NEC

MOS INTEGRATED CIRCUIT

μPD444004

4M-BIT CMOS FAST SRAM
1M-WORD BY 4-BIT

Description

The μPD444004 is a high speed, low power, 4,194,304 bits (1,048,576 words by 4 bits) CMOS static RAM.

Operating supply voltage is 5.0 V ± 0.5 V.

★ The μPD444004 is packaged in a 32-pin PLASTIC SOJ.

Features

- 1,048,576 words by 4 bits organization
- Fast access time : 8, 10, 12 ns (MAX.)
- Output Enable input for easy application
- Single +5.0 V power supply

★ Ordering Information

Part number	Package	Access time	Supply current mA (MAX.)	
		ns (MAX.)	At operating	At standby
μPD444004LE-8	32-pin PLASTIC SOJ	8	190	10
μPD444004LE-10	(10.16 mm (400))	10	170	
μPD444004LE-12		12	160	

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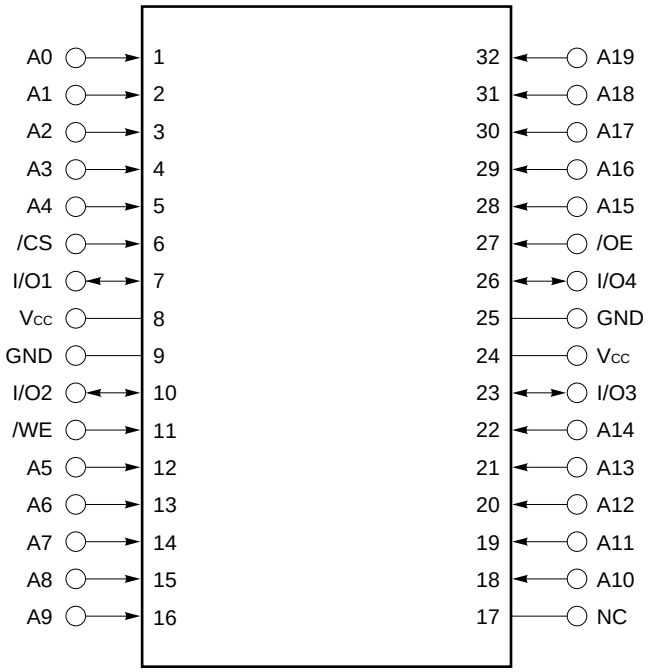
The mark ★ shows major revised points.

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★ Pin Configuration (Marking Side)

/xxx indicates active low signal.

