

# Memory FRAM

CMOS

## 1 M Bit (128 K × 8)

# MB85R1001

### ■ DESCRIPTIONS

The MB85R1001 is an FRAM (Ferroelectric Random Access Memory) chip in a configuration of 131,072 words x 8 bits, using the ferroelectric process and silicon gate CMOS process technologies for forming the nonvolatile memory cells.

Unlike SRAM, MB85R1001 is able to retain data without back-up battery.

The memory cells used for the MB85R1001 has improved at least  $10^{10}$  times of read/write access, significantly outperforming FLASH memory and E<sup>2</sup>PROM in endurance.

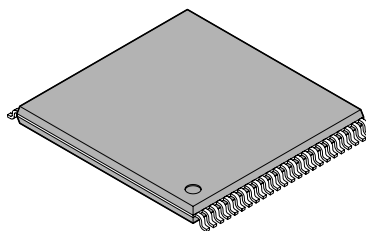
The MB85R1001 used a pseudo - SRAM interface compatible with conventional asynchronous SRAM.

### ■ FEATURES

- Bit configuration : 131,072 words x 8bits
- Read/write endurance :  $10^{10}$  times
- Operating power supply voltage : 3.0 V to 3.6 V
- Operating temperature range : -20 °C to +85 °C
- 48-pin, TSOP (1) plastic package

### ■ PACKAGE

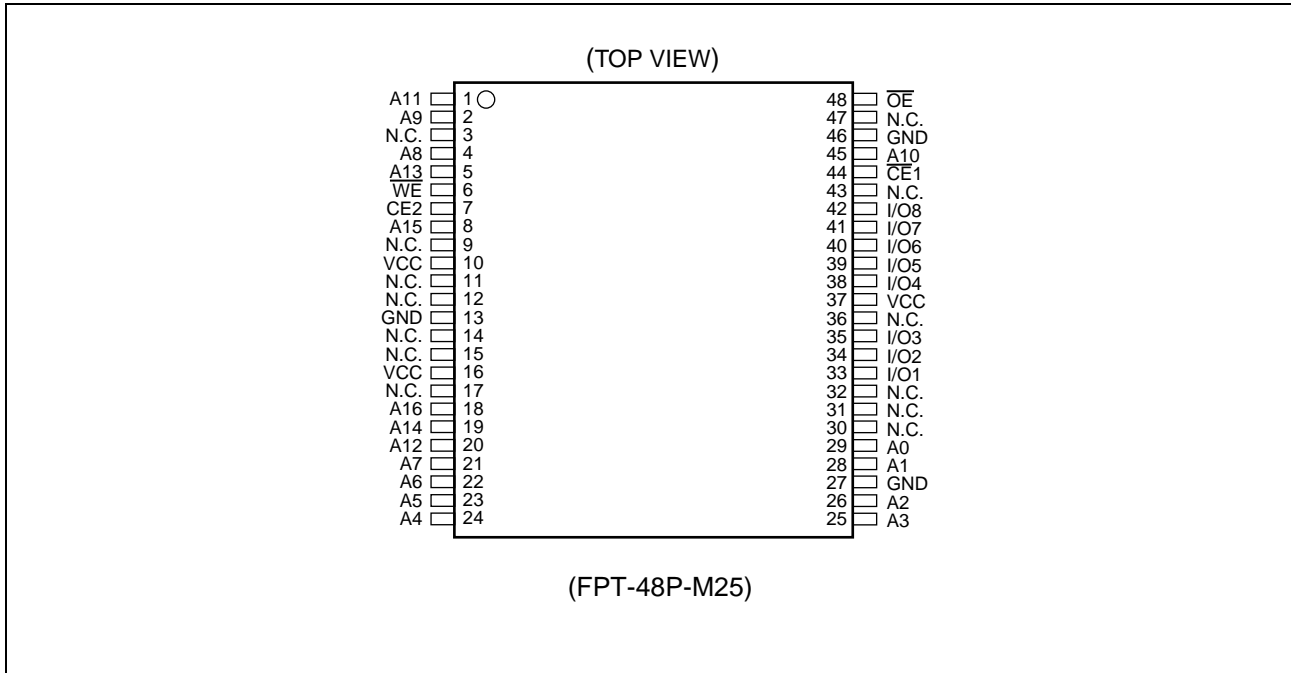
48-pin plastic TSOP(1)



(FPT-48P-M25)

