

# Memory FRAM

## 16 K (2 K × 8) Bit I<sup>2</sup>C

### MB85RC16

#### ■ DESCRIPTION

The MB85RC16 is an FRAM (Ferroelectric Random Access Memory) chip in a configuration of 2,048 words × 8 bits, using the ferroelectric process and silicon gate CMOS process technologies for forming the nonvolatile memory cells.

Unlike SRAM, the MB85RC16 is able to retain data without using a data backup battery.

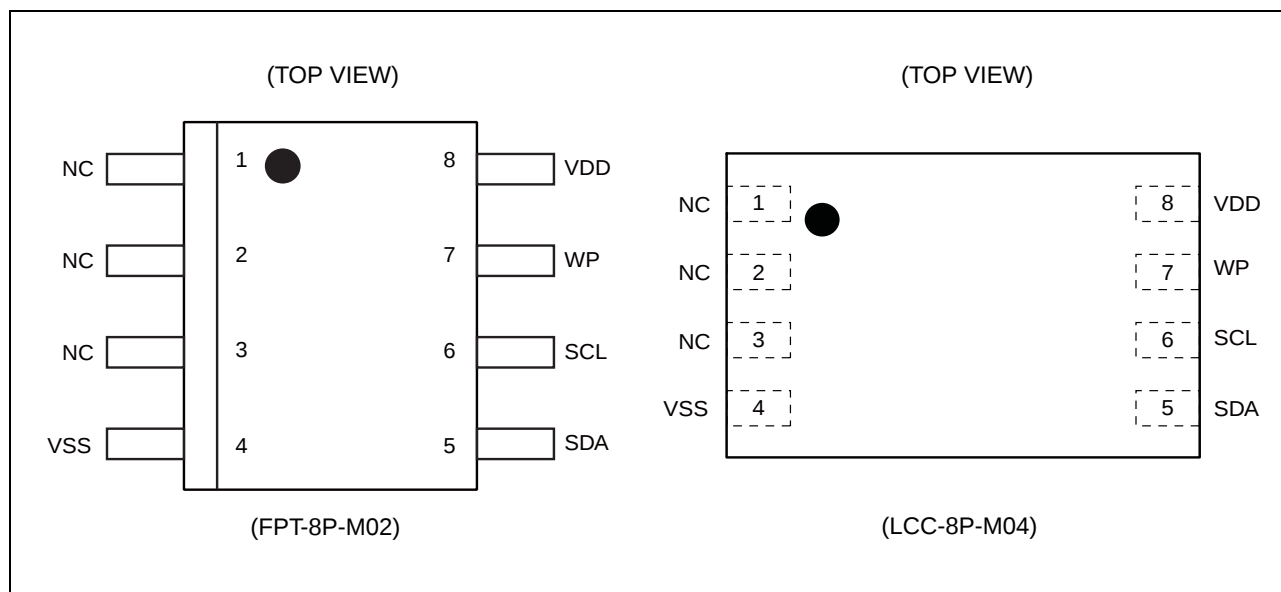
The memory cells used in the MB85RC16 have at least 10<sup>12</sup> Read/Write operation endurance per byte, which is a significant improvement over the number of read and write operations supported by other nonvolatile memory products.

The MB85RC16 can provide writing in one byte units because the long writing time is not required unlike Flash memory and E<sup>2</sup>PROM. Therefore, the writing completion waiting sequence like a write busy state is not required.

#### ■ FEATURES

- Bit configuration : 2,048 words × 8 bits
- Two-wire serial interface : Fully controllable by two ports: serial clock (SCL) and serial data (SDA).
- Operating frequency : 1 MHz (Max)
- Read/Write endurance : 10<sup>12</sup> 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 70 μA (Typ @1 MHz)  
Standby current 0.1 μA (Typ)
- Operation ambient temperature range : – 40 °C to + 85 °C
- Package : 8-pin plastic SOP (FPT-8P-M02)  
8-pin plastic SON (LCC-8P-M04)  
RoHS compliant

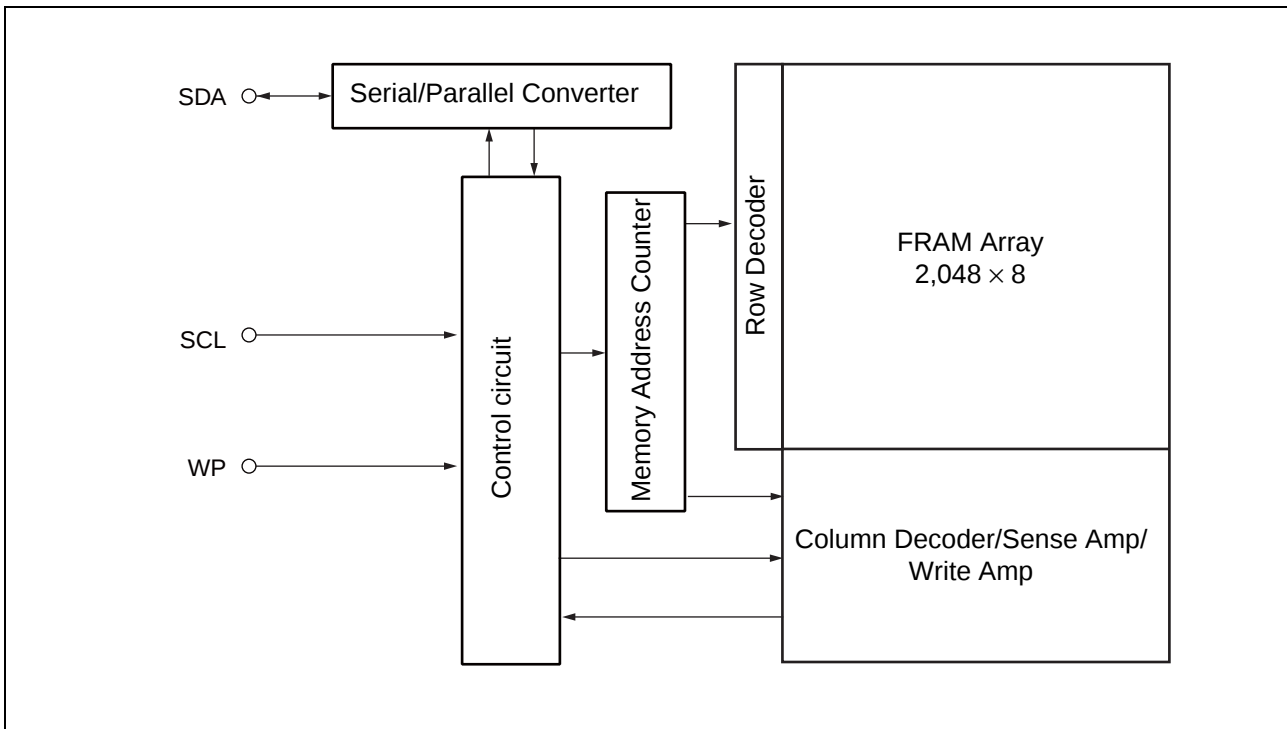
## PIN ASSIGNMENT



## PIN FUNCTIONAL DESCRIPTIONS

| Pin Number | Pin Name | Functional Description                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 to 3     | NC       | No Connect pins<br>Leave these pins open, or connect to VDD or VSS.                                                                                                                                                                                                                                                                                                                                                                 |
| 4          | VSS      | Ground pin                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 5          | SDA      | Serial Data I/O pin<br>This is an I/O pin which performs bidirectional communication for both memory address and writing/reading data. It is possible to connect multiple devices. It is an open drain output, so a pull-up resistor is required to be connected to the external circuit.                                                                                                                                           |
| 6          | SCL      | Serial Clock pin<br>This is a clock input pin for input/output timing serial data. Data is sampled on the rising edge of the clock and output on the falling edge.                                                                                                                                                                                                                                                                  |
| 7          | WP       | Write Protect pin<br>When the Write Protect pin is the "H" level, writing operation is disabled. When the Write Protect pin is the "L" level, the entire memory region can be overwritten. Reading operation is always enabled regardless of the Write Protect pin input level. The write protect pin is internally pulled down to VSS pin, and that is recognized as the "L" level (write enabled) when the pin is the open state. |
| 8          | VDD      | Supply Voltage pin                                                                                                                                                                                                                                                                                                                                                                                                                  |

## ■ BLOCK DIAGRAM

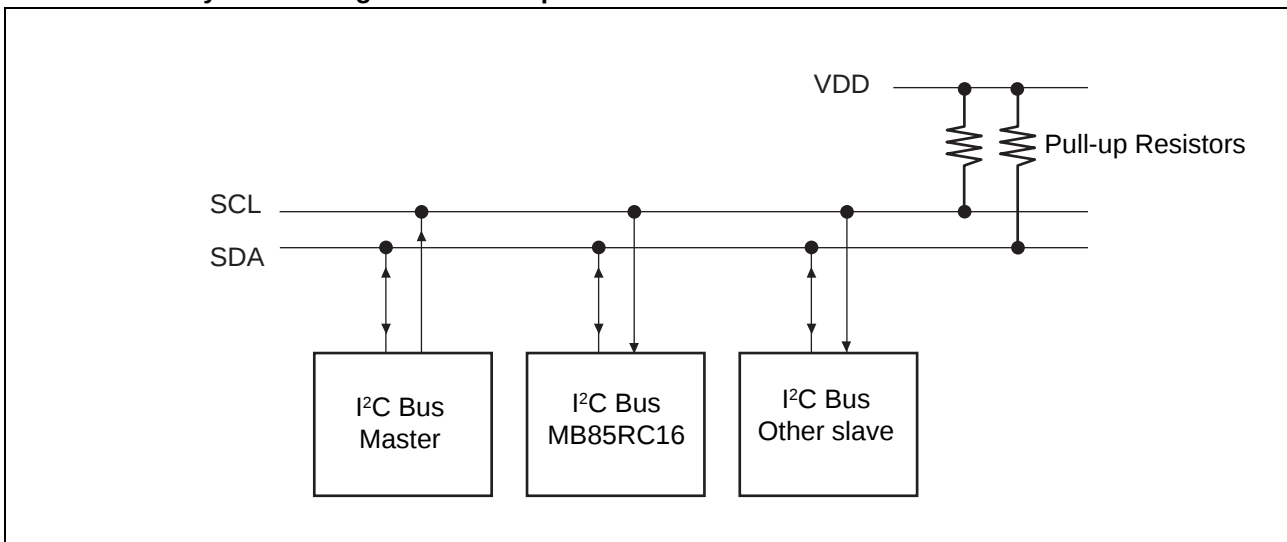


## ■ I<sup>2</sup>C (Inter-Integrated Circuit)

The MB85RC16 has the two-wire serial interface; the I<sup>2</sup>C bus, and operates as a slave device.

The I<sup>2</sup>C bus defines communication roles of “master” and “slave” devices, with the master side holding the authority to initiate control. Furthermore, an I<sup>2</sup>C bus connection is possible where a single master device is connected to multiple slave devices in a party-line configuration.

### • I<sup>2</sup>C Interface System Configuration Example



## ■ I<sup>2</sup>C COMMUNICATION PROTOCOL

The I<sup>2</sup>C bus provides communication by two wires only, therefore, the SDA input should change while SCL is the “L” level. However, when starting and stopping the communication sequence, SDA is allowed to change while SCL is the “H” level.

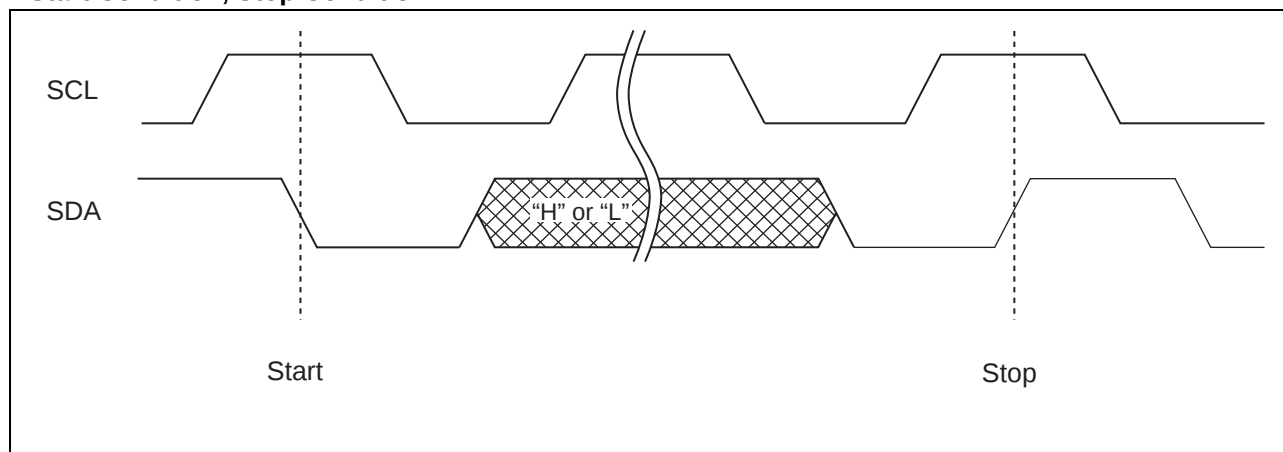
- Start Condition

To start read or write operations by the I<sup>2</sup>C bus, change the SDA input from the “H” level to the “L” level while the SCL input is in the “H” level.

