NEC

MOS INTEGRATED CIRCUIT

μPD444016

4M-BIT CMOS FAST SRAM
256K-WORD BY 16-BIT

Description

The μPD444016 is a high speed, low power, 4,194,304 bits (262,144 words by 16 bits) CMOS static RAM.

Operating supply voltage is 5.0 V ± 0.5 V.

The μPD444016 is packaged in 44-pin plastic SOJ and 44-pin plastic TSOP (II).

Features

- 262,144 words by 16 bits organization
- Fast access time : 8, 10, 12 ns (MAX.)
- Byte data control : /LB (I/O1 - I/O8), /UB (I/O9 - I/O16)
- 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
μPD444016LE-8	44-pin plastic SOJ	8	220	10
μPD444016LE-10	(10.16 mm (400))	10	200	
μPD444016LE-12		12	190	
μPD444016G5-8-7JF	44-pin plastic TSOP (II)	8	220	
μPD444016G5-10-7JF	(10.16 mm (400))	10	200	
μPD444016G5-12-7JF	(Normal bent)	12	190	

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The mark ★ shows major revised points.

Pin Configuration (Marking Side)

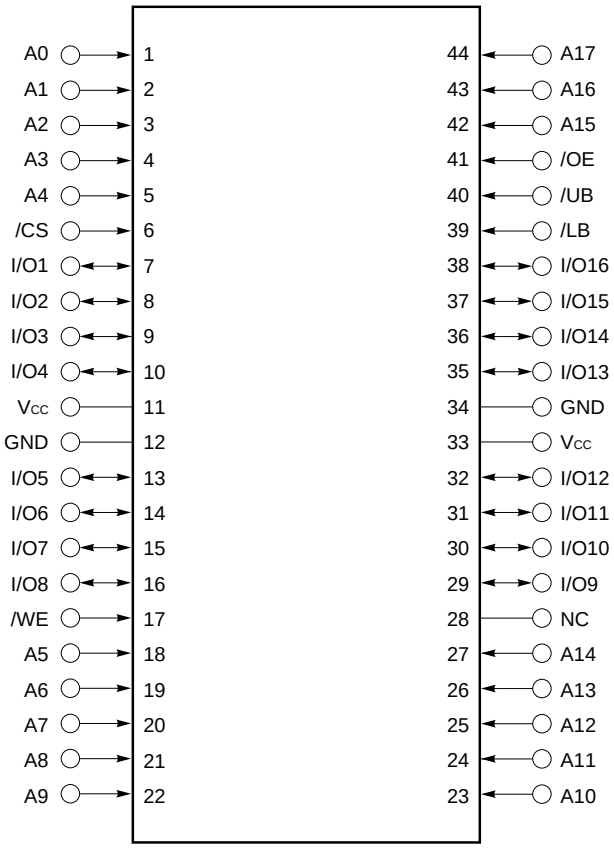
/xxx indicates active low signal.

44-pin plastic SOJ (10.16 mm (400))

[μPD444016LE]

44-pin plastic TSOP (II) (10.16 mm (400)) (Normal bent)

