.1 Tube Dimensions

- Tube/stopper shape



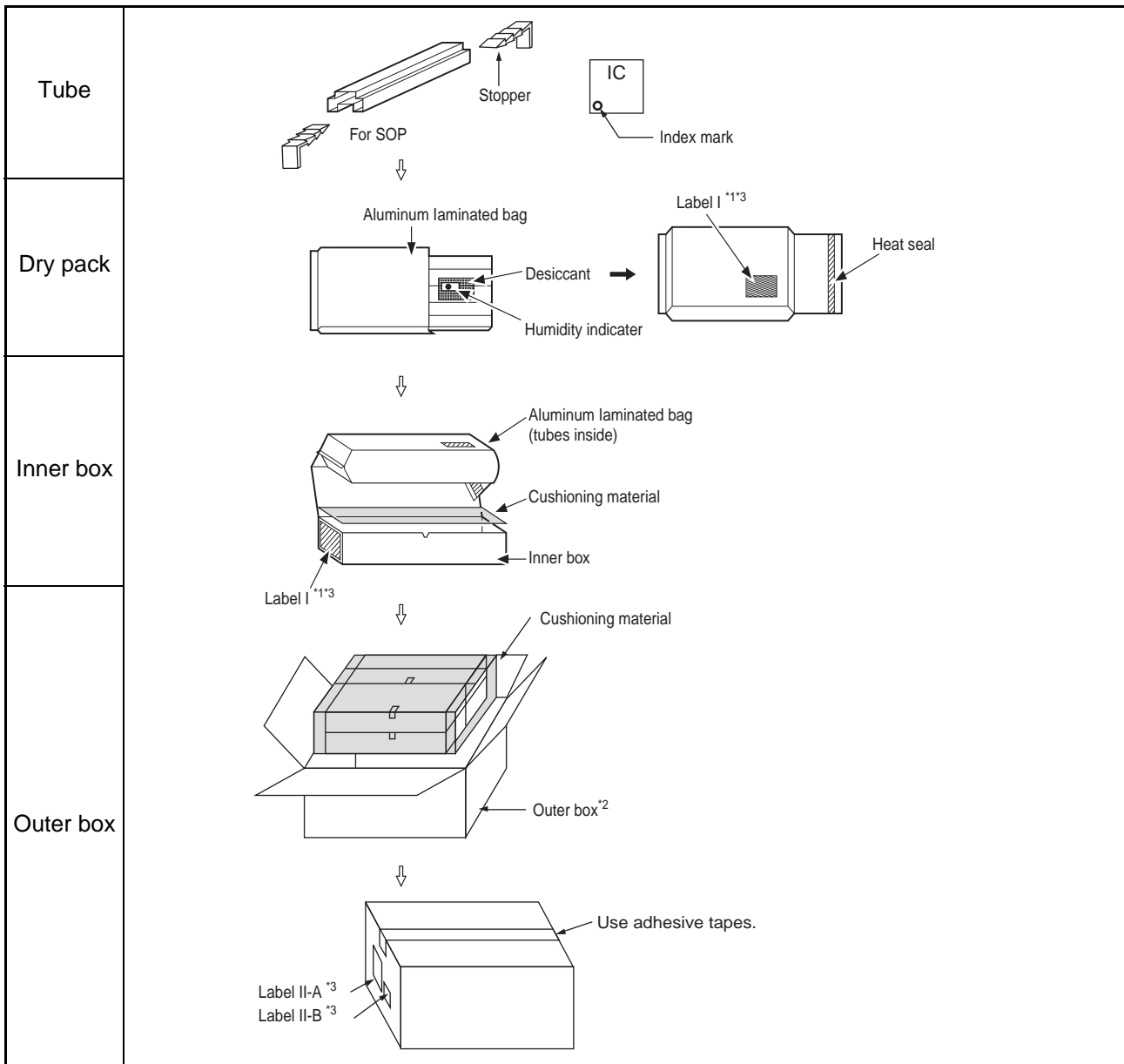
#### Tube cross-sections and Maximum quantity

| Package form   | Package code | Maximum quantity |                  |                  |
|--|--------------|------------------|------------------|------------------|
|  |              | pcs/<br>tube     | pcs/inner<br>box | pcs/outer<br>box |
| SOP, 8, plastic (2)<br><br><br>©2006-2010 FUJITSU SEMICONDUCTOR LIMITED<br>F08008-SET1-PET:FJ99L-0022-E0008-1-K-3<br><br>$t = 0.5$<br>Transparent polyethylene terephthalate | FPT-8P-M02   | 95               | 7600             | 30400            |

