

MOS INTEGRATED CIRCUIT

μ PD42S4400, 424400

4 M-BIT DYNAMIC RAM

1 M-WORD BY 4-BIT, FAST PAGE MODE

Description

The μ PD42S4400, 424400 are 1,048,576 words by 4 bits CMOS dynamic RAMs. The fast page mode capability realize high speed access and low power consumption.

Besides, the μ PD42S4400 can execute $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh.

These are packaged in 26-pin plastic TSOP(II) and 26-pin plastic SOJ.

Features

- 1,048,576 words by 4 bits organization
- Single +5.0 V $\pm$ 10 % power supply
- Fast page mode
- Fast access and cycle time

Part number	Power consumption Active (MAX.)	Access time (MAX.)	R/W cycle time (MIN.)	Fast page mode cycle time (MIN.)
μ PD42S4400-60, 424400-60	495 mW	60 ns	120 ns	40 ns
μ PD42S4400-70, 424400-70	440 mW	70 ns	140 ns	45 ns
μ PD424400-80	440 mW	80 ns	160 ns	50 ns
μ PD424400-10	440 mW	100 ns	190 ns	60 ns

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- The μ PD42S4400 can execute $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh

Part number	Refresh cycle	Refresh	Power consumption at standby (MAX.)
μ PD42S4400	1,024 cycles/128 ms	$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh, $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh, $\overline{\text{RAS}}$ only refresh, Hidden refresh	0.825 mW (CMOS level input)
μ PD424400	1,024 cycles/16 ms	$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh, $\overline{\text{RAS}}$ only refresh, Hidden refresh	5.5 mW (CMOS level input)

- Multiplexed address inputs Row address: A0 - A9, Column address: A0 - A9

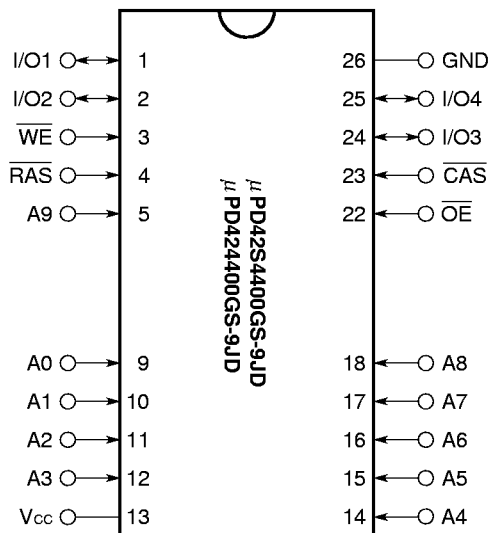
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Ordering Information

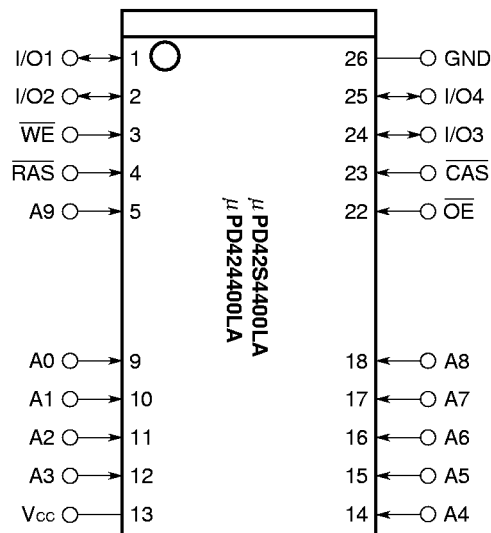
Part number	Access time (MAX.)	Package	Refresh
μ PD42S4400GS-60-9JD	60 ns	26-pin plastic TSOP (II) (300 mil)	$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh $\overline{\text{RAS}}$ only refresh Hidden refresh
μ PD42S4400GS-70-9JD	70 ns		
μ PD42S4400LA-60	60 ns	26-pin plastic SOJ (300 mil)	
μ PD42S4400LA-70	70 ns		
μ PD424400GS-60-9JD	60 ns	26-pin plastic TSOP (II) (300 mil)	$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh $\overline{\text{RAS}}$ only refresh Hidden refresh
μ PD424400GS-70-9JD	70 ns		
μ PD424400GS-80-9JD	80 ns		
μ PD424400GS-10-9JD	100 ns		
μ PD424400LA-60	60 ns	26-pin plastic SOJ (300 mil)	
μ PD424400LA-70	70 ns		
μ PD424400LA-80	80 ns		
μ PD424400LA-10	100 ns		

