FUJITSU SEMICONDUCTOR
MEMORY SOLUTION DATA SHEET

DS501-00011-8v4-E

*Memory FRAM*

# 256 K (32 K × 8) Bit

# MB85R256F

## ■ DESCRIPTIONS

The MB85R256F is an 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.

The MB85R256F is able to retain data without using a back-up battery, as is needed for SRAM.

The memory cells used in the MB85R256F 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 $E^2$PROM.

The MB85R256F uses a pseudo - SRAM interface.

## ■ FEATURES

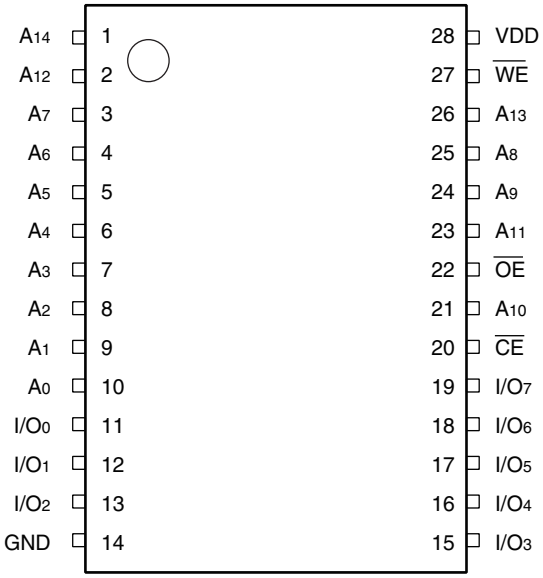
- Bit configuration : 32,768 words × 8 bits
- Read/write endurance : $10^{12}$ times / byte
- Data retention : 10 years ( + 85 °C), 95 years ( + 55 °C), over 200 years ( + 35 °C)
- Operating power supply voltage : 2.7 V to 3.6 V
- Low power consumption : Operating power supply current 5 mA (Typ)
  Standby current 5 μA (Typ)
- Operation ambient temperature range: − 40 °C to + 85 °C
- Package : 28-pin plastic SOP
  : 28-pin plastic TSOP(1)
  Both are RoHS compliant


2020.06

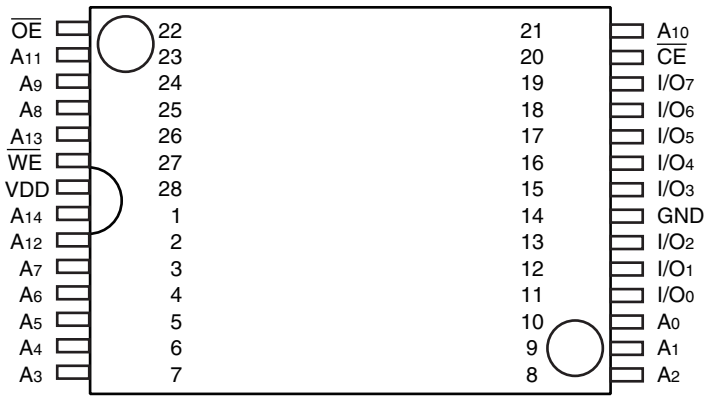
FUJITSU

## ■ PIN ASSIGNMENTS

(TOP VIEW)




(28-pin plastic SOP)

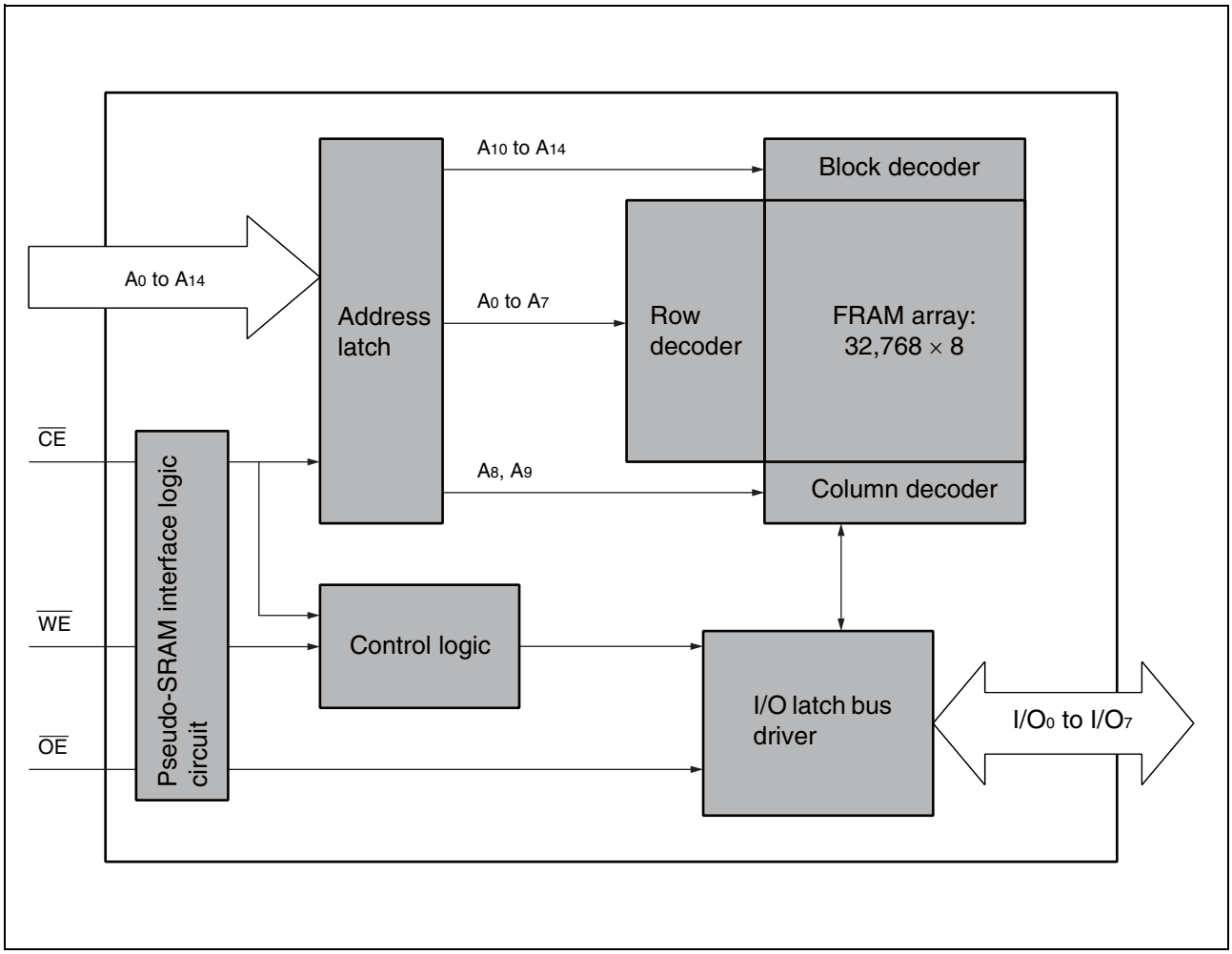



(28-pin plastic TSOP(1))

## ■ PIN FUNCTIONAL DESCRIPTIONS

| Pin no. | Pin name | Functional description |
|---|---|---|
| 1 to 10, 21, 23 to 26 | $A_0$ to $A_{14}$ | Address input pins |
| 11 to 13, 15 to 19 | $I/O_0$ to $I/O_7$ | Data input/output pins |
| 20 | $\overline{CE}$ | Chip enable input pin |
| 27 | $\overline{WE}$ | Write Enable input pin |
| 22 | $\overline{OE}$ | Output enable input pin |
| 28 | VDD | Supply Voltage pin |
| 14 | GND | Ground pin |

## ■ BLOCK DIAGRAM




## ■ FUNCTION LIST

| Operation mode | $\overline{CE}$ | $\overline{WE}$ | $\overline{OE}$ | $I/O_0$ to $I/O_7$ | Power supply current |
|---|---|---|---|---|---|
| Standby precharge | H | × | × | Hi-Z | Standby ($I_{SB}$) |
| | × | L | L | | |
| | × | H | H | | |
| Latch address | L | ↓ | ↓ | — | — |
| | ↓ | H | L | | |
| | ↓ | L | H | | |
| Write | L | L | H | Data input | Operation ($I_{DD}$) |
| Read | L | H | L | Data output | |

H: High level, L: Low level, × : can be either H, L, ↓ or ↑, Hi-Z: High impedance, ↓ : Latch address at falling edge

## ■ ABSOLUTE MAXIMUM RANGES

| 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 | Tstg | − 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*1 | $V_{DD}$ | 2.7 | 3.3 | 3.6 | V |
| Operation ambient temperature*2 | $T_A$ | − 40 | — | + 85 | °C |