(Dimensions in mm)

# MB85RS256B

## 1.2 Tube Dry pack packing specifications



\*1: For a product of which part number is suffixed with "E1", a "G" (Pb) mark is displayed to the moisture barrier bag and the inner boxes.

\*2: The space in the outer box will be filled with empty inner boxes, or cushions, etc.

\*3: Please refer to an attached sheet about the indication label.

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

## 1.3 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)]

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

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

|   |                                     |
|---|-------------------------------------|
| ← D Label   |                                     |
| 発注者 XXXXXXXXXXXXXXXX (Customer Name)<br>(CUST.)                               | 受注者 (VENDOR)<br>富士通                 |
| 受渡場所名 XXXXXXXXXXXXXXXX (Delivery Address)<br>(DELIVERY POINT)                 | セミコンダクター株式会社                        |
| 納品キー番号 XXXXXXXXXXXXXXXX<br>(TRANS.NO.) (FJ control number)                    | XXX (FJ control number)             |
| 品名コード XXXXXXXXXXXXXXXX<br>(PART NO.) (Customer part number or FJ part number) | XXX (FJ control number)             |
|   | XXXXXXXXXXXXXXXXXXXXX (Part number) |
| 品名 (PART NAME) XXXXXXXXXXXXXXXX (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>XXXXXXXXXXXXXXXXXXXXX                          | 梱包個数 (PACKAGE COUNT)<br>XXX/XXX     |
| (3N)3 XXXXXXXXXXXXXXXX XXX (FJ control number + Product quantity)             |                                     |
| XXXXXXXXXXXXXXXXXXXXX (FJ control number + Product quantity bar code)         |                                     |
| (3N)4 XXXXXXXXXXXXXXXX XXX (Part number + Product quantity)                   |                                     |
| XXXXXXXXXXXXXXXXXXXXX (Part number + Product quantity bar code)               |                                     |
| (3N)5 XXXXXXXXXXXXXXXX (FJ control number)                                    |                                     |
| XXXXXXXXXXXXXXXXXXXXX (FJ control number bar code)                            |                                     |

Label II-B: Outer boxes product indicate

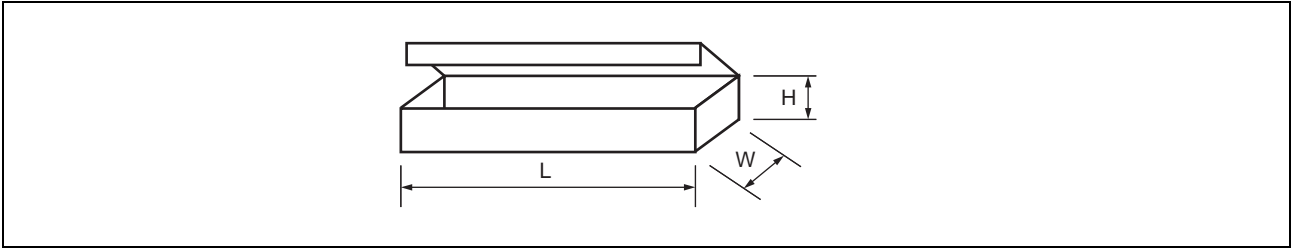
|                                     |         |            |
|-------------------------------------|---------|------------|
| XXXXXXXXXXXXXXXXXXXXX (Part number) |         |            |
| (Lot Number)                        | (Count) | (Quantity) |
| XXXX-XXX                            | X 箱     |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

