NEC

MOS INTEGRATED CIRCUIT

μPD444010L-X

4M-BIT CMOS STATIC RAM
512K-WORD BY 8-BIT
EXTENDED TEMPERATURE OPERATION

Description

The μPD444010L-X is a high speed, low power, 4,194,304 bits (524,288 words by 8 bits) CMOS static RAM.

The μPD444010L-X has two chip enable pins (/CE1, CE2) to extend the capacity.

The μPD444010L-X is packed in 48-pin plastic TSOP (I).

Features

- 524,288 words by 8 bits organization
- Fast access time: 70, 85, 100, 120, 150 ns (MAX.)
- Low voltage operation
  (B version : V_{CC} = 2.7 to 3.6 V, C version : V_{CC} = 2.2 to 3.6 V, D version : V_{CC} = 1.8 to 3.6 V)
- Operating ambient temperature: T_A = –25 to +85 °C
- Output Enable input for easy application
- Two Chip Enable inputs: /CE1, CE2

Part number	Access time ns (MAX.)	Operating supply voltage V	Operating ambient temperature °C	Supply current		
				At operating mA (MAX.)	At standby μA (MAX.)	At data retention μA (MAX.)
μPD444010L-BxxX	70, 85	2.7 to 3.6	–25 to +85	40	7	7
μPD444010L-CxxX	100, 120	2.2 to 3.6				
μPD444010L-DxxX	120, 150	1.8 to 3.6				

The information in this document is subject to change without notice.

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Ordering Information

Part number	Package	Access time ns (MAX.)	Operating supply voltage V	Operating temperature °C	Remark
μPD444010LGY-B70X-MJH	48-pin Plastic TSOP (I) (12×18 mm) (Normal bent)	70	2.7 to 3.6	−25 to +85	B version
μPD444010LGY-B70X-MKH	48-pin Plastic TSOP (I) (12×18 mm) (Reverse bent)				
μPD444010LGY-B85X-MJH	48-pin Plastic TSOP (I) (12×18 mm) (Normal bent)	85			
μPD444010LGY-B85X-MKH	48-pin Plastic TSOP (I) (12×18 mm) (Reverse bent)				
μPD444010LGY-C10X-MJH	48-pin Plastic TSOP (I) (12×18 mm) (Normal bent)	100	2.2 to 3.6		C version
μPD444010LGY-C10X-MKH	48-pin Plastic TSOP (I) (12×18 mm) (Reverse bent)				
μPD444010LGY-C12X-MJH	48-pin Plastic TSOP (I) (12×18 mm) (Normal bent)	120			
μPD444010LGY-C12X-MKH	48-pin Plastic TSOP (I) (12×18 mm) (Reverse bent)				
μPD444010LGY-D12X-MJH	48-pin Plastic TSOP (I) (12×18 mm) (Normal bent)	120	1.8 to 3.6		D version
μPD444010LGY-D12X-MKH	48-pin Plastic TSOP (I) (12×18 mm) (Reverse bent)				
μPD444010LGY-D15X-MJH	48-pin Plastic TSOP (I) (12×18 mm) (Normal bent)	150			
μPD444010LGY-D15X-MKH	48-pin Plastic TSOP (I) (12×18 mm) (Reverse bent)				

Pin Configuration (Marking Side)

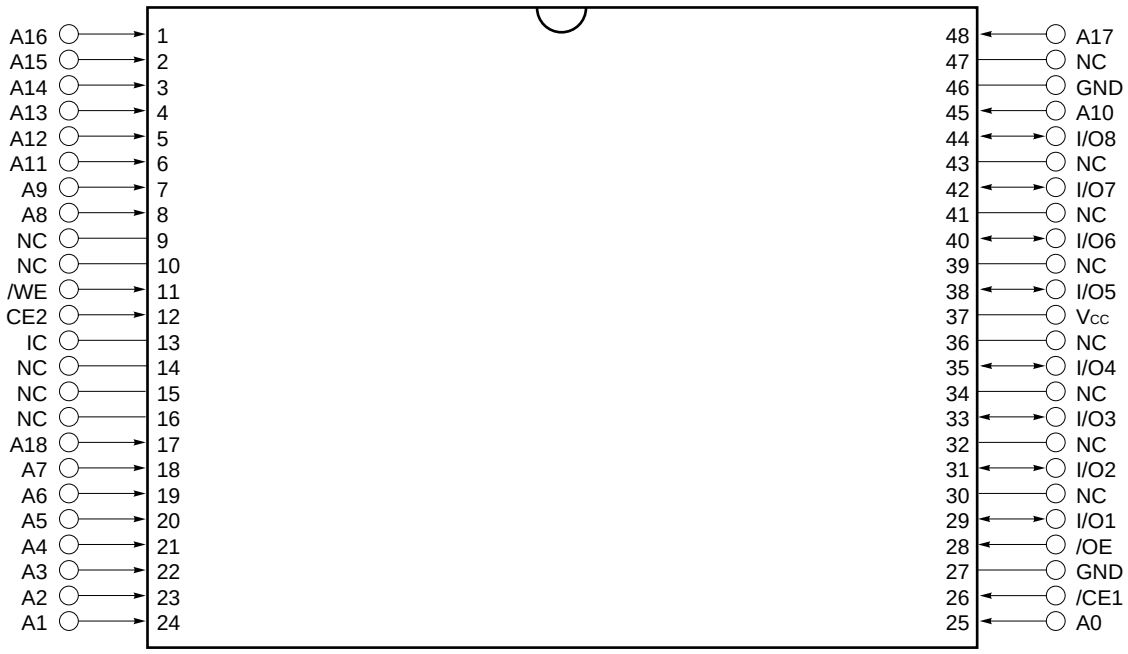
/xxx indicates active low signal.

48-pin Plastic TSOP (I) (12×18 mm) (Normal Bent)

[μPD444010LGY-BxxX-MJH]

[μPD444010LGY-CxxX-MJH]

[μPD444010LGY-DxxX-MJH]



A0 - A18	:	Address inputs
I/O1 - I/O8	:	Data inputs / outputs
/CE1, CE2	:	Chip Enable 1, 2
/WE	:	Write Enable
/OE	:	Output Enable
V_{CC}	:	Power supply
GND	:	Ground
NC	:	No Connection
IC [Note]	:	Internal Connection

Note Leave this pin unconnected or connect to GND.

