To our customers,

Old Company Name in Catalogs and Other Documents

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Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

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DATA SHEET

NEC

MOS INTEGRATED CIRCUIT

μPD431000A-X

1M-BIT CMOS STATIC RAM
128K-WORD BY 8-BIT
EXTENDED TEMPERATURE OPERATION

Description

The μPD431000A-X is a high speed, low power, and 1,048,576 bits (131,072 words by 8 bits) CMOS static RAM.

The μPD431000A-X has two chip enable pins (/CE1, CE2) to extend the capacity. And battery backup is available. In addition to this, A and B versions are low voltage operations.

The μPD431000A-X is packed in 32-pin PLASTIC SOP, 32-pin PLASTIC TSOP (I) (8 × 13.4 mm) and (8 × 20 mm).

Features

- 131,072 words by 8 bits organization
- Fast access time: 70, 85, 100, 120, 150 ns (MAX.)
- Low voltage operation (A version: V_{CC} = 3.0 to 5.5 V, B version: V_{CC} = 2.7 to 5.5 V)
- Operating ambient temperature: T_A = –25 to +85 °C
- Low V_{CC} data retention: 2.0 V (MIN.)
- 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.) Note1
μPD431000A-xxX	70, 85	4.5 to 5.5	–25 to +85	70	50	2.5
μPD431000A-AxxX	70 Note2, 100	3.0 to 5.5		35 Note3	26 Note5	
μPD431000A-BxxX	70 Note2, 100, 120, 150	2.7 to 5.5		30 Note4	22 Note6	

Notes 1. $T_A \leq 40$ °C

2. V_{CC} = 4.5 to 5.5 V

3. 70 mA (V_{CC} > 3.6 V)

4. 70 mA (V_{CC} > 3.3 V)

5. 50 μA (V_{CC} > 3.6 V)

6. 50 μA (V_{CC} > 3.3 V)

Document No. M10430EJBV0DS00 (11th edition)
Date Published November 2008
Printed in Japan

Ordering Information

Part number	Package	Access time ns (MAX.)	Operating supply voltage V	Operating ambient temperature °C	Remark
μPD431000AGW-70X	32-pin PLASTIC SOP (13.34 mm (525))	70	4.5 to 5.5	–25 to +85	–
μPD431000AGZ-70X-KJH	32-pin PLASTIC TSOP (I) (8 × 20) (Normal bent)				
μPD431000AGZ-85X-KJH		85			
μPD431000AGZ-A10X-KJH		100	3.0 to 5.5		A version
μPD431000AGZ-B10X-KJH		100	2.7 to 5.5		B version
μPD431000AGZ-B12X-KJH		120			
μPD431000AGZ-B15X-KJH		150			
μPD431000AGU-B10X-9JH	32-pin PLASTIC TSOP (I) (8 × 13.4) (Normal bent)	100	2.7 to 5.5		B version
μPD431000AGU-B12X-9JH		120			
μPD431000AGU-B15X-9JH		150			
μPD431000AGW-70X-A	32-pin PLASTIC SOP (13.34 mm (525))	70	4.5 to 5.5		–
μPD431000AGZ-70X-KJH-A	32-pin PLASTIC TSOP (I) (8 × 20) (Normal bent)				
μPD431000AGZ-85X-KJH-A		85			
μPD431000AGZ-A10X-KJH-A		100	3.0 to 5.5		A version
μPD431000AGZ-B10X-KJH-A		100	2.7 to 5.5		B version
μPD431000AGZ-B12X-KJH-A		120			
μPD431000AGZ-B15X-KJH-A		150			
μPD431000AGU-B10X-9JH-A	32-pin PLASTIC TSOP (I) (8 × 13.4) (Normal bent)	100	2.7 to 5.5		B version
μPD431000AGU-B12X-9JH-A		120			
μPD431000AGU-B15X-9JH-A		150			

Remark Products with -A at the end of the part number are lead-free products.

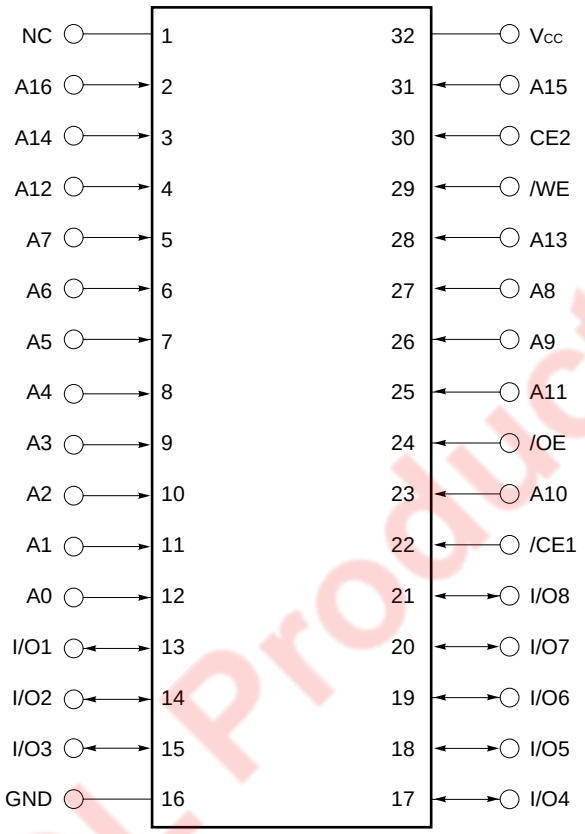
Pin Configurations (Marking Side)

/xxx indicates active low signal.

32-pin PLASTIC SOP (13.34 mm (525))

[μPD431000AGW-xxX]

[μPD431000AGW-xxX-A]



A0 - A16	:	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

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

32-pin PLASTIC TSOP (I) (8×20) (Normal bent)

[μPD431000AGZ-xxX-KJH]

[μPD431000AGZ-AxxX-KJH]

[μPD431000AGZ-BxxX-KJH]

[μPD431000AGZ-xxX-KJH-A]

[μPD431000AGZ-AxxX-KJH-A]

[μPD431000AGZ-BxxX-KJH-A]