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

# MB85RS256B

## 1.4 Dimensions for Containers

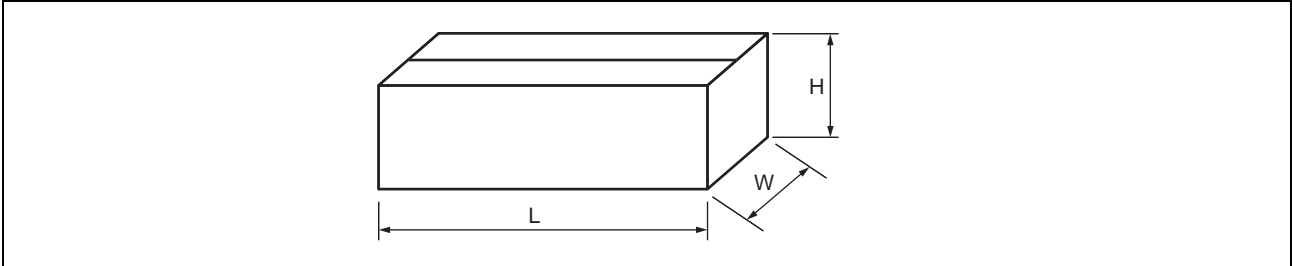
### (1) Dimensions for inner box



| L   | W   | H  |
|-----|-----|----|
| 540 | 125 | 75 |

(Dimensions in mm)

### (2) Dimensions for outer box



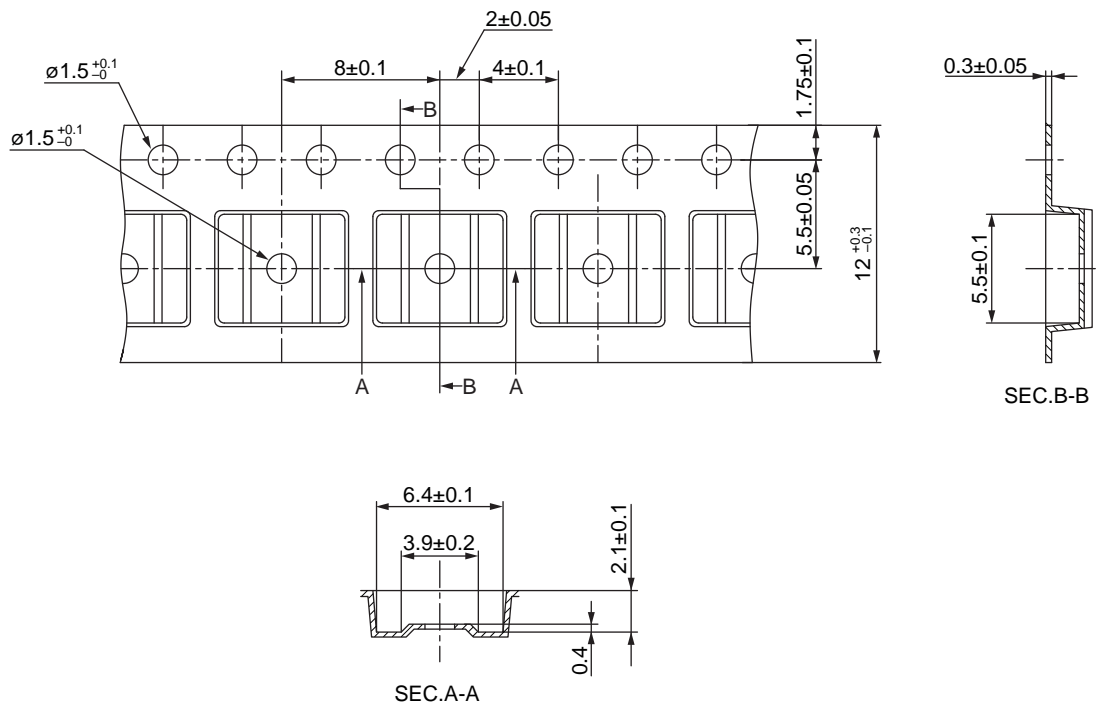
| L   | W   | H   |
|-----|-----|-----|
| 565 | 270 | 180 |

(Dimensions in mm)