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

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

WARNING: The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated 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 | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| Input leakage current | $\lvert I_{LI} \rvert$ | $V_{IN}$ = 0 V to $V_{DD}$ | — | — | 10 | μA |
| Output leakage current | $\lvert I_{LO} \rvert$ | $V_{OUT}$ = 0 V to $V_{DD}$, $\overline{CE}$ = $V_{IH}$ or $\overline{OE}$ = $V_{IH}$ | — | — | 10 | μA |
| Operating power supply current*1 | $I_{DD}$ | $\overline{CE}$ = 0.2 V, Other inputs = $V_{DD}$ − 0.2 V/0.2 V, $t_{RC}$ (Min), Iout = 0 mA | — | 5 | 10 | mA |
| Standby current*2 | $I_{SB}$ | $\overline{CE}$, $\overline{WE}$, $\overline{OE}$ ≥ $V_{DD}$ | — | 5 | 50 | μA |
| High level input voltage | $V_{IH}$ | $V_{DD}$ = 2.7 V to 3.6 V | $V_{DD}$ × 0.8 | — | $V_{DD}$ + 0.5 (≤ 4.0) | V |
| Low level input voltage | $V_{IL}$ | $V_{DD}$ = 2.7 V to 3.6 V | − 0.5 | — | + 0.6 | V |
| High level output voltage | $V_{OH}$ | $I_{OH}$ = − 2.0 mA | $V_{DD}$ × 0.8 | — | — | V |
| Low level output voltage | $V_{OL}$ | $I_{OL}$ = 2.0 mA | — | — | 0.4 | V |

*1: During the measurement of $I_{DD}$, the Address and Data In were taken to only change once per active cycle. Iout: output current

*2: All pins other than setting pins shall be input at the CMOS level voltages such as H ≥ $V_{DD}$, L ≤ 0 V.

## 2. AC Characteristics

• AC Characteristics Test Condition

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 : 10 ns

Input falling time : 10 ns

Input evaluation level : $V_{DD}/2$

Output evaluation level : $V_{DD}/2$

Output Load Capacitance: 100 pF

**(1) Read cycle**

| Parameter | Symbol | Value | | Unit |
|---|---|---|---|---|
| | | Min | Max | |
| Read cycle time | $t_{RC}$ | 150 | — | ns |
| $\overline{CE}$ active time | $t_{CA}$ | 70 | 500 | |
| Read pulse width | $t_{RP}$ | 70 | 500 | |
| Precharge time | $t_{PC}$ | 80 | — | |
| Address setup time | $t_{AS}$ | 0 | — | |
| Address hold time | $t_{AH}$ | 25 | — | |
| $\overline{CE}$ access time | $t_{CE}$ | — | 70 | |
| $\overline{OE}$ access time | $t_{OE}$ | — | 70 | |
| $\overline{CE}$ output floating time | $t_{HZ}$ | — | 25 | |
| $\overline{OE}$ output floating time | $t_{OHZ}$ | — | 25 | |

**(2) Write cycle**

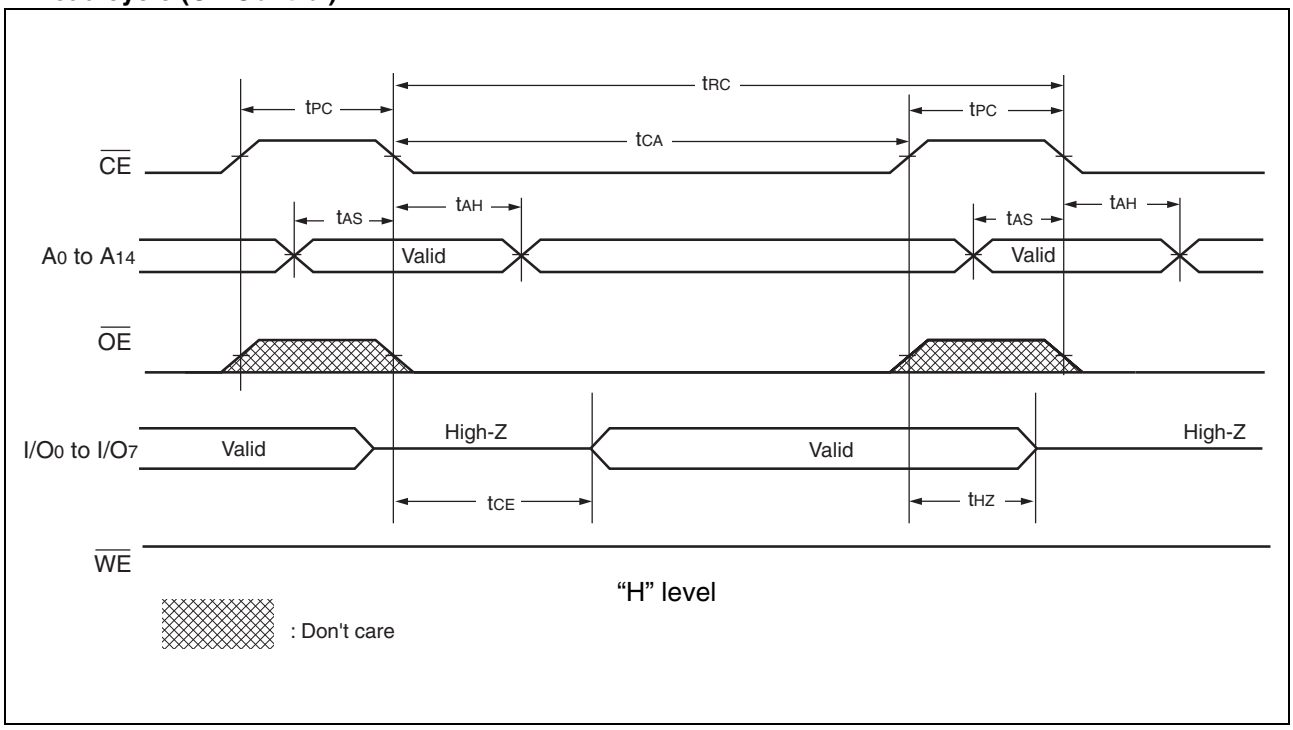
| Parameter | Symbol | Value | | Unit |
|---|---|---|---|---|
| | | Min | Max | |
| Write cycle time | $t_{WC}$ | 150 | — | ns |
| $\overline{CE}$ active time | $t_{CA}$ | 70 | 500 | |
| Write pulse width | $t_{WP}$ | 70 | 500 | |
| Precharge time | $t_{PC}$ | 80 | — | |
| Address setup time | $t_{AS}$ | 0 | — | |
| Address hold time | $t_{AH}$ | 25 | — | |
| Data setup time | $t_{DS}$ | 50 | — | |
| Data hold time | $t_{DH}$ | 0 | — | |

### 3. Pin Capacitance

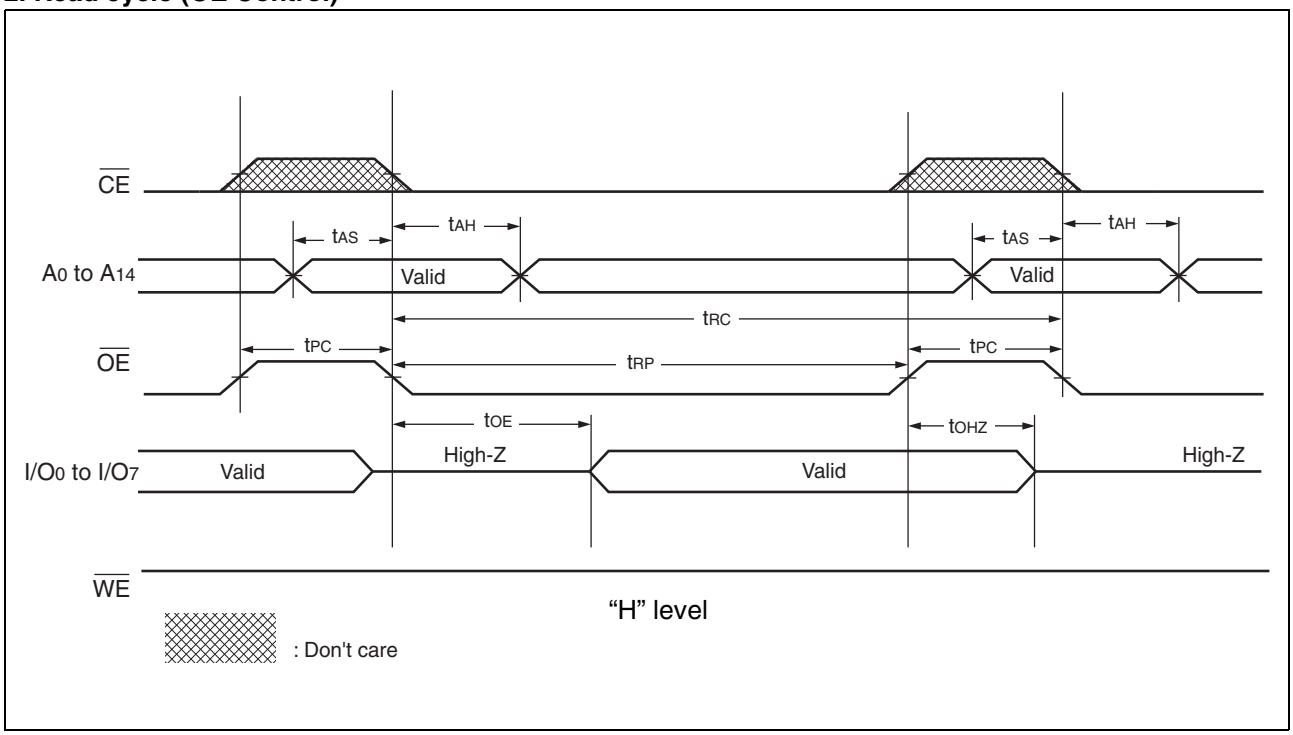
| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| Input capacitance | $C_{IN}$ | $V_{DD} = V_{IN} = V_{OUT} = 0$ V, f = 1 MHz, $T_A = +25$ °C | — | — | 10 | pF |
| Output capacitance | $C_{OUT}$ | | — | — | 10 | pF |