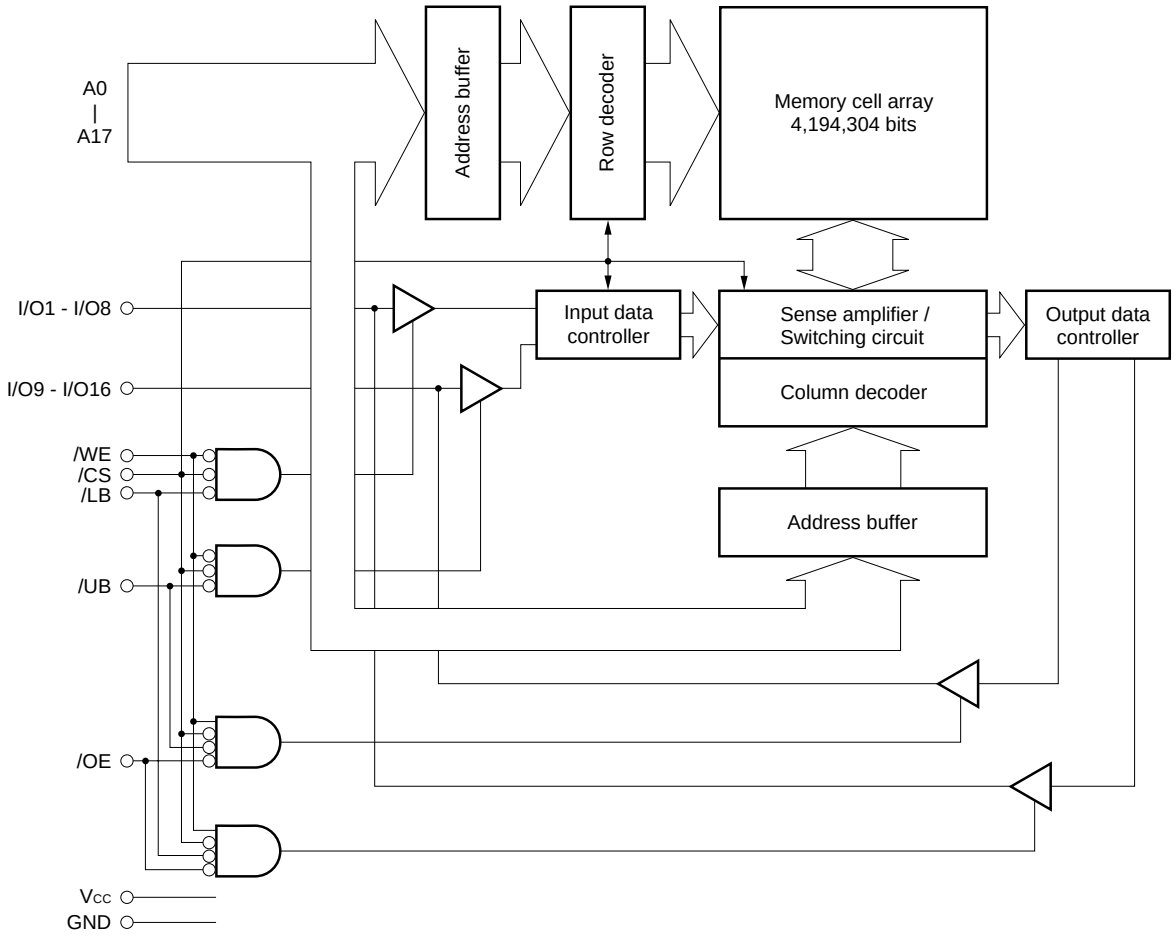
[μPD444016G5-xx-7JF]



A0 - A17	:	Address Inputs
I/O1 - I/O16	:	Data Inputs / Outputs
/CS	:	Chip Select
/WE	:	Write Enable
/OE	:	Output Enable
/LB, /UB	:	Byte data select
VCC	:	Power supply
GND	:	Ground
NC	:	No connection

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

Block Diagram



Truth Table

/CS	/OE	/WE	/LB	/UB	Mode	I/O		Supply current
						I/O1 - I/O8	I/O9 - I/O16	
H	×	×	×	×	Not selected	High impedance	High impedance	I_{SB}
L	L	H	L	L	Read	D_{OUT}	D_{OUT}	I_{CC}
			L	H		D_{OUT}	High impedance	
			H	L		High impedance	D_{OUT}	
L	×	L	L	L	Write	D_{IN}	D_{IN}	
			L	H		D_{IN}	High impedance	
			H	L		High impedance	D_{IN}	
L	H	H	×	×	Output disable	High impedance	High impedance	
L	×	×	H	H		High impedance	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} or /LB = V_{IH} or /UB = V_{IH}		–2		+2	μA
Operating supply current	I_{CC}	/CS = V_{IL},	Cycle time : 8 ns			220	mA
		$I_{I/O}$ = 0 mA,	Cycle time : 10 ns			200	
		Minimum cycle time	Cycle time : 12 ns			190	
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