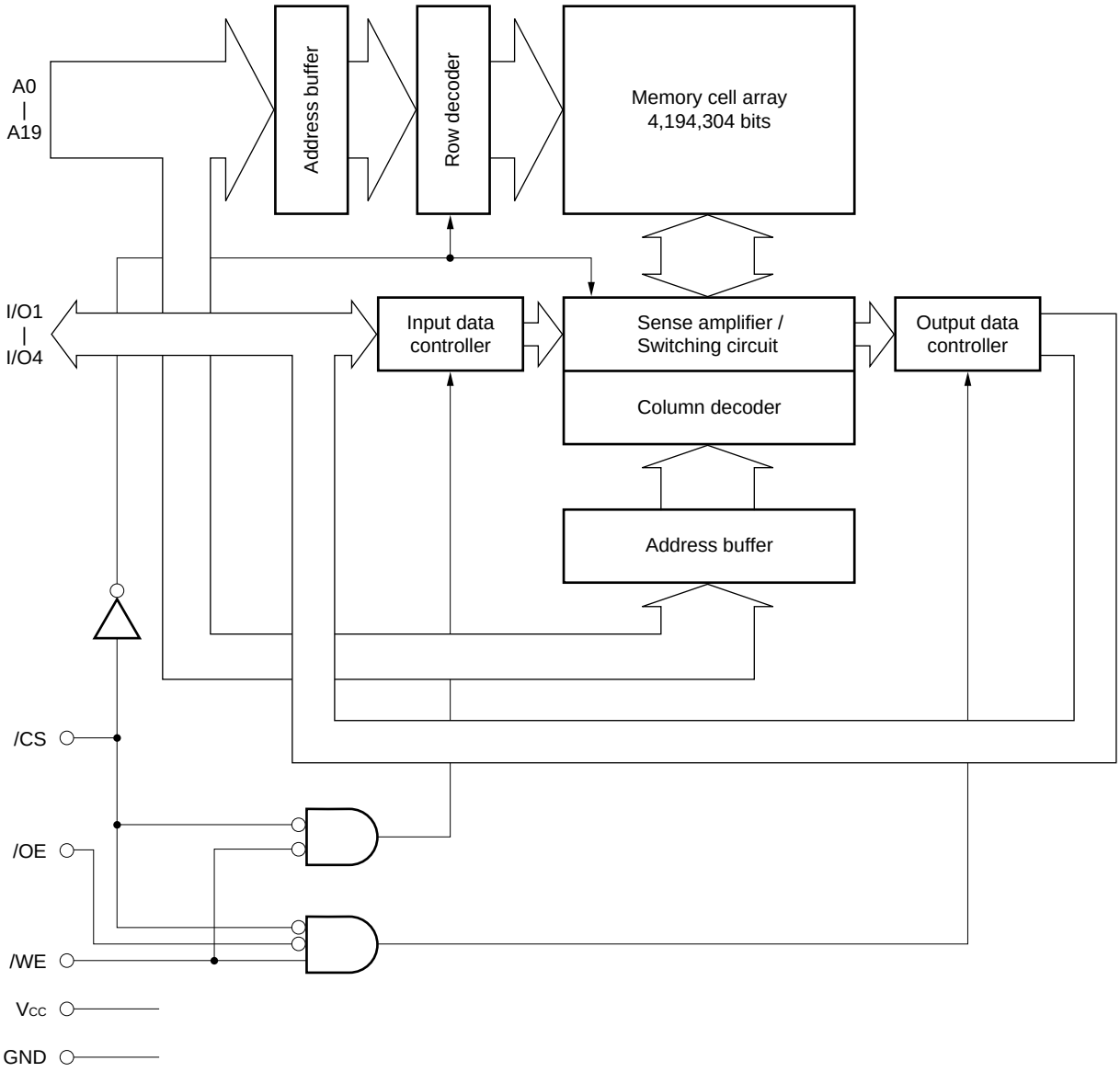
32-pin PLASTIC SOJ (10.16 mm (400))



A0 - A19	:	Address Inputs
I/O1 - I/O4	:	Data Inputs / Outputs
/CS	:	Chip Select
/WE	:	Write Enable
/OE	:	Output Enable
Vcc	:	Power supply
GND	:	Ground
NC	:	No connection

Remark Refer to **Package Drawing** for the 1-pin index mark.

Block Diagram



Truth Table

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

Remark × : Don't care

Electrical Specifications

Absolute Maximum Ratings

Parameter	Symbol	Condition	Rating	Unit
Supply voltage	V_{CC}		–0.5 Note to +7.0	V
Input / Output voltage	V_T		–0.5 Note to V_{CC}+0.5	V
Operating ambient temperature	T_A		0 to 70	°C
Storage temperature	T_{stg}		–55 to +125	°C

Note –2.0 V (MIN.) (pulse width : 2 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	MIN.	TYP.	MAX.	Unit
Supply voltage	V_{CC}		4.5	5.0	5.5	V
High level input voltage	V_{IH}		2.2		V_{CC}+0.5	V
Low level input voltage	V_{IL}		–0.5 Note		+0.8	V
Operating ambient temperature	T_A		0		70	°C

Note –2.0 V (MIN.) (pulse width : 2 ns)

DC Characteristics (Recommended Operating Conditions Unless Otherwise Noted)

Parameter	Symbol	Test condition		MIN.	TYP.	MAX.	Unit
Input leakage current	I_{LI}	V_{IN} = 0 V to V_{CC}		–2		+2	μA
Output leakage current	I_{LO}	$V_{I/O}$ = 0 V to V_{CC}, /CS = V_{IH} or /OE = V_{IH} or /WE = V_{IL}		–2		+2	μA
Operating supply current	I_{CC}	/CS = V_{IL},	Cycle time : 8 ns			190	mA
		$I_{I/O}$ = 0 mA,	Cycle time : 10 ns			170	
		Minimum cycle time	Cycle time : 12 ns			160	
Standby supply current	I_{SB}	/CS = V_{IH}, V_{IN} = V_{IH} or V_{IL}				40	mA
	I_{SB1}	/CS ≥ V_{CC} – 0.2 V, V_{IN} ≤ 0.2 V or V_{IN} ≥ V_{CC} – 0.2 V				10	
High level output voltage	V_{OH}	I_{OH} = –4.0 mA		2.4			V
Low level output voltage	V_{OL}	I_{OL} = +8.0 mA				0.4	V