48-pin Plastic TSOP (I) (12×18 mm) (Reverse Bent)

[μPD444010LGY-BxxX-MKH]

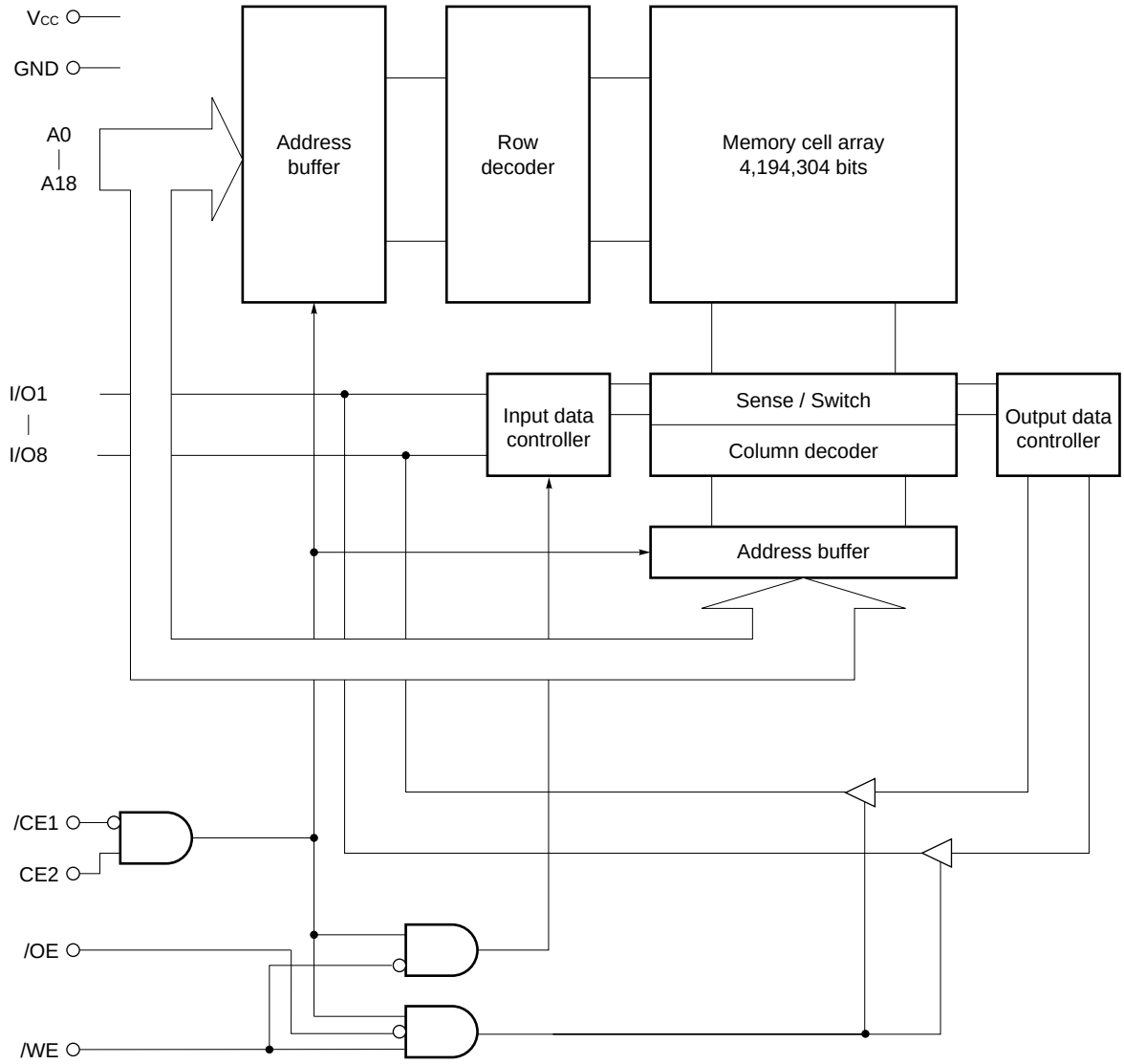
[μPD444010LGY-CxxX-MKH]

[μPD444010LGY-DxxX-MKH]

A0 - A18	:	Address inputs
I/O1 - I/O8	:	Data inputs / outputs
/CE1, CE2	:	Chip Enable 1, 2
/WE	:	Write Enable
/OE	:	Output Enable
V_{CC}	:	Power supply
GND	:	Ground
NC	:	No Connection
IC [Note]	:	Internal Connection

Note Leave this pin unconnected or connect to GND.

Block Diagram



Truth Table

/CE1	CE2	/OE	/WE	Mode	I/O	Supply current
H	×	×	×	Not selected	High impedance	I_{SB}
×	L	×	×			
L	H	H	H	Output disable		I_{CCA}
L	H	L	H	Read	D_{OUT}	
L	H	×	L	Write	D_{IN}	

Remark × : Don't care

Electrical Specifications (Preliminary)

Absolute Maximum Ratings

Parameter	Symbol	Condition	Rating	Unit
Supply voltage	V_{CC}		–0.5 Note to +4.0	V
Input / Output voltage	V_T		–0.5 Note to V_{CC}+0.4 (4.0 V MAX.)	V
Operating ambient temperature	T_A		–25 to +85	°C
Storage temperature	T_{stg}		–55 to +125	°C

Note –3.0 V (MIN.) (Pulse width : 30 ns)

Caution Exposing the device to stress above those listed in Absolute Maximum Rating could cause permanent damage. The device is not meant to be operated under conditions outside the limits described in the operational section of this specification. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Symbol	Condition	μPD444010L-BxxX		μPD444010L-CxxX		μPD444010L-DxxX		Unit
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
Supply voltage	V_{CC}		2.7	3.6	2.2	3.6	1.8	3.6	V
High level input voltage	V_{IH}	2.7 V ≤ V_{CC} ≤ 3.6 V	2.4	V_{CC}+0.4	2.4	V_{CC}+0.4	2.4	V_{CC}+0.4	V
		2.2 V ≤ V_{CC} < 2.7 V	–	–	2.0	V_{CC}+0.3	2.0	V_{CC}+0.3	
		1.8 V ≤ V_{CC} < 2.2 V	–	–	–	–	1.6	V_{CC}+0.2	
Low level input voltage	V_{IL}		–0.3 Note	+0.5	–0.3 Note	+0.3	–0.3 Note	+0.2	V
Operating ambient temperature	T_A		–25	+85	–25	+85	–25	+85	°C