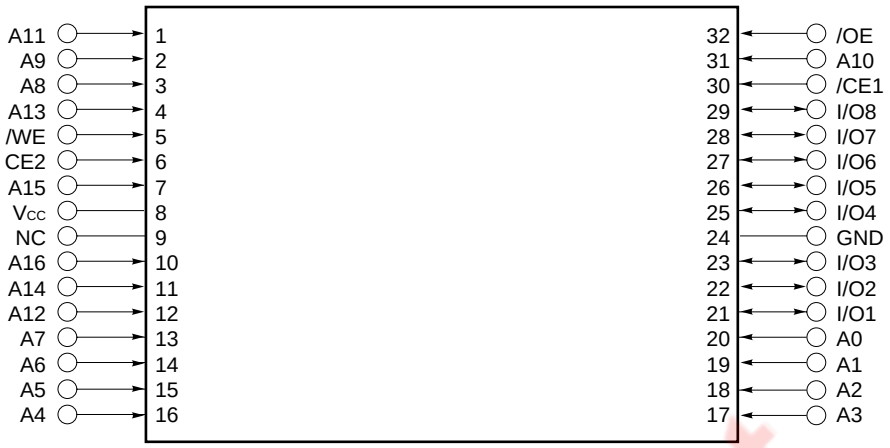
A0 - A16	: Address inputs	/OE	: Output Enable
I/O1 - I/O8	: Data inputs / outputs	Vcc	: Power supply
/CE1, CE2	: Chip Enable 1, 2	GND	: Ground
/WE	: Write Enable	NC	: No connection

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

32-pin PLASTIC TSOP (I) (8×13.4) (Normal bent)

[μPD431000AGU-BxxX-9JH]

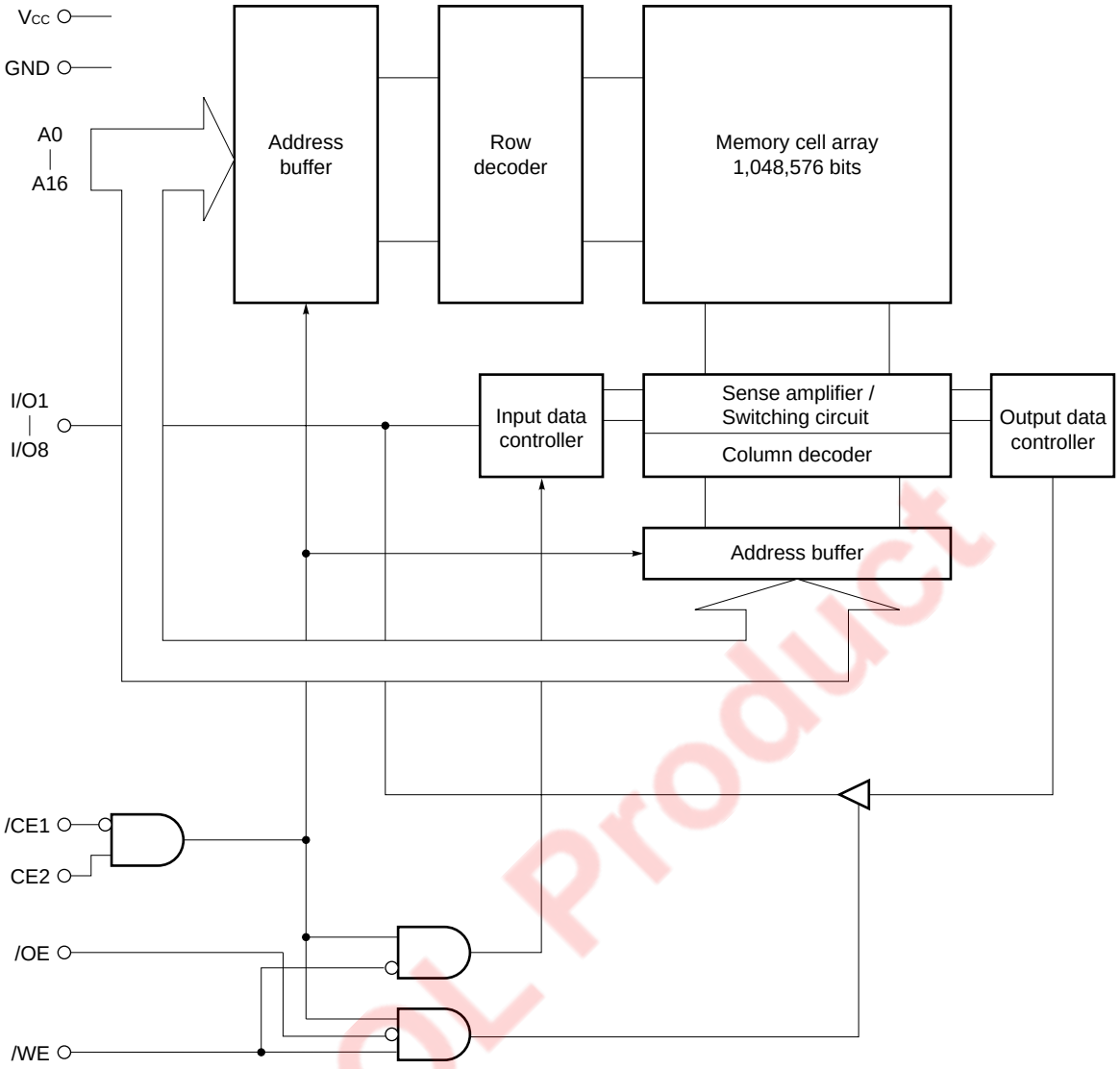
[μPD431000AGU-BxxX-9JH-A]



A0 - A16	:	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

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

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 × : V_{IH} or V_{IL}

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		–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	μPD431000A-xxX		μPD431000A-AxxX		μPD431000A-BxxX		Unit
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
Supply voltage	V_{CC}		4.5	5.5	3.0	5.5	2.7	5.5	V
High level input voltage	V_{IH}		2.4	V_{CC}+0.5	2.4	V_{CC}+0.5	2.4	V_{CC}+0.5	V
Low level input voltage	V_{IL}		–0.3 Note	+0.6	–0.3 Note	+0.5	–0.3 Note	+0.5	V
Operating ambient temperature	T_A		–25	+85	–25	+85	–25	+85	°C

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

Capacitance (T_A = 25 °C, f = 1 MHz)

Parameter	Symbol	Test conditions	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			10	pF

Remarks 1. V_{IN} : Input voltage

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

2. These parameters are not 100% tested.

DC Characteristics (Recommended Operating Conditions Unless Otherwise Noted)