- Stop Condition

To stop the I<sup>2</sup>C bus communication, change the SDA input from the “L” level to the “H” level while the SCL input is in the “H” level. In the reading operation, inputting the stop condition finishes reading and enters the standby state. In the writing operation, inputting the stop condition finishes inputting the rewrite data and enters the standby state.

- Start Condition, Stop Condition



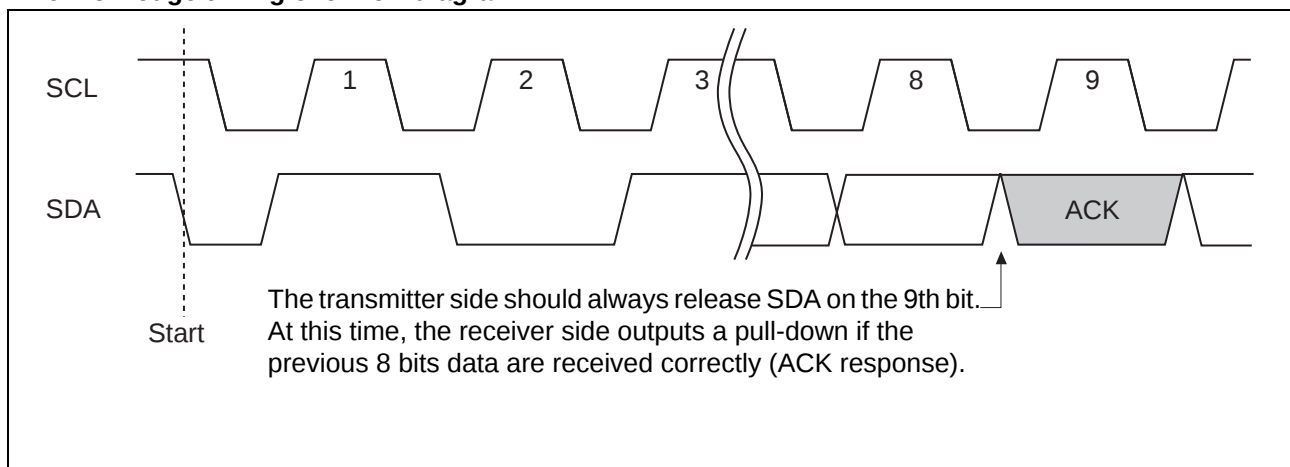
Note : At the write operation, the FRAM device does not need the memory programming wait time ( $t_{wc}$ ) after issuing the Stop Condition.

## ■ ACKNOWLEDGE (ACK)

In the I<sup>2</sup>C bus, serial data including memory address or memory information is sent and received in units of 8 bits. The acknowledge signal indicates that every 8 bits of the data is successfully sent and received. The receiver side usually outputs the “L” level every time on the 9th SCL clock after each 8 bits are successfully transmitted and received. On the transmitter side, the bus is temporarily released to Hi-Z every time on this 9th clock to allow the acknowledge signal to be received and checked. During this Hi-Z released period, the receiver side pulls the SDA line down to indicate the “L” level that the previous 8 bits communication is successfully received.

In case the slave side receives Stop condition before sending or receiving the ACK “L” level, the slave side stops the operation and enters to the standby state. On the other hand, the slave side releases the bus state after sending or receiving the NACK “H” level. The master side generates Stop condition or Start condition in this released bus state.

### • Acknowledge timing overview diagram



## ■ MEMORY ADDRESS STRUCTURE

The MB85RC16 has the memory address buffer to store the 11-bit information for the memory address.

As for byte write, page write and random read commands, the complete 11-bit memory address is configured by inputting the memory upper address (3 bits) and the memory lower address (8 bits), and saved to the memory address buffer. Then access to the memory is performed.

As for a current address read command, the complete 11-bit memory address is configured and saved to the memory address buffer, by inputting the memory upper address (3 bits) and the memory lower address (8 bits) which has saved in the memory address buffer. Then access to the memory is performed.

## ■ DEVICE ADDRESS WORD

Following the start condition, the 8 bit device address word is input. Inputting the device address word decides whether writing or reading operation. However, the clock is always driven by the master. The device address word (8 bits) consists of a device Type code (4 bits), memory upper address code (3 bits), and a Read/Write code (1 bit).

- Device Type Code (4 bits)

The upper 4 bits of the device address word are a device type code that identifies the device type, and are fixed at "1010" for the MB85RC16.

- Memory Upper Address Code (3 bits)

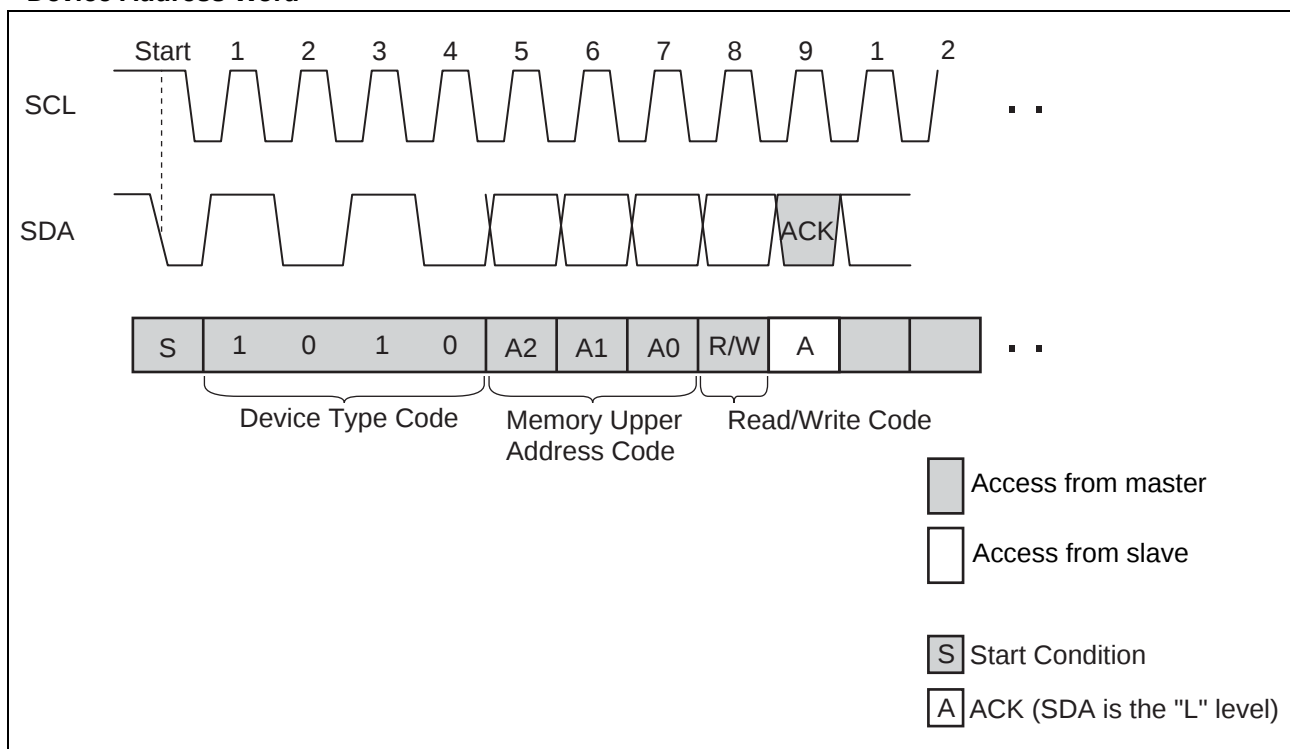
Following the device type code, the 3 bits of the memory upper address code are input.

The slave address selection is not performed by the external pin setting on this device. These 3 bits are not the setting bits for the slave address, but the upper 3-bit setting bits for the memory address.

- Read/Write Code (1 bit)

The 8th bit of the device address word is the R/W (Read/Write) code. When the R/W code is "0" input, a write operation is enabled, and the R/W code is "1" input, a read operation is enabled for the MB85RC16. If the device code is not "1010", the Read/Write operation is not performed and the standby state is chosen.

### • Device Address Word



## ■ DATA STRUCTURE

The master inputs the device address word (8 bits) following the start condition, and then the slave outputs the Acknowledge “L” level on the 9th bit. After confirming the Acknowledge response, the sequential 8-bit memory lower address is input, to the byte write, page write and random read commands.

As for the current address read command, inputting the memory lower address is not performed, and the address buffer lower 8-bit is used as the memory lower address.

When inputting the memory lower address finishes, the slave outputs the Acknowledge “L” level on the 9th bit again.

Afterwards, the input and the output data continue in 8-bit units, and then the Acknowledge “L” level is output for every 8-bit data.

## ■ FRAM ACKNOWLEDGE -- POLLING NOT REQUIRED

The MB85RC16 performs the high speed write operations, so any waiting time for an ACK\* by the acknowledge polling does not occur.

- \*: In E<sup>2</sup>PROM, the Acknowledge Polling is performed as a progress check whether rewriting is executed or not. It is normal to judge by the 9th bit of Acknowledge whether rewriting is performed or not after inputting the start condition and then the device address word (8 bits) during rewriting.

## ■ WRITE PROTECT (WP)

The entire memory array can be write protected by setting the WP pin to the “H” level. When the WP pin is set to the “L” level, the entire memory array will be rewritten. Reading is allowed regardless of the WP pin's “H” level or “L” level.

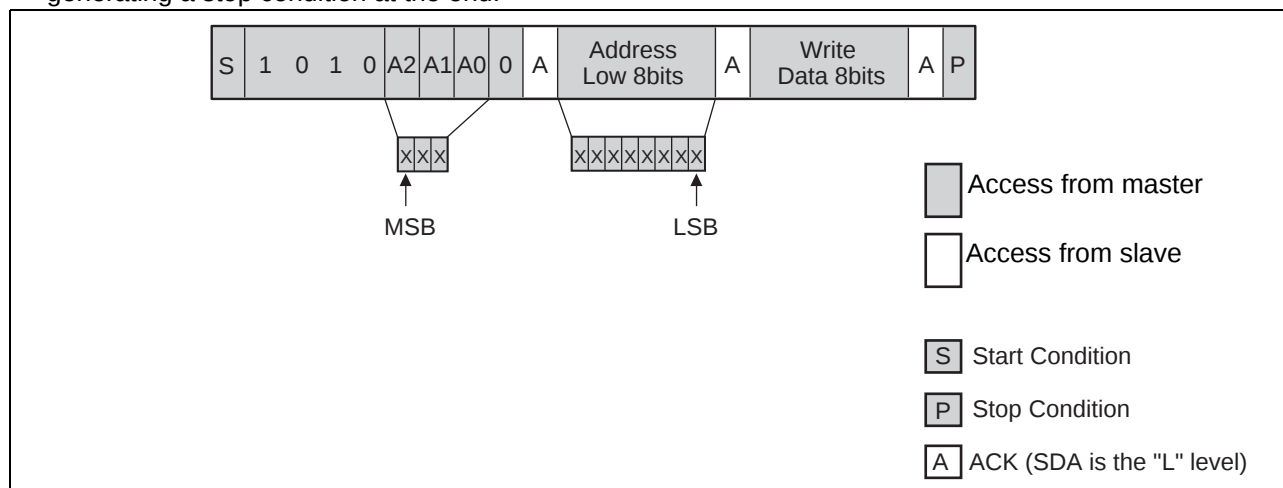
Do not change the WP signal level during the communication period from the start condition to the stop condition.

Note : The WP pin is pulled down internally to VSS pin, therefore if the WP pin is open, the pin status is detected as the “L” level (write enabled).