Note –1.5 V (MIN.) (Pulse width: 30 ns)

Capacitance (T_A = 25 °C, f = 1 MHz)

Parameter	Symbol	Test condition	MIN.	TYP.	MAX.	Unit
Input capacitance	C_{IN}	V_{IN} = 0 V			8	pF
Input / Output capacitance	$C_{I/O}$	$V_{I/O}$ = 0 V			10	pF

Remarks 1. V_{IN} : Input voltage

2. These parameters are periodically sampled and not 100% tested.

DC Characteristics (Recommended Operating Conditions Unless Otherwise Noted)

Parameter	Symbol	Test condition		$V_{CC} \geq 2.7$ V			$V_{CC} \geq 2.2$ V			$V_{CC} \geq 1.8$ V			Unit
				μPD444010L-BxxX			μPD444010L-CxxX			μPD444010L-DxxX			
				MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Input leakage current	I_{LI}	V_{IN} = 0 V to V_{CC}		–1.0		+1.0	–1.0		+1.0	–1.0		+1.0	μA
I/O leakage current	I_{LO}	$V_{I/O}$ = 0 V to V_{CC}, /CE1 = V_{IH} or CE2 = V_{IL} or /WE = V_{IL} or /OE = V_{IH}		–1.0		+1.0	–1.0		+1.0	–1.0		+1.0	μA
Operating supply current	I_{CCA1}	/CE1 = V_{IL}, CE2 = V_{IH},			–	40		–	40		–	40	mA
		Minimum cycle time,	$V_{CC} \leq 2.7$ V		–	–		–	38		–	38	
		$I_{I/O}$ = 0 mA	$V_{CC} \leq 2.2$ V		–	–		–	–		–	35	
	I_{CCA2}	/CE1 = V_{IL}, CE2 = V_{IH},				10			10			10	
		$I_{I/O}$ = 0 mA	$V_{CC} \leq 2.7$ V			–			8			8	
			$V_{CC} \leq 2.2$ V			–			–			6	
	I_{CCA3}	/CE1 ≤ 0.2 V, CE2 ≥ V_{CC} – 0.2 V, Cycle = 1 MHz, $I_{I/O}$ = 0 mA,				8			8			8	
		$V_{IL} \leq 0.2$ V,	$V_{CC} \leq 2.7$ V			–			6			6	
		$V_{IH} \geq V_{CC}$ – 0.2 V	$V_{CC} \leq 2.2$ V			–			–			6	
Standby supply current	I_{SB}	/CE1 = V_{IH} or CE2 = V_{IL},				0.6			0.6			0.6	mA
	I_{SB1}	/CE1 ≥ V_{CC} – 0.2 V,			0.5	7		0.5	7		0.5	7	μA
		CE2 ≥ V_{CC} – 0.2 V	$V_{CC} \leq 2.7$ V		–	–		0.4	6		0.4	6	
			$V_{CC} \leq 2.2$ V		–	–		–	–		0.3	5	
	I_{SB2}	CE2 ≤ 0.2 V			0.5	7		0.5	7		0.5	7	
			$V_{CC} \leq 2.7$ V		–	–		0.4	6		0.4	6	
			$V_{CC} \leq 2.2$ V		–	–		–	–		0.3	5	
High level output voltage	V_{OH}	I_{OH} = –0.5 mA		2.4			2.4			2.4			V
			$V_{CC} \leq 2.7$ V	–			1.8			1.8			
			$V_{CC} \leq 2.2$ V	–			–			1.5			
Low level output voltage	V_{OL}	I_{OL} = 1.0 mA				0.4			0.4			0.4	V

Remarks 1. V_{IN} : Input voltage

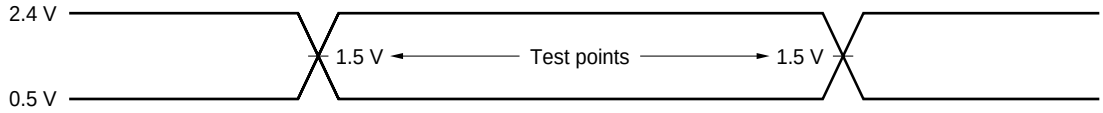
2. These DC characteristics are in common regardless of package types and access time.

AC Characteristics (Recommended Operating Conditions Unless Otherwise Noted)

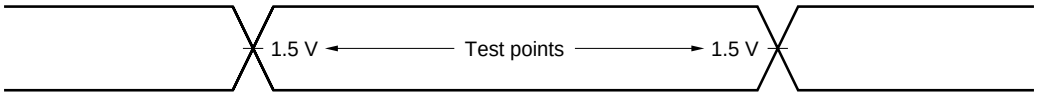
AC Test Conditions

[μPD444010L-B70X, μPD444010L-B85X]

Input Waveform (Rise and Fall Time ≤ 5 ns)



Output Waveform

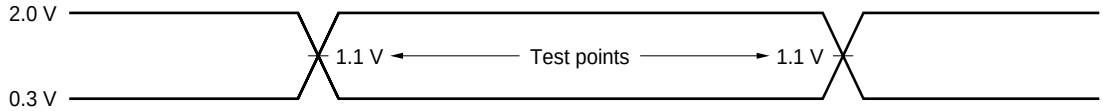


Output Load

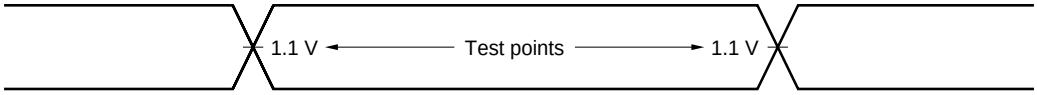
1TTL + 50 pF

[μPD444010L-C10X, μPD444010L-C12X]

Input Waveform (Rise and Fall Time ≤ 5 ns)