## 2. Emboss Tape

### 2.1 Tape Dimensions

| PKG code   | Reel No | Maximum storage capacity |               |               |
|------------|---------|--------------------------|---------------|---------------|
|            |         | pcs/reel                 | pcs/inner box | pcs/outer box |
| FPT-8P-M02 | 3       | 1500                     | 1500          | 10500         |



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(Dimensions in mm)

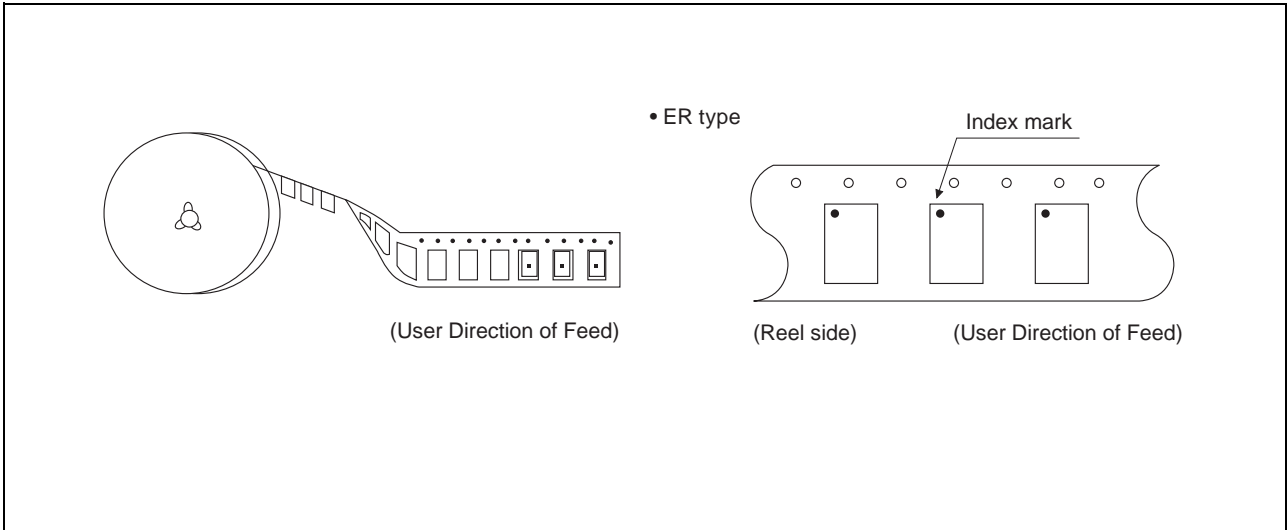
Material : Conductive polystyrene

Heat proof temperature : No heat resistance.

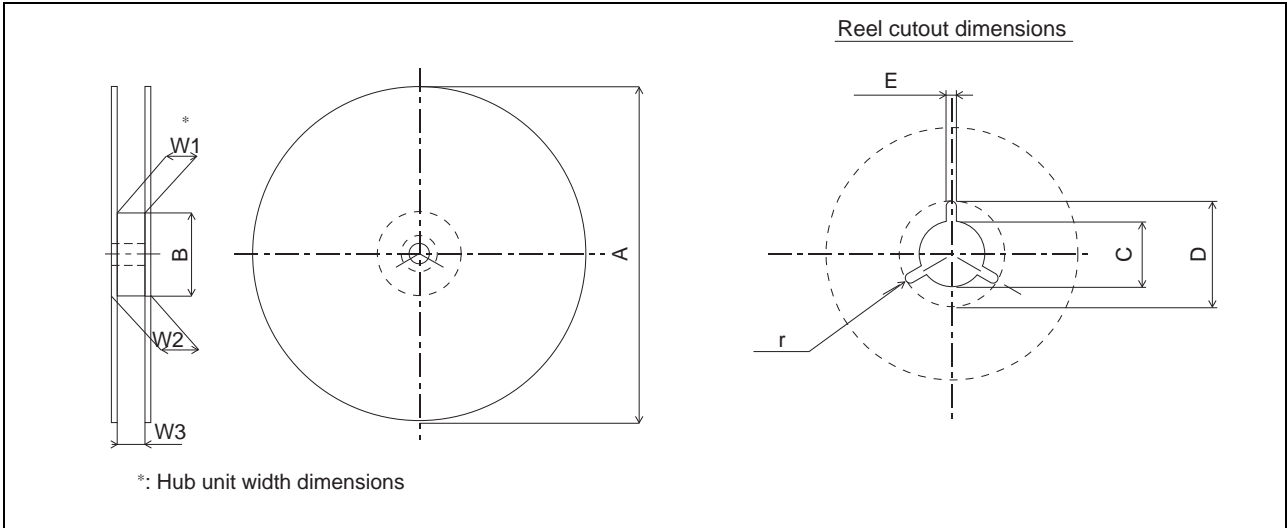
Package should not be baked  
by using tape and reel.