# MB85R1001

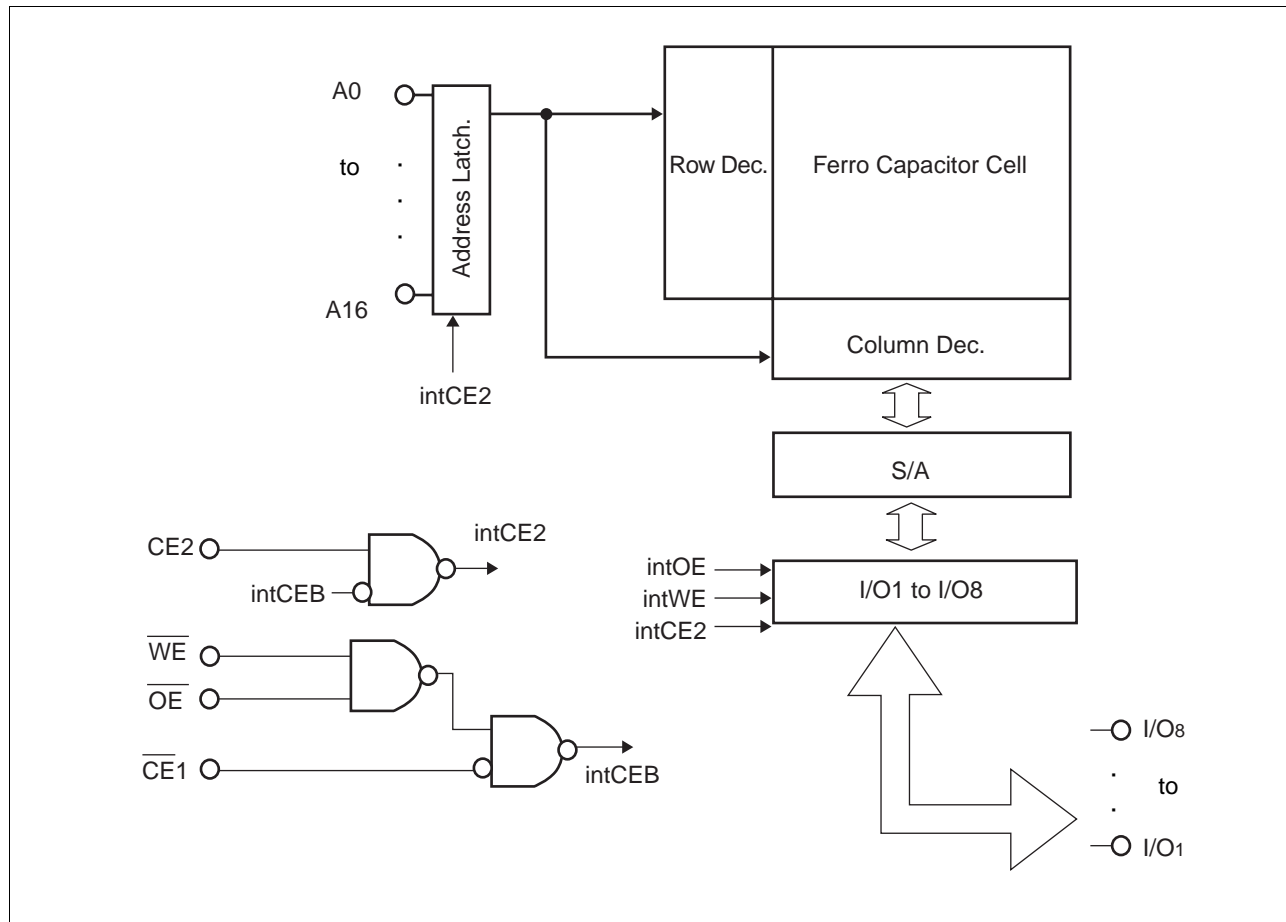
## ■ PIN ASSIGNMENTS



## ■ PIN DESCRIPTIONS

Pin name	Function
A0 to A16	Address In
I/O1 to I/O8	Data Input/Output
$\overline{CE}1$	Chip Enable 1 in
CE2	Chip Enable 2 in
$\overline{WE}$	Write Enable in
$\overline{OE}$	Output Enable in
VCC	Power Supply
GND	Ground

## ■ BLOCK DIAGRAM



## ■ FUNCTION TRUTH TABLE

Operation Mode	$\overline{CE1}$	CE2	$\overline{WE}$	$\overline{OE}$	I/O <sub>1</sub> to I/O <sub>8</sub>	Supply Current
Standby Pre-charge	H	X	X	X	High-Z	Standby (I <sub>SB</sub> )
	X	L	X	X		
	X	X	H	H		
Read	$\downarrow$ L	H $\uparrow$	H	L	Dout	Operation (I <sub>CC</sub> )
Read (Pseudo SRAM, $\overline{OE}$ control)	L	H	H	$\downarrow$		
Write	$\downarrow$ L	H $\uparrow$	L	H	Din	
Write (Pseudo SRAM, $\overline{WE}$ control)	L	H	$\downarrow$	H		
Output Disable	L	H	H	H	High-Z	