## ■ TIMING DIAGRAM

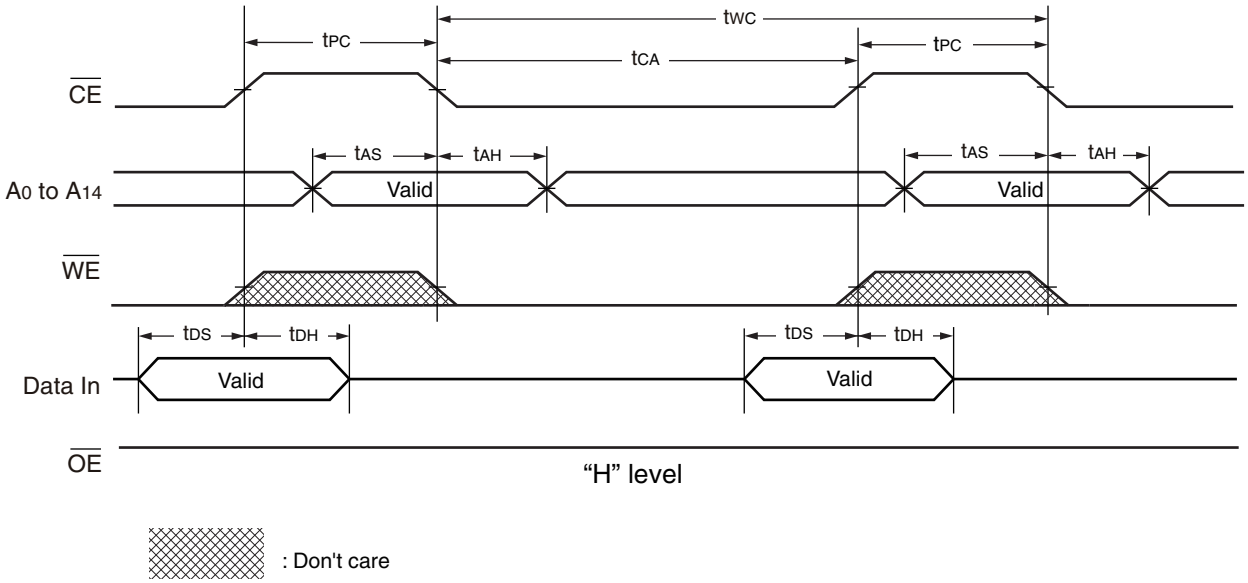
### 1. Read cycle ($\overline{CE}$ Control)



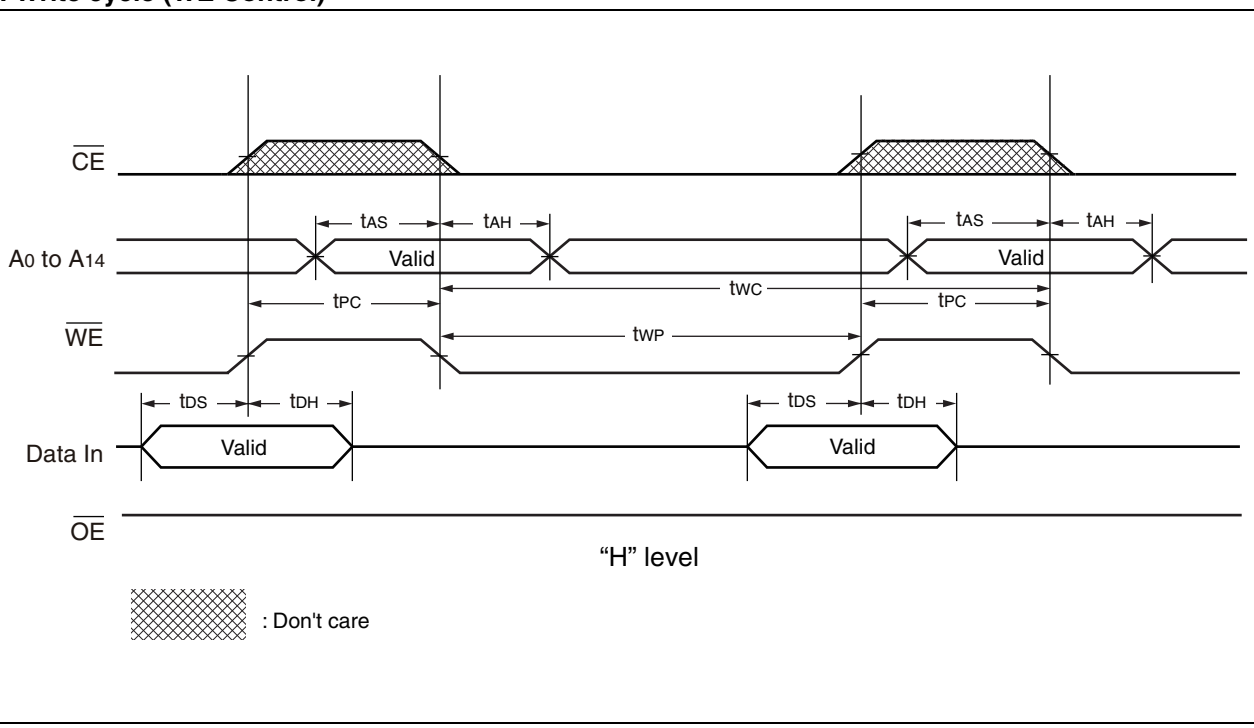

### 2. Read cycle ($\overline{OE}$ Control)



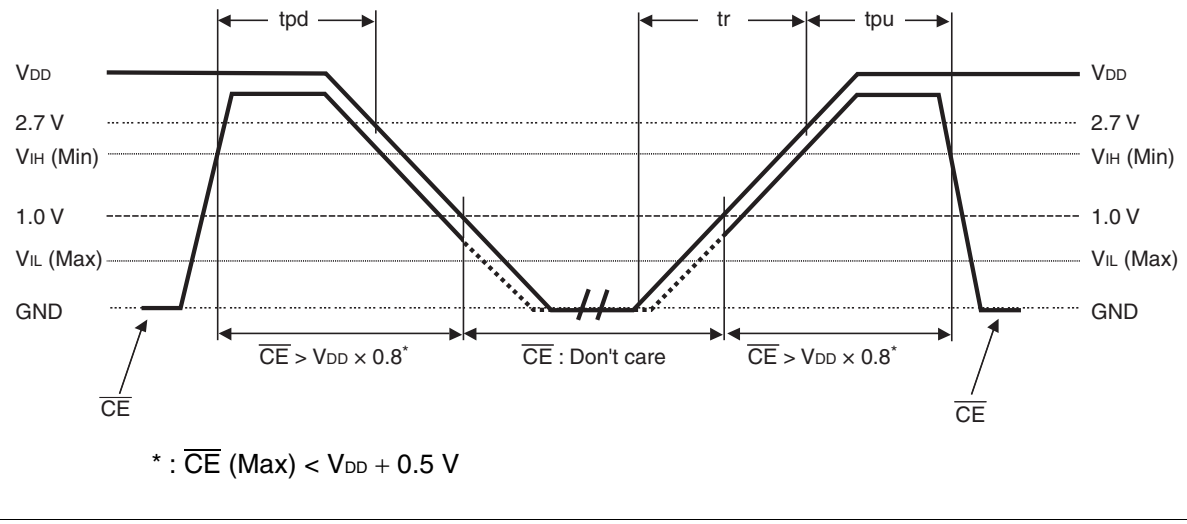
### 3. Write cycle ($\overline{CE}$ Control)




### 4. Write cycle ($\overline{WE}$ Control)



## ■ POWER ON/OFF SEQUENCE




| Parameter | Symbol | Value | | | Unit |
|---|---|---|---|---|---|
| | | Min | Typ | Max | |
| $\overline{CE}$ level hold time at power OFF | tpd | 80 | — | — | ns |
| $\overline{CE}$ level hold time at power ON | tpu | 80 | — | — | 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 °C |
| Data Retention*2 | 10 | — | Years | Operation Ambient Temperature $T_A$ = + 85 °C |
| | 95 | — | | Operation Ambient Temperature $T_A$ = + 55 °C |
| | ≥ 200 | — | | Operation Ambient Temperature $T_A$ = + 35 °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.