Parameter	Symbol	Test condition		μPD431000A-xxX			μPD431000A-AxxX			μPD431000A-BxxX			Unit
				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	70		40	70		40	70	mA
		$I_{I/O}$ = 0 mA	$V_{CC} \leq 3.6$ V		–	–		15	35		–	–	
		Minimum cycle time	$V_{CC} \leq 3.3$ V			–			–		15	30	
	I_{CCA2}	/CE1 = V_{IL}, CE2 = V_{IH},				15			15			15	
		$I_{I/O}$ = 0 mA,	$V_{CC} \leq 3.6$ V			–			10			–	
		Cycle time = ∞	$V_{CC} \leq 3.3$ V			–			–			8	
	I_{CCA3}	/CE1 ≤ 0.2 V, CE2 ≥ V_{CC} – 0.2 V, Cycle time = 1 μs, $I_{I/O}$ = 0 mA,				10			10			10	
		$V_{IL} \leq 0.2$ V,	$V_{CC} \leq 3.6$ V			–			8			–	
		$V_{IH} \geq V_{CC}$ – 0.2 V	$V_{CC} \leq 3.3$ V			–			–			7	
Standby supply current	I_{SB}	/CE1 = V_{IH} or CE2 = V_{IL}				3			3			3	mA
			$V_{CC} \leq 3.6$ V			–			2			–	
			$V_{CC} \leq 3.3$ V			–			–			2	
	I_{SB1}	/CE1 ≥ V_{CC} – 0.2 V,			1	50		–	50		–	50	μA
		CE2 ≥ V_{CC} – 0.2 V	$V_{CC} \leq 3.6$ V		–	–		0.5	26		–	–	
			$V_{CC} \leq 3.3$ V		–	–		–	–		0.5	22	
	I_{SB2}	CE2 ≤ 0.2 V			1	50		–	50		–	50	
			$V_{CC} \leq 3.6$ V		–	–		0.5	26		–	–	
			$V_{CC} \leq 3.3$ V		–	–		–	–		0.5	22	
High level output voltage	V_{OH}	I_{OH} = –1.0 mA, $V_{CC} \geq 4.5$ V		2.4			2.4			2.4			V
		I_{OH} = –0.5 mA		–			2.4			2.4			
Low level output voltage	V_{OL}	I_{OL} = 2.1 mA, $V_{CC} \geq 4.5$ V				0.4			0.4			0.4	V
		I_{OL} = 1.0 mA				–			0.4			0.4	

Remarks 1. V_{IN} : Input voltage

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

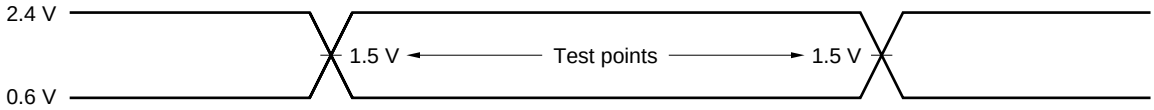
2. These DC characteristics are in common regardless product classification.

AC Characteristics (Recommended Operating Conditions Unless Otherwise Noted)

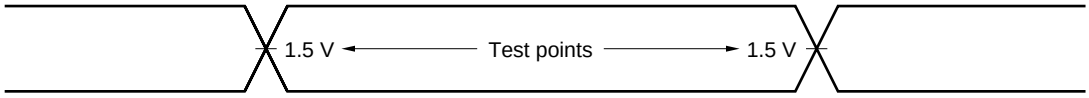
AC Test Conditions

[μPD431000A-70X, μPD431000A-85X]

Input Waveform (Rise and Fall Time ≤ 5 ns)



Output Waveform



Output Load

AC characteristics should be measured with the following output load conditions.

Figure 1

(t_{AA}, t_{CO1}, t_{CO2}, t_{OE}, t_{OH})

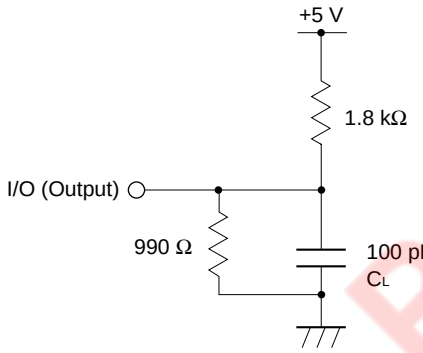
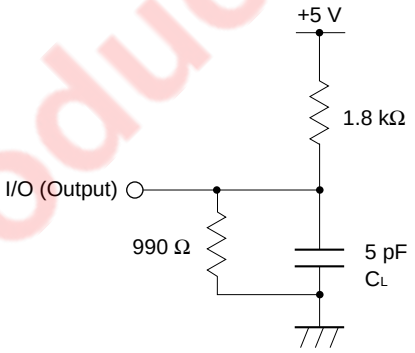


Figure 2

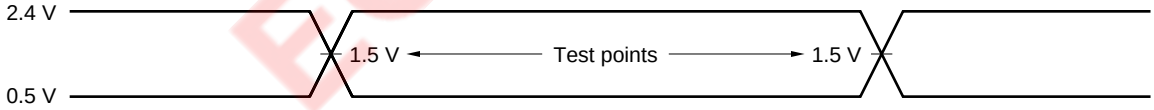
(t_{LZ1}, t_{LZ2}, t_{OLZ}, t_{HZ1}, t_{HZ2}, t_{OHZ}, t_{WHZ}, t_{OW})



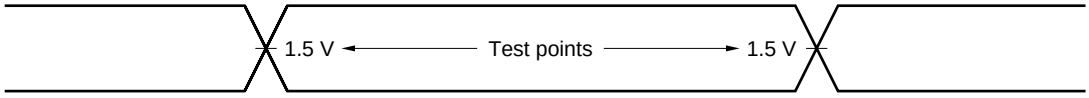
Remark C_L includes capacitance of the probe and jig, and stray capacitance.

[μPD431000A-A10X, μPD431000A-B10X, μPD431000A-B12X, μPD431000A-B15X]

Input Waveform (Rise and Fall Time ≤ 5 ns)



Output Waveform



Output Load

AC characteristics should be measured with the following output load conditions.

Part number	Output load condition	
	t_{AA}, t_{CO1}, t_{CO2}, t_{OE}, t_{OH}	t_{LZ1}, t_{LZ2}, t_{OLZ}, t_{HZ1}, t_{HZ2}, t_{OHZ}, t_{WHZ}, t_{OW}
μPD431000A-A10X, μPD431000A-B10X, μPD431000A-B12X	1TTL + 50 pF	1TTL + 5 pF
μPD431000A-B15X	1TTL + 100 pF	1TTL + 5 pF

Read Cycle (1/2)

Parameter	Symbol	$V_{CC} \geq 4.5$ V				$V_{CC} \geq 3.0$ V		Unit	Condition
		μPD431000A-70X μPD431000A-AxxX μPD431000A-BxxX		μPD431000A-85X		μPD431000A-A10X			
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Read cycle time	t_{RC}	70		85		100		ns	
Address access time	t_{AA}		70		85		100	ns	**Note**
/CE1 access time	t_{CO1}		70		85		100	ns	
CE2 access time	t_{CO2}		70		85		100	ns	
/OE to output valid	t_{OE}		35		45		50	ns	
Output hold from address change	t_{OH}	10		10		10		ns	
/CE1 to output in low impedance	t_{LZ1}	10		10		10		ns	
CE2 to output in low impedance	t_{LZ2}	10		10		10		ns	
/OE to output in low impedance	t_{OLZ}	5		5		5		ns	
/CE1 to output in high impedance	t_{HZ1}		25		30		35	ns	
CE2 to output in high impedance	t_{HZ2}		25		30		35	ns	
/OE to output in high impedance	t_{OHZ}		25		30		35	ns	

Note See the **output load**.