L = V<sub>IL</sub>, H = V<sub>IH</sub>, X can be either V<sub>IL</sub> or V<sub>IH</sub>, High-Z = High Impedance

$\downarrow$  : Latch address at falling edge,  $\uparrow$  : Latch address at rising edge

# MB85R1001

## ■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating		Unit
		Min	Max	
Supply Voltage	$V_{CC}$	-0.5	+4.0	V
Input Voltage	$V_{IN}$	-0.5	$V_{CC}+0.5$	V
Output Voltage	$V_{OUT}$	-0.5	$V_{CC}+0.5$	V
Ambient Temperature	$T_A$	-20	+85	°C
Storage Temperature	$T_{stg}$	-40	+125	°C

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

( $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ ,  $T_A = -20\text{ °C to }+85\text{ °C}$ )

Parameter	Symbol	Value			Unit
		Min	Typ	Max	
Supply Voltage	$V_{CC}$	3.0	3.3	3.6	V
Input Voltage (high)	$V_{IH}$	$V_{CC} \times 0.8$	—	$V_{CC} + 0.5$	V
Input Voltage (low)	$V_{IL}$	-0.5	—	0.8	V
Operating Temperature	$T_A$	-20	—	+85	°C

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 FUJITSU representatives beforehand.

## ■ ELECTRICAL CHARACTERISTICS

### 1. DC CHARACTERISTICS

( $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ ,  $T_A = -20\text{ }^{\circ}\text{C to }+85\text{ }^{\circ}\text{C}$ )

Parameter	Symbol	Test Condition	Value			Unit
			Min	Typ	Max	
Input Leakage Current	$ I_{LI} $	$V_{IN} = 0\text{ V to }V_{CC}$	—	—	10	$\mu\text{A}$
Output Leakage Current	$ I_{LO} $	$V_{OUT} = 0\text{ V to }V_{CC}$ , $\overline{CE1} = V_{IH}$ or $\overline{OE} = V_{IH}$	—	—	10	$\mu\text{A}$
Supply Current	$I_{CC}$	$\overline{CE1} = 0.2\text{ V}$ , $CE2 = V_{CC}-0.2\text{ V}$ , $I_{out} = 0\text{ mA}^{*1}$	—	—	10	$\text{mA}$
Standby Current	$I_{SB}$	$\overline{CE1} \geq V_{CC}-0.2\text{ V}$	—	10	100	$\mu\text{A}$
		$CE2 \leq 0.2\text{ V}^{*2}$				
		$\overline{OE} \geq V_{CC}-0.2\text{ V}$ , $\overline{WE} \geq V_{CC}-0.2\text{ V}^{*2}$				
Output Voltage (high)	$V_{OH}$	$I_{OH} = -2.0\text{ mA}$	$0.8 \times V_{CC}$	—	—	$\text{V}$
Output Voltage (low)	$V_{OL}$	$I_{OL} = 2.0\text{ mA}$	—	—	0.4	$\text{V}$

\*1 :  $I_{out}$  : Output current

\*2 : All other inputs ( $\overline{CE1}$ ,  $CE2$ ,  $\overline{OE}$ ,  $\overline{WE}$ ) should be at CMOS levels, i.e.,  $H \geq V_{CC} - 0.2\text{ V}$ ,  $L \leq 0.2\text{ V}$ .

# MB85R1001

## 2. AC CHARACTERISTICS

### • AC TEST CONDITIONS

Supply Voltage	: 3.0 V to 3.6 V
Operating Temperature	: -20 °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	: 2.0 V / 0.8 V
Output Evaluation Level	: 2.0 V / 0.8 V
Output Impedance	: 50 pF

### (1) Read Operation

(V<sub>CC</sub> = 3.0 V to 3.6 V, T<sub>A</sub> = -20 °C to +85 °C)

Parameter	Symbol	Value		Unit
		Min	Max	
Read Cycle Time	t <sub>RC</sub>	250	—	ns
$\overline{\text{CE}}1$ Active Time	t <sub>CA1</sub>	210	2,000	ns
$\overline{\text{OE}}$ Active Time	t <sub>RP</sub>	210	2,000	ns
Pre-charge Time	t <sub>PC</sub>	40	—	ns
Address Setup Time	t <sub>AS</sub>	10	—	ns
Address Hold Time	t <sub>AH</sub>	50	—	ns
$\overline{\text{OE}}$ Setup Time	t <sub>ES</sub>	10	—	ns
$\overline{\text{CE}}1$ Access Time	t <sub>CE1</sub>	—	100	ns
CE2 Access Time	t <sub>CE2</sub>	—	100	ns
$\overline{\text{OE}}$ Access Time	t <sub>OE</sub>	—	100	ns
$\overline{\text{OE}}$ Output Floating Time	t <sub>OHZ</sub>	—	25	ns