Remarks 1. V_{IN} : Input voltage

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

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

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

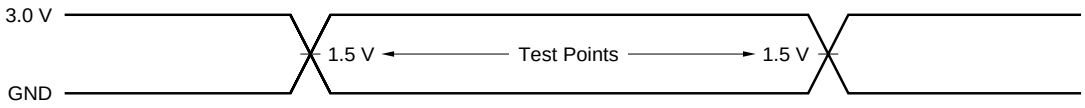
$V_{I/O}$: Input / Output voltage

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

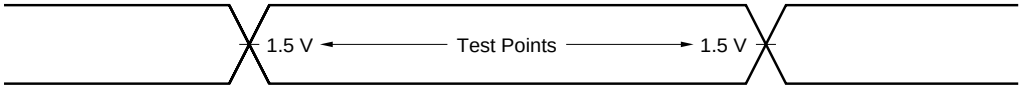
AC Characteristics (Recommended Operating Conditions Unless Otherwise Noted)

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_{ABD}, t_{OH})

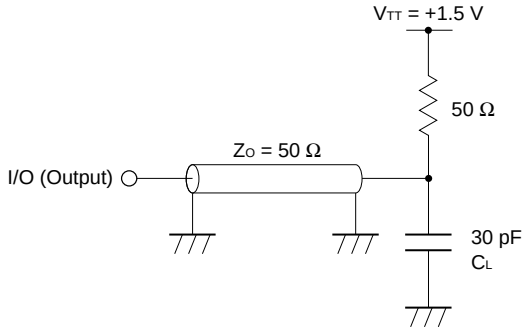
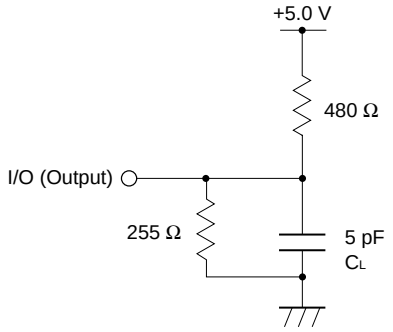


Figure 2

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



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

Read Cycle

Parameter	Symbol	μPD444016-8		μPD444016-10		μPD444016-12		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	
/LB, /UB access time	t_{ABD}		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	
/LB, /UB to output in low impedance	t_{BLZ}	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	
/LB, /UB to output hold in high impedance	t_{BHZ}		4		5		6	ns	

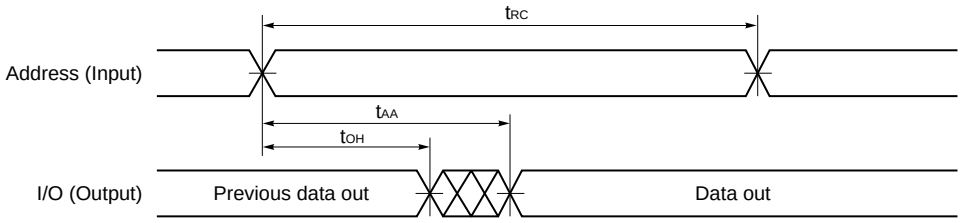
Notes 1. See the output load shown in **Figure 1**.

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.