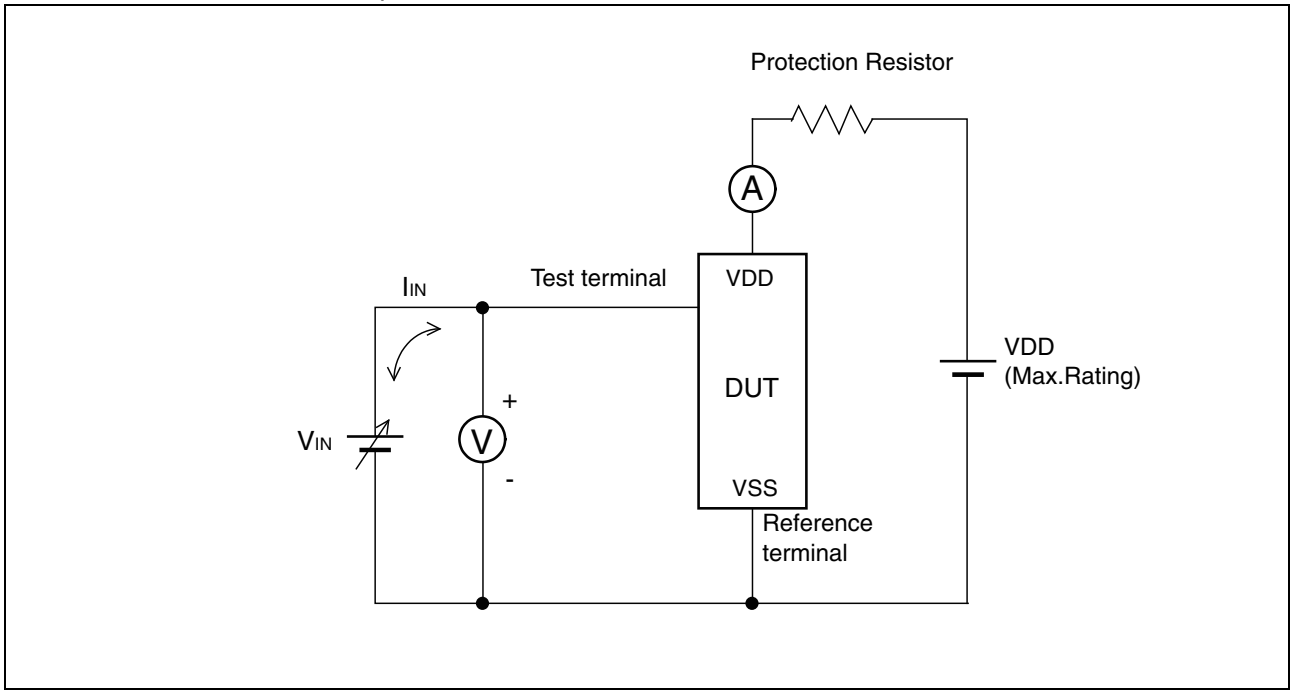
## ■ NOTES ON USE

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

## ■ ESD AND LATCH-UP

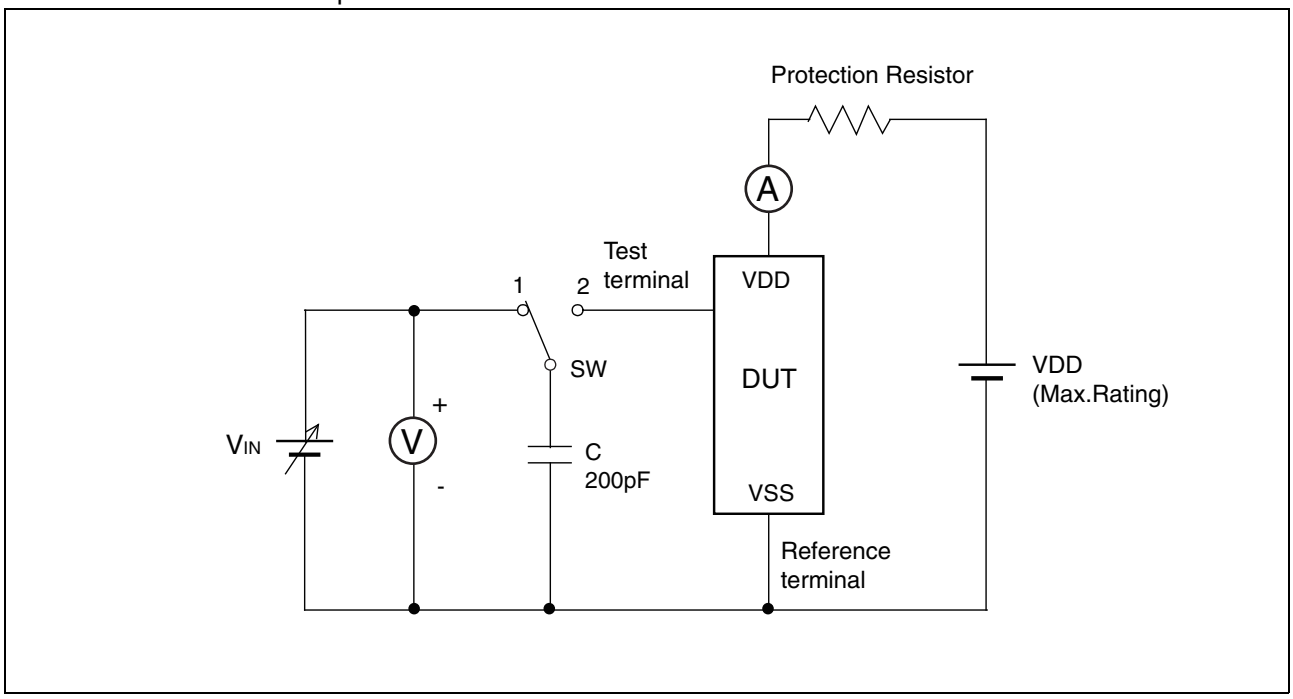
| Test | DUT | Value |
|---|---|---|
| ESD HBM (Human Body Model)<br>JESD22-A114 compliant | MB85R256FPNF-G-JNE2<br>MB85R256FPFCN-G-BNDE1 | ≥ \|2000 V\| |
| ESD MM (Machine Model)<br>JESD22-A115 compliant | | ≥ \|200 V\| |
| ESD CDM (Charged Device Model)<br>JESD22-C101 compliant | | ≥ \|1000 V\| |
| Latch-Up (I-test)<br>JESD78 compliant | | — |
| Latch-Up ($V_{supply}$ overvoltage test)<br>JESD78 compliant | | — |
| Latch-Up (Current Method)<br>Proprietary method | | ≥ \|300 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 $I_{IN} = \pm 300$ 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 5 times, this test must be stopped immediately.

## ■ REFLOW CONDITIONS AND FLOOR LIFE

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

## ■ CURRENT STATUS ON CONTAINED RESTRICTED SUBSTANCES

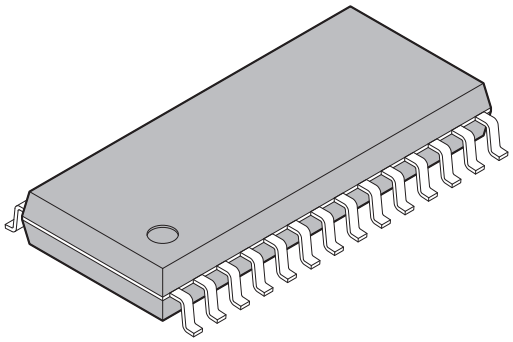
This product complies with the regulations of REACH Regulations, EU RoHS Directive and China RoHS.