★ **Remark** V_{IN} : Input voltage

$V_{I/O}$: Input / Output voltage

Capacitance (T_A = 25 °C, f = 1 MHz)

Parameter	Symbol	Test condition	MIN.	TYP.	MAX.	Unit
Input capacitance	C_{IN}	V_{IN} = 0 V			6	pF
Input / Output capacitance	$C_{I/O}$	$V_{I/O}$ = 0 V			8	pF

Remarks 1. V_{IN} : Input voltage

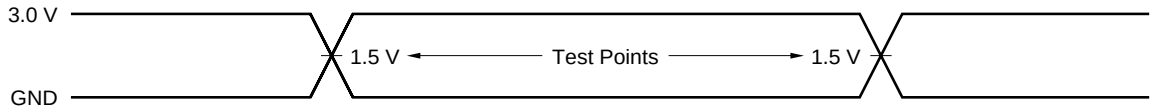
$V_{I/O}$: Input / Output voltage

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

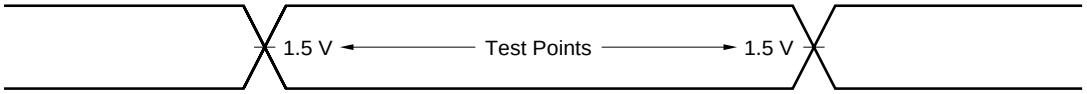
AC Characteristics (Recommended Operating Conditions Unless Otherwise Noted)

AC Test Conditions

Input Waveform (Rise and Fall Time ≤ 3 ns)



Output Waveform



Output Load

AC characteristics directed with the note should be measured with the output load shown in **Figure 1** or **Figure 2**.

Figure 1

(t_{AA}, t_{ACS}, t_{OE}, t_{OH})

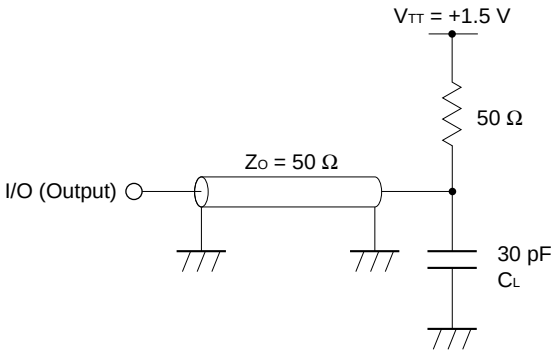
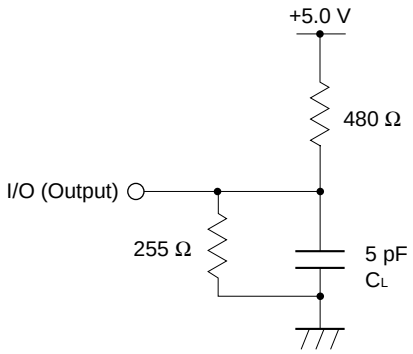


Figure 2

(t_{CLZ}, t_{OLZ}, t_{CHZ}, t_{OHZ}, t_{WHZ}, t_{OW})



Remark C_L includes capacitances of the probe and jig, and stray capacitances.

★ **Read Cycle**

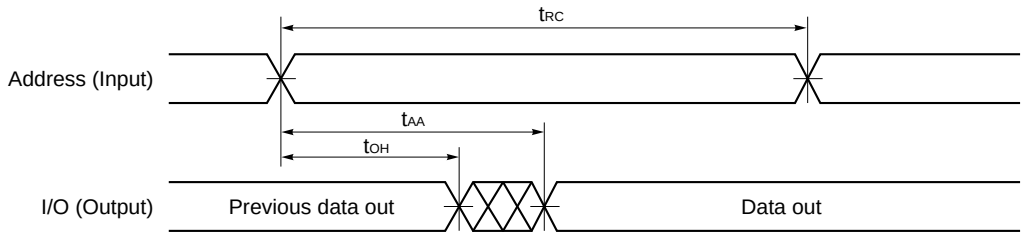
Parameter	Symbol	-8		-10		-12		Unit	Notes
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Read cycle time	t_{RC}	8		10		12		ns	
Address access time	t_{AA}		8		10		12	ns	1
/CS access time	t_{ACS}		8		10		12	ns	
/OE access time	t_{OE}		4		5		6	ns	
Output hold from address change	t_{OH}	3		3		3		ns	
/CS to output in low impedance	t_{CLZ}	3		3		3		ns	2, 3
/OE to output in low impedance	t_{OLZ}	0		0		0		ns	
/CS to output in high impedance	t_{CHZ}		4		5		6	ns	
/OE to output hold in high impedance	t_{OHZ}		4		5		6	ns	

Notes 1. See the output load shown in **Figure 1**.