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

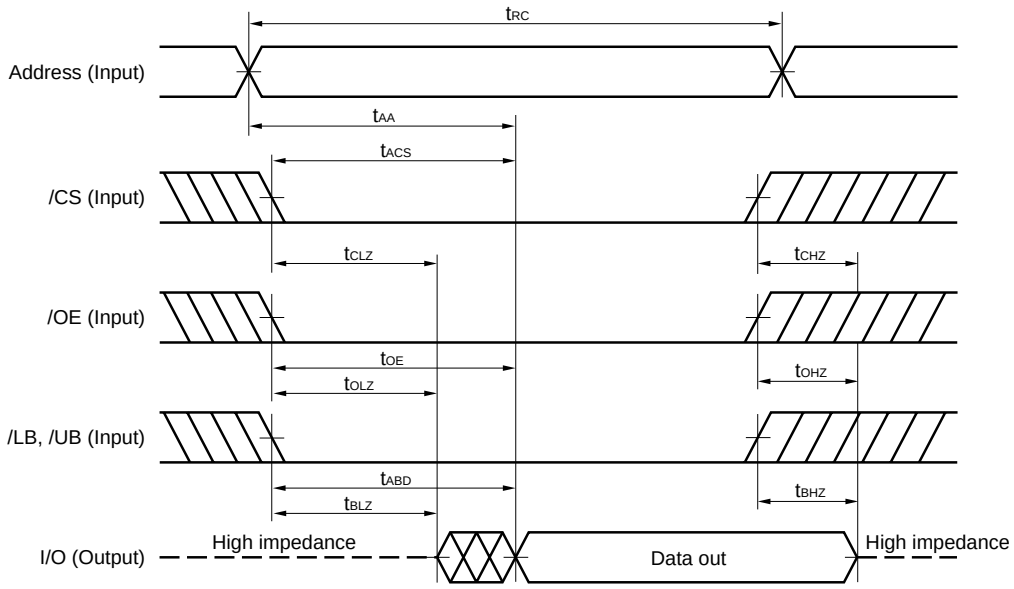
Read Cycle Timing Chart 1 (Address Access)



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

2. /CS = /OE = /LB (or /UB) = 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

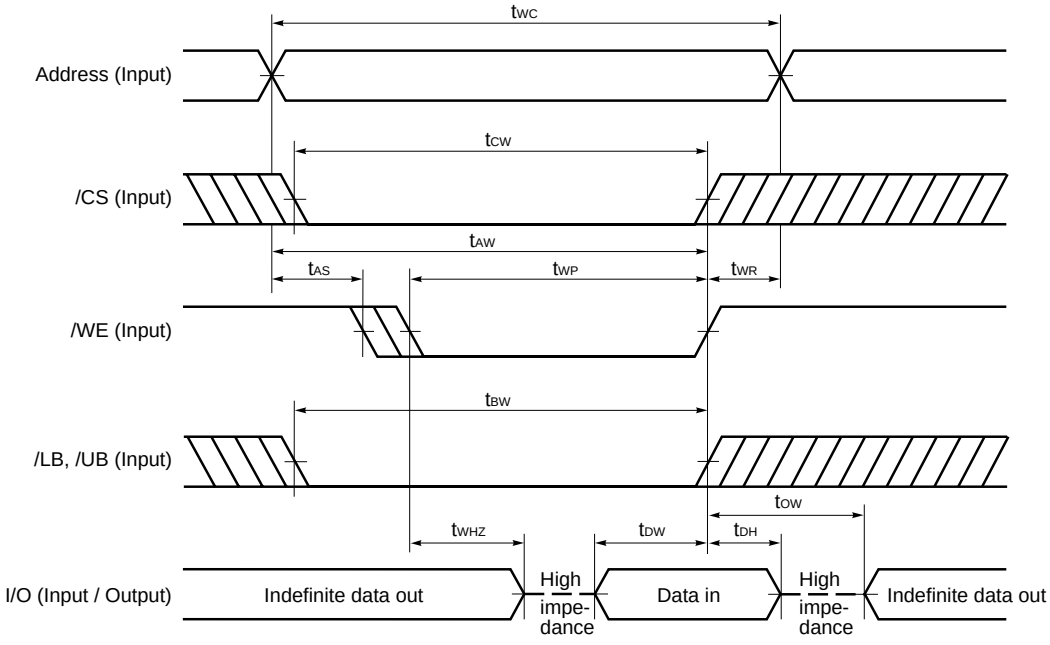
Parameter	Symbol	μPD444016-8		μPD444016-10		μPD444016-12		Unit	Notes
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Write cycle time	t_{WC}	8		10		12		ns	
/CS to end of write	t_{CW}	6		7		8		ns	
Address valid to end of write	t_{AW}	6		7		8		ns	
Write pulse width	t_{WP}	6		7		8		ns	
/LB, /UB to end of write	t_{BW}	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.