Output Waveform

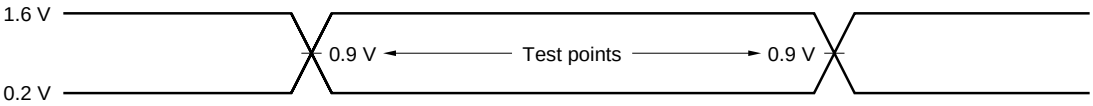


Output Load

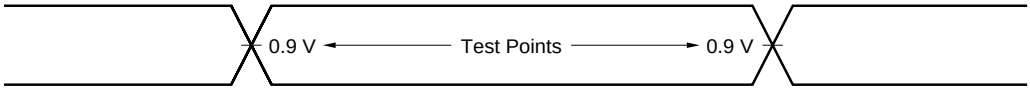
1TTL + 30 pF

[μPD444010L-D12X, μPD444010L-D15X]

Input Waveform (Rise and Fall Time ≤ 5 ns)



Output Waveform



Output Load

1TTL + 30 pF

Read Cycle

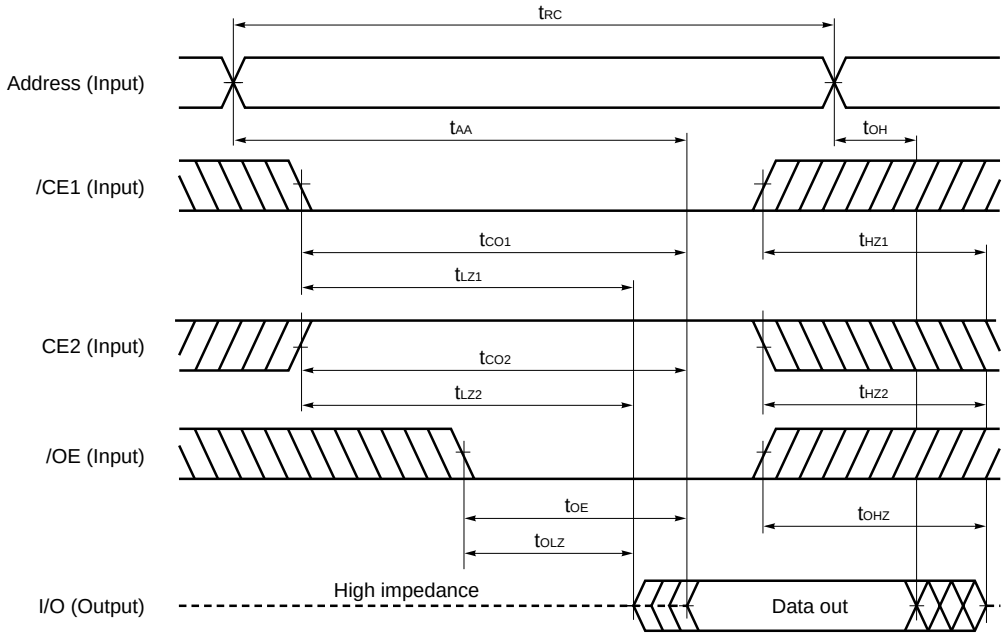
Parameter	Symbol	$V_{CC} \geq 2.7$ V				$V_{CC} \geq 2.2$ V				$V_{CC} \geq 1.8$ V				Unit	Condition
		μPD444010L -B70X		μPD444010L -B85X		μPD444010L -C10X		μPD444010L -C12X		μPD444010L -D12X		μPD444010L -D15X			
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Read cycle time	t_{RC}	70		85		100		120		120		150		ns	
Address access time	t_{AA}		70		85		100		120		120		150	ns	**Note 1**
/CE1 access time	t_{CO1}		70		85		100		120		120		150	ns	
CE2 access time	t_{CO2}		70		85		100		120		120		150	ns	
/OE to output valid	t_{OE}		35		40		50		60		60		70	ns	
Output hold from address change	t_{OH}	10		10		10		10		10		10		ns	
/CE1 to output in low impedance	t_{LZ1}	10		10		10		10		10		10		ns	**Note 2**
CE2 to output in low impedance	t_{LZ2}	10		10		10		10		10		10		ns	
/OE to output in low impedance	t_{OLZ}	5		5		5		5		5		5		ns	
/CE1 to output in high impedance	t_{HZ1}		25		30		35		40		40		50	ns	
CE2 to output in high impedance	t_{HZ2}		25		30		35		40		40		50	ns	
/OE to output in high impedance	t_{OHZ}		25		30		35		40		40		50	ns	

Notes 1. The output load is 1TTL + 50 pF (μPD444010L-BxxX) or 1TTL + 30 pF (μPD444010L-CxxX, -DxxX).

2. The output load is 1TTL + 5 pF.

Remark These AC characteristics are in common regardless of package types.

Read Cycle Timing Chart



Remark In read cycle, /WE should be fixed to high level.