## ■ COMMAND

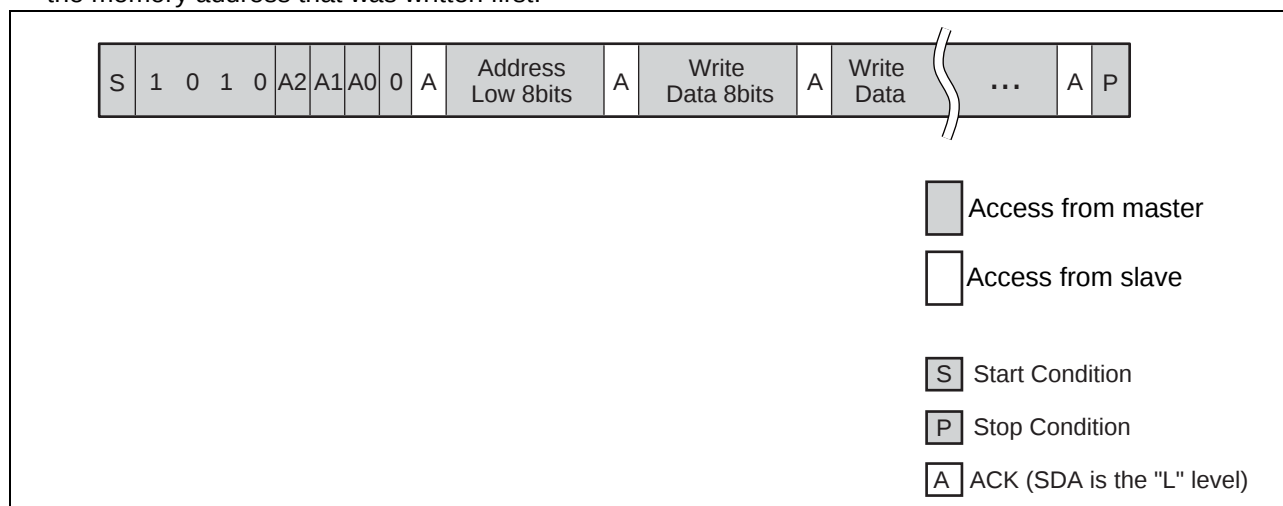
### • Byte Write

If the device address word (R/W "0" input) is sent after the start condition, the slave responds with an ACK. After this ACK, write memory addresses and write data are sent in the same way, and the write ends by generating a stop condition at the end.



### • Page Write

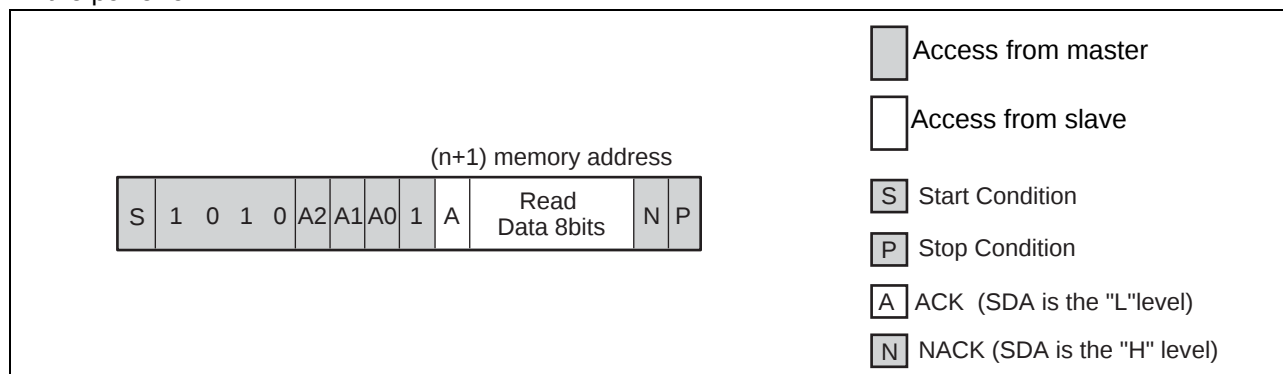
If additional 8 bits are continuously sent after the same command (except stop condition) as Byte Write, a page write is performed. The memory address rolls over to first memory address (000<sub>H</sub>) at the end of the address. Therefore, if more than 2 Kbytes are sent, the data is overwritten in order starting from the start of the memory address that was written first.



## • Current Address Read

If the last write or read operation finishes successfully up to the end of stop condition, the memory address that was accessed last remains in the memory address buffer (the length is 11 bits).

When sending this command without turning the power off, it is possible to read from the memory address  $n+1$  which adds 1 to the total 11-bit memory address  $n$ , which consists of the memory upper address 3-bit from the device address word input and the lower 8-bit of the memory address buffer. If the memory address  $n$  is the last address, it is possible to read with rolling over to the head of the memory address ( $000_H$ ). The current address (address that the memory address buffer indicates) is undefined immediately after turning the power on.

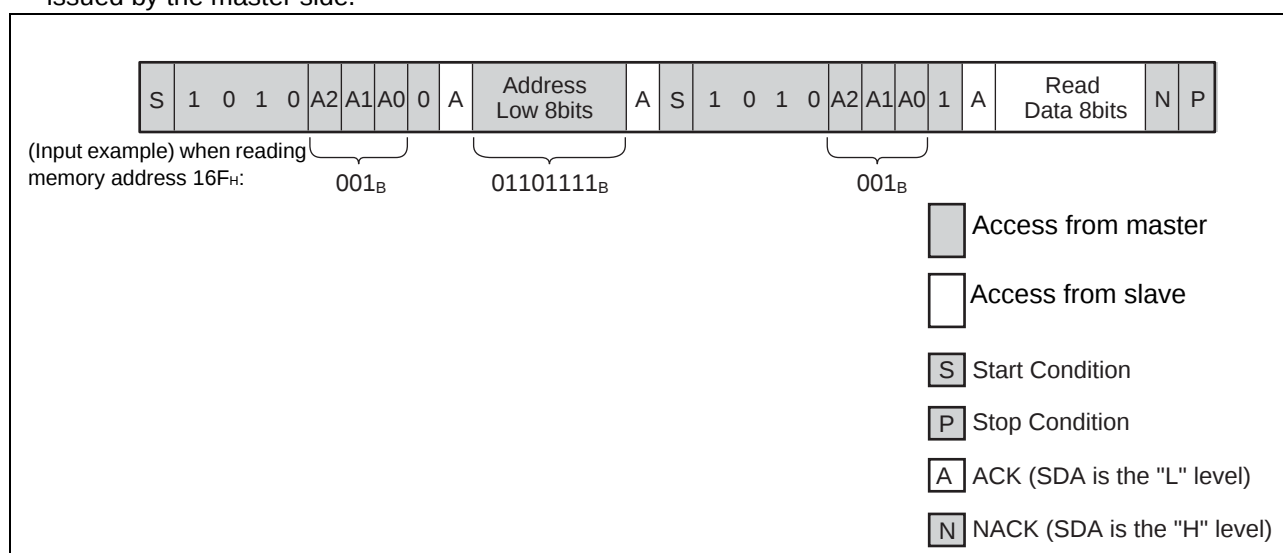


## • Random Read

The one byte of data from the memory address saved in the memory address buffer can be read out synchronously to SCL by specifying the address in the same way as for a write, and then issuing another start condition and sending the Device Address Word (R/W "1" input).

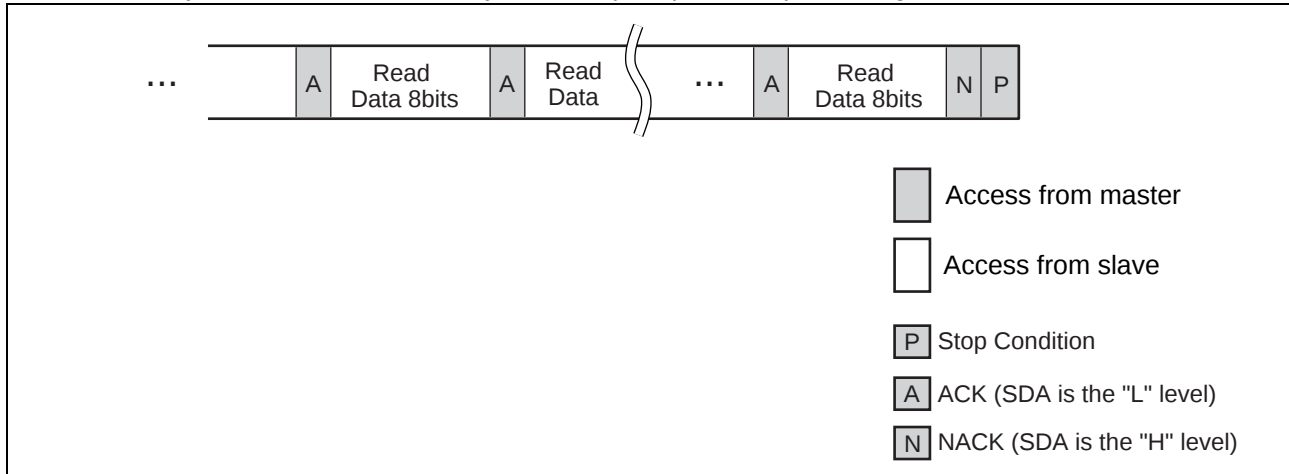
Setting values for the first and the second memory upper address codes should be the same (an example is shown in below).

The final NACK (SDA is the "H" level) is issued by the receiver that receives the data. In this case, this bit is issued by the master side.



- Sequential Read

Data can be received continuously following the Device address word (R/W "1" input) after specifying the address in the same way as for Random Read. If the read reaches the end of address, the read address automatically rolls over to first memory address (000<sub>H</sub>) and keeps reading.

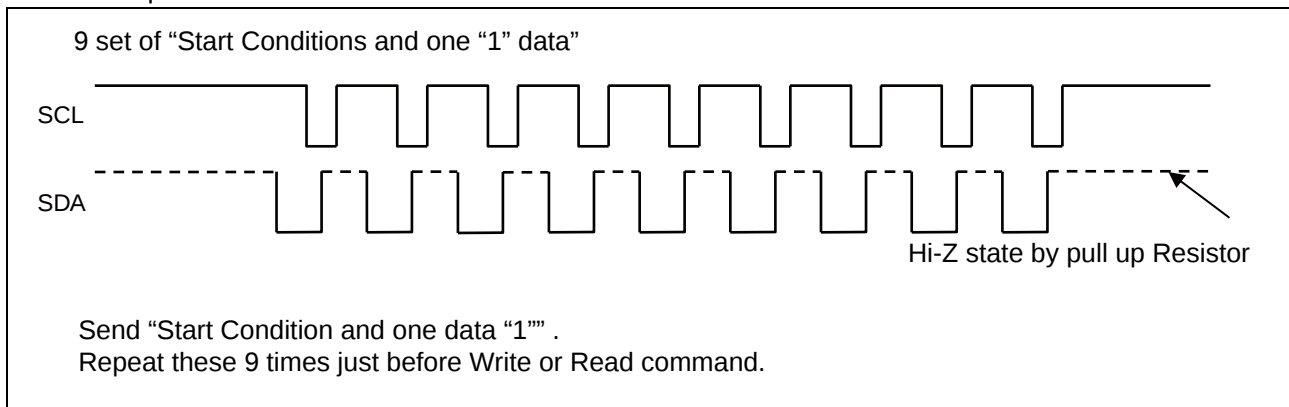


## ■ SOFTWARE RESET SEQUENCE OR COMMAND RETRY

In case the malfunction has occurred after power on, the master side stopped the I<sup>2</sup>C communication during processing, or unexpected malfunction has occurred, execute the following (1) software recovery sequence just before each command, or (2) retry command just after failure of each command.

### (1) Software Reset Sequence

Since the slave side may be outputting "L" level, do not force to drive "H" level, when the master side drives the SDA port. This is for preventing a bus conflict. The additional hardware is not necessary for this software reset sequence.



### (2) Command Retry

Command retry is useful to recover from failure response during I<sup>2</sup>C communication.