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

Write Cycle Timing Chart 1 (/WE Controlled)



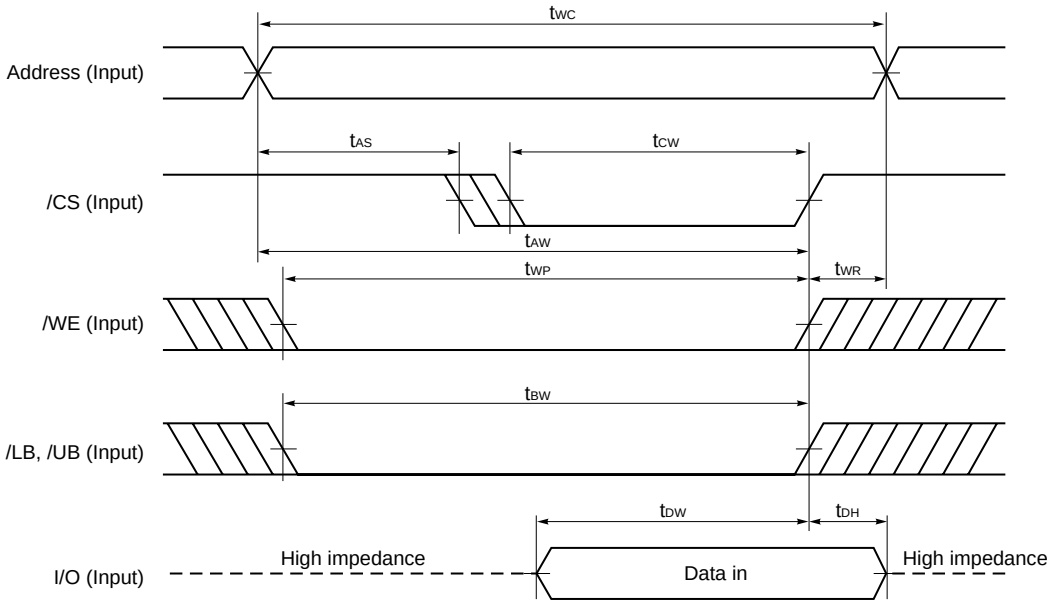
Cautions 1. /CS or /WE should be fixed to high level during address transition.

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, a low level /WE and a low level /LB (or low level /UB).

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)