# MB85RS256B

## 2.2 IC orientation



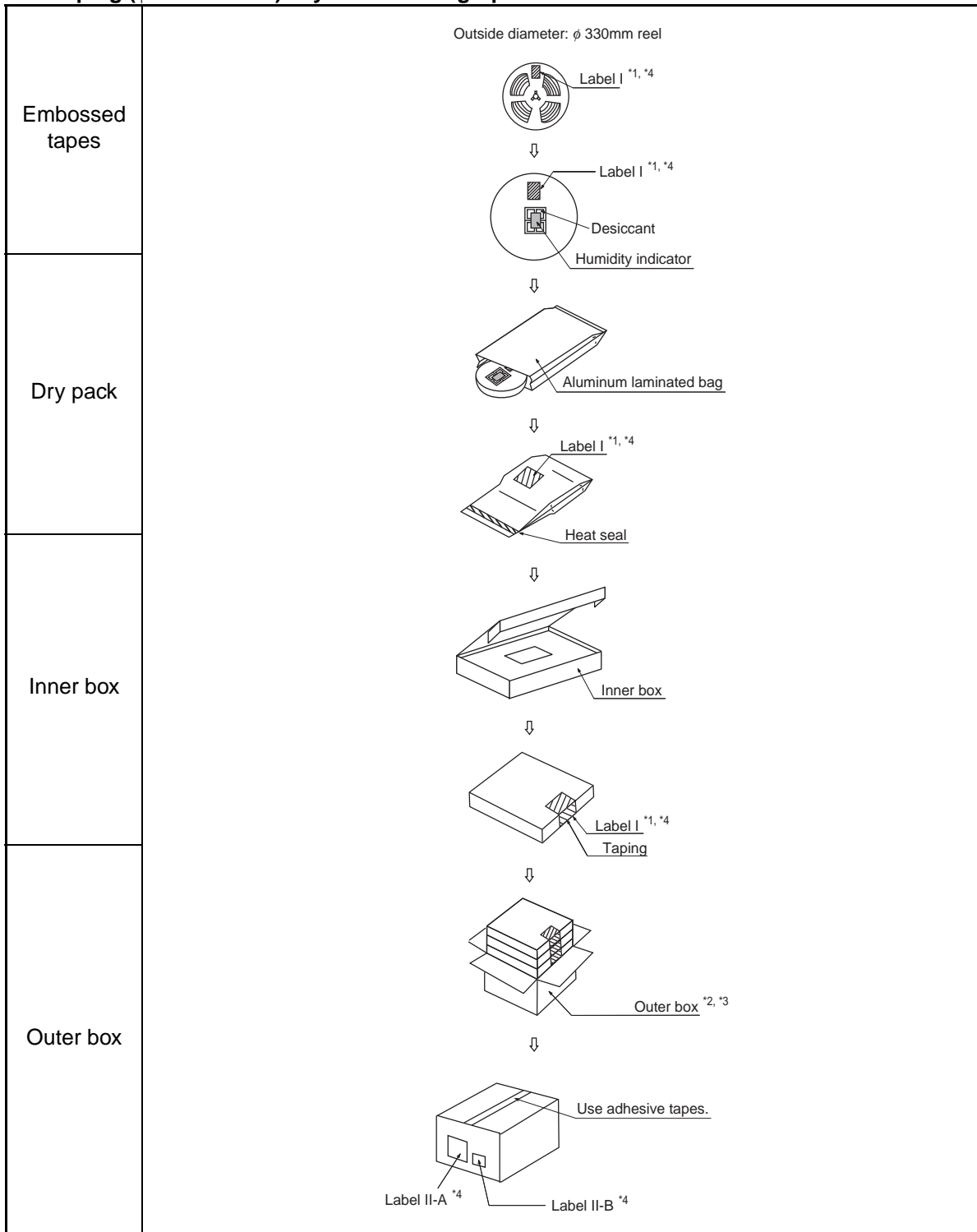
## 2.3 Reel dimensions



Dimensions in mm

| Reel No           | 1                               | 2                                | 3                                | 4                                | 5                                | 6                                | 7                                | 8                                | 9                                | 10                                 | 11                              | 12                                 | 13      | 14 | 15 |
|-------------------|---------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|------------------------------------|---------------------------------|------------------------------------|---------|----|----|
| Tape width 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 <sup>+2</sup> <sub>-0</sub> | 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                             |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                    |                                 |                                    |         |    |    |

## 2.4 Taping ( $\phi$ 330mm Reel) Dry Pack Packing Specifications



\*1: For a product of witch part number is suffixed with "E1", a "G" (Pb) 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.

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




# MB85RS256B

## 2.5 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)]

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

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

|  |  |                     |   |   |  |                         |  |  |   |  |                                      |                 |  |                                 |           |
|--|--|---------------------|---|---|--|-------------------------|--|--|---|--|--------------------------------------|-----------------|--|---------------------------------|-----------|
| <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 2px;">                             発注者 XXXXXXXXXXXXXXXX (Customer Name)<br/>                             (CUST.)                         </td> <td style="width: 50%; padding: 2px;">                             受注者 (VENDOR)<br/>                             富士通                         </td> </tr> <tr> <td style="padding: 2px;">                             受渡場所名 XXXXXXXXXXXXXXXX (Delivery Address)<br/>                             (DELIVERY POINT)                         </td> <td style="padding: 2px;">                             セミコンダクター株式会社<br/>                             XXX (FJ control number)                         </td> </tr> <tr> <td style="padding: 2px;">                             納品キー番号 XXXXXXXXXXXXXXXX<br/>                             (TRANS.NO.) (FJ control number)                         </td> <td style="padding: 2px;">                             XXX (FJ control number)                         </td> </tr> <tr> <td style="padding: 2px;">                             品名コード XXXXXXXXXXXXXXXX<br/>                             (PART NO.) (Customer part number or<br/>                             FJ part number)                         </td> <td style="padding: 2px;">                             XXX (FJ control number)<br/>                             XXXXXXXXXXXXXXXX<br/>                             (Part number)                         </td> </tr> <tr> <td colspan="2" style="padding: 2px;">                             品名 (PART NAME) XXXXXXXXXXXXXXXX (Part number)                         </td> </tr> <tr> <td style="padding: 2px;">                             