## ■ 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  | $V_{DD} + 0.5$ ( ≤ 4.0) | V    |
| Output voltage*               | $V_{OUT}$ | - 0.5  | $V_{DD} + 0.5$ ( ≤ 4.0) | V    |
| Operation ambient temperature | $T_A$     | - 40   | + 85                    | °C   |
| Storage temperature           | $T_{stg}$ | - 55   | + 125                   | °C   |

\*: These parameters are based on the condition that VSS 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    |
| "H" level input voltage*      | $V_{IH}$ | $V_{DD} \times 0.8$ | —   | $V_{DD} + 0.5$<br>( ≤ 4.0) | V    |
| "L" level input voltage*      | $V_{IL}$ | - 0.5               | —   | + 0.6                      | V    |
| Operation ambient temperature | $T_A$    | - 40                | —   | + 85                       | °C   |

\*: These parameters are based on the condition that VSS 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} $ | $V_{IN} = 0\text{ V to }V_{DD}$                                                         | —     | —   | 1   | $\mu\text{A}$    |
| Output leakage current*2       | $ I_{LO} $ | $V_{OUT} = 0\text{ V to }V_{DD}$                                                        | —     | —   | 1   | $\mu\text{A}$    |
| Operating power supply current | $I_{DD}$   | SCL = 1 MHz                                                                             | —     | 70  | 100 | $\mu\text{A}$    |
| Standby current                | $I_{SB}$   | SCL, SDA = $V_{DD}$<br>WP = 0V or $V_{DD}$ or OPEN<br>$T_A = +25\text{ }^\circ\text{C}$ | —     | 0.1 | 1   | $\mu\text{A}$    |
| “L” level output voltage       | $V_{OL}$   | $I_{OL} = 3\text{ mA}$                                                                  | —     | —   | 0.4 | V                |
| Input resistance for WP pin    | $R_{IN}$   | $V_{IN} = V_{IL}(\text{Max})$                                                           | 50    | —   | —   | $\text{k}\Omega$ |
|                                |            | $V_{IN} = V_{IH}(\text{Min})$                                                           | 1     | —   | —   | $\text{M}\Omega$ |

\*1: Applicable pin: SCL, SDA

\*2: Applicable pin: SDA

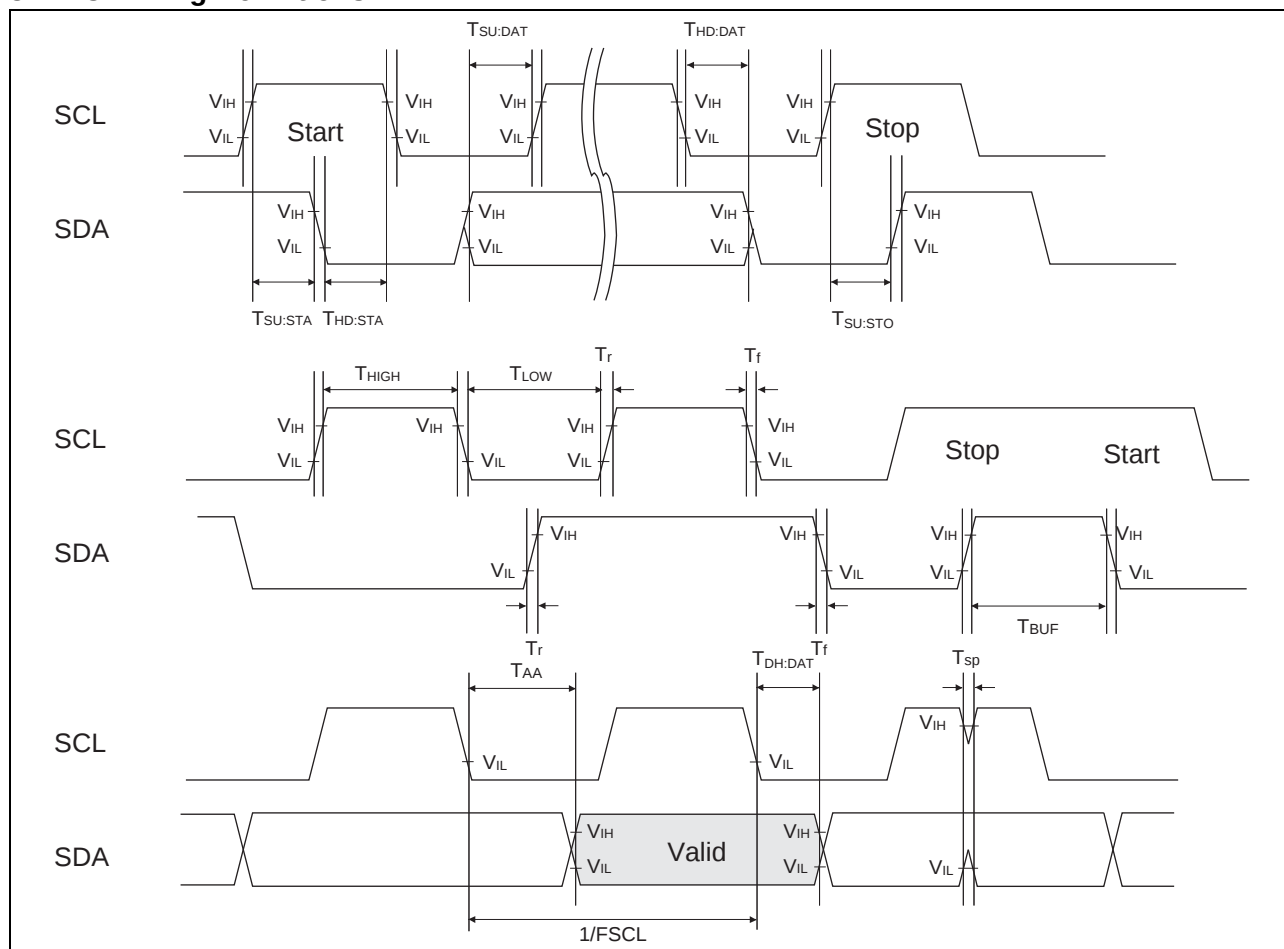
## 2. AC Characteristics

| Parameter                               | Symbol              | Value         |      |           |     |                |      | Unit |
|-----------------------------------------|---------------------|---------------|------|-----------|-----|----------------|------|------|
|                                         |                     | Standard Mode |      | Fast Mode |     | Fast Mode Plus |      |      |
|                                         |                     | Min           | Max  | Min       | Max | Min            | Max  |      |
| SCL clock frequency                     | F <sub>SCL</sub>    | 0             | 100  | 0         | 400 | 0              | 1000 | kHz  |
| Clock high time                         | T <sub>HIGH</sub>   | 4000          | —    | 600       | —   | 400            | —    | ns   |
| Clock low time                          | T <sub>LOW</sub>    | 4700          | —    | 1300      | —   | 600            | —    | ns   |
| SCL/SDA rising time                     | T <sub>r</sub>      | —             | 1000 | —         | 300 | —              | 300  | ns   |
| SCL/SDA falling time                    | T <sub>f</sub>      | —             | 300  | —         | 300 | —              | 100  | ns   |
| Start condition hold                    | T <sub>HD:STA</sub> | 4000          | —    | 600       | —   | 250            | —    | ns   |
| Start condition setup                   | T <sub>SU:STA</sub> | 4700          | —    | 600       | —   | 250            | —    | ns   |
| SDA input hold                          | T <sub>HD:DAT</sub> | 20            | —    | 20        | —   | 20             | —    | ns   |
| SDA input setup                         | T <sub>SU:DAT</sub> | 250           | —    | 100       | —   | 100            | —    | ns   |
| SDA output hold                         | T <sub>DH:DAT</sub> | 0             | —    | 0         | —   | 0              | —    | ns   |
| Stop condition setup                    | T <sub>SU:STO</sub> | 4000          | —    | 600       | —   | 250            | —    | ns   |
| SDA output access after SCL falling     | T <sub>AA</sub>     | —             | 3000 | —         | 900 | —              | 550  | ns   |
| Pre-charge time                         | T <sub>BUF</sub>    | 4700          | -    | 1300      | -   | 500            | —    | ns   |
| Noise suppression time<br>(SCL and SDA) | T <sub>SP</sub>     | —             | 50   | —         | 50  | —              | 50   | ns   |

AC characteristics were measured under the following measurement conditions.

Power supply voltage : 2.7 V to 3.6 V  
 Operation ambient temperature: - 40 °C to + 85 °C  
 Input voltage amplitude : 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

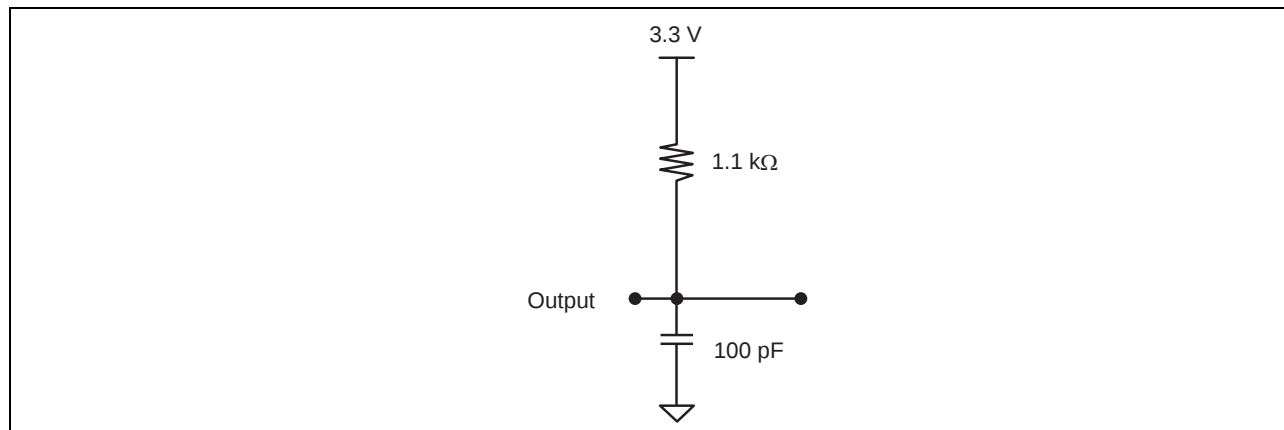
## 3. AC Timing Definitions



## 4. Pin capacitance

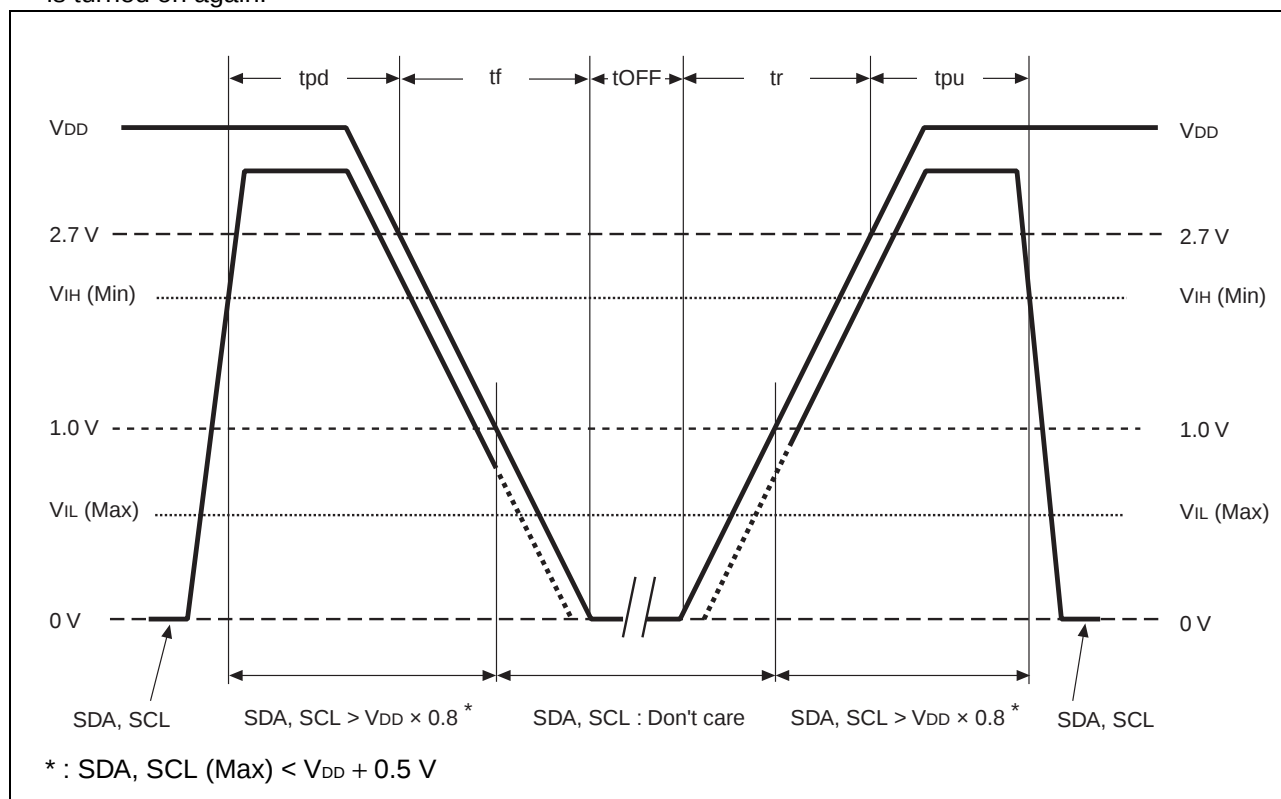
| Parameter         | Symbol    | Conditions                                                                                             | Value |     |     | Unit |
|-------------------|-----------|--------------------------------------------------------------------------------------------------------|-------|-----|-----|------|
|                   |           |                                                                                                        | Min   | Typ | Max |      |
| I/O capacitance   | $C_{I/O}$ | $V_{DD} = V_{IN} = V_{OUT} = 0\text{ V}$ ,<br>$f = 1\text{ MHz}$ , $T_A = +25\text{ }^{\circ}\text{C}$ | —     | —   | 15  | pF   |
| Input capacitance | $C_{IN}$  |                                                                                                        | —     | —   | 15  | pF   |

## 5. AC Test Load Circuit



## POWER ON/OFF SEQUENCE

If  $V_{DD}$  falls down below 2.0V,  $V_{DD}$  is required to be started from 0V to prevent malfunctions when the power is turned on again.



| Parameter                                  | Symbol    | Value |     | Unit |
|--------------------------------------------|-----------|-------|-----|------|
|                                            |           | Min   | Max |      |
| SDA, SCL level hold time during power down | $t_{pd}$  | 85    | —   | ns   |
| SDA, SCL level hold time during power up   | $t_{pu}$  | 85    | —   | ns   |
| Power supply rising time                   | $t_r$     | 0.01  | 50  | ms   |
| Power supply falling time                  | $t_f$     | 0.01  | 50  | ms   |
| Power off time                             | $t_{OFF}$ | 50    | —   | 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 $T_A = +85^\circ\text{C}$ |
| 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.