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

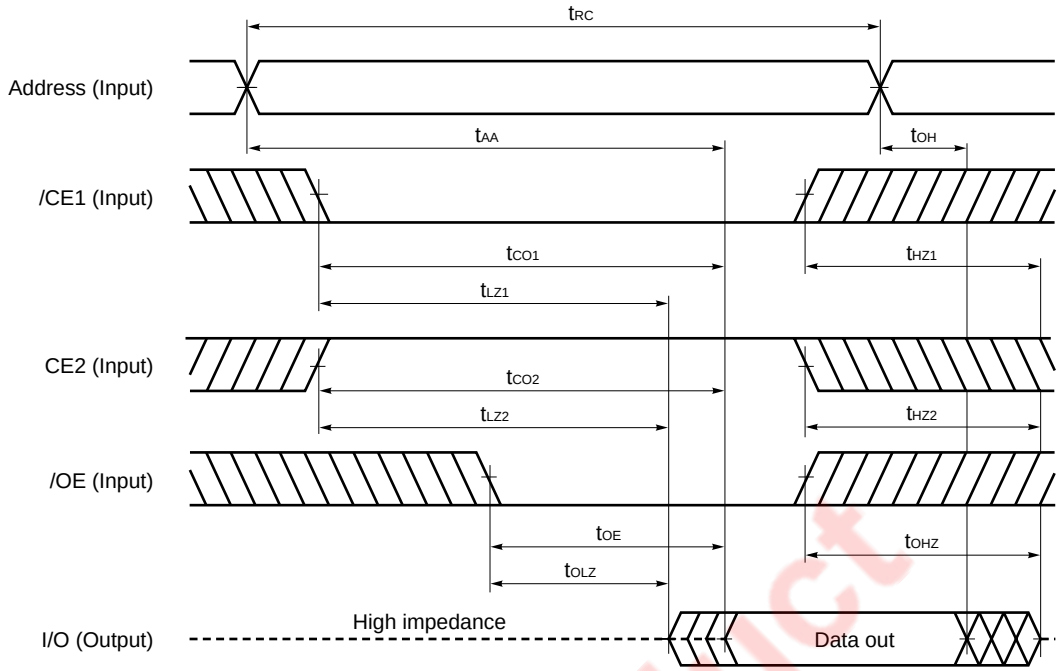
Read Cycle (2/2)

Parameter	Symbol	$V_{CC} \geq 2.7$ V						Unit	Condition
		μPD431000A-B10X		μPD431000A-B12X		μPD431000A-B15X			
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Read cycle time	t_{RC}	100		120		150		ns	
Address access time	t_{AA}		100		120		150	ns	**Note**
/CE1 access time	t_{CO1}		100		120		150	ns	
CE2 access time	t_{CO2}		100		120		150	ns	
/OE to output valid	t_{OE}		50		60		70	ns	
Output hold from address change	t_{OH}	10		10		10		ns	
/CE1 to output in low impedance	t_{LZ1}	10		10		10		ns	
CE2 to output in low impedance	t_{LZ2}	10		10		10		ns	
/OE to output in low impedance	t_{OLZ}	5		5		5		ns	
/CE1 to output in high impedance	t_{HZ1}		35		40		50	ns	
CE2 to output in high impedance	t_{HZ2}		35		40		50	ns	
/OE to output in high impedance	t_{OHZ}		35		40		50	ns	

Note See the **output load**.

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 (1/2)

Parameter	Symbol	$V_{CC} \geq 4.5$ V				$V_{CC} \geq 3.0$ V		Unit	Condition
		μPD431000A-70X μPD431000A-AxxX μPD431000A-BxxX		μPD431000A-85X		μPD431000A-A10X			
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Write cycle time	t_{WC}	70		85		100		ns	
/CE1 to end of write	t_{CW1}	55		70		80		ns	
CE2 to end of write	t_{CW2}	55		70		80		ns	
Address valid to end of write	t_{AW}	55		70		80		ns	
Address setup time	t_{AS}	0		0		0		ns	
Write pulse width	t_{WP}	50		60		60		ns	
Write recovery time	t_{WR}	5		5		0		ns	
Data valid to end of write	t_{DW}	35		35		60		ns	
Data hold time	t_{DH}	0		0		0		ns	
/WE to output in high impedance	t_{WHZ}		25		30		35	ns	**Note**
Output active from end of write	t_{OW}	5		5		5		ns	

Note See the **output load**.

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

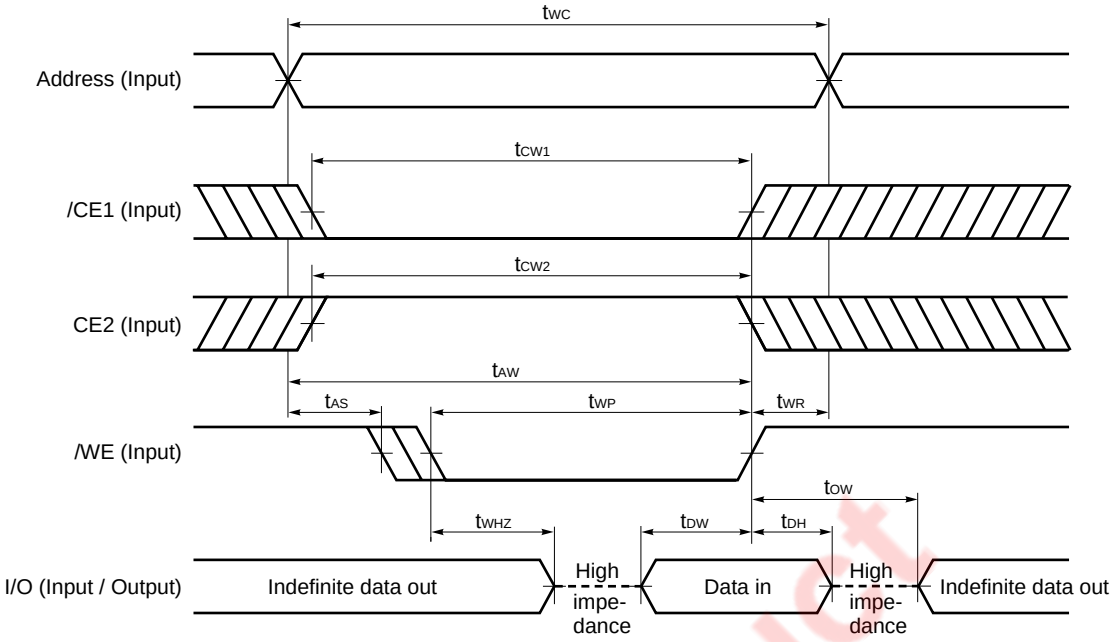
Write Cycle (2/2)