### (2) Write Operation

(V<sub>CC</sub> = 3.0 V to 3.6 V, T<sub>A</sub> = -20 °C to +85 °C)

Parameter	Symbol	Value		Unit
		Min	Max	
Write Cycle Time	t <sub>WC</sub>	250	—	ns
$\overline{\text{CE}}1$ Active Time	t <sub>CA1</sub>	210	2,000	ns
CE2 Active Time	t <sub>CA2</sub>	210	2,000	ns
Pre-charge Time	t <sub>PC</sub>	40	—	ns
Address Setup Time	t <sub>AS</sub>	10	—	ns
Address Hold Time	t <sub>AH</sub>	50	—	ns
Write Pulse Width	t <sub>WP</sub>	210	—	ns
Data Setup Time	t <sub>DS</sub>	10	—	ns
Data Hold Time	t <sub>DH</sub>	50	—	ns
Write Setup Time	t <sub>WS</sub>	0	—	ns

### (3) Power ON/OFF Sequence

Parameter	Sym- bol	Value			Units
		Min	Typ	Max	
$\overline{\text{CE1}}$ LEVEL holding time in Power OFF	$t_{pd}$	85	—	—	ns
$\overline{\text{CE1}}$ LEVEL holding time in Power ON	$t_{pu}$	85	—	—	ns
Power interval *	$t_{pi}$	0.5	—	—	s

\* : Condition for power detection circuit to function

### 3. Pin Capacitance

(f = 1 MHz, T<sub>A</sub> = +25 °C)

Parameter	Symbol	Test Condition	Value			Unit
			Min	Typ	Max	
Input Capacitance	C <sub>IN</sub>	V <sub>IN</sub> = GND	—	—	10	pF
Output Capacitance	C <sub>OUT</sub>	V <sub>OUT</sub> = GND	—	—	10	pF

### 4. Reliability

Data retention 10 years (T<sub>A</sub> = 0 °C to +55 °C)

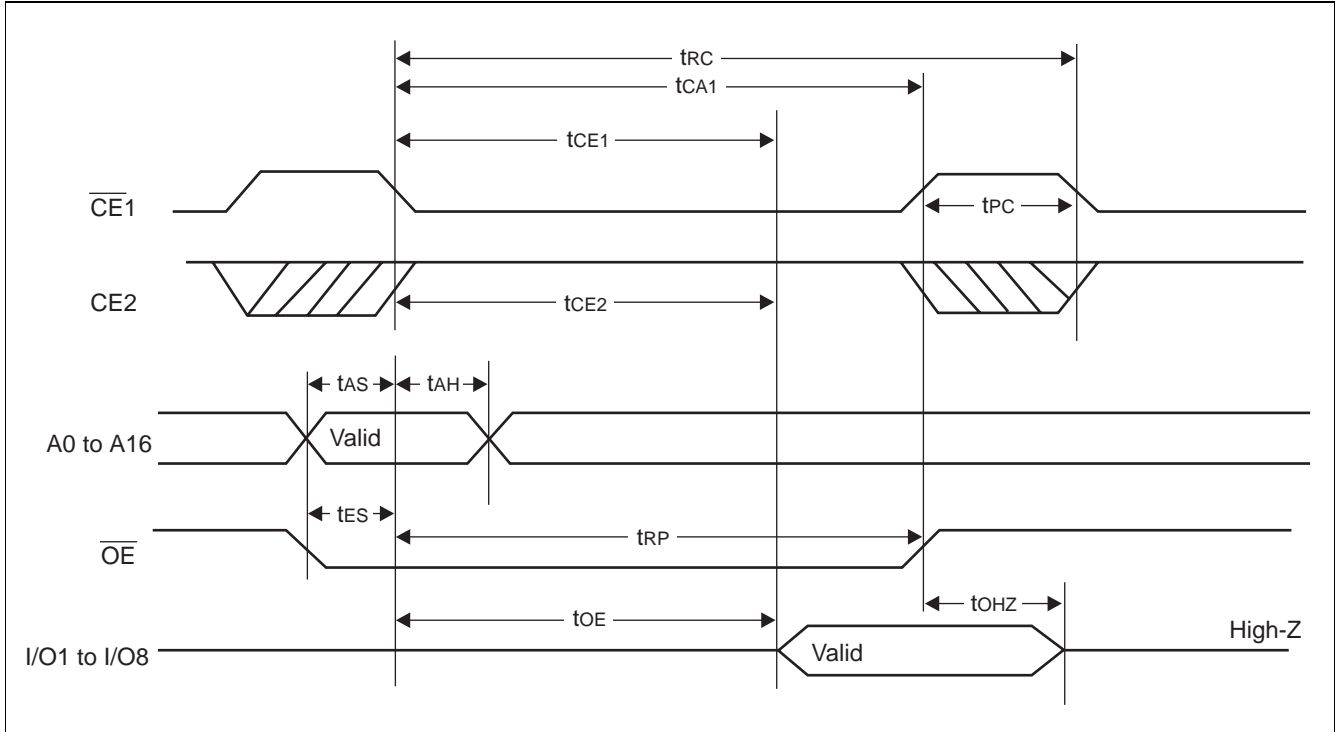
Access endurance 10<sup>10</sup> times (T<sub>A</sub> = -20 °C to +85 °C)