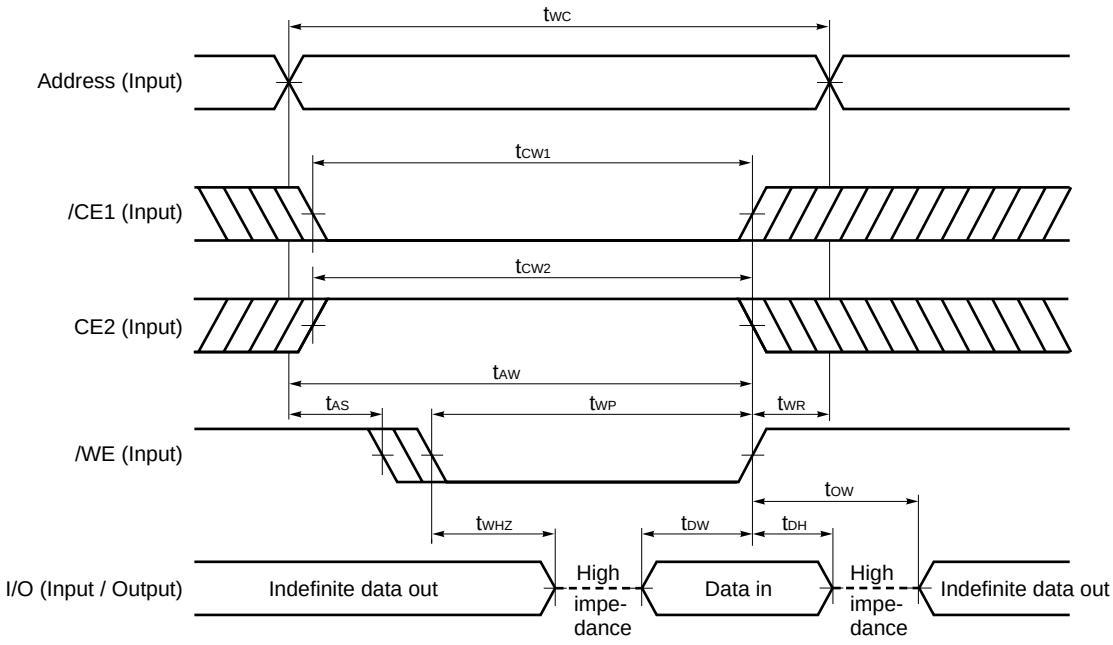
Write Cycle

Parameter	Symbol	$V_{CC} \geq 2.7$ V				$V_{CC} \geq 2.2$ V				$V_{CC} \geq 1.8$ V				Unit	Condition
		μPD444010L -B70X		μPD444010L -B85X		μPD444010L -C10X		μPD444010L -C12X		μPD444010L -D12X		μPD444010L -D15X			
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Write cycle time	t_{WC}	70		85		100		120		120		150		ns	
/CE1 to end of write	t_{CW1}	55		70		80		100		100		120		ns	
CE2 to end of write	t_{CW2}	55		70		80		100		100		120		ns	
Address valid to end of write	t_{AW}	55		70		80		100		100		120		ns	
Address setup time	t_{AS}	0		0		0		0		0		0		ns	
Write pulse width	t_{WP}	50		55		60		85		85		100		ns	
Write recovery time	t_{WR}	0		0		0		0		0		0		ns	
Data valid to end of write	t_{DW}	30		35		40		60		60		80		ns	
Data hold time	t_{DH}	0		0		0		0		0		0		ns	
/WE to output in high impedance	t_{WHZ}		25		30		35		40		40		50	ns	**Note**
Output active from end of write	t_{OW}	5		5		5		5		5		5		ns	

Note The output load is 1TTL + 5 pF.

Remark These AC characteristics are in common regardless of package types.

Write Cycle Timing Chart 1 (/WE Controlled)



Cautions 1. During address transition, at least one of pins /CE1, CE2, /WE should be inactivated.

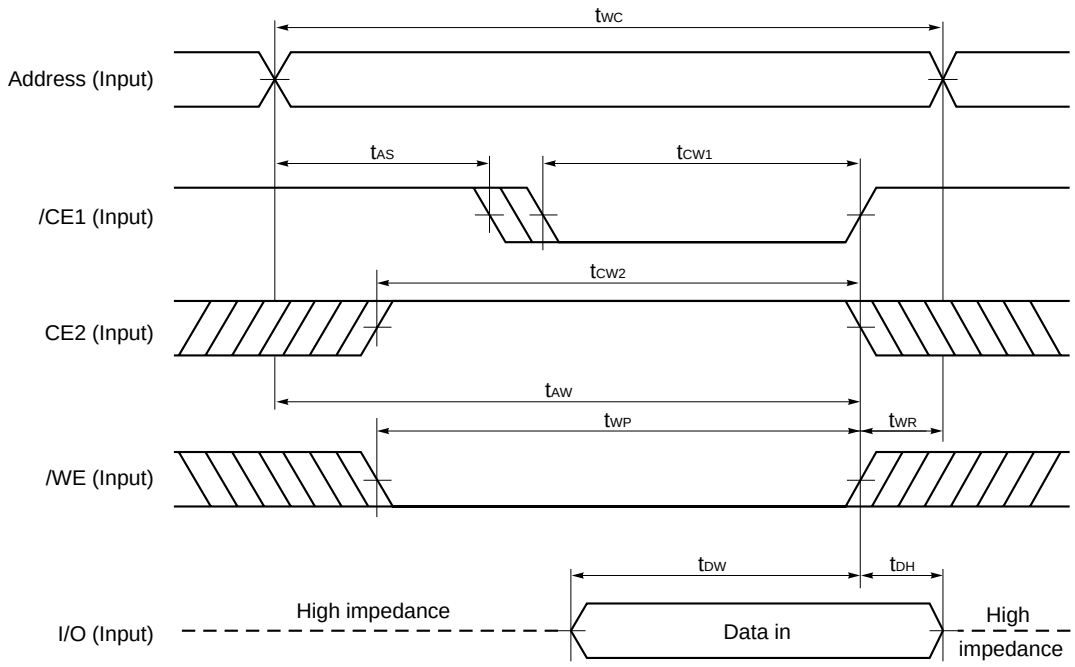
2. When I/O pins are in the output state, do not apply to the I/O pins signals that are opposite in phase with output signals.

Remarks 1. Write operation is done during the overlap time of a low level /CE1, /WE and a high level CE2.

2. If /CE1 changes to low level at the same time or after the change of /WE to low level, or if CE2 changes to high level at the same time or after the change of /WE to low level, the I/O pins will remain high impedance state.

3. When /WE is at low level, the I/O pins are always high impedance. When /WE is at high level, read operation is executed. Therefore /OE should be at high level to make the I/O pins high impedance.