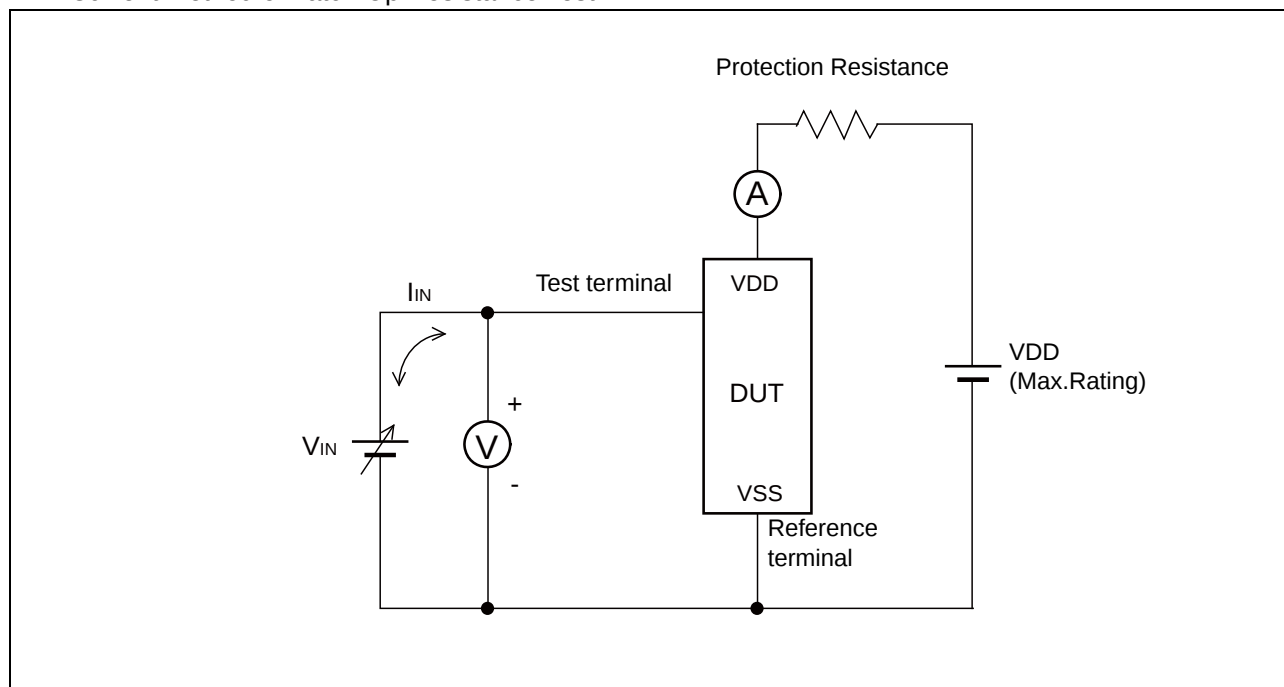
## NOTE ON USE

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

## ■ ESD AND LATCH-UP

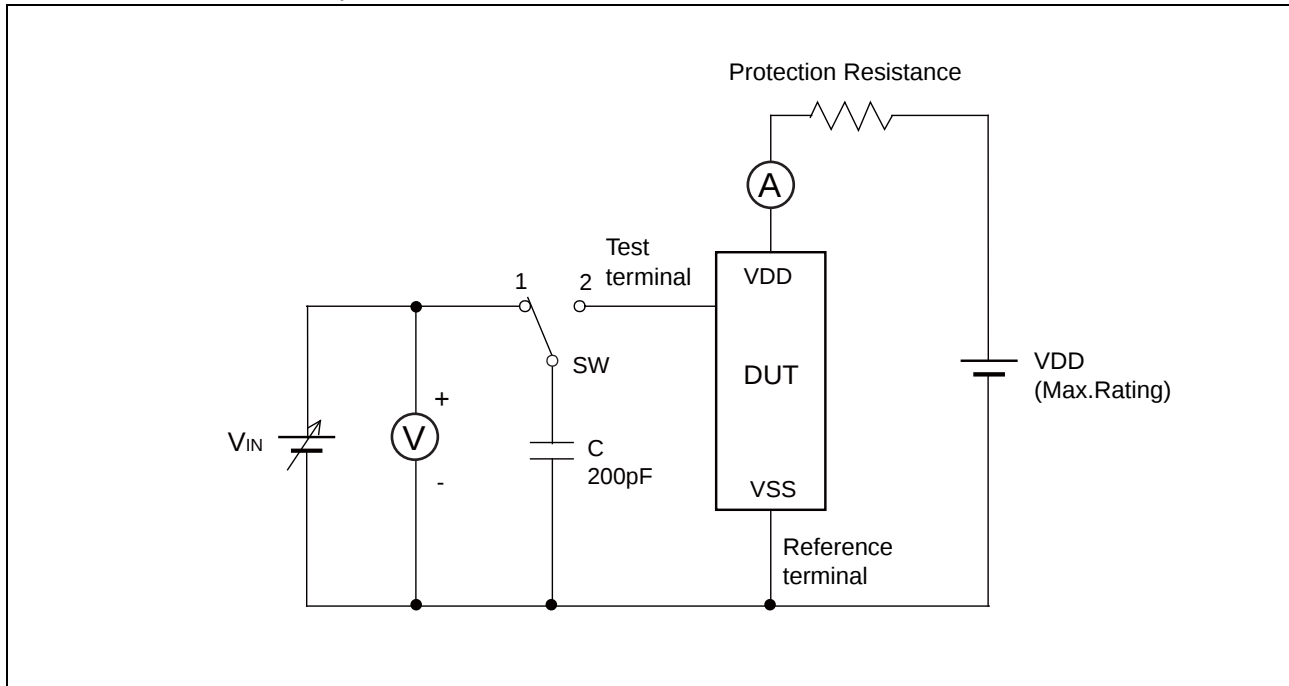
| Test                                                                 | DUT                | Value                   |
|----------------------------------------------------------------------|--------------------|-------------------------|
| ESD HBM (Human Body Model)<br>JESD22-A114 compliant                  | MB85RC16PNF-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              |                    | $\geq  1000 \text{ V} $ |
| Latch-Up (I-test)<br>JESD78 compliant                                |                    | —                       |
| Latch-Up ( $V_{\text{supply}}$ overvoltage test)<br>JESD78 compliant |                    | —                       |
| Latch-Up (Current Method)<br>Proprietary method                      |                    | $\geq  300 \text{ mA} $ |
| Latch-Up (C-V Method)<br>Proprietary method                          |                    | —                       |

### • 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

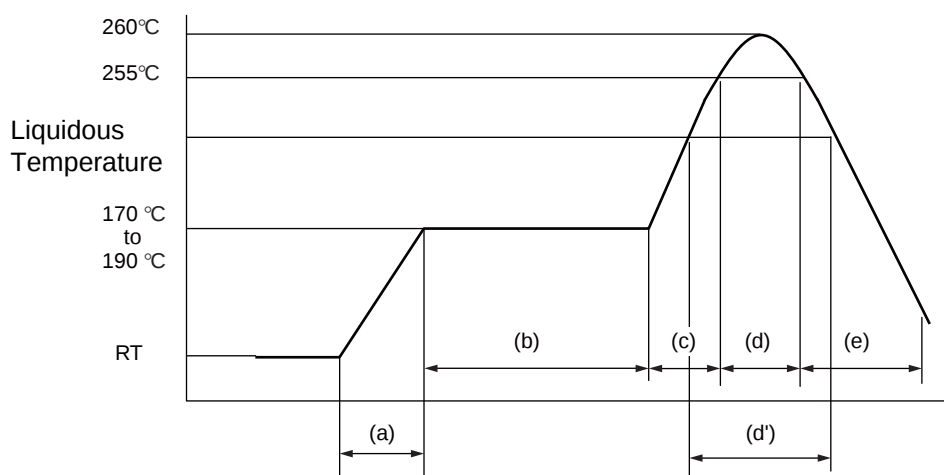


Note : Charge voltage alternately switching 1 and 2 approximately 2 sec interval. This switching process is considered as one cycle.  
Repeat this process 5 times. However, if the latch-up condition occurs before completing 5times, this test must be stopped immediately.

## REFLOW CONDITIONS AND FLOOR LIFE

| 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.<br>Then please use within 8 days.<br>(Please remember baking is up to 2 times) |
| Floor life condition | Between 5 °C and 30 °C and also below 70%RH required.<br>(It is preferred lower humidity in the required temp range.) |                                                                                                                                           |

### Reflow Profile



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 | ○               |

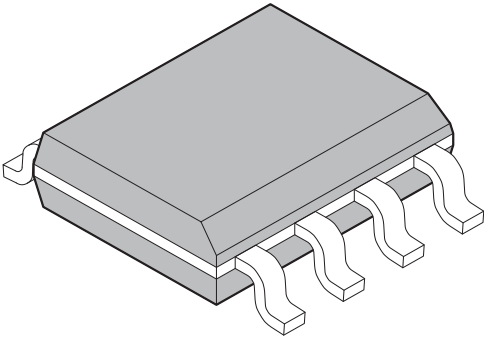
\* : The mark of "○" shows below a threshold value.

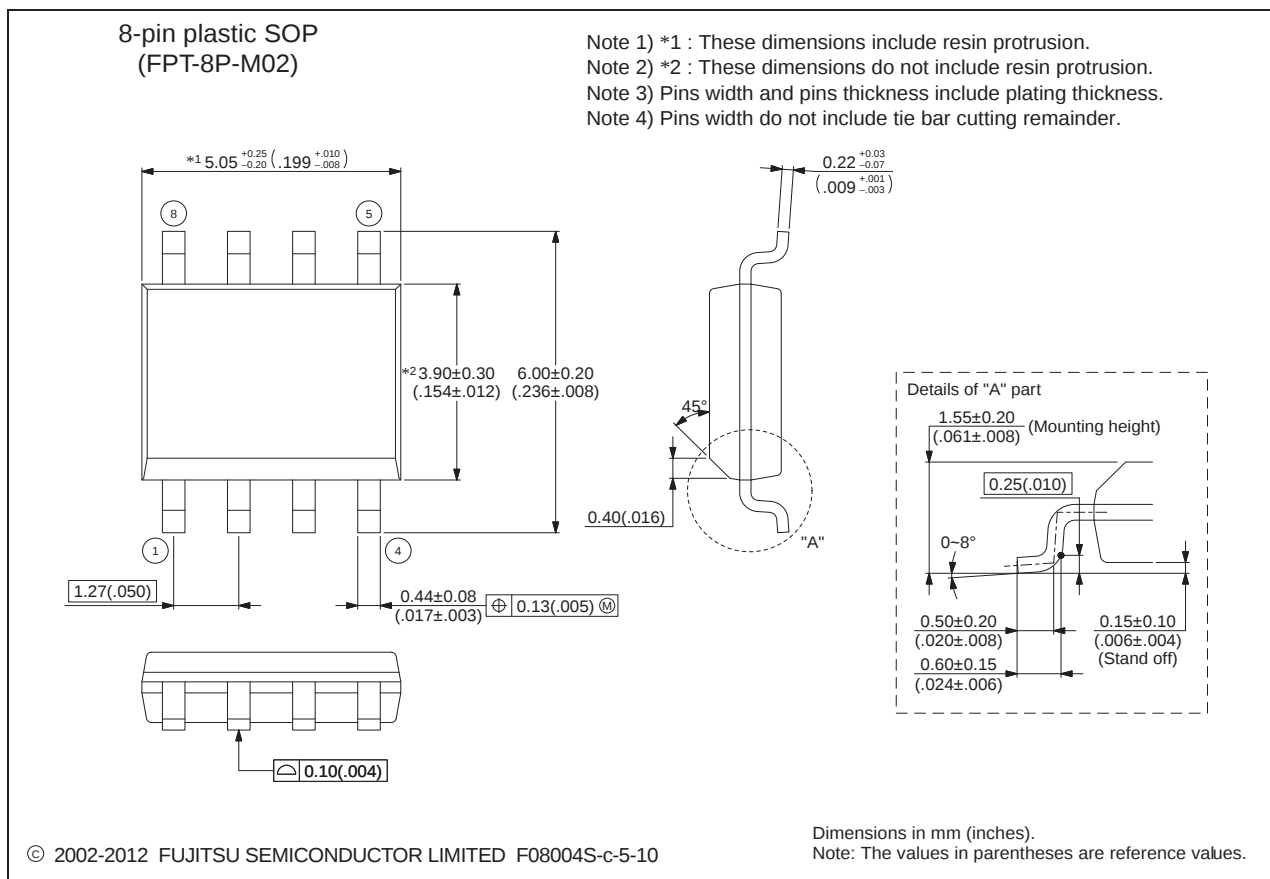
# MB85RC16

## ■ ORDERING INFORMATION

| Part number          | Package                            | Shipping form         | Minimum shipping quantity |
|----------------------|------------------------------------|-----------------------|---------------------------|
| MB85RC16PNF-G-JNE1   | 8-pin, plastic SOP<br>(FPT-8P-M02) | Tube                  | 1                         |
| MB85RC16PNF-G-JNERE1 | 8-pin, plastic SOP<br>(FPT-8P-M02) | Embossed Carrier tape | 1500                      |
| MB85RC16PN-G-AMERE1  | 8-pin, plastic SON<br>(LCC-8P-M04) | Embossed Carrier tape | 7000                      |