Parameter	Symbol	$V_{CC} \geq 2.7$						Unit	Condition
		μPD431000A-B10X		μPD431000A-B12X		μPD431000A-B15X			
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Write cycle time	t_{WC}	100		120		150		ns	
/CE1 to end of write	t_{CW1}	80		100		120		ns	
CE2 to end of write	t_{CW2}	80		100		120		ns	
Address valid to end of write	t_{AW}	80		100		120		ns	
Address setup time	t_{AS}	0		0		0		ns	
Write pulse width	t_{WP}	60		85		100		ns	
Write recovery time	t_{WR}	0		0		0		ns	
Data valid to end of write	t_{DW}	60		60		80		ns	
Data hold time	t_{DH}	0		0		0		ns	
/WE to output in high impedance	t_{WHZ}		35		40		50	ns	**Note**
Output active from end of write	t_{OW}	5		5		5		ns	

Note See the **output load**.

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.

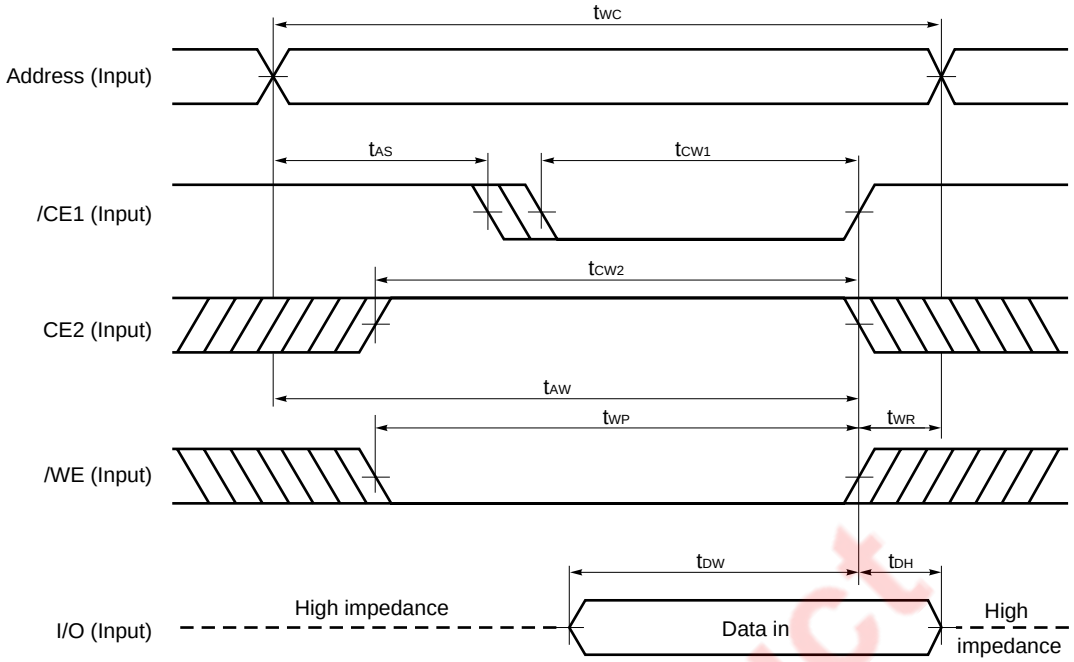
2. Do not input data to the I/O pins while they are in the output state.

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

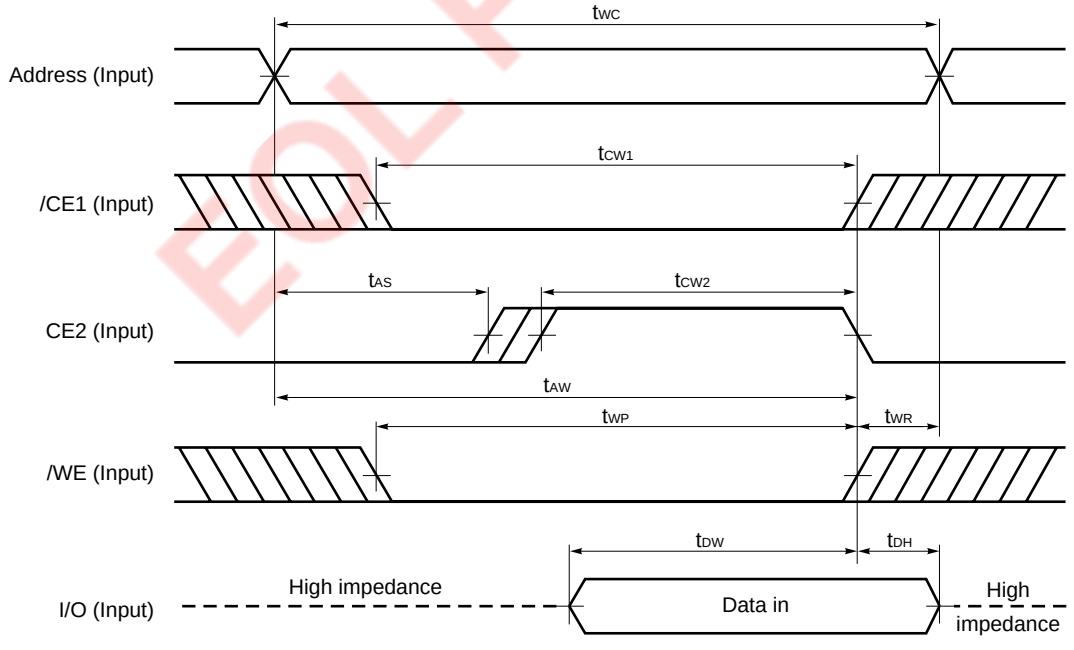


Cautions 1. During address transition, at least one of pins /CE1, CE2, /WE should be inactivated.

2. 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 /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. 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 /CE1, /WE and a high level CE2.