2. Transition is measured at ± 200 mV from steady-state voltage with the output load shown in **Figure 2**.

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

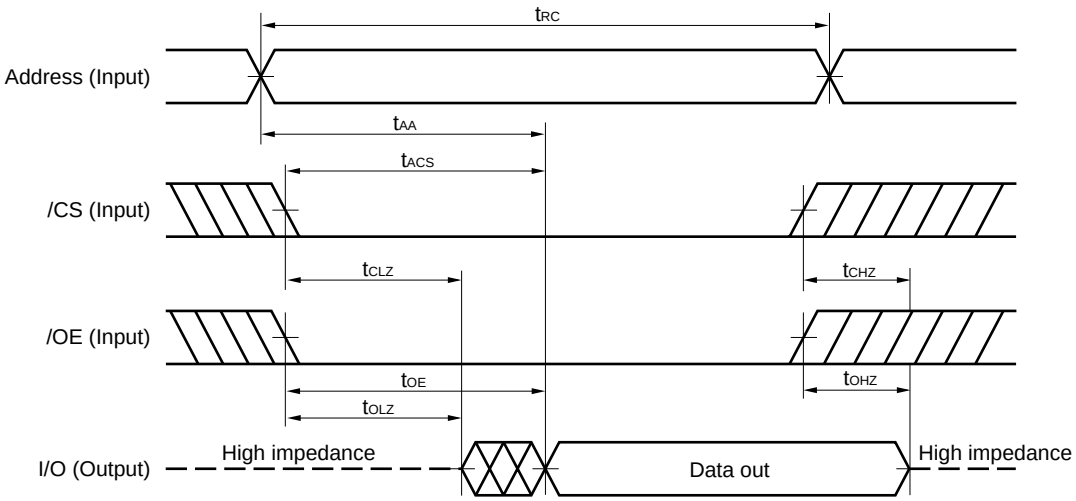
Read Cycle Timing Chart 1 (Address Access)



Remarks 1. In read cycle, /WE should be fixed to high level.

2. /CS = /OE = V_{IL}

Read Cycle Timing Chart 2 (/CS Access)



Caution Address valid prior to or coincident with /CS low level input.