## ■ PACKAGE DIMENSION

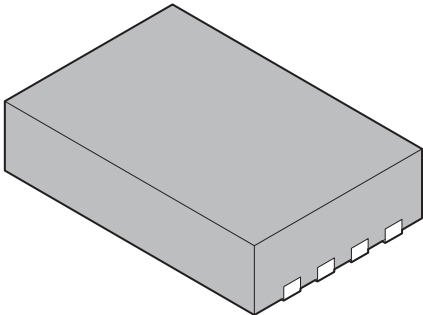
|                                                                                                                                |                                |                  |
|--------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------------------|
|  <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           |
|                                                                                                                                |                                |                  |

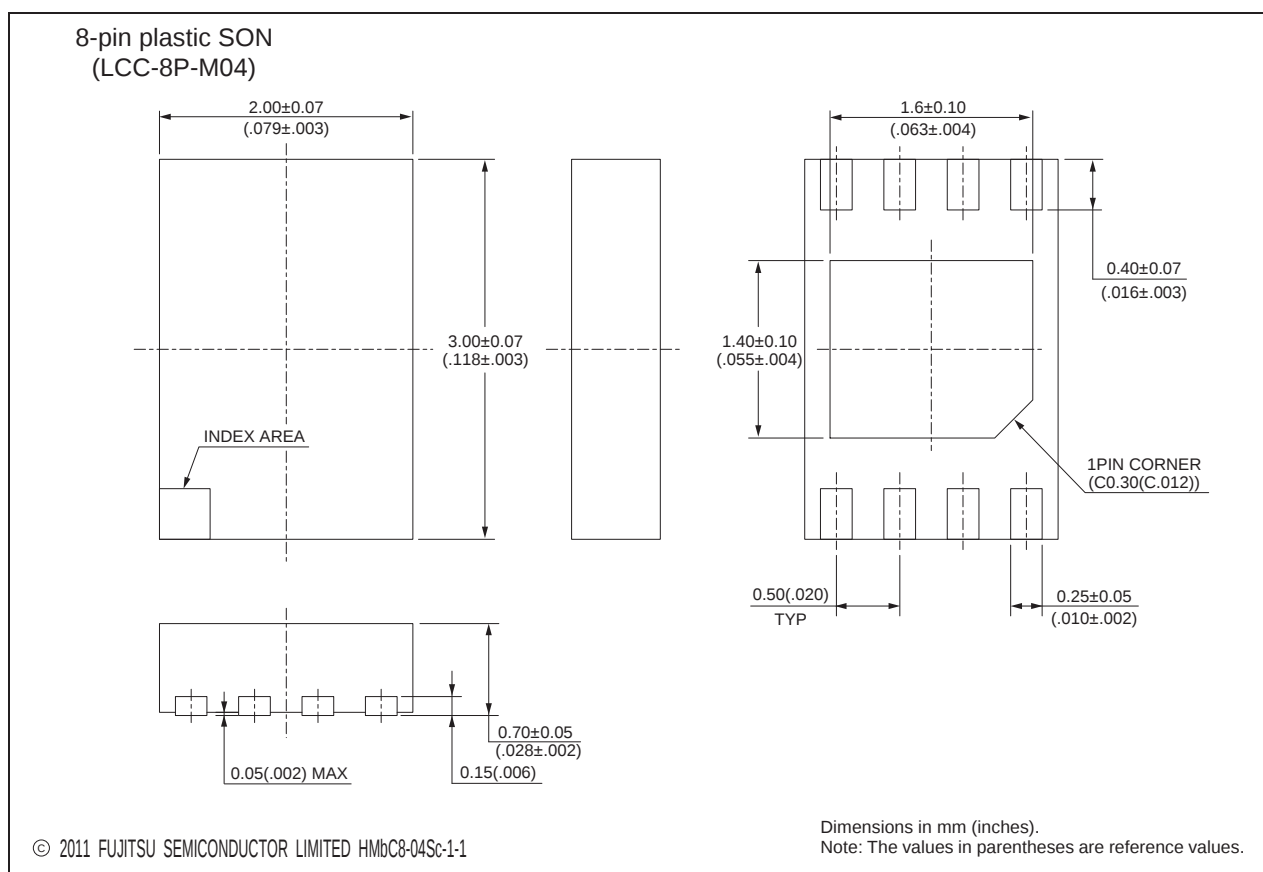


Please check the latest package dimension at the following URL.  
<http://edevic.fujitsu.com/package/en-search/>

(Continued)

(Continued)

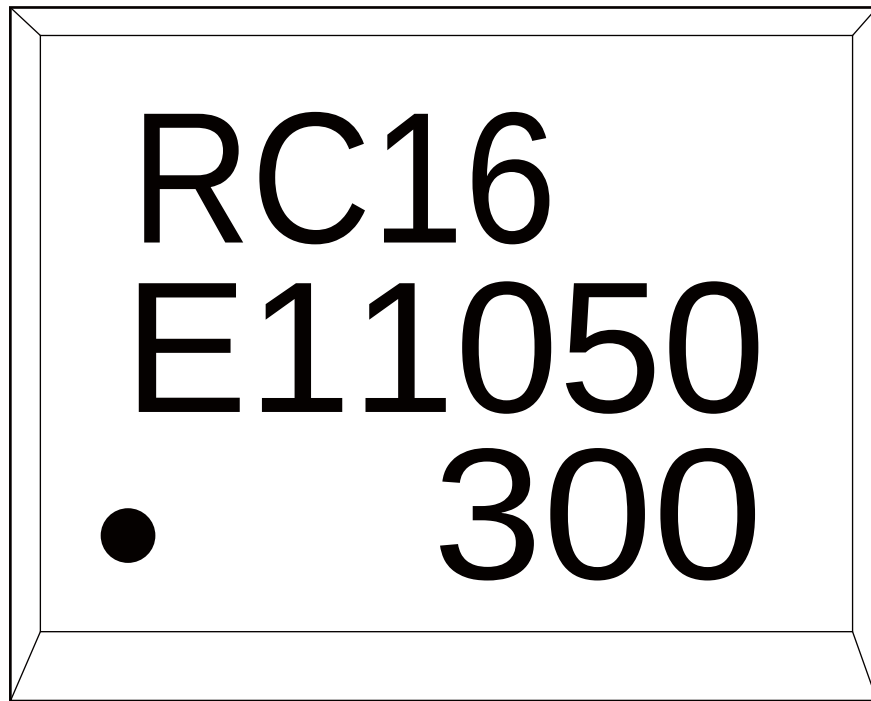
|                                                                                                                                |                                |                 |
|--------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-----------------|
| <p>8-pin plastic SON</p>  <p>(LCC-8P-M04)</p> | Lead pitch                     | 0.5 mm          |
|                                                                                                                                | Package width × package length | 2.0 mm × 3.0 mm |
|                                                                                                                                | Sealing method                 | Plastic mold    |
|                                                                                                                                | Mounting height                | 0.75 mm MAX     |
|                                                                                                                                | Weight                         | 0.015g          |
|                                                                                                                                |                                |                 |



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

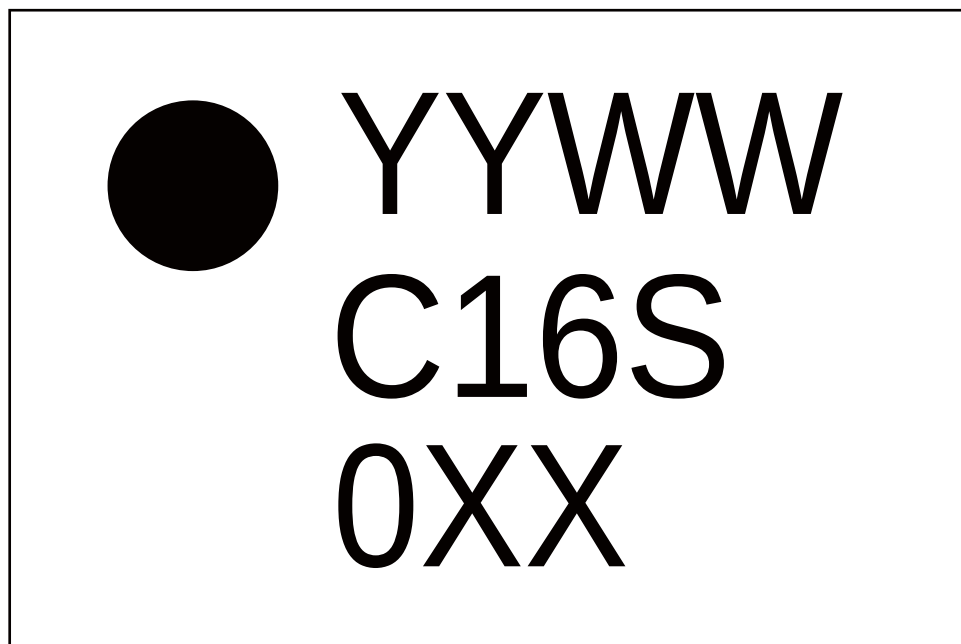
## ■ MARKING

[MB85RC16PNF-G-JNE1]  
[MB85RC16PNF-G-JNERE1]



[FPT-8P-M02]

[MB85RC16PN-G-AMERE1]



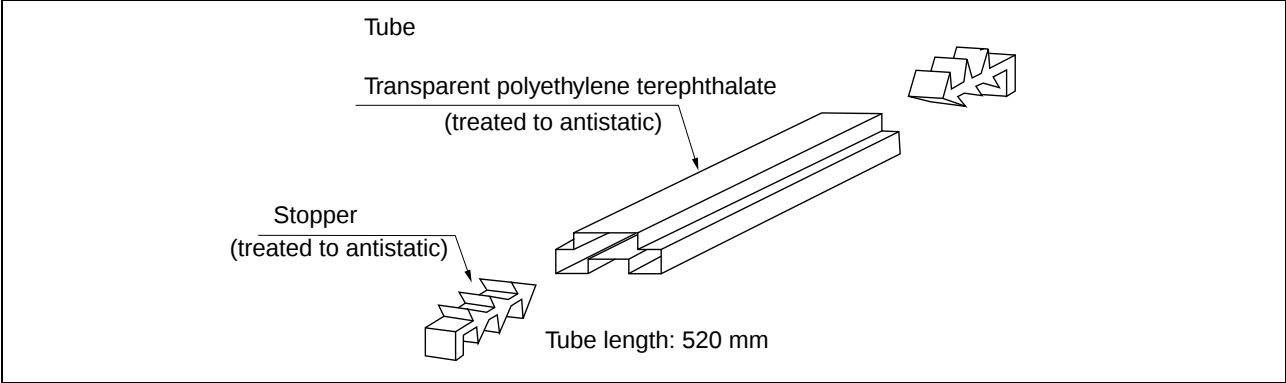
[LCC-8P-M04]