Write Cycle Timing Chart 2 (/CE1 Controlled)

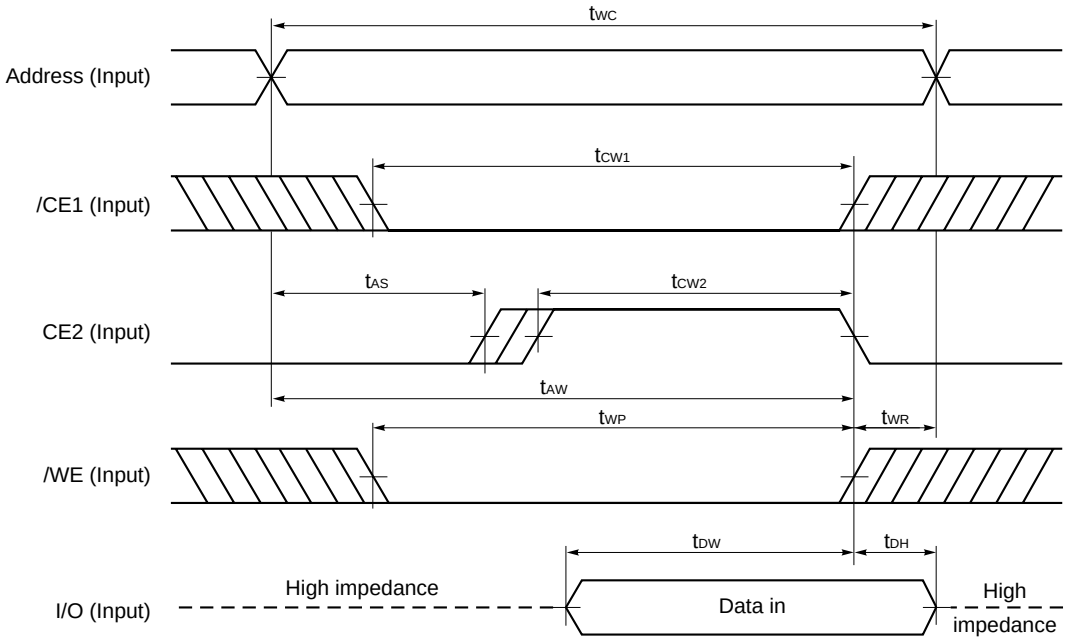


Cautions 1. During address transition, at least one of pins /CE1, CE2, /WE should be inactivated.

2. When I/O pins are in the output state, do not apply to the I/O pins signals that are opposite in phase with output signals.

Remark Write operation is done during the overlap time of a low level /CE1, /WE and a high level CE2.

Write Cycle Timing Chart 3 (CE2 Controlled)



Cautions 1. During address transition, at least one of pins /CE1, CE2, /WE should be inactivated.

2. When I/O pins are in the output state, do not apply to the I/O pins signals that are opposite in phase with output signals.

Remark Write operation is done during the overlap time of a low level /CE1, /WE and a high level CE2.

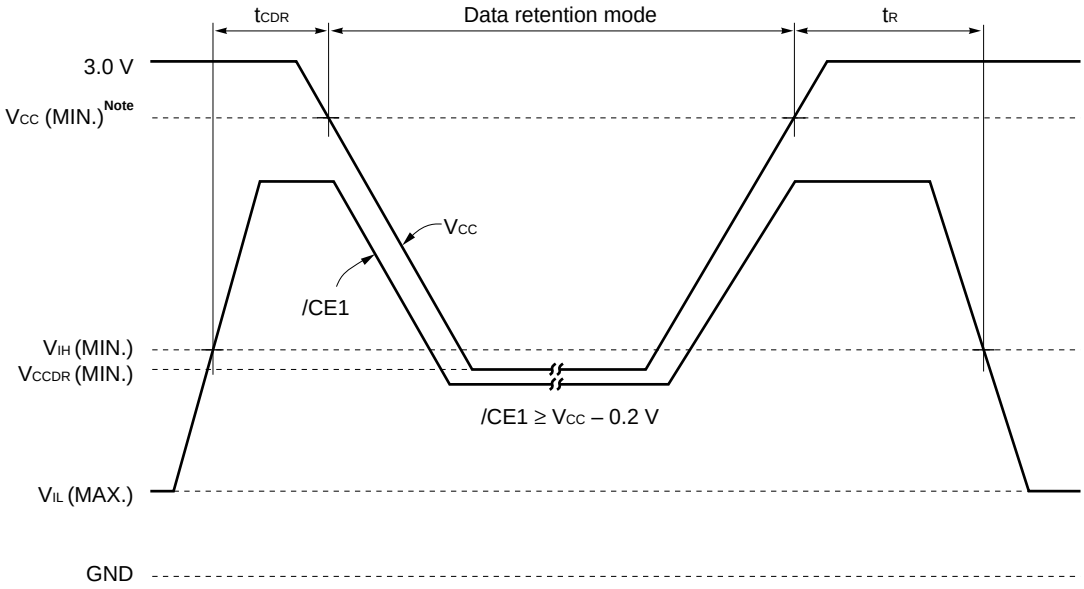
Low V_{CC} Data Retention Characteristics (T_A = –25 to +85 °C)

Parameter	Symbol	Test Condition	V_{CC} ≥ 2.7 V			V_{CC} ≥ 2.2 V			V_{CC} ≥ 1.8 V			Unit
			μPD444010L -B××X			μPD444010L -C××X			μPD444010L -D××X			
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Data retention supply voltage	V_{CCDR1}	/CE1 ≥ V_{CC} – 0.2 V, CE2 ≥ V_{CC} – 0.2 V	2.0		3.6	1.5		3.6	1.5		3.6	V
	V_{CCDR2}	CE2 ≤ 0.2 V	2.0		3.6	1.5		3.6	1.5		3.6	
Data retention supply current	I_{CCDR1}	V_{CC} = 3.0 V, /CE1 ≥ V_{CC} – 0.2 V, CE2 ≥ V_{CC} – 0.2 V or CE2 ≤ 0.2 V		0.5	7		0.5	7		0.5	7	μA
	I_{CCDR2}	V_{CC} = 3.0 V, CE2 ≤ 0.2 V		0.5	7		0.5	7		0.5	7	
Chip deselection to data retention mode	t_{CDR}		0			0			0			ns
Operation recovery time	t_R		t_{RC} Note			t_{RC} Note			t_{RC} Note			ns