# MB85R1001

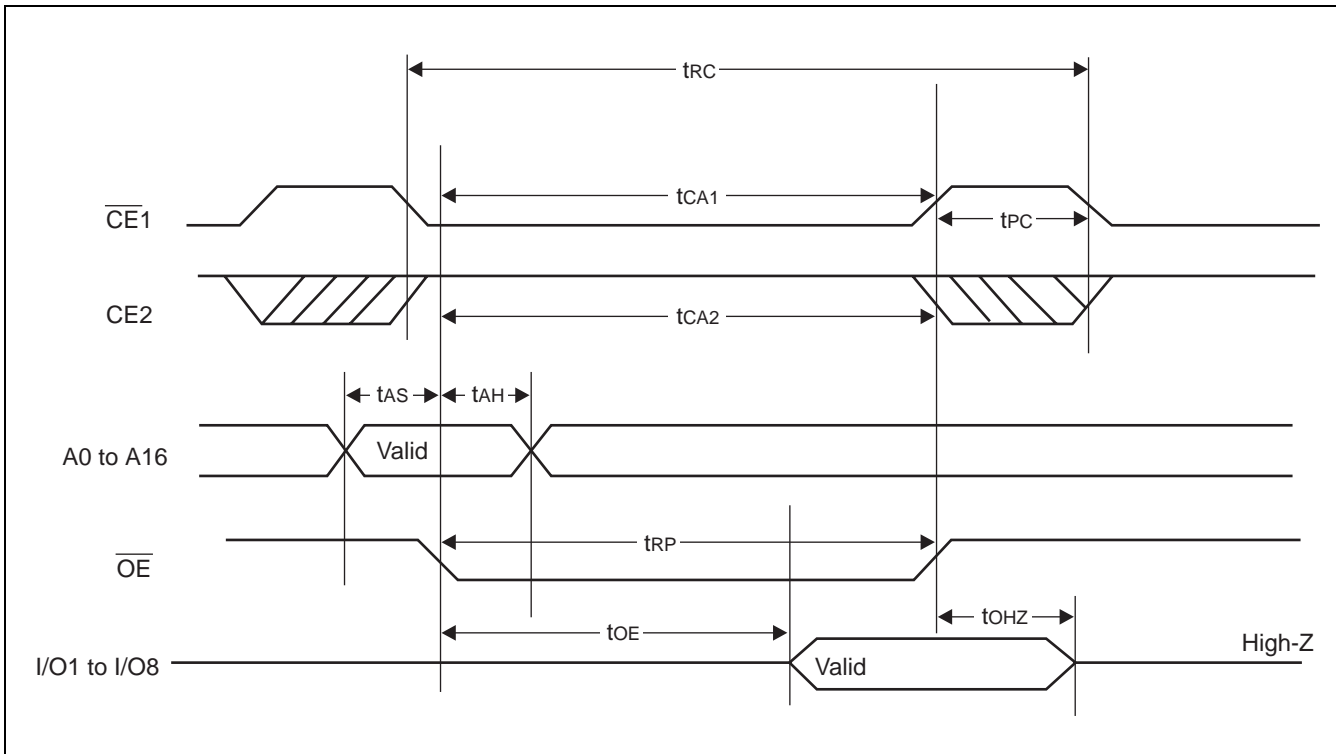
## ■ TIMING DIAGRAMS

### 1. Read Cycle Timing

- $\overline{CE1}$ ,  $\overline{CE2}$  Control



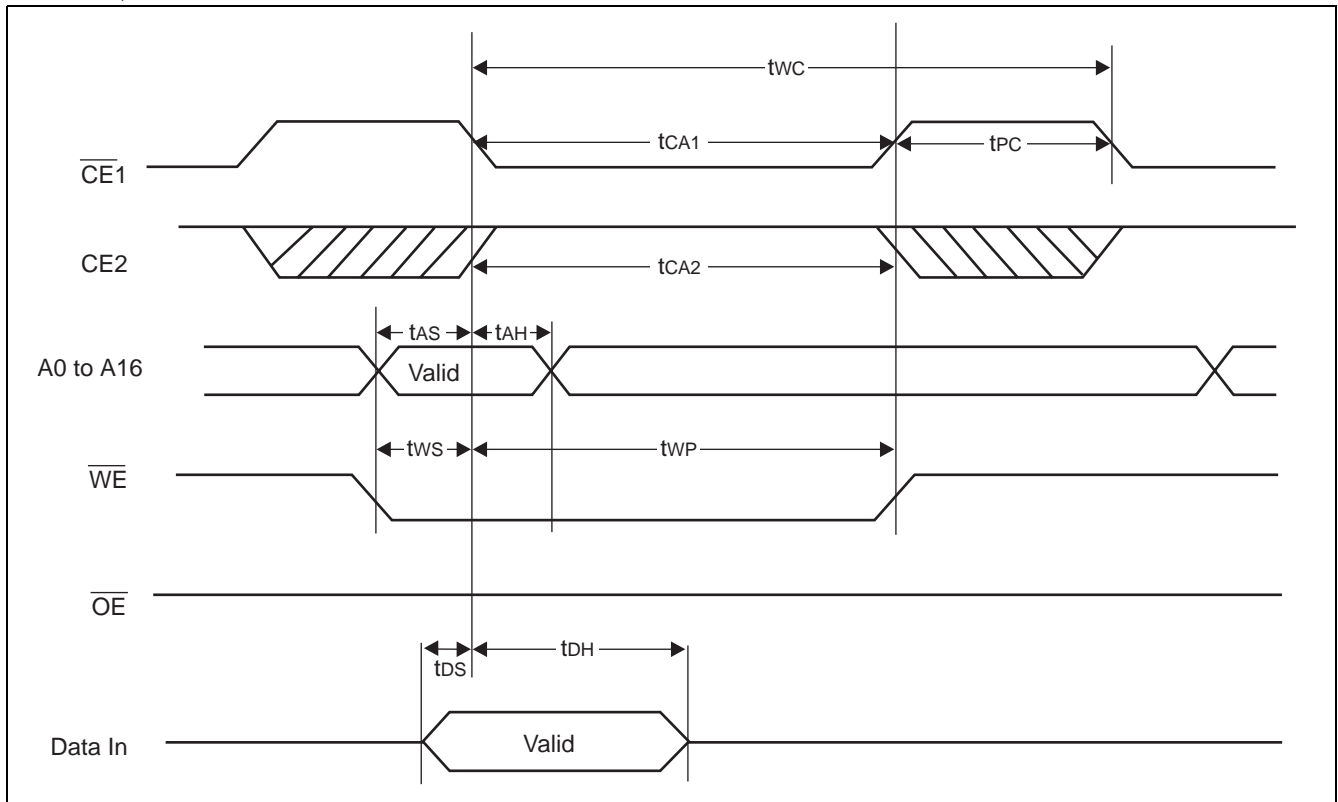
- $\overline{OE}$  Control



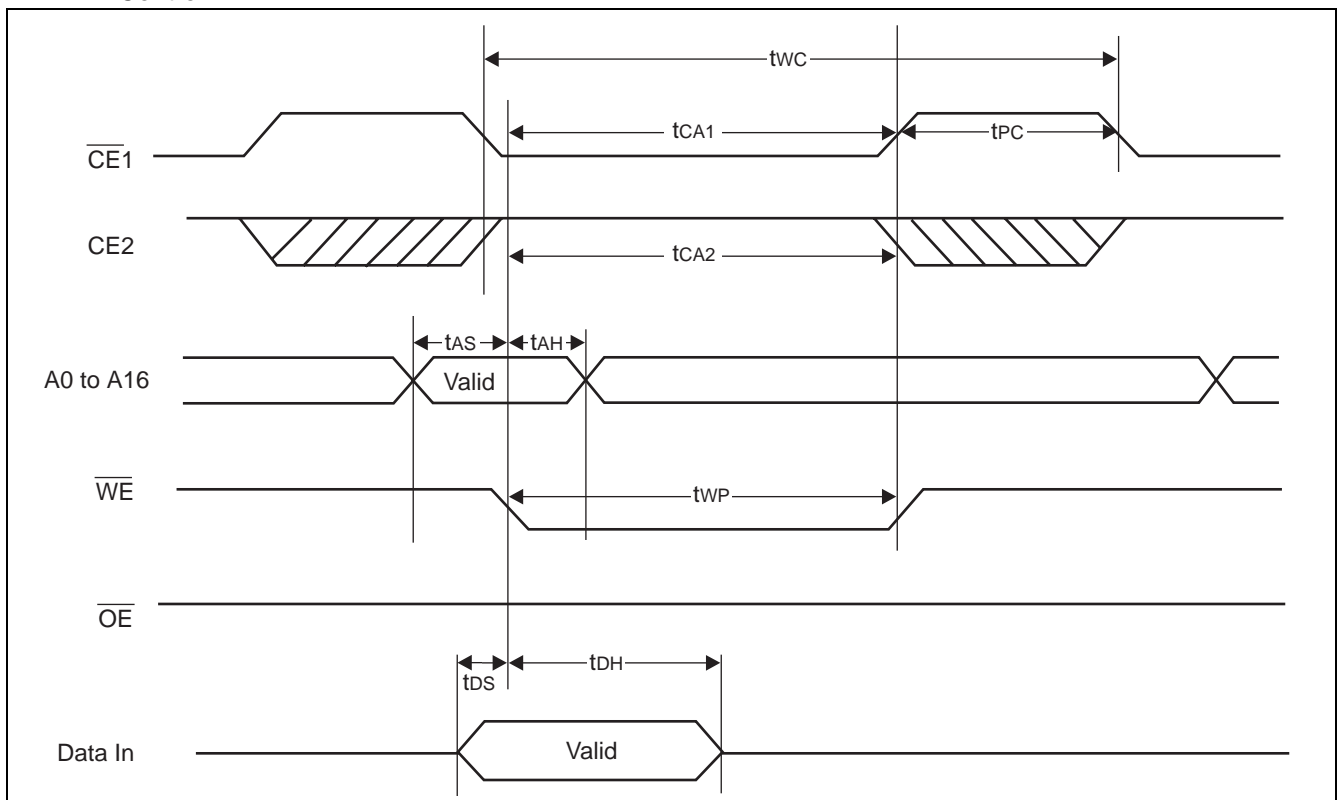