## ■ ORDERING INFORMATION

| Part number | Package | Shipping form | Minimum shipping quantity |
|---|---|---|---|
| MB85R256FPNF-G-JNE2 | 28-pin plastic SOP | Tube | —* |
| MB85R256FPFCN-G-BNDE1 | 28-pin plastic TSOP(1) | Tray | —* |
| MB85R256FPNF-G-JNERE2 | 28-pin plastic SOP | Embossed carrier tape | 1000 |

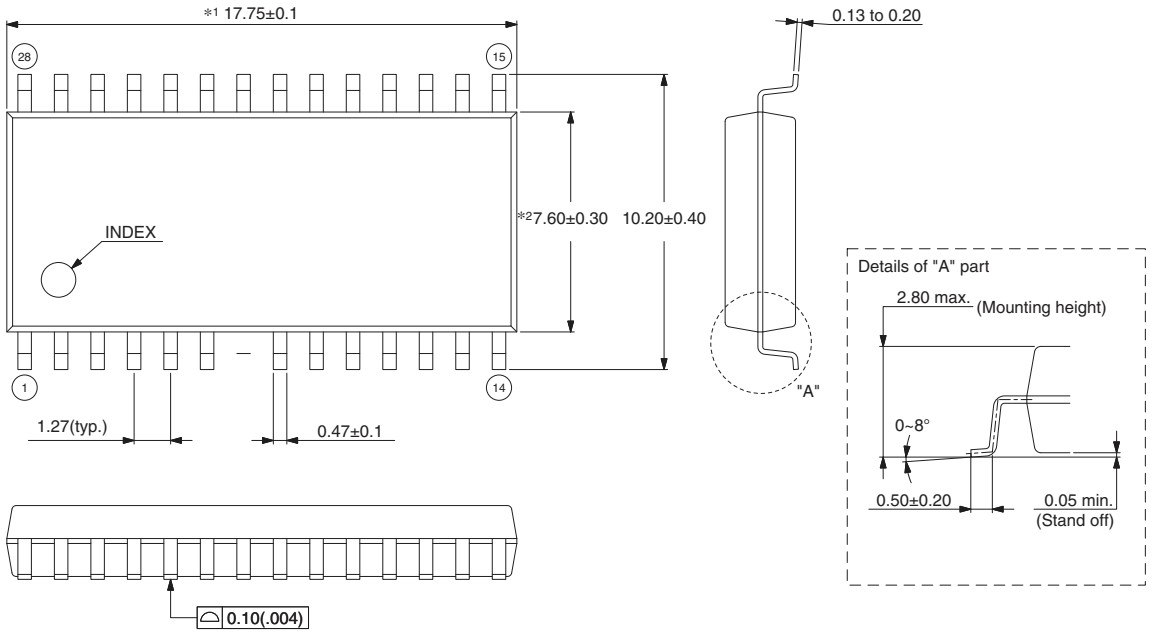
*: Please contact our sales office about minimum shipping quantity.

## ■ PACKAGE DIMENSION

| 28-pin plastic SOP | | |
|---|---|---|
|  | Lead pitch | 1.27 mm |
| | Package width × package length | 7.6 × 17.75 mm |
| | Lead shape | Gullwing |
| | Sealing method | Plastic mold |
| | Mounting height | 2.80 mm MAX |
| | | |
| | | |

28-pin plastic SOP

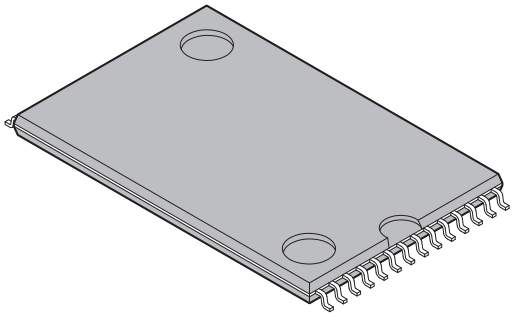
Note 1) *1 : These dimensions include resin protrusion.
Note 2) *2 : These dimensions do not include resin protrusion.
Note 3) Pins width and pins thickness include plating thickness.
Note 4) Pins width do not include tie bar cutting remainder.



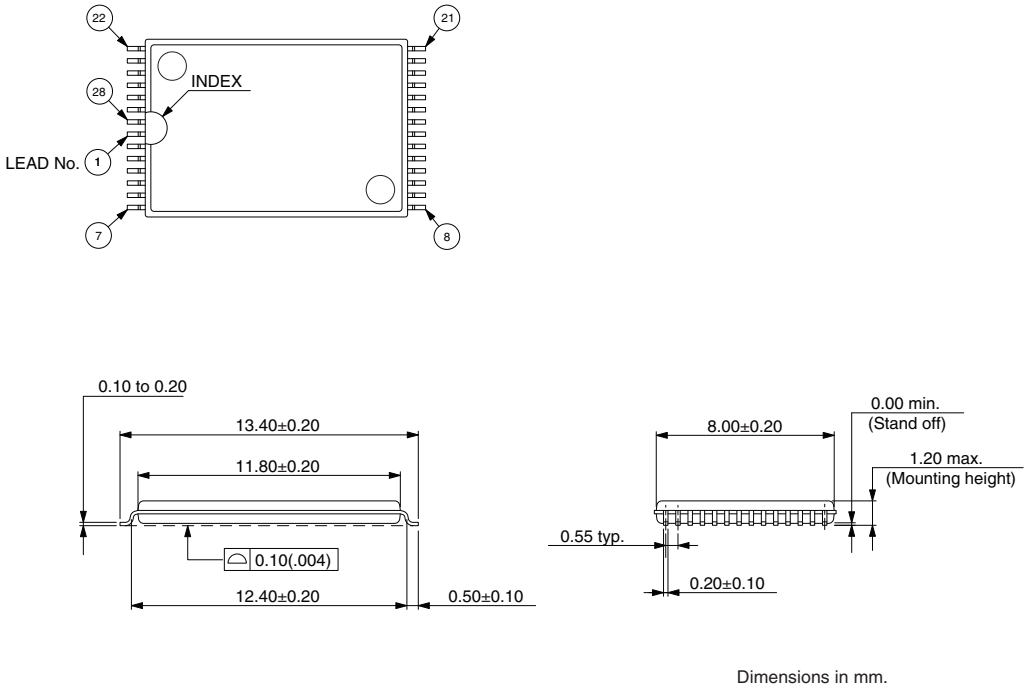

Dimensions in mm.

*(Continued)*

*(Continued)*

| 28-pin plastic TSOP (1) | | |
|---|---|---|
|  | Lead pitch | 0.55 mm |
| | Package width × package length | 11.80 × 8.00 mm |
| | Lead shape | Gullwing |
| | Sealing method | Plastic mold |
| | Mounting height | 1.20 mm Max |
| | | |
| | | |

28-pin plastic TSOP (1)



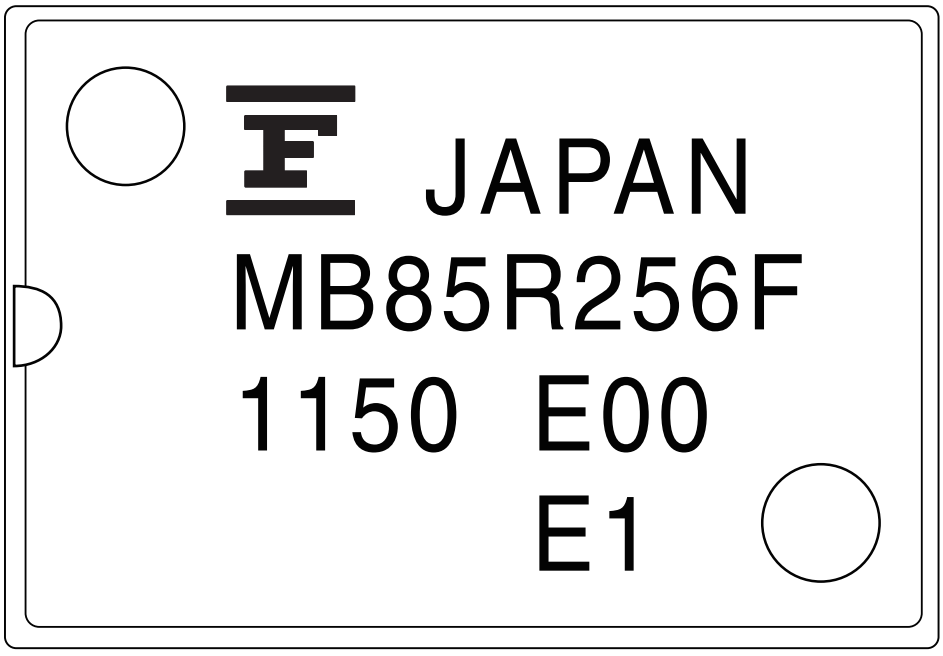

Dimensions in mm.