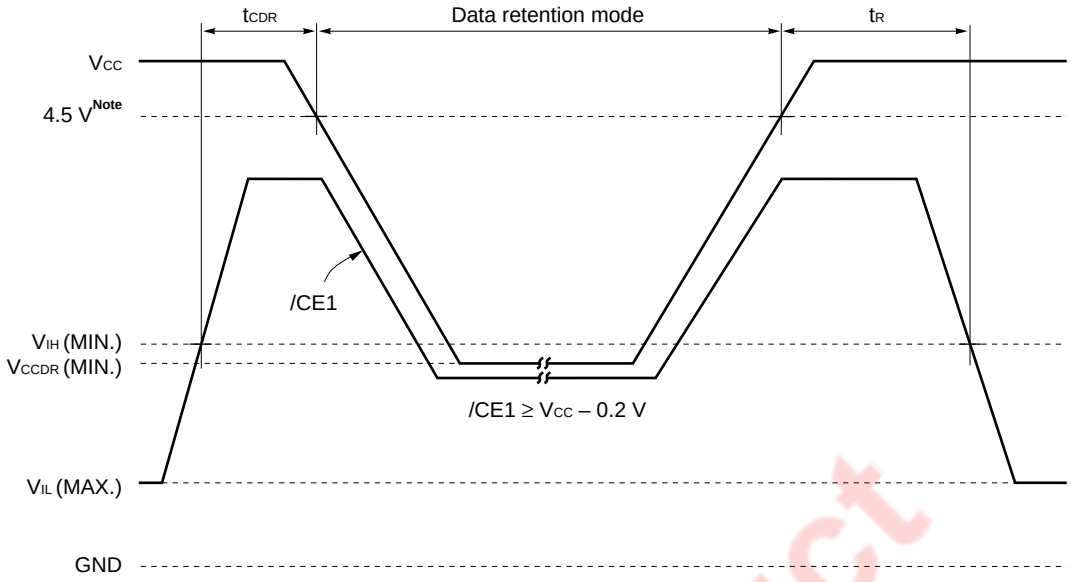
Low V_{CC} Data Retention Characteristics (T_A = –25 to +85 °C)

Parameter	Symbol	Test Condition	μPD431000A-xxX μPD431000A-AxxX μPD431000A-BxxX			Unit
			MIN.	TYP.	MAX.	
Data retention supply voltage	V_{CCDR1}	/CE1 ≥ V_{CC} – 0.2 V, CE2 ≥ V_{CC} – 0.2 V	2.0		5.5	V
	V_{CCDR2}	CE2 ≤ 0.2 V	2.0		5.5	
Data retention supply current	I_{CCDR1}	V_{CC} = 3.0 V, /CE1 ≥ V_{CC} – 0.2 V, CE2 ≥ V_{CC} – 0.2 V		0.5	20 Note	μA
	I_{CCDR2}	V_{CC} = 3.0 V, CE2 ≤ 0.2 V		0.5	20 Note	
Chip deselection to data retention mode	t_{CDR}		0			ns
Operation recovery time	t_R		5			ms

Note 2.5 μA (T_A ≤ 40 °C)

Data Retention Timing Chart

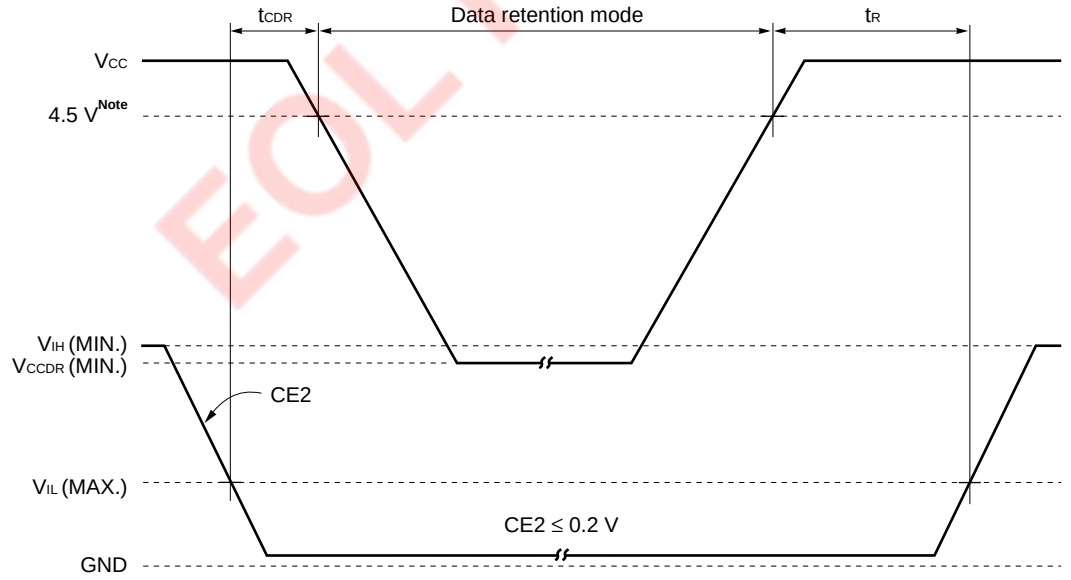
(1) /CE1 Controlled



Note A version : 3.0 V, B version : 2.7 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