入数/納入数量 XXX/XXX<br/>                             (Q'TY/TOTAL Q'TY)                         </td> <td style="padding: 2px;">                             単位 XX<br/>                             (UNIT)                         </td> </tr> <tr> <td style="padding: 2px;">                             発注者用備考 (CUSTOMER'S<br/>                             REMARKS)<br/>                             XXXXXXXXXXXXXXXX                         </td> <td style="padding: 2px;">                             梱包個数 (PACKAGE COUNT)<br/>                             XXX/XXX                         </td> </tr> </table> | 発注者 XXXXXXXXXXXXXXXX (Customer Name)<br>(CUST.)              | 受注者 (VENDOR)<br>富士通 | 受渡場所名 XXXXXXXXXXXXXXXX (Delivery Address)<br>(DELIVERY POINT) | セミコンダクター株式会社<br>XXX (FJ control number) | 納品キー番号 XXXXXXXXXXXXXXXX<br>(TRANS.NO.) (FJ control number) | XXX (FJ control number) | 品名コード XXXXXXXXXXXXXXXX<br>(PART NO.) (Customer part number or<br>FJ part number) | XXX (FJ control number)<br>XXXXXXXXXXXXXXXX<br>(Part number) | 品名 (PART NAME) XXXXXXXXXXXXXXXX (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<br>REMARKS)<br>XXXXXXXXXXXXXXXX | 梱包個数 (PACKAGE COUNT)<br>XXX/XXX | ← D Label |
| 発注者 XXXXXXXXXXXXXXXX (Customer Name)<br>(CUST.)  | 受注者 (VENDOR)<br>富士通  |                     |   |   |  |                         |  |  |   |  |                                      |                 |  |                                 |           |
| 受渡場所名 XXXXXXXXXXXXXXXX (Delivery Address)<br>(DELIVERY POINT)  | セミコンダクター株式会社<br>XXX (FJ control number)                      |                     |   |   |  |                         |  |  |   |  |                                      |                 |  |                                 |           |
| 納品キー番号 XXXXXXXXXXXXXXXX<br>(TRANS.NO.) (FJ control number)   | XXX (FJ control number)                                      |                     |   |   |  |                         |  |  |   |  |                                      |                 |  |                                 |           |
| 品名コード XXXXXXXXXXXXXXXX<br>(PART NO.) (Customer part number or<br>FJ part number)   | XXX (FJ control number)<br>XXXXXXXXXXXXXXXX<br>(Part number) |                     |   |   |  |                         |  |  |   |  |                                      |                 |  |                                 |           |
| 品名 (PART NAME) XXXXXXXXXXXXXXXX (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<br>REMARKS)<br>XXXXXXXXXXXXXXXX   | 梱包個数 (PACKAGE COUNT)<br>XXX/XXX                              |                     |   |   |  |                         |  |  |   |  |                                      |                 |  |                                 |           |
| (3N)3 XXXXXXXXXXXXXXXX XXX (FJ control number + Product quantity)<br><br>(FJ control number + Product quantity bar code)  |  |                     |   |   |  |                         |  |  |   |  |                                      |                 |  |                                 |           |
| (3N)4 XXXXXXXXXXXXXXXX XXX (Part number + Product quantity)<br><br>(Part number + Product quantity bar code)  |  |                     |   |   |  |                         |  |  |   |  |                                      |                 |  |                                 |           |
| (3N)5 XXXXXXXXXXXXXXXX (FJ control number)<br><br>(FJ control number bar code)  |  |                     |   |   |  |                         |  |  |   |  |                                      |                 |  |                                 |           |