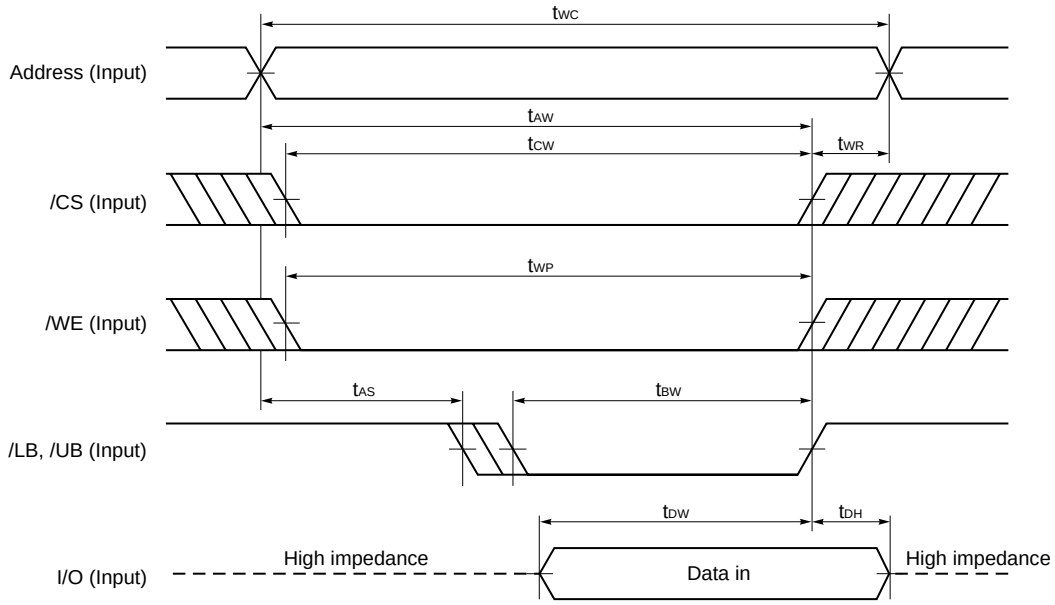


Cautions 1. /CS or /WE should be fixed to high level during address transition.

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, a low level /WE and a low level /LB (or low level /UB).

Write Cycle Timing Chart 3 (/LB, /UB Controlled)



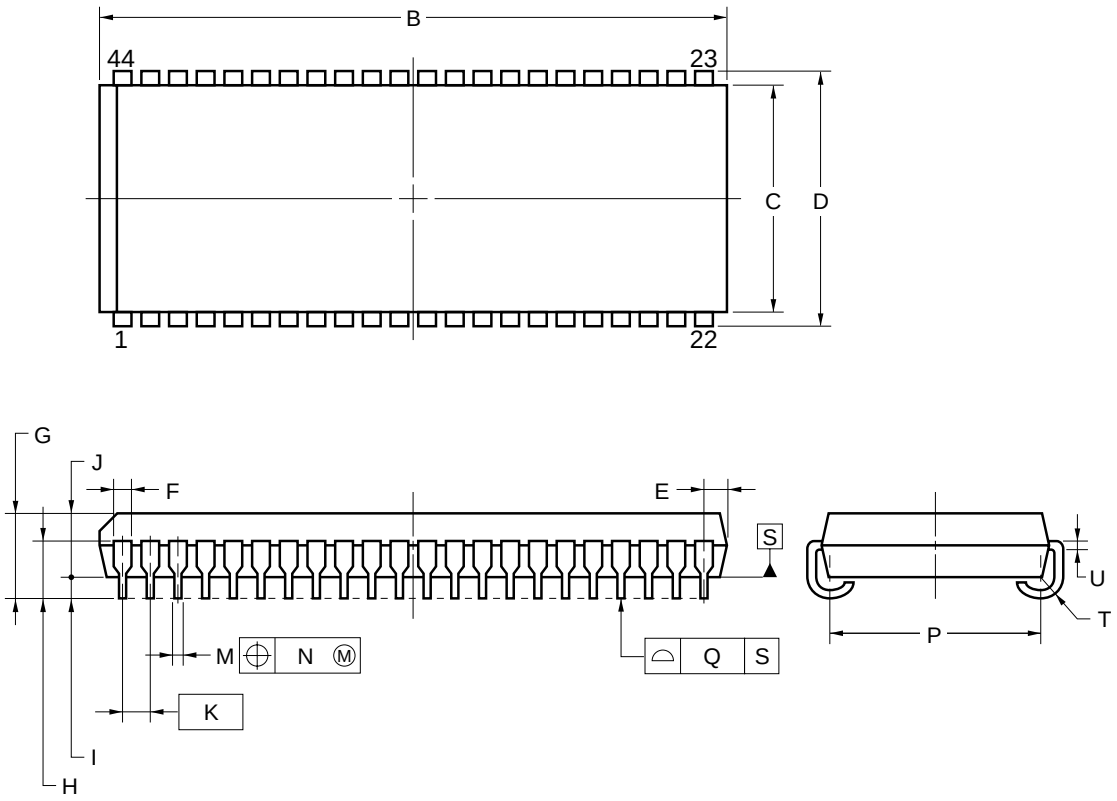
Cautions 1. /CS or /WE should be fixed to high level during address transition.