## ■ MARKING(Example)

[MB85R256FPNF-G-JNE2]
[MB85R256FPNF-G-JNERE2]


[28-pin plastic SOP]

[MB85R256FPFCN-G-BNDE1]



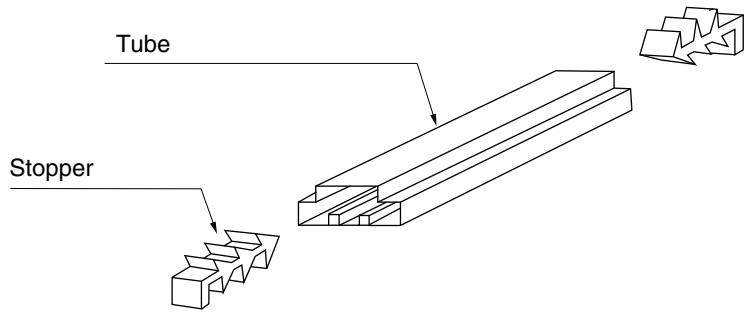

[28-pin plastic TSOP(1)]

## ■ PACKING INFORMATION

### 1. Tube

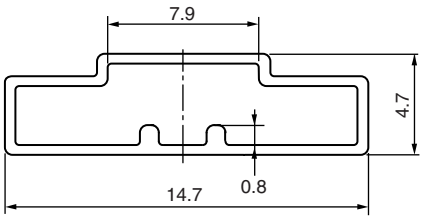
#### 1.1 Tube Dimensions

• Tube/stopper shape (example)




• **Tube cross-sections and Maximum quantity**

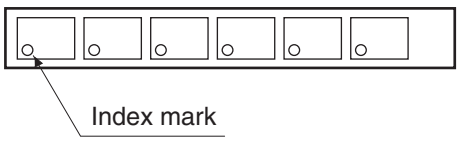
| Maximum quantity | | |
|---|---|---|
| pcs/ tube(508mm) | pcs/inner box | pcs/outer box |
| 25 | 1,750 | 7,000 |




No heat resistance.
Package should not be baked by using tube.

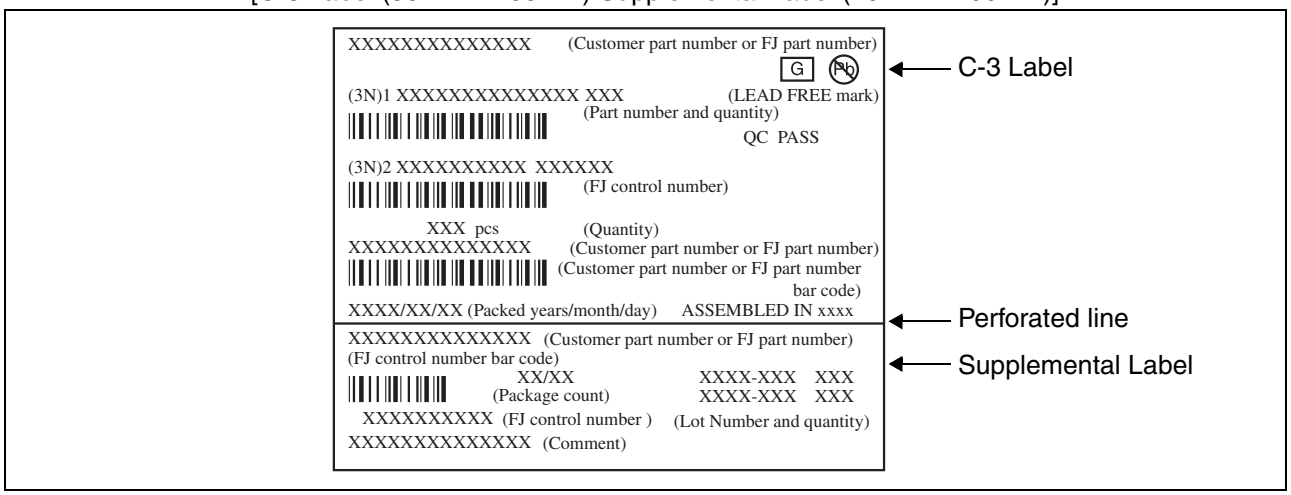
(Dimensions in mm)

• **Direction of index in tube**



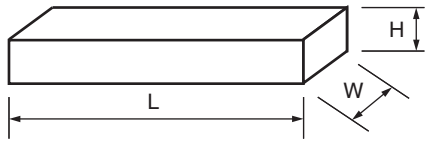
### 1.2 Product label indicators(example)

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)]



### 1.3 Dimensions for Containers

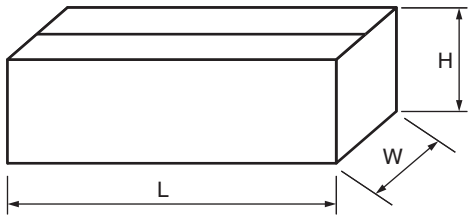
**(1) Dimensions for inner box**




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

(Dimensions in mm)

**(2) Dimensions for outer box**




| L | W | H |
|---|---|---|
| 549 | 277 | 180 |

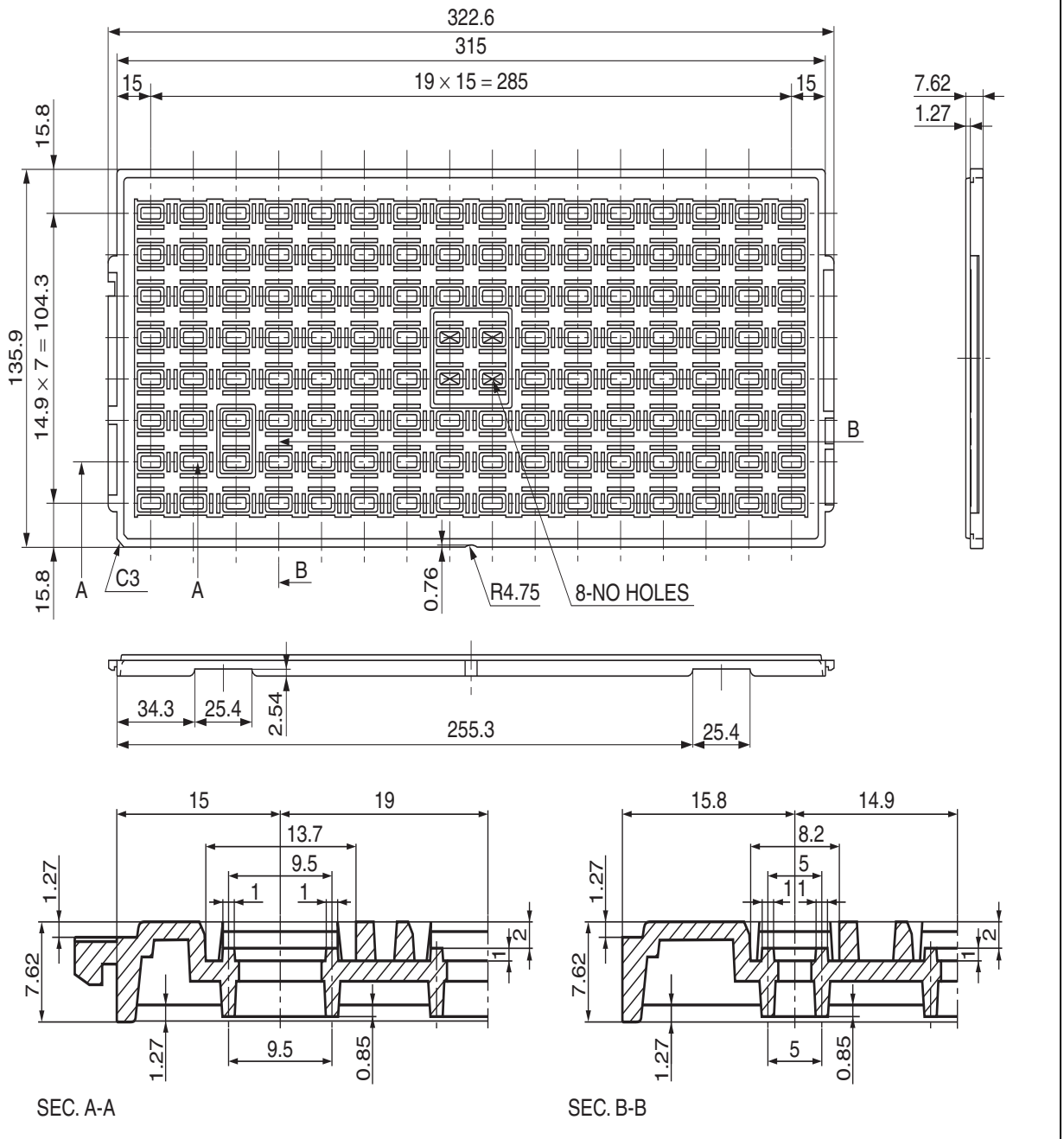
(Dimensions in mm)