Label II-B: Outer boxes product indicate

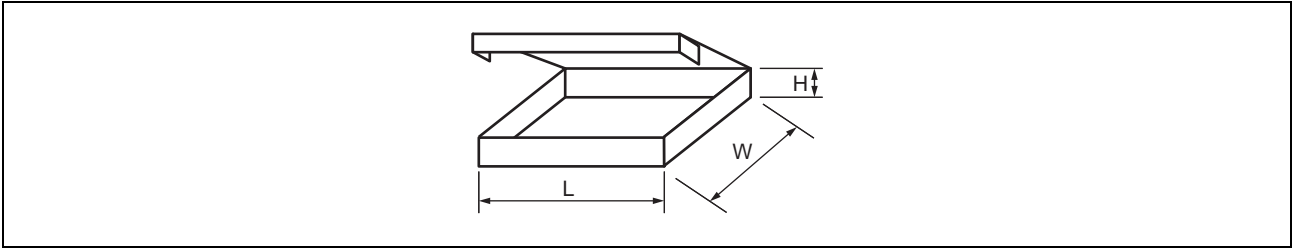
|   |              |            |            |          |     |       |          |     |       |  |   |       |  |
|---|--------------|------------|------------|----------|-----|-------|----------|-----|-------|--|---|-------|--|
| XXXXXXXXXXXXXXXX (Part number)<br><br><table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; text-align: center;">(Lot Number)</td> <td style="width: 33%; text-align: center;">(Count)</td> <td style="width: 33%; text-align: center;">(Quantity)</td> </tr> <tr> <td style="text-align: center;">XXXX-XXX</td> <td style="text-align: center;">X 箱</td> <td style="text-align: center;">XXX 個</td> </tr> <tr> <td style="text-align: center;">XXXX-XXX</td> <td style="text-align: center;">X 箱</td> <td style="text-align: center;">XXX 個</td> </tr> <tr> <td></td> <td style="text-align: center;">計</td> <td style="text-align: center;">XXX 個</td> </tr> </table> | (Lot Number) | (Count)    | (Quantity) | XXXX-XXX | X 箱 | XXX 個 | XXXX-XXX | X 箱 | XXX 個 |  | 計 | XXX 個 |  |
| (Lot Number)  | (Count)      | (Quantity) |            |          |     |       |          |     |       |  |   |       |  |
| XXXX-XXX  | X 箱          | XXX 個      |            |          |     |       |          |     |       |  |   |       |  |
| XXXX-XXX  | X 箱          | XXX 個      |            |          |     |       |          |     |       |  |   |       |  |
|   | 計            | XXX 個      |            |          |     |       |          |     |       |  |   |       |  |