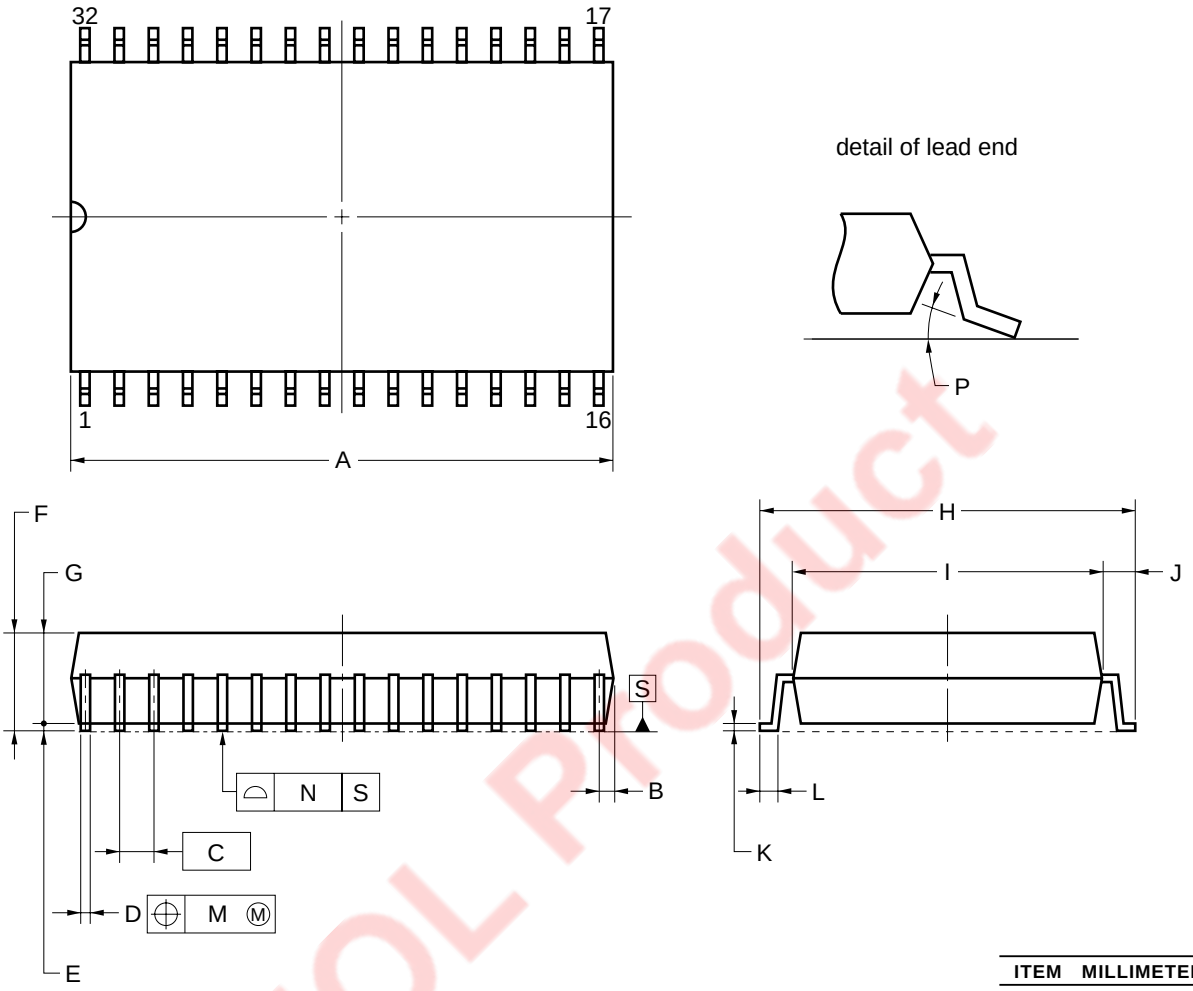


Note A version : 3.0 V, B version : 2.7 V

Remark On the data retention mode by controlling CE2, the other pins (/CE1, Address, I/O, /WE, /OE) can be in high impedance state.

Package Drawings

32-PIN PLASTIC SOP (13.34 mm (525))



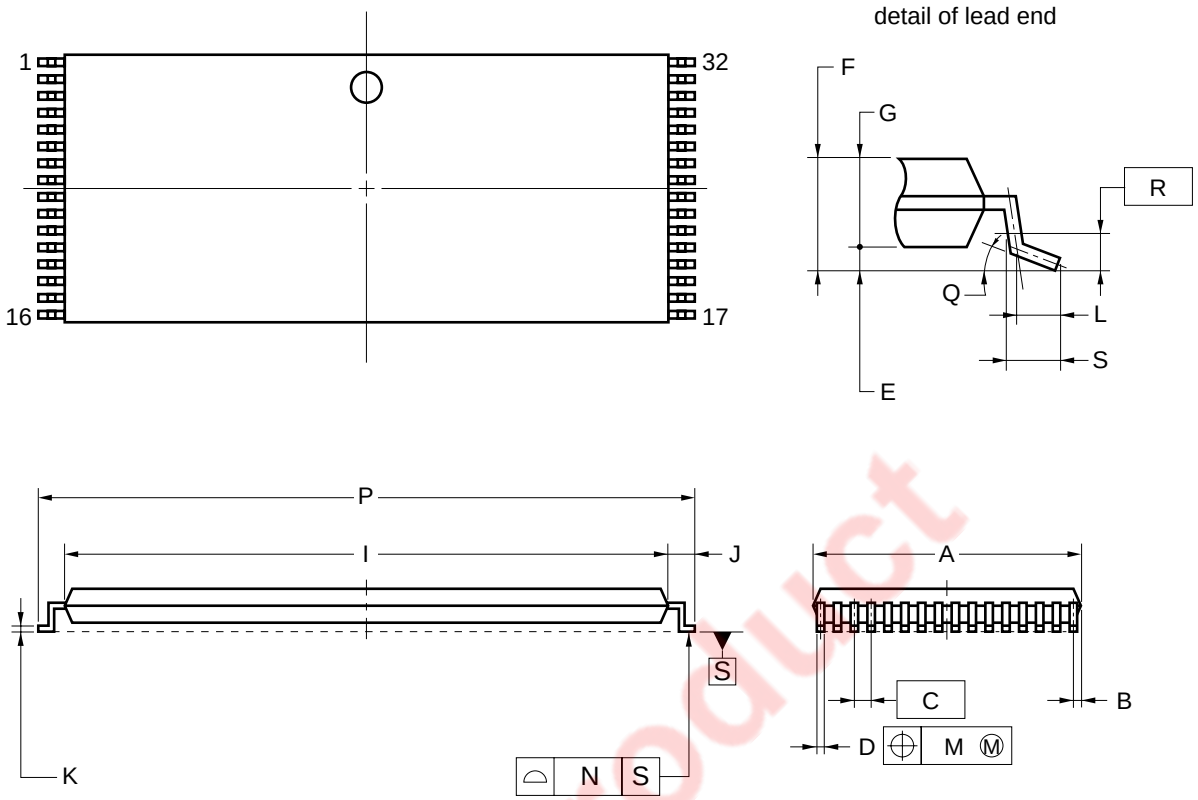
NOTE

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

ITEM	MILLIMETERS
A	20.61 MAX.
B	0.78 MAX.
C	1.27 (T.P.)
D	$0.40^{+0.10}_{-0.05}$
E	0.15±0.05
F	2.95 MAX.
G	2.7
H	14.1±0.3
I	11.3
J	1.4±0.2
K	$0.20^{+0.10}_{-0.05}$
L	0.8±0.2
M	0.12
N	0.10
P	$3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$

P32GW-50-525A-1

32-PIN PLASTIC TSOP(I) (8x20)