## 2. Tray

### 2.1 Tray Dimensions

TSOP28(I)

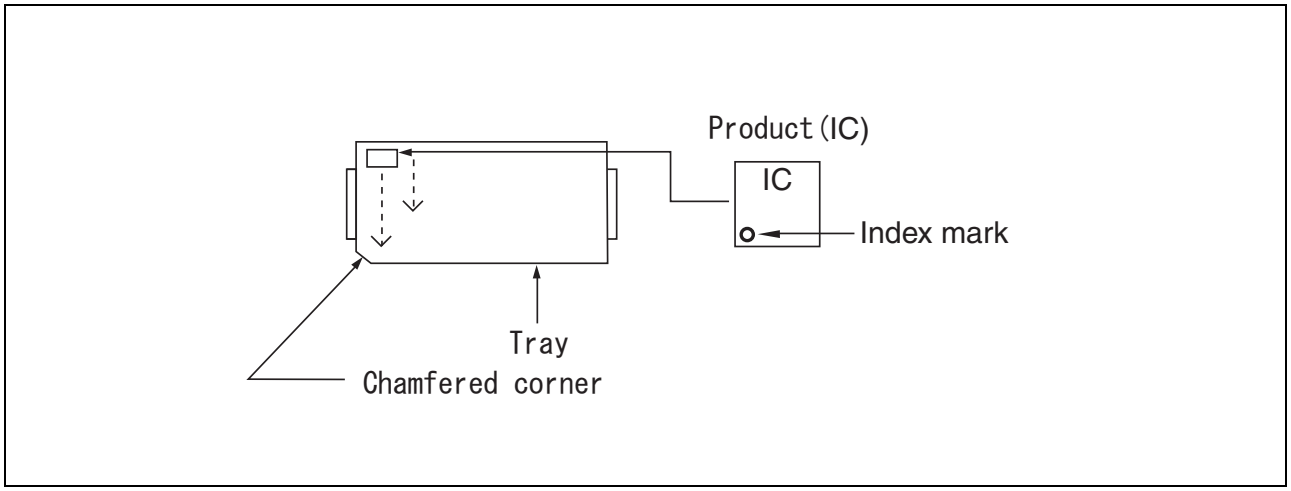
| Maximum storage capacity | | |
|---|---|---|
| pcs/tray | pcs/inner box | pcs/outer box |
| 128 | 1280 | 5120 |




(Dimensions in mm)

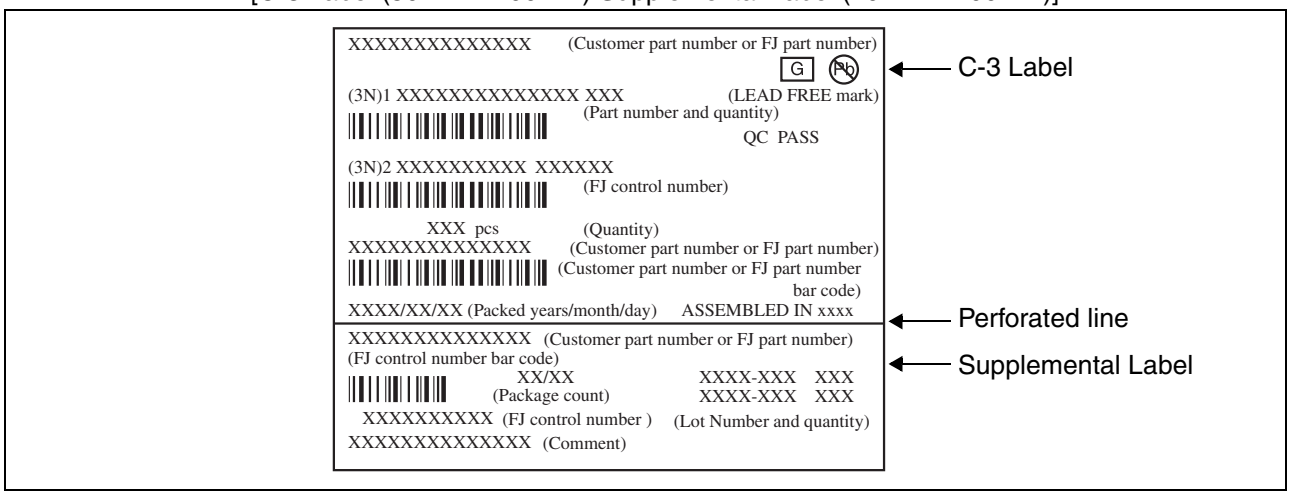
Heat proof temperature : 150 °C Max
Weight : 136 g

### 2.2 IC orientation



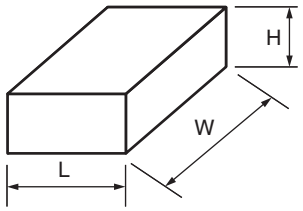
### 2.3 Product label indicators(example)

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)]



### 2.4 Dimensions for Containers

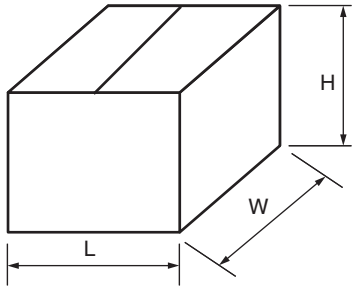
**(1) Dimensions for inner box**




| L | W | H |
|---|---|---|
| 165 | 360 | 75 |

(Dimensions in mm)

**(2) Dimensions for outer box**



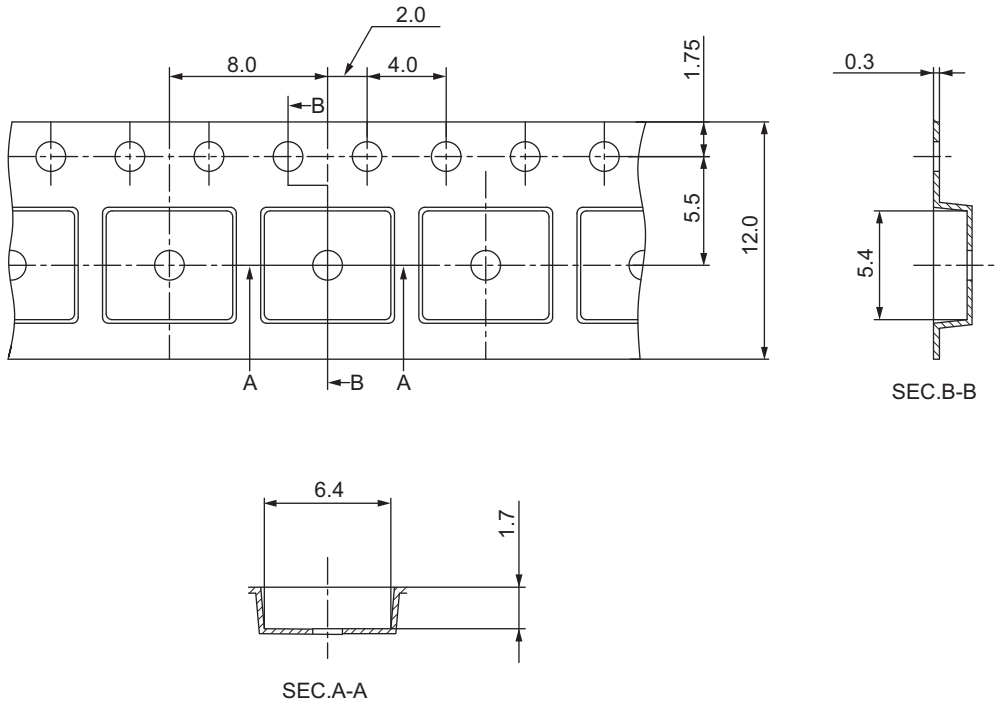

| L | W | H |
|---|---|---|
| 355 | 385 | 195 |

(Dimensions in mm)