## 2. Write Cycle Timing

### • $\overline{\text{CE1}}$ , $\text{CE2}$ Control

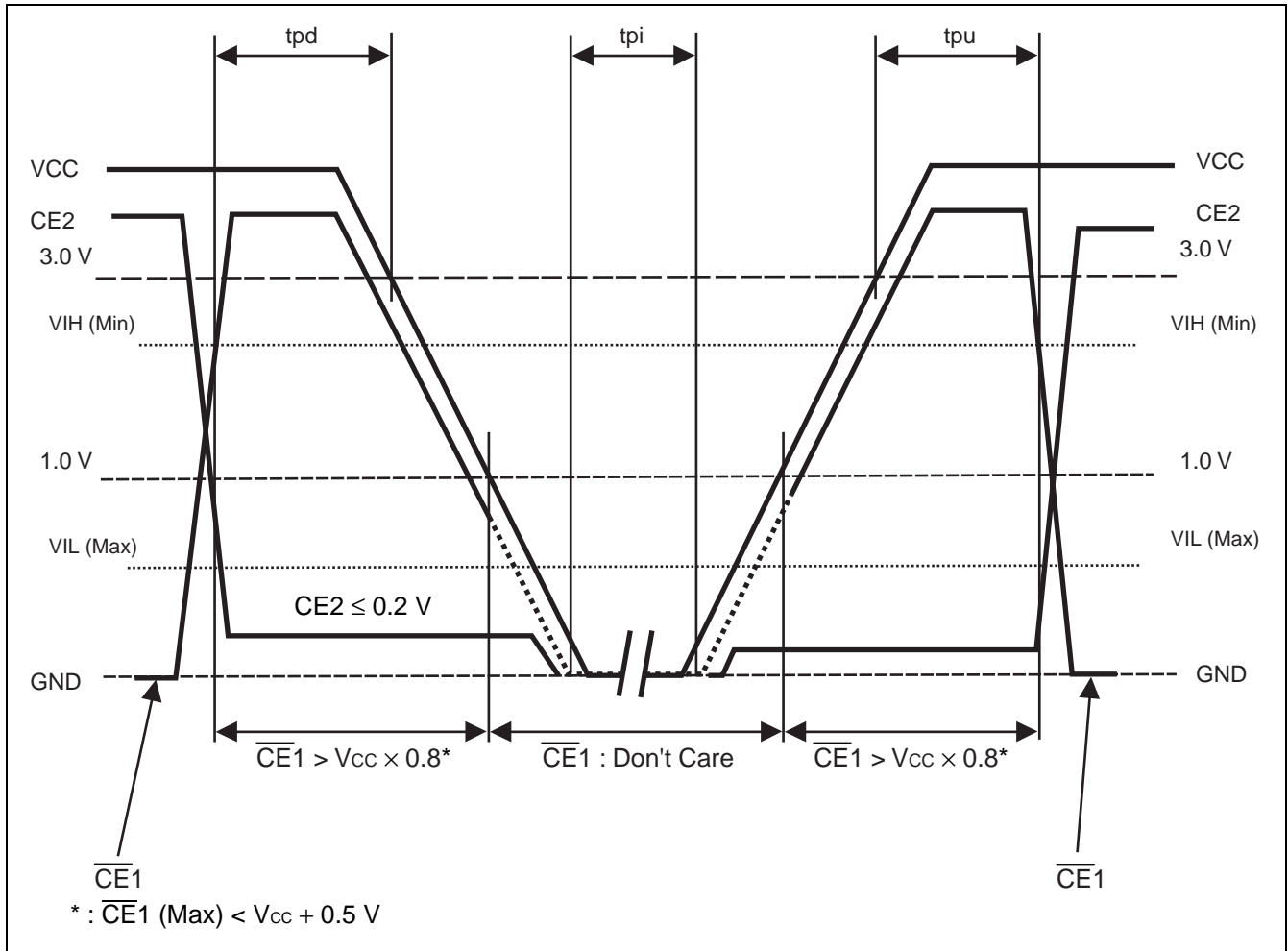


### • $\overline{\text{WE}}$ Control



# MB85R1001

## POWER ON/OFF SEQUENCE



## NOTES ON USE

After IR reflow, the hold of data that was written before IR reflow is not guaranteed.