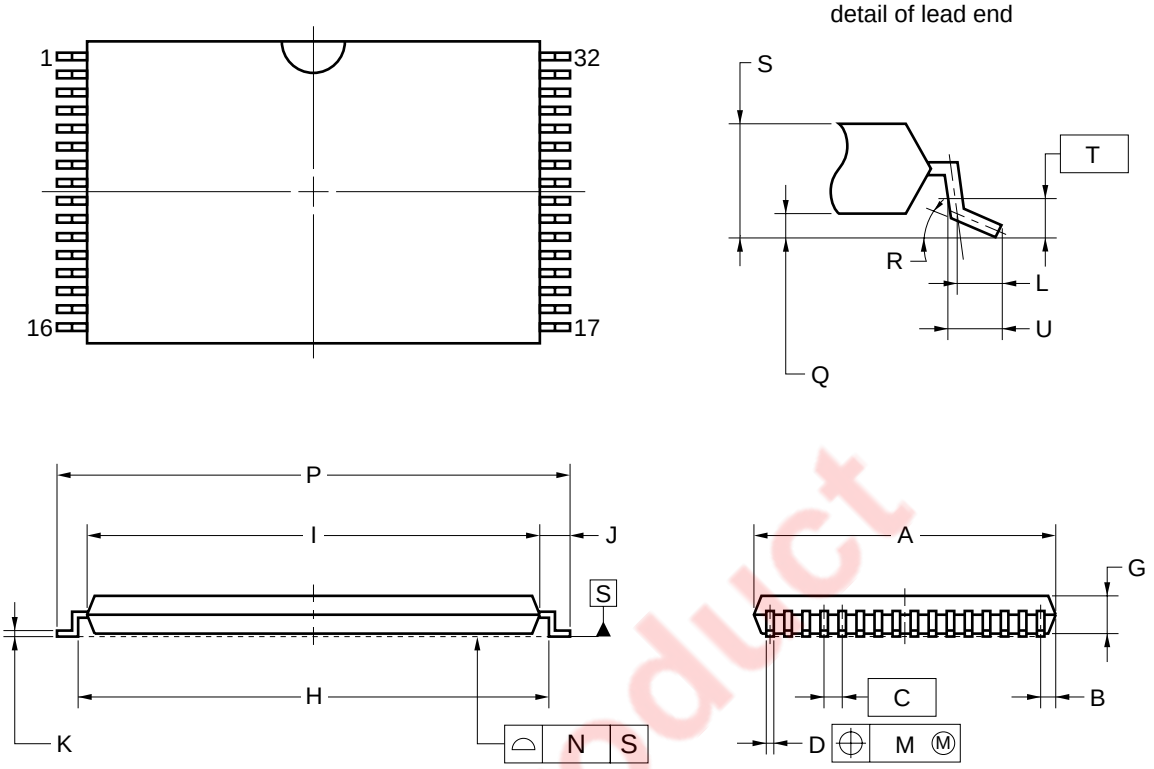
NOTES

1. Each lead centerline is located within 0.10 mm of its true position (T.P.) at maximum material condition.
2. "A" excludes mold flash. (Includes mold flash : 8.3 mm MAX.)

ITEM	MILLIMETERS
A	8.0±0.1
B	0.45 MAX.
C	0.5 (T.P.)
D	0.22±0.05
E	0.1±0.05
F	1.2 MAX.
G	0.97±0.08
I	18.4±0.1
J	0.8±0.2
K	0.145±0.05
L	0.5
M	0.10
N	0.10
P	20.0±0.2
Q	$3^{\circ}{}^{+5^{\circ}}_{-3^{\circ}}$
R	0.25
S	0.60±0.15

S32GZ-50-KJH1-2

32-PIN PLASTIC TSOP(I) (8x13.4)



NOTES

1. Each lead centerline is located within 0.08 mm of its true position (T.P.) at maximum material condition.

2. "A" excludes mold flash. (Includes mold flash : 8.3 mm MAX.)

ITEM	MILLIMETERS
A	8.0±0.1
B	0.45 MAX.
C	0.5 (T.P.)
D	0.22±0.05
G	1.0±0.05
H	12.4±0.2
I	11.8±0.1
J	0.8±0.2
K	$0.145^{+0.025}_{-0.015}$
L	0.5
M	0.08
N	0.08
P	13.4±0.2
Q	0.1±0.05
R	$3^{\circ}{}^{+5^{\circ}}_{-3^{\circ}}$
S	1.2 MAX.
T	0.25
U	0.6±0.15

P32GU-50-9JH-2

Recommended Soldering Conditions

Please consult with our sales offices for soldering conditions of the μPD431000A-X.

Types of Surface Mount Device

μPD431000AGW-xxX : 32-pin PLASTIC SOP (13.34 mm (525))
μPD431000AGZ-xxX-KJH : 32-pin PLASTIC TSOP (I) (8×20) (Normal bent)
μPD431000AGZ-AxxX-KJH : 32-pin PLASTIC TSOP (I) (8×20) (Normal bent)
μPD431000AGZ-BxxX-KJH : 32-pin PLASTIC TSOP (I) (8×20) (Normal bent)
μPD431000AGU-BxxX-9JH : 32-pin PLASTIC TSOP (I) (8×13.4) (Normal bent)
μPD431000AGW-xxX-A : 32-pin PLASTIC SOP (13.34 mm (525))
μPD431000AGZ-xxX-KJH-A : 32-pin PLASTIC TSOP (I) (8×20) (Normal bent)
μPD431000AGZ-AxxX-KJH-A : 32-pin PLASTIC TSOP (I) (8×20) (Normal bent)
μPD431000AGZ-BxxX-KJH-A : 32-pin PLASTIC TSOP (I) (8×20) (Normal bent)
μPD431000AGU-BxxX-9JH-A : 32-pin PLASTIC TSOP (I) (8×13.4) (Normal bent)

Revision History

Edition/ Date	Page		Type of revision	Description
	This edition	Previous edition		
11th edition/ Nov. 2008	through	through	Modification	Ordering Information revised.

[MEMO]

NOTES FOR CMOS DEVICES

① VOLTAGE APPLICATION WAVEFORM AT INPUT PIN

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (MAX) and V_{IH} (MIN) due to noise, etc., the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (MAX) and V_{IH} (MIN).

② HANDLING OF UNUSED INPUT PINS

Unconnected CMOS device inputs can be cause of malfunction. If an input pin is unconnected, it is possible that an internal input level may be generated due to noise, etc., causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using pull-up or pull-down circuitry. Each unused pin should be connected to V_{DD} or GND via a resistor if there is a possibility that it will be an output pin. All handling related to unused pins must be judged separately for each device and according to related specifications governing the device.

③ PRECAUTION AGAINST ESD

A 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 when it has occurred. Environmental control must be adequate. When it is dry, a humidifier should be used. It is recommended to avoid using insulators that easily build up 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 benches and floors should be grounded. The operator should be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with mounted semiconductor devices.

④ STATUS BEFORE INITIALIZATION

Power-on does not necessarily define the initial status of a MOS device. Immediately after the power source is turned ON, devices with reset functions have not yet been initialized. Hence, power-on does not guarantee output pin levels, I/O settings or contents of registers. A device is not initialized until the reset signal is received. A reset operation must be executed immediately after power-on for devices with reset functions.

⑤ POWER ON/OFF SEQUENCE

In the case of a device that uses different power supplies for the internal operation and external interface, as a rule, switch on the external power supply after switching on the internal power supply. When switching the power supply off, as a rule, switch off the external power supply and then the internal power supply. Use of the reverse power on/off sequences may result in the application of an overvoltage to the internal elements of the device, causing malfunction and degradation of internal elements due to the passage of an abnormal current.

The correct power on/off sequence must be judged separately for each device and according to related specifications governing the device.

⑥ INPUT OF SIGNAL DURING POWER OFF STATE

Do not input signals or an I/O pull-up power supply while the device is not powered. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements.

Input of signals during the power off state must be judged separately for each device and according to related specifications governing the device.

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