Note t_{RC} : Read cycle time

Data Retention Timing Chart

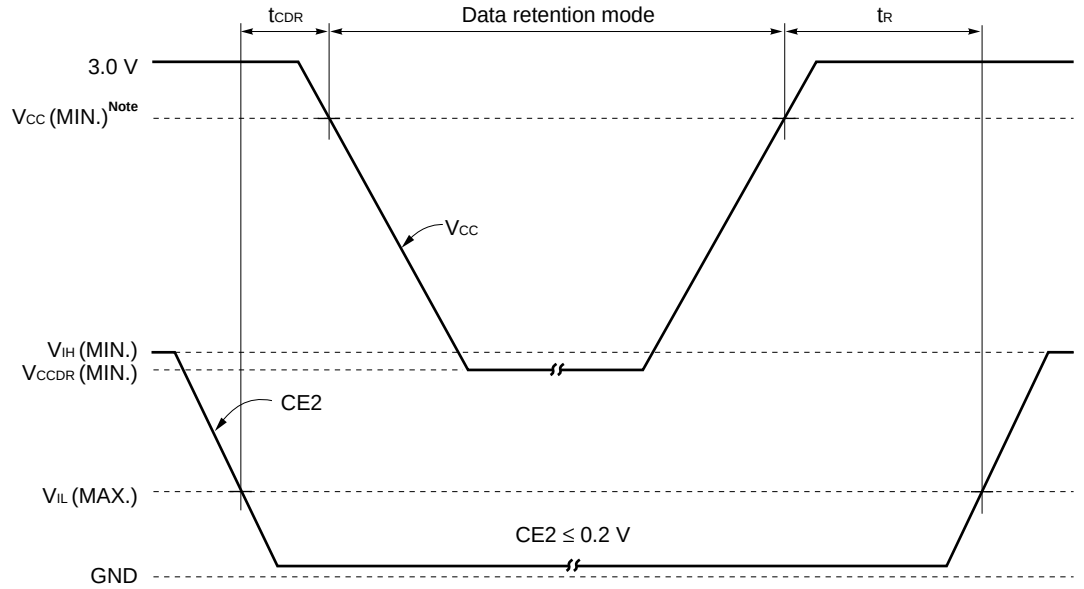
(1) /CE1 Controlled



Note B version : 2.7 V, C version : 2.2 V, D version : 1.8 V

Remark On the data retention mode by controlling /CE1, the input level of CE2 must be CE2 ≥ V_{CC} – 0.2 V or CE2 ≤ 0.2 V. The other pins (Address, I/O, /WE, /OE) can be in high impedance state.

(2) CE2 Controlled

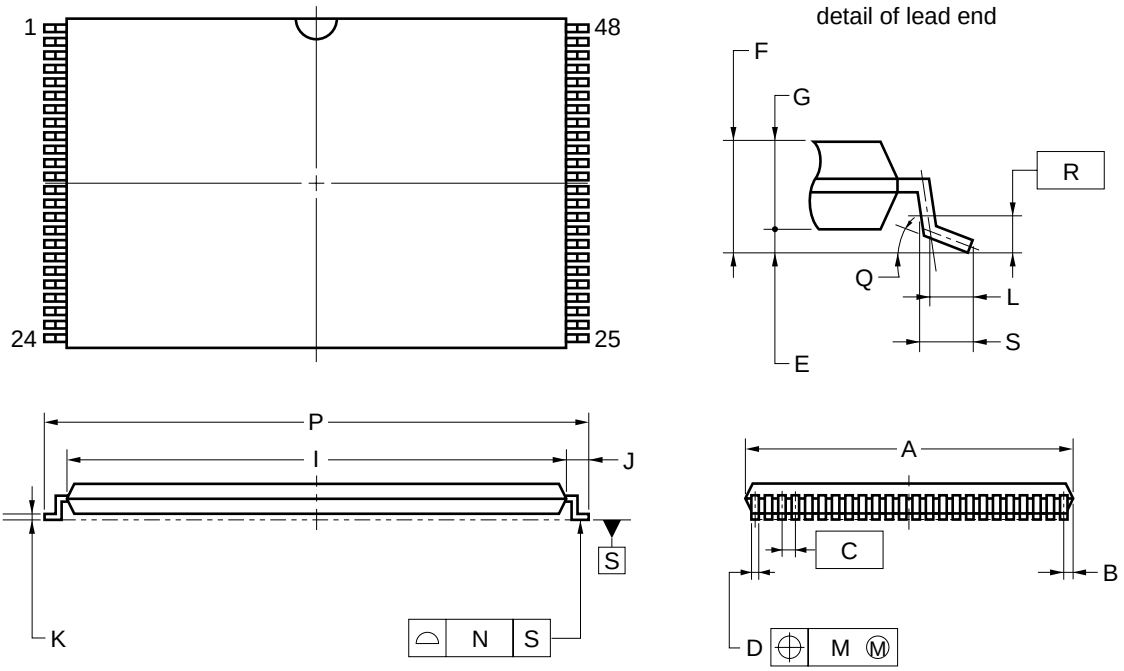


Note B version : 2.7 V, C version : 2.2 V, D version : 1.8 V

Remark The other pins (/CE1, Address, I/O, /WE, /OE) can be in high impedance state.