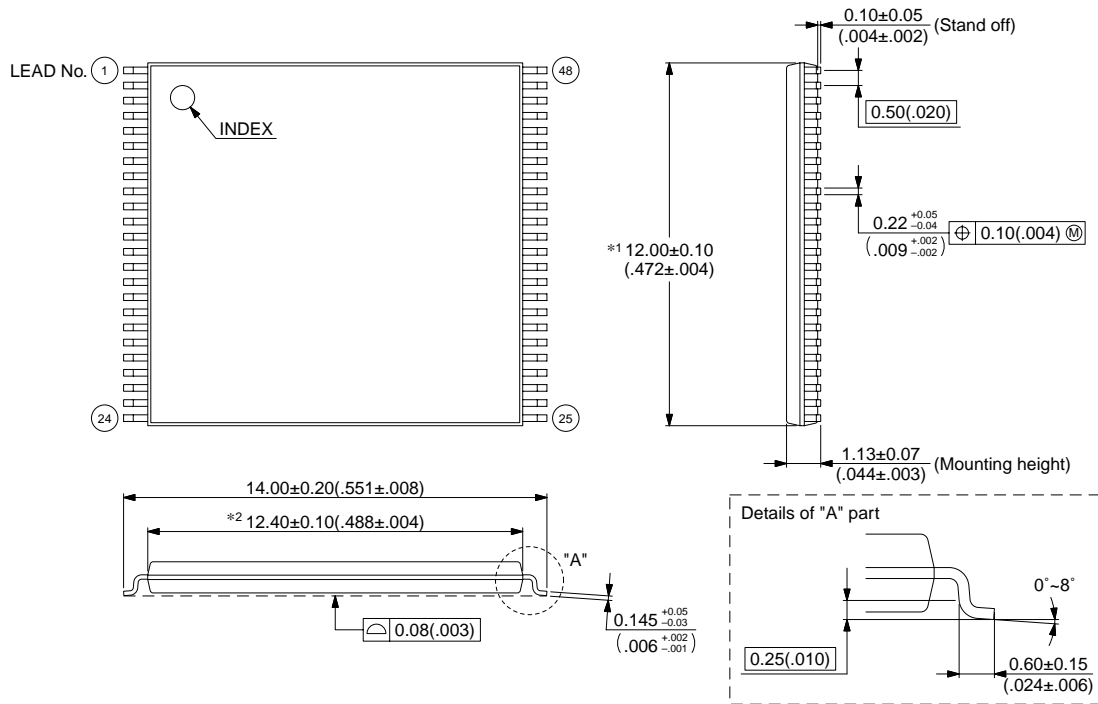
## ORDERING INFORMATION

Part number	Package	Remarks
MB85R1001PFTN	48-pin plastic TSOP(1) (FPT-48P-M25)	

## ■ PACKAGE DIMENTION

48-pin plastic TSOP(1)  
(FPT-48P-M25)

Note 1) \*1 : Resin protrusion. (Each side : +0.15 (.006) Max).  
 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.



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Dimensions in mm (inches).

Note: The values in parentheses are reference values.

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