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

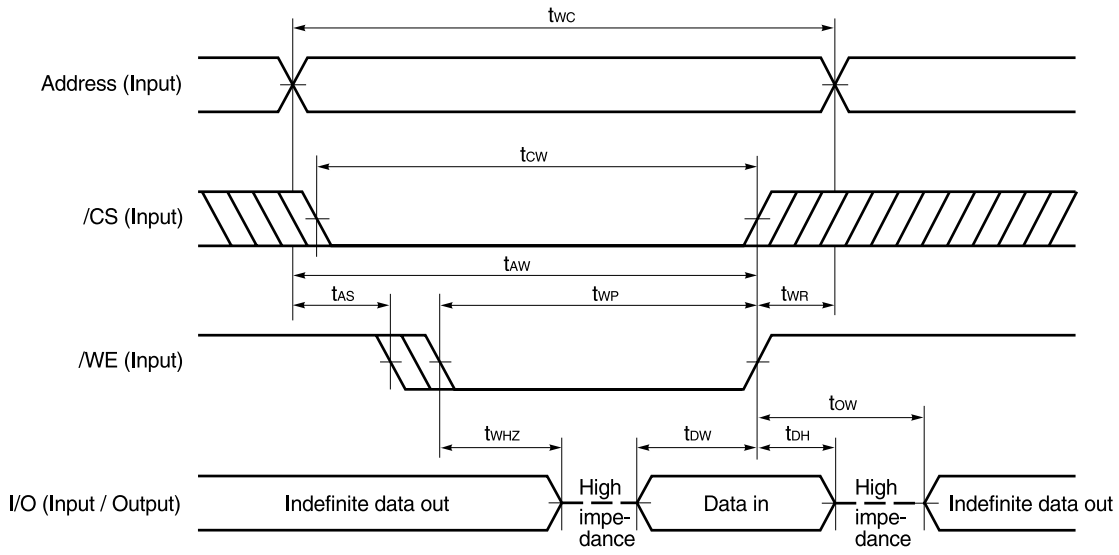
★ **Write Cycle**

Parameter	Symbol	-8		-10		-12		Unit	Notes
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Write cycle time	t_{WC}	8		10		12		ns	
/CS to end of write	t_{CW}	6		7		8		ns	
Address valid to end of write	t_{AW}	6		7		8		ns	
Write pulse width	t_{WP}	6		7		8		ns	
Data valid to end of write	t_{DW}	4		5		6		ns	
Data hold time	t_{DH}	0		0		0		ns	
Address setup time	t_{AS}	0		0		0		ns	
Write recovery time	t_{WR}	0		0		0		ns	
/WE to output in high impedance	t_{WHZ}		4		5		6	ns	1, 2
Output active from end of write	t_{OW}	3		3		3		ns	

Notes 1. Transition is measured at ± 200 mV from steady-state voltage with the output load shown in **Figure 2**.

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

Write Cycle Timing Chart 1 (/WE Controlled)



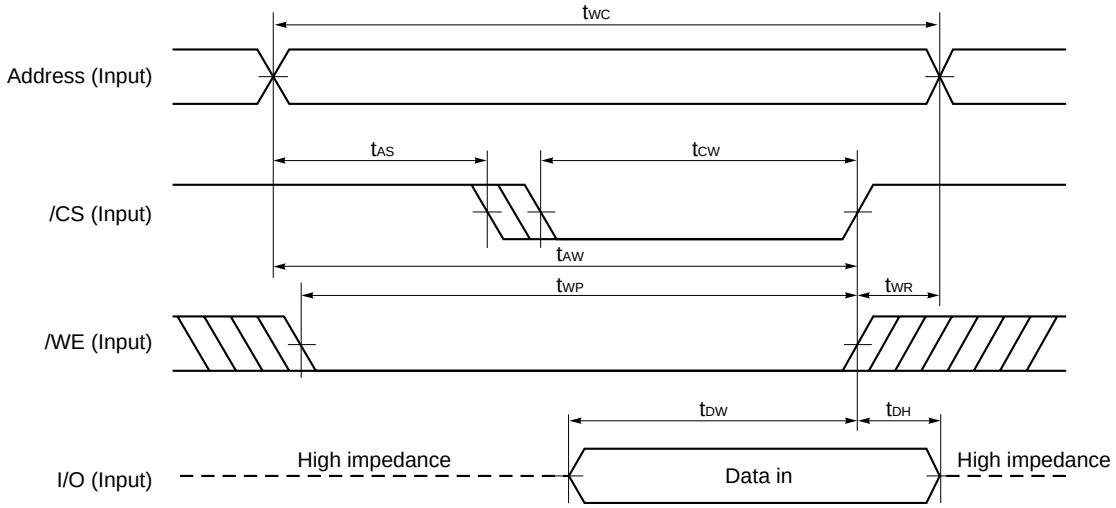
Cautions 1. /CS or /WE should be fixed to high level during address transition.

2. Do not input data to the I/O pins while they are in the output state.

Remarks 1. Write operation is done during the overlap time of a low level /CS and a low level /WE.

2. 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 (/CS Controlled)