## ■ PACKING INFORMATION

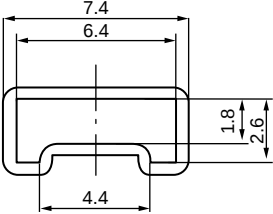
### 1. Tube

#### 1.1 Tube Dimensions

- Tube/stopper shape

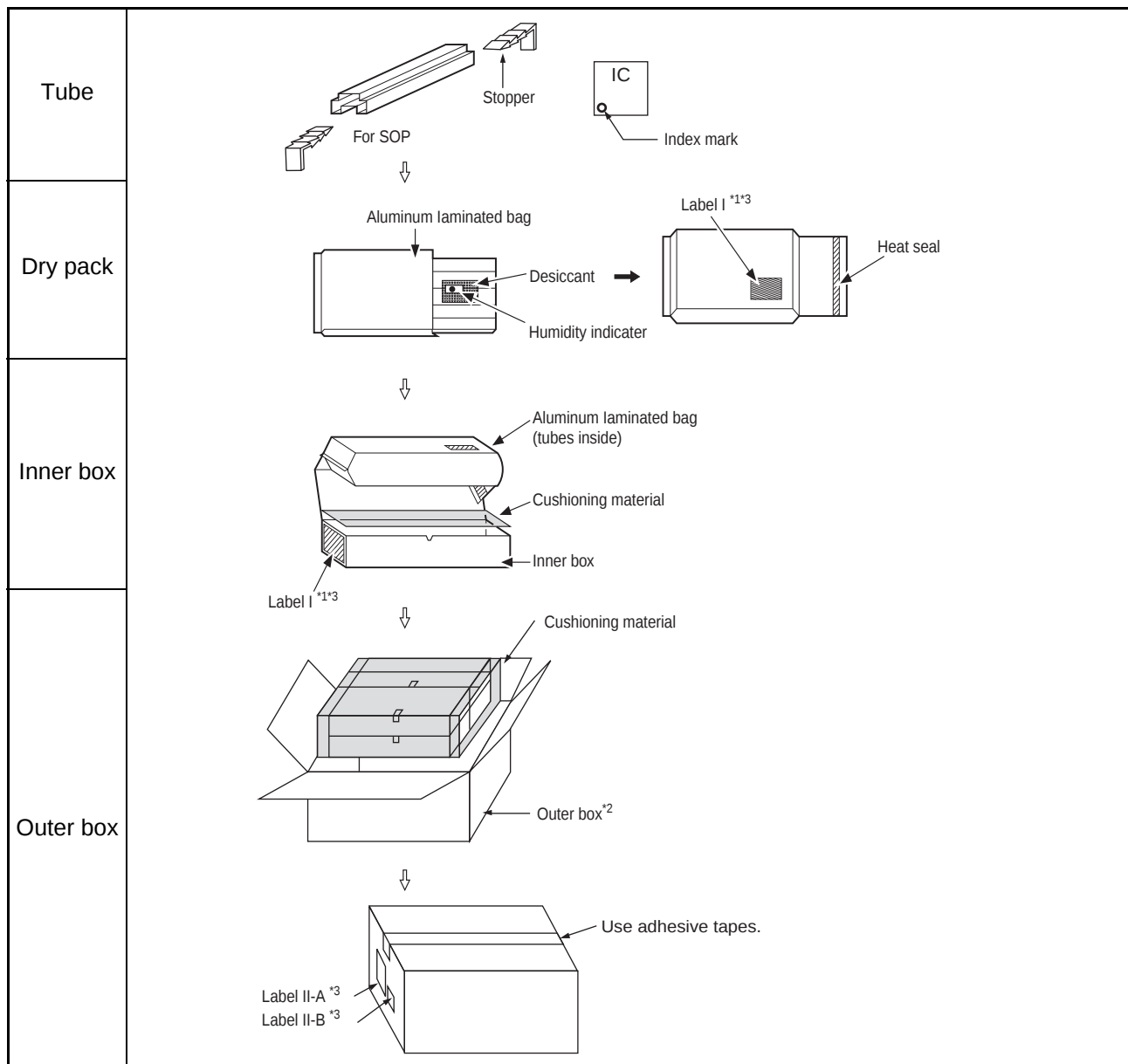


#### Tube cross-sections and Maximum quantity

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

(Dimensions in mm)

## 1.2 Tube Dry pack packing specifications



\*1: For a product of which part number is suffixed with "E1", a "G" and "No" marks is display 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)]

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

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

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

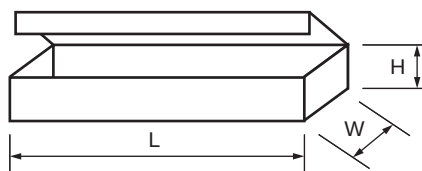
Label II-B: Outer boxes product indicate

|                             |         |            |
|-----------------------------|---------|------------|
| XXXXXXXXXXXXX (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.

## 1.4 Dimensions for Containers

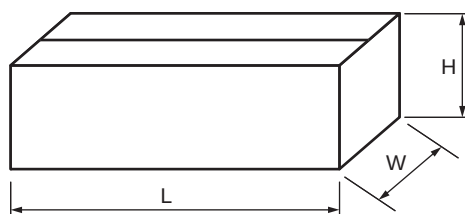
### (1) Dimensions for inner box



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

(Dimensions in mm)

### (2) Dimensions for outer box

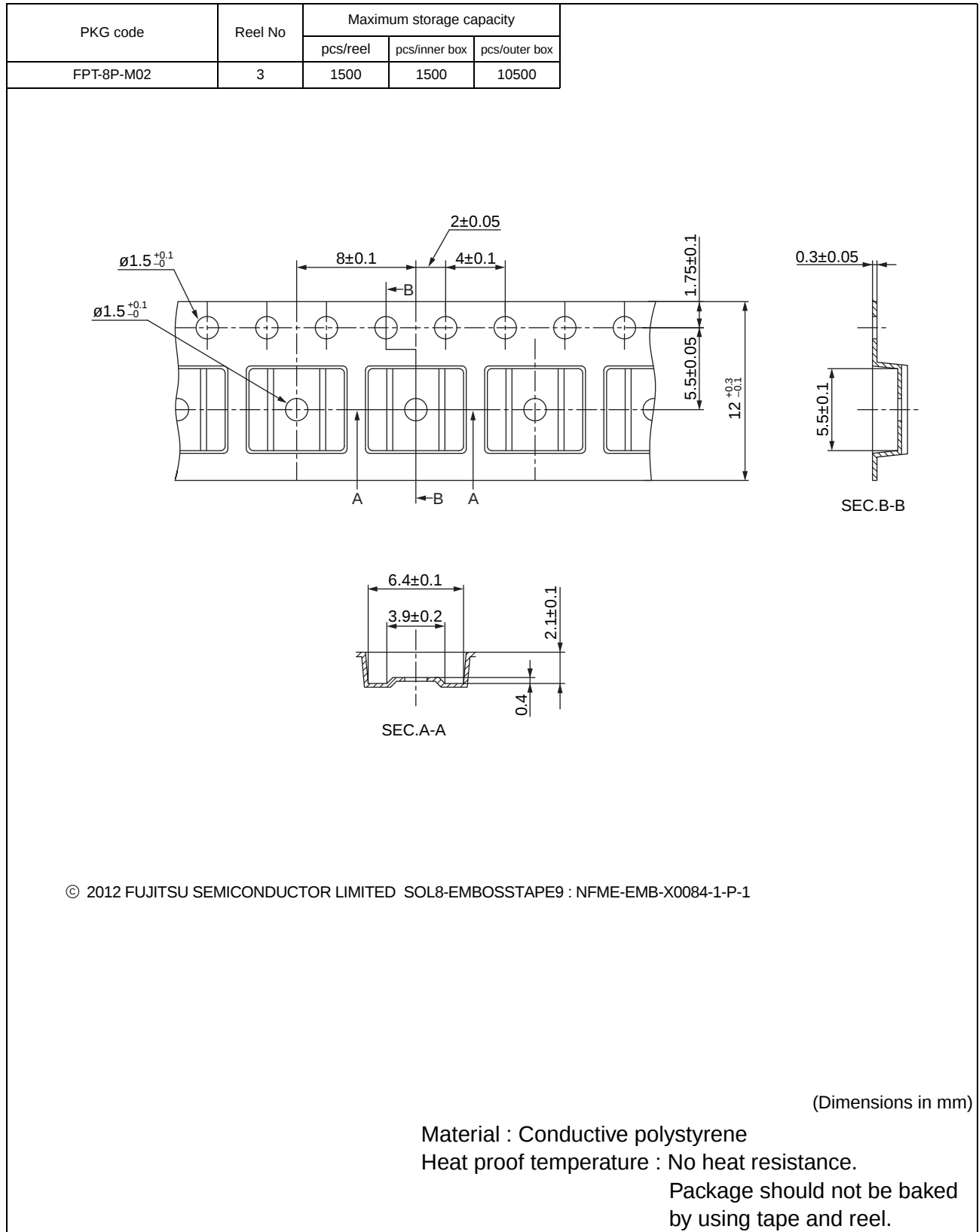


| L   | W   | H   |
|-----|-----|-----|
| 565 | 270 | 180 |

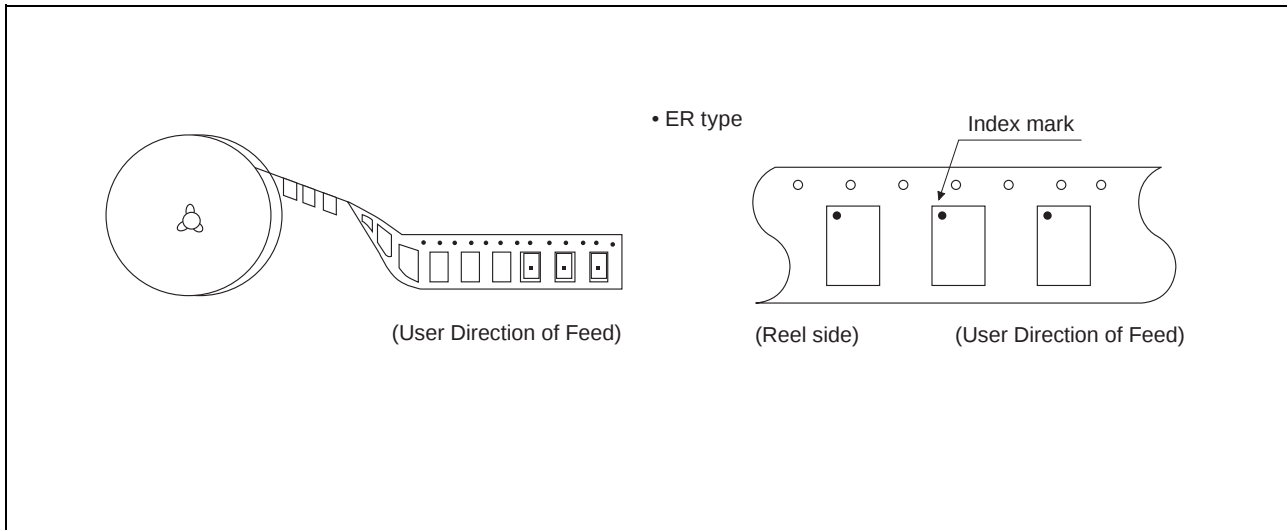
(Dimensions in mm)