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



## 2.6 Dimensions for Containers

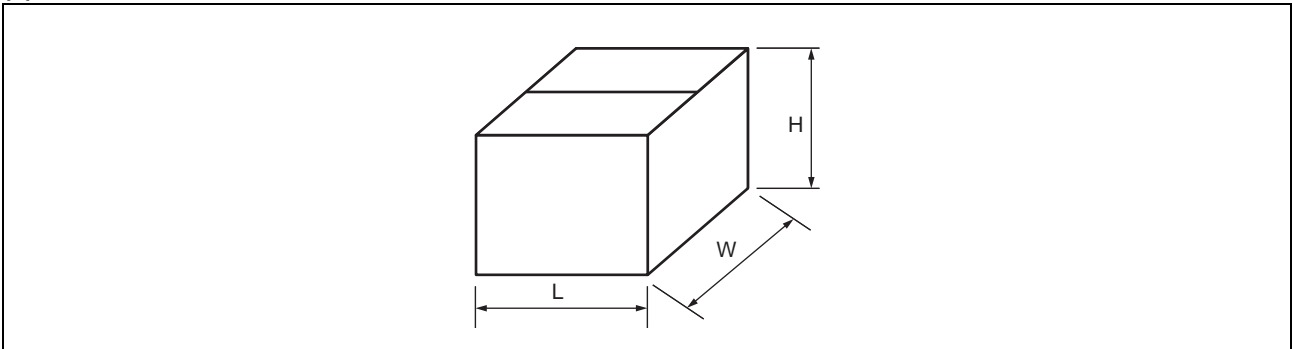
### (1) Dimensions for inner box



| Tape width | L   | W   | H  |
|------------|-----|-----|----|
| 12, 16     | 365 | 345 | 40 |
| 24, 32     |     |     | 50 |
| 44         |     |     | 65 |
| 56         |     |     | 75 |

(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  |
|------|-------------------------|---|
| 1    | ■ FEATURES              | Revised the Data retention<br>10 years ( + 85 °C)<br>→10 years ( + 85 °C), 95 years ( + 55 °C),<br>over 200 years ( + 35 °C)  |
| 10   | ■ COMMAND<br>• RDID     | Deleted the following description:<br>“RDID command is applicable to “Up to 33 MHz operation”.”   |
| 17   | ■ POWER ON/OFF SEQUENCE | Revised the following description:<br>“V <sub>DD</sub> pin is required to be rising from 0 V because turning the power on from an intermediate level may cause malfunctions, when the power is turned on.”<br>→ “If V <sub>DD</sub> falls down below 2.0 V, V <sub>DDin</sub> is required to be started from 1.0 V or less to prevent malfunctions when the power is turned on again (see the figure below).”<br><br>Moved the following description under the table:<br>“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  | Revised the table and Note  |
| 18   | ■ ESD AND LATCH-UP      | Revised the following description:<br>“occurred” → “occur”  |
| 21   | ■ RESTRICTED SUBSTANCES | Revised the following description:<br>“the below regulations” → “the regulations below”<br>“as belows” → “as follows”   |

**MEMO**

# MB85RS256B

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