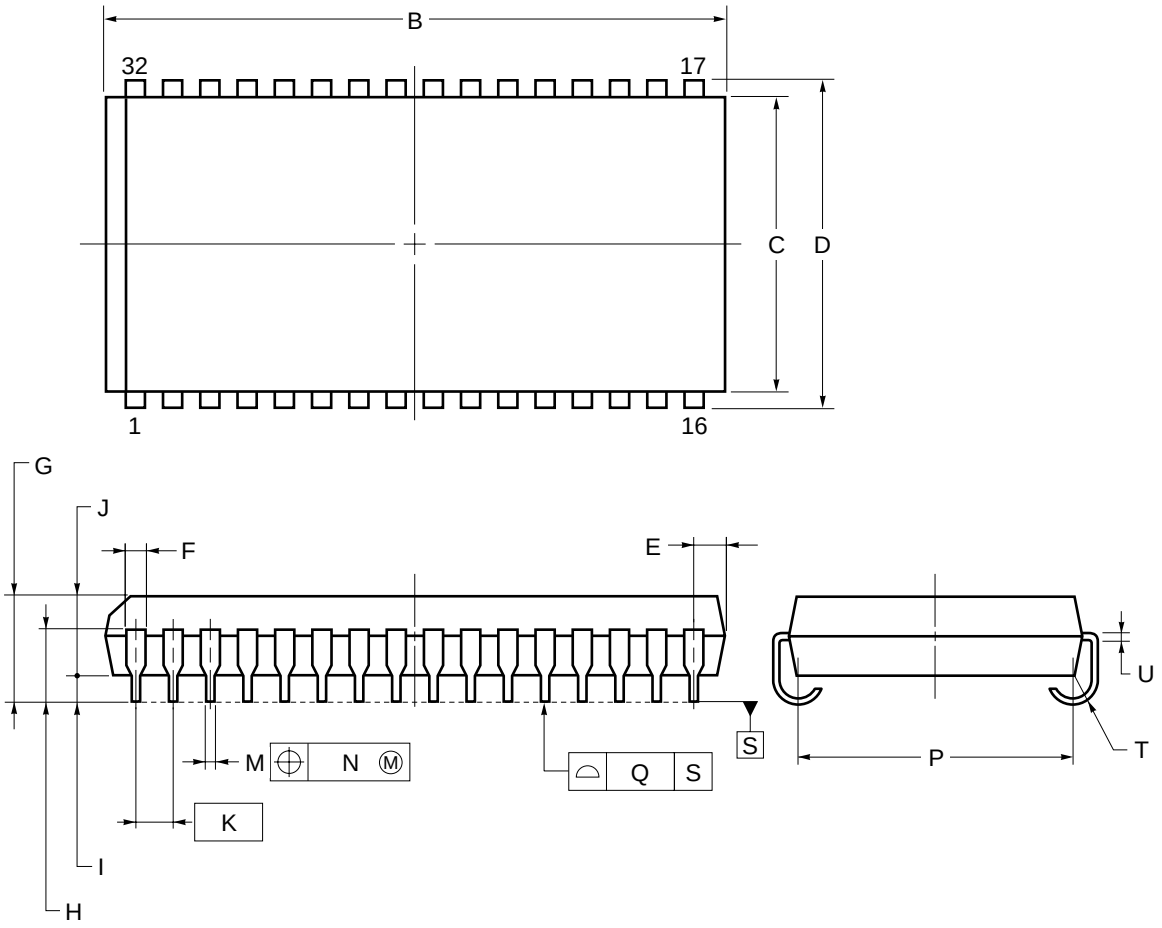
Cautions 1. /CS or /WE should be fixed to high level during address transition.

2. Do not input data to the I/O pins while they are in the output state.

Remark Write operation is done during the overlap time of a low level /CS and a low level /WE.

★ **Package Drawing**

32-PIN PLASTIC SOJ (10.16 mm (400))



NOTE
Each lead centerline is located within 0.12 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
B	21.26±0.2
C	10.16
D	11.18±0.2
E	1.005±0.1
F	0.74
G	3.5±0.2
H	2.545±0.2
I	0.8 MIN.
J	2.6
K	1.27(T.P.)
M	0.40±0.10
N	0.12
P	9.4±0.20
Q	0.1
T	R0.85
U	$0.20^{+0.10}_{-0.05}$

P32LE-400A-1

Recommended Soldering Conditions

Please consult with our sales offices for soldering conditions of the μPD444004.

★ **Type of Surface Mount Device**

μPD444004LE : 32-pin PLASTIC SOJ (10.16 mm (400))

Revision History

Edition/ Date	Page		Type of revision	Location	Description (Previous edition → This edition)
	This edition	Previous edition			
4th edition/ May 2002	p.1, 2, 11, 12	p.1, 2, 12, 13	Deletion	Ordering Information, Pin Configuration, Package Drawing, Type of Surface Mount Device	32-pin PLASTIC TSOP (II)
	p.5	p.5	Deletion	DC Characteristics	Remark 2
	p.7, 9	p.7, 9	Deletion	Read Cycle, Write Cycle	Remark

[MEMO]

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 devices 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 immediately after power-on for devices having reset function.

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