## 3. Emboss Tape

### 3.1 Tape Dimensions (not drawn to scale) (8-pin plastic SOP 150mil)

| Maximum storage capacity | | |
|---|---|---|
| pcs/reel(φ330mm) | pcs/inner box | pcs/uter boxo |
| 1000 | 1000 | 7000 |



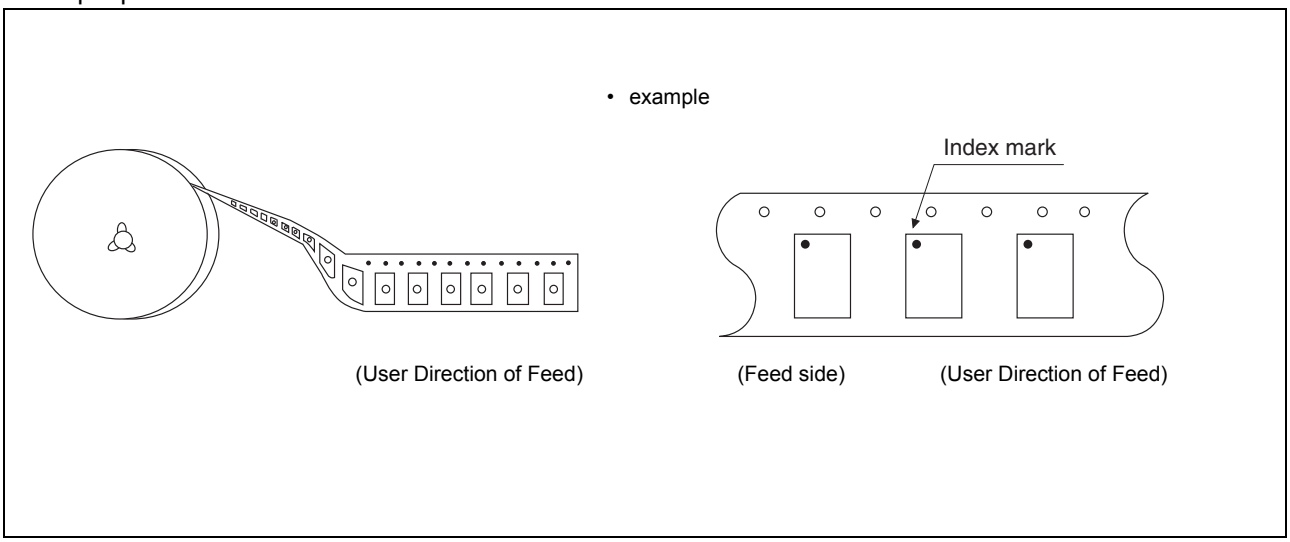

(Dimensions in mm)

Heat proof temperature : No heat resistance.

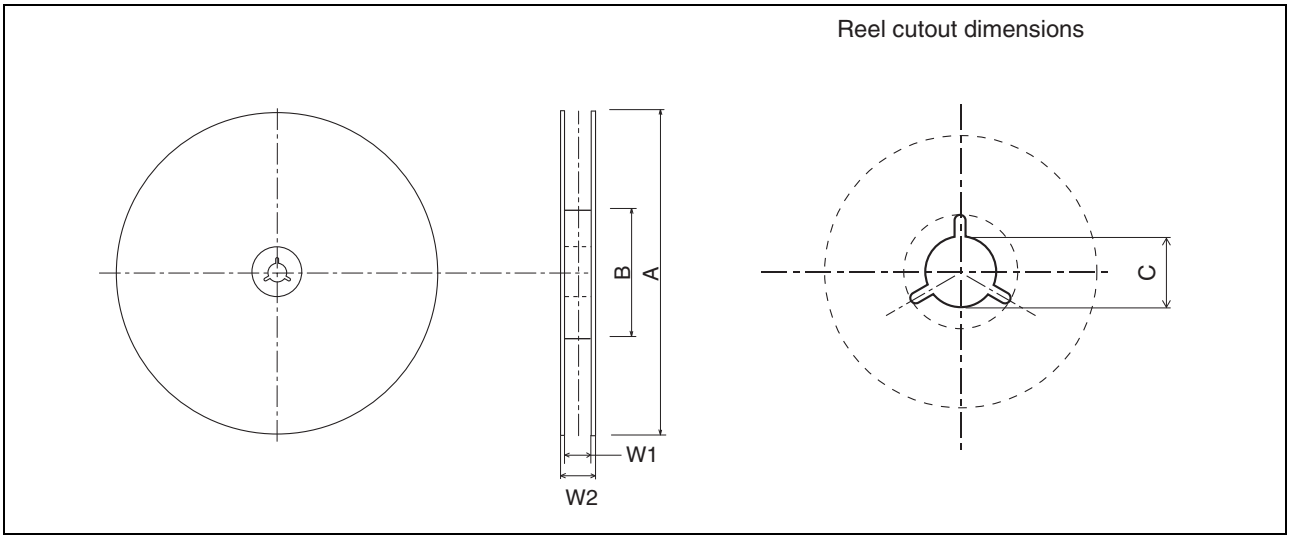
Package should not be baked by using tape and reel.

### 3.2 IC orientation

8-pin plastic SOP 150mil




### 3.3 Reel dimensions

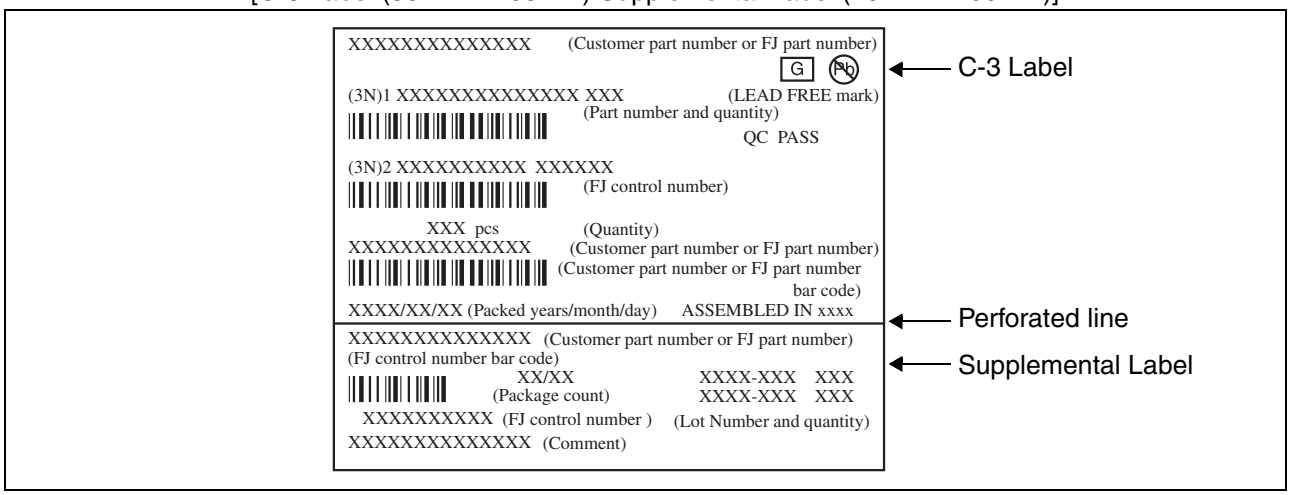



Dimensions in mm

| A | B | C | W1 | W2 |
|---|---|---|---|---|
| 330 | 100 | 13 | 25.4 | 29.4 |

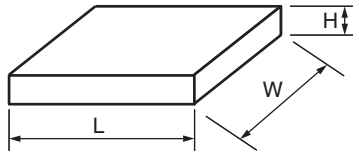
### 3.4 Product label indicators(example)

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)]



### 3.5 Dimensions for Containers

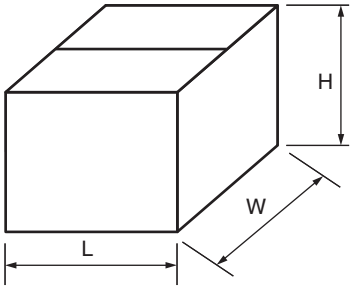
**(1) Dimensions for inner box**




| Tape width | L | W | H |
|---|---|---|---|
| 24 | 365 | 345 | 40 |

(Dimensions in mm)

**(2) Dimensions for outer box**




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

(Dimensions in mm)

## ■ MAJOR CHANGES IN THIS EDITION

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

| Page | Section | Change Results |
|---|---|---|
| 14 | ■ ORDERING INFORMATION | Deleted obsolete parts numbers. |
| 18 to 20 | ■ PACKING INFORMATION<br>1. Tube | Tube information is added. |
| 25 to 28 | ■ PACKING INFORMATION<br>3. EmbossTape | Tape information is added. |

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