Package Drawings

48 PIN PLASTIC TSOP (I) (12×18)



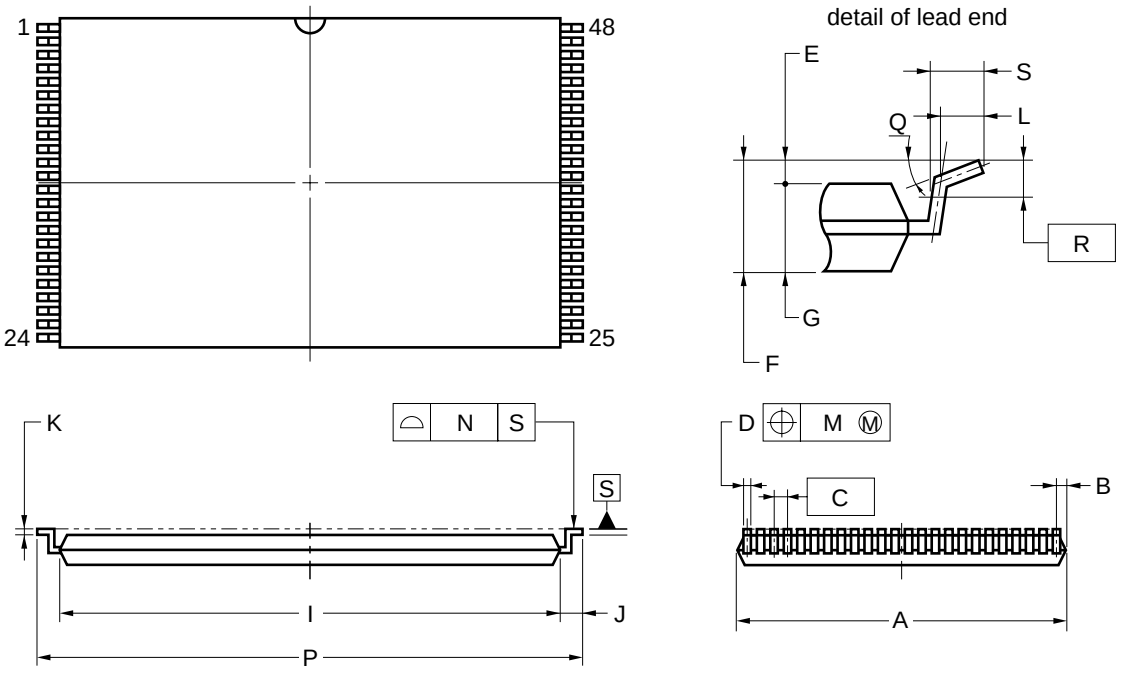
NOTES

1. Controlling dimension — Millimeter.
2. Each lead centerline is located within 0.10 mm (0.004 inch) of its true position (T.P.) at maximum material condition.
3. "A" excludes mold flash. (Includes mold flash : 12.4 mm MAX. <0.489 inch MAX.>)

ITEM	MILLIMETERS	INCHES
A	12.0±0.1	$0.472^{+0.005}_{-0.004}$
B	0.45 MAX.	0.018 MAX.
C	0.5 (T.P.)	0.020 (T.P.)
D	0.22±0.05	$0.009^{+0.002}_{-0.003}$
E	0.1±0.05	0.004±0.002
F	1.2 MAX.	0.048 MAX.
G	1.0±0.05	$0.039^{+0.003}_{-0.002}$
I	16.4±0.1	$0.646^{+0.004}_{-0.005}$
J	0.8±0.2	$0.031^{+0.009}_{-0.008}$
K	0.145±0.05	$0.006^{+0.002}_{-0.003}$
L	0.5	0.020
M	0.10	0.004
N	0.10	0.004
P	18.0±0.2	$0.709^{+0.008}_{-0.009}$
Q	$3^{\circ}{}^{+5^{\circ}}_{-3^{\circ}}$	$3^{\circ}{}^{+5^{\circ}}_{-3^{\circ}}$
R	0.25	0.010
S	0.60±0.15	$0.024^{+0.006}_{-0.007}$

S48GY-50-MJH1

48 PIN PLASTIC TSOP (I) (12×18)



NOTES

1. Controlling dimension — Millimeter.
2. Each lead centerline is located within 0.10 mm (0.004 inch) of its true position (T.P.) at maximum material condition.
3. "A" excludes mold flash. (Includes mold flash : 12.4 mm MAX. <0.489 inch MAX.>)

ITEM	MILLIMETERS	INCHES
A	12.0±0.1	$0.472^{+0.005}_{-0.004}$
B	0.45 MAX.	0.018 MAX.
C	0.5 (T.P.)	0.020 (T.P.)
D	0.22±0.05	$0.009^{+0.002}_{-0.003}$
E	0.1±0.05	0.004±0.002
F	1.2 MAX.	0.048 MAX.
G	1.0±0.05	$0.039^{+0.003}_{-0.002}$
I	16.4±0.1	$0.646^{+0.004}_{-0.005}$
J	0.8±0.2	$0.031^{+0.009}_{-0.008}$
K	0.145±0.05	$0.006^{+0.002}_{-0.003}$
L	0.5	0.020
M	0.10	0.004
N	0.10	0.004
P	18.0±0.2	$0.709^{+0.008}_{-0.009}$
Q	$3^{\circ}{}^{+5^{\circ}}_{-3^{\circ}}$	$3^{\circ}{}^{+5^{\circ}}_{-3^{\circ}}$
R	0.25	0.010
S	0.60±0.15	$0.024^{+0.006}_{-0.007}$

S48GY-50-MKH1

Recommended Soldering Conditions

Please consult with our sales offices for soldering conditions of the μPD444010L-X.

Type of Surface Mount Device

μPD444010LGY-BxxX-MJH: 48-pin Plastic TSOP (I) (12×18 mm) (Normal bent)
μPD444010LGY-BxxX-MKH: 48-pin Plastic TSOP (I) (12×18 mm) (Reverse bent)
μPD444010LGY-CxxX-MJH: 48-pin Plastic TSOP (I) (12×18 mm) (Normal bent)
μPD444010LGY-CxxX-MKH: 48-pin Plastic TSOP (I) (12×18 mm) (Reverse bent)
μPD444010LGY-DxxX-MJH: 48-pin Plastic TSOP (I) (12×18 mm) (Normal bent)
μPD444010LGY-DxxX-MKH: 48-pin Plastic TSOP (I) (12×18 mm) (Reverse bent)

NOTES FOR CMOS DEVICES

① PRECAUTION AGAINST ESD FOR SEMICONDUCTORS

Note: Strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred. Environmental control must be adequate. When it is dry, humidifier should be used. It is recommended to avoid using insulators that easily build static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work bench and floor should be grounded. The operator should be grounded using wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor devices on it.

② HANDLING OF UNUSED INPUT PINS FOR CMOS

Note: No connection for CMOS device inputs can be cause of malfunction. If no connection is provided to the input pins, it is possible that an internal input level may be generated due to noise, etc., hence causing malfunction. CMOS device behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using a pull-up or pull-down circuitry. Each unused pin should be connected to V_{DD} or GND with a resistor, if it is considered to have a possibility of being an output pin. All handling related to the unused pins must be judged device by device and related specifications governing the devices.

③ STATUS BEFORE INITIALIZATION OF MOS DEVICES

Note: Power-on does not necessarily define initial status of MOS device. Production process of MOS does not define the initial operation status of the device. Immediately after the power source is turned ON, the devices with reset function have not yet been initialized. Hence, power-on does not guarantee out-pin levels, I/O settings or contents of registers. Device is not initialized until the reset signal is received. Reset operation must be executed imme-diately after power-on for devices having reset function.

[MEMO]

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NEC devices are classified into the following three quality grades:

"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.

Standard: Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.

Anti-radioactive design is not implemented in this product.

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