## 2. Emboss Tape

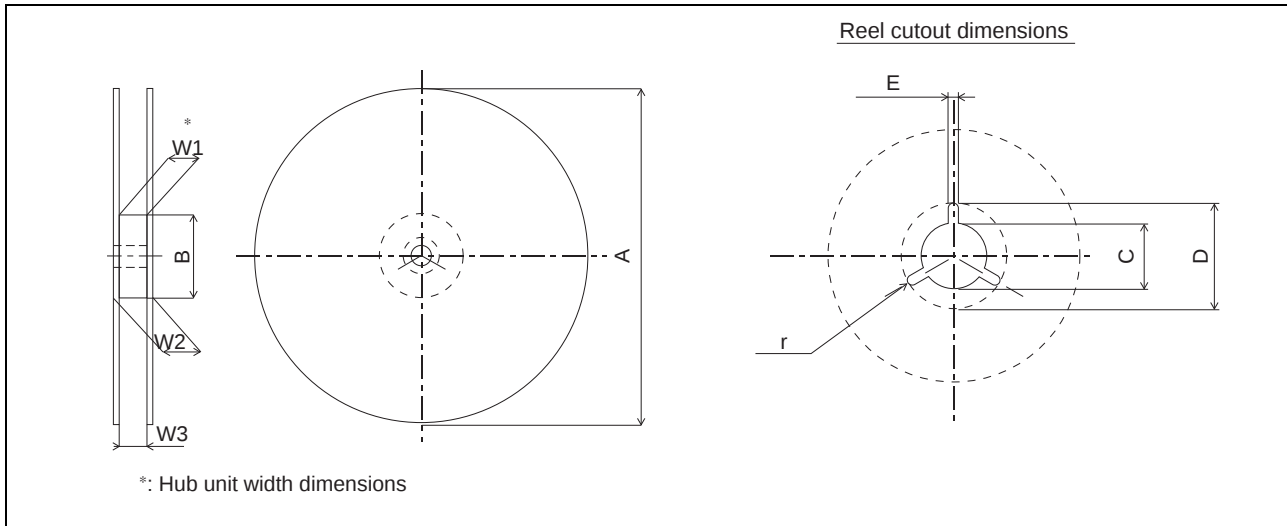
### 2.1 Tape Dimensions



## 2.2 IC orientation

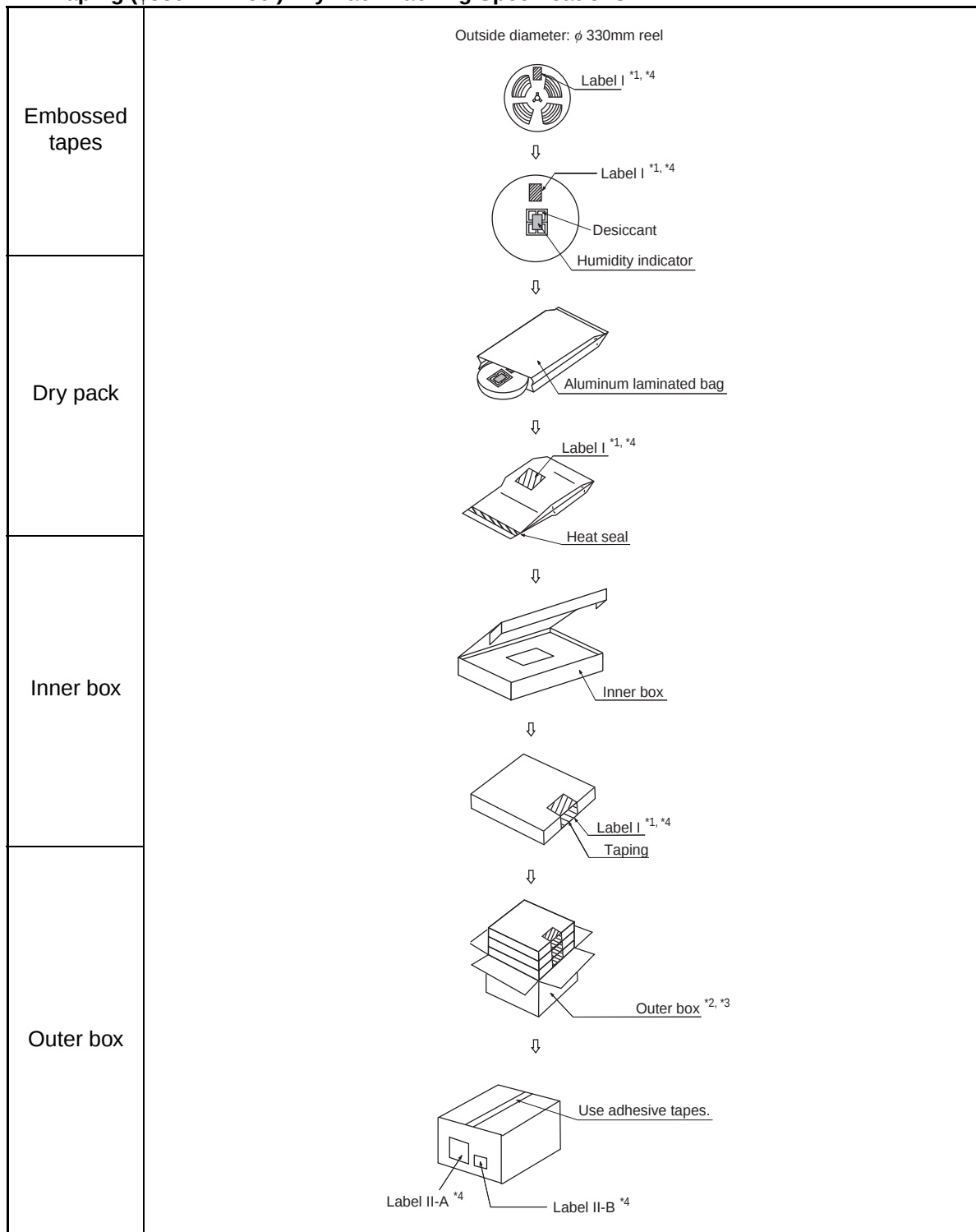


## 2.3 Reel dimensions



| Dimensions in mm     |                                 |                                  |         |                                  |         |                                  |         |                                  |                                 |                                  |                                 |                                  |                                    |                                  |                                    |
|----------------------|---------------------------------|----------------------------------|---------|----------------------------------|---------|----------------------------------|---------|----------------------------------|---------------------------------|----------------------------------|---------------------------------|----------------------------------|------------------------------------|----------------------------------|------------------------------------|
| Reel No              | 1                               | 2                                | 3       | 4                                | 5       | 6                                | 7       | 8                                | 9                               | 10                               | 11                              | 12                               | 13                                 | 14                               | 15                                 |
| Tape width<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 <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 (ø330mm Reel) Dry Pack Packing Specifications



\*1: For a product of which part number is suffixed with "E1", a "G" and "No" 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.

## 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)]

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

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

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

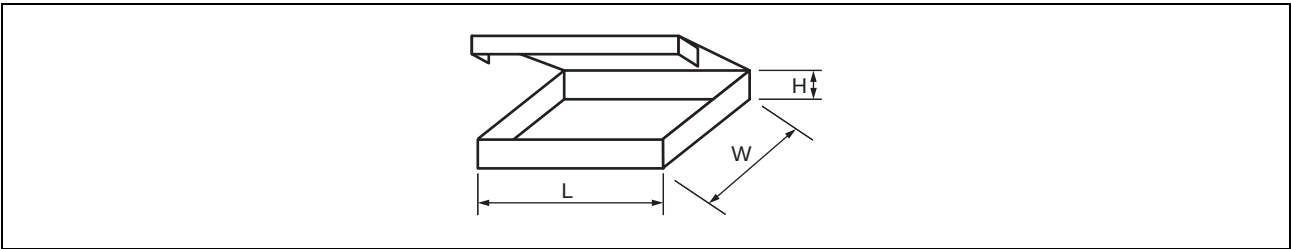
Label II-B: Outer boxes product indicate

|                             |         |            |
|-----------------------------|---------|------------|
| XXXXXXXXXXXXX (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.

2.6 Dimensions for Containers

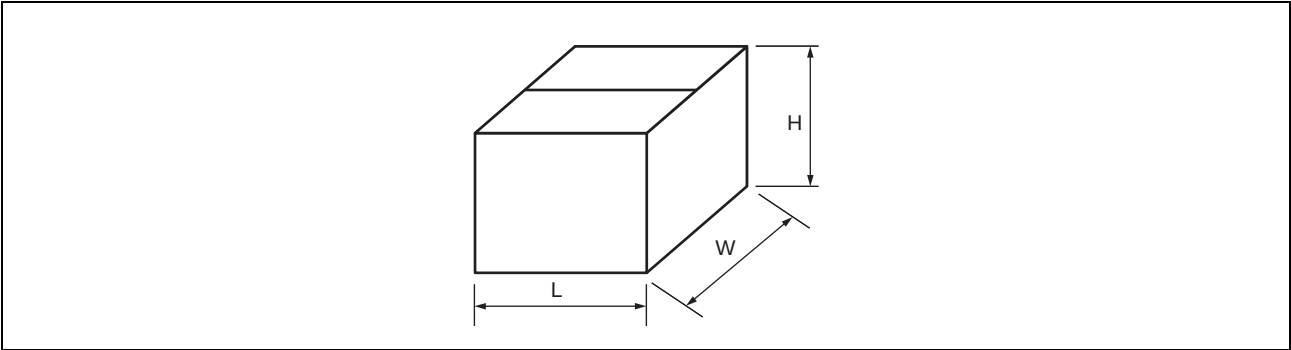
(1) Dimensions for inner box



| 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)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 11   | ■ ABSOLUTE MAXIMUM RATINGS | Revised the Storage Temperature<br>– 40 °C → – 55 °C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 15   | ■ POWER ON/OFF SEQUENCE    | Revised the following description:<br>“POWER ON SEQUENCE”<br>→“POWER ON/OFF SEQUENCE”<br><br>Added the following description:<br>“If the device does not operate within the specified<br>conditions of read cycle, write cycle or power on/off<br>sequence, memory data can not be guaranteed.”<br><br>Revised the following description:<br>“V <sub>DD</sub> pin is required to be rising from 0 V because turn-<br>ing the power on from an intermediate level may cause<br>malfunctions, when the power is turned on”<br>→“If V <sub>DD</sub> falls down below 2.0V, V <sub>DD</sub> is required to be<br>started from 0V to prevent malfunctions when the pow-<br>er is turned on again.” |
|      | ■ FRAM CHARACTERISTICS     | Revised the table and Note                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 20   | ■ ORDERING INFORMATION     | Deleted the following description:<br>“Will be available in January, 2013.”                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

**MEMO**

**MEMO**

## FUJITSU SEMICONDUCTOR LIMITED

Nomura Fudosan Shin-yokohama Bldg. 10-23, Shin-yokohama 2-Chome,  
Kohoku-ku Yokohama Kanagawa 222-0033, Japan

Tel: +81-45-415-5858

<http://jp.fujitsu.com/fsl/en/>

*For further information please contact:*

### North and South America

FUJITSU SEMICONDUCTOR AMERICA, INC.

1250 E. Arques Avenue, M/S 333

Sunnyvale, CA 94085-5401, U.S.A.

Tel: +1-408-737-5600 Fax: +1-408-737-5999

<http://us.fujitsu.com/micro/>

### Europe

FUJITSU SEMICONDUCTOR EUROPE GmbH

Pittlerstrasse 47, 63225 Langen, Germany

Tel: +49-6103-690-0 Fax: +49-6103-690-122

<http://emea.fujitsu.com/semiconductor/>

### Korea

FUJITSU SEMICONDUCTOR KOREA LTD.

902 Kosmo Tower Building, 1002 Daechi-Dong,

Gangnam-Gu, Seoul 135-280, Republic of Korea

Tel: +82-2-3484-7100 Fax: +82-2-3484-7111

<http://kr.fujitsu.com/fsk/>

### Asia Pacific

FUJITSU SEMICONDUCTOR ASIA PTE. LTD.

151 Lorong Chuan,

#05-08 New Tech Park 556741 Singapore

Tel : +65-6281-0770 Fax : +65-6281-0220

<http://sg.fujitsu.com/semiconductor/>

FUJITSU SEMICONDUCTOR SHANGHAI CO., LTD.

30F, Kerry Parkside, 1155 Fang Dian Road, Pudong District,

Shanghai 201204, China

Tel : +86-21-6146-3688 Fax : +86-21-6146-3660

<http://cn.fujitsu.com/fss/>

FUJITSU SEMICONDUCTOR PACIFIC ASIA LTD.

2/F, Green 18 Building, Hong Kong Science Park,

Shatin, N.T., Hong Kong

Tel : +852-2736-3232 Fax : +852-2314-4207

<http://cn.fujitsu.com/fsp/>

Specifications are subject to change without notice. For further information please contact each office.

### All Rights Reserved.

The contents of this document are subject to change without notice.

Customers are advised to consult with sales representatives before ordering.

The information, such as descriptions of function and application circuit examples, in this document are presented solely for the purpose of reference to show examples of operations and uses of FUJITSU SEMICONDUCTOR device; FUJITSU SEMICONDUCTOR does not warrant proper operation of the device with respect to use based on such information. When you develop equipment incorporating the device based on such information, you must assume any responsibility arising out of such use of the information.

FUJITSU SEMICONDUCTOR assumes no liability for any damages whatsoever arising out of the use of the information.

Any information in this document, including descriptions of function and schematic diagrams, shall not be construed as license of the use or exercise of any intellectual property right, such as patent right or copyright, or any other right of FUJITSU SEMICONDUCTOR or any third party or does FUJITSU SEMICONDUCTOR warrant non-infringement of any third-party's intellectual property right or other right by using such information. FUJITSU SEMICONDUCTOR assumes no liability for any infringement of the intellectual property rights or other rights of third parties which would result from the use of information contained herein.

The products described in this document are designed, developed and manufactured as contemplated for general use, including without limitation, ordinary industrial use, general office use, personal use, and household use, but are not designed, developed and manufactured as contemplated (1) for use accompanying fatal risks or dangers that, unless extremely high safety is secured, could have a serious effect to the public, and could lead directly to death, personal injury, severe physical damage or other loss (i.e., nuclear reaction control in nuclear facility, aircraft flight control, air traffic control, mass transport control, medical life support system, missile launch control in weapon system), or (2) for use requiring extremely high reliability (i.e., submersible repeater and artificial satellite).

Please note that FUJITSU SEMICONDUCTOR will not be liable against you and/or any third party for any claims or damages arising in connection with above-mentioned uses of the products.

Any semiconductor devices have an inherent chance of failure. You must protect against injury, damage or loss from such failures by incorporating safety design measures into your facility and equipment such as redundancy, fire protection, and prevention of over-current levels and other abnormal operating conditions.

Exportation/release of any products described in this document may require necessary procedures in accordance with the regulations of the Foreign Exchange and Foreign Trade Control Law of Japan and/or US export control laws.

The company names and brand names herein are the trademarks or registered trademarks of their respective owners.

Edited: Sales Promotion Department