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, a low level /WE and a low level /LB (or low level /UB).

Package Drawings

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



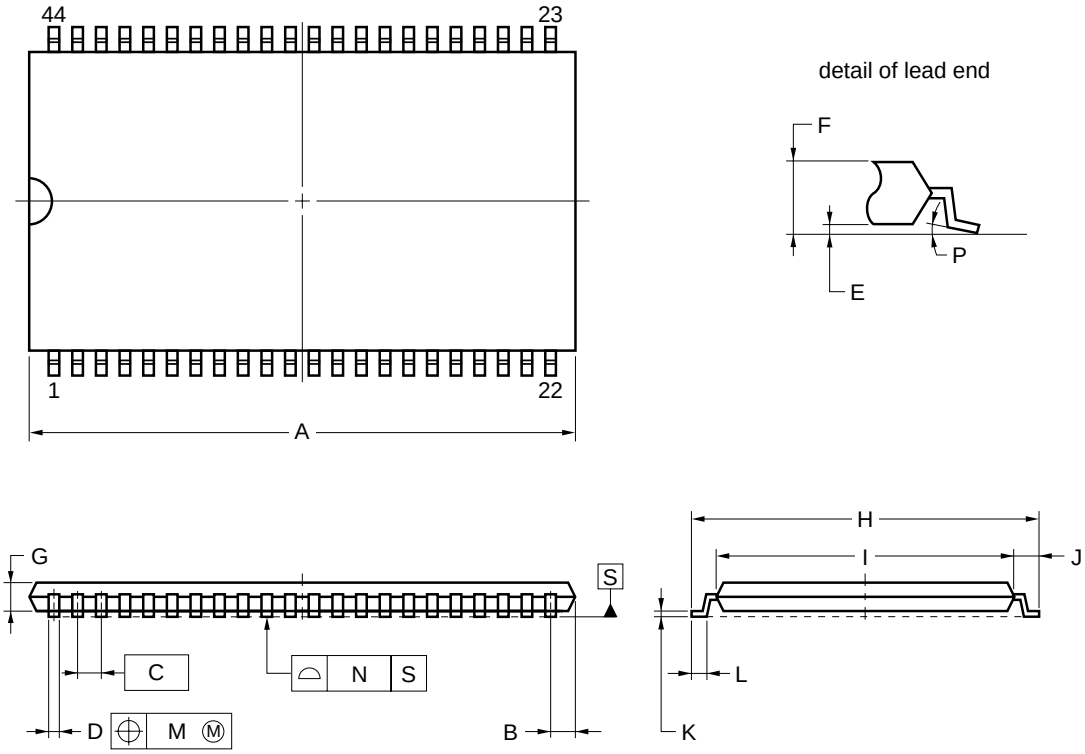
NOTE

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

ITEM	MILLIMETERS
B	$28.73^{+0.20}_{-0.35}$
C	10.16
D	11.18±0.20
E	1.03±0.15
F	0.74
G	3.5±0.2
H	2.3±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	0.10
T	R 0.85
U	$0.20^{+0.10}_{-0.05}$

P44LE-400A-1

44-PIN PLASTIC TSOP (II) (10.16 mm (400))



NOTE

Each lead centerline is located within 0.13 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	18.63 MAX.
B	0.93 MAX.
C	0.8 (T.P.)
D	$0.32^{+0.08}_{-0.07}$
E	0.1±0.05
F	1.2 MAX.
G	0.97
H	11.76±0.2
I	10.16±0.1
J	0.8±0.2
K	$0.145^{+0.025}_{-0.015}$
L	0.5±0.1
M	0.13
N	0.10
P	$3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$

S44G5-80-7JF5-1

Recommended Soldering Conditions

Please consult with our sales offices for soldering conditions of the μPD444016.

Types of Surface Mount Device

μPD444016LE	: 44-pin plastic SOJ (10.16 mm (400))
μPD444016G5-7JF	: 44-pin plastic TSOP (II) (10.16 mm (400)) (Normal 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 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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