Pin Configurations (Marking Side)

26-pin Plastic TSOP (II) (300 mil)

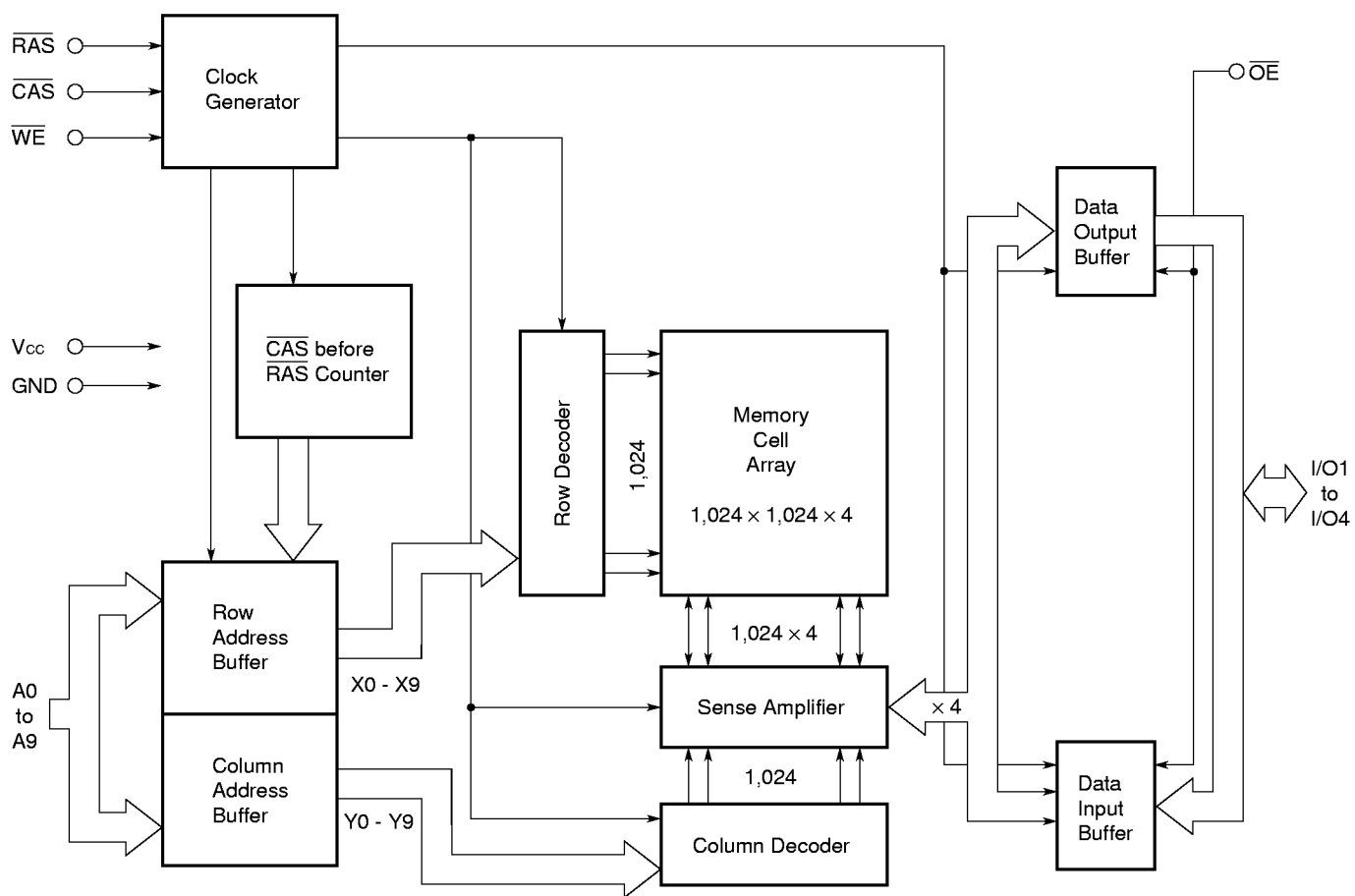


26-pin Plastic SOJ (300 mil)



A0 to A9 : Address Inputs
 I/O1 to I/O4 : Data Inputs/Outputs
 $\overline{RAS}$: Row Address Strobe
 $\overline{CAS}$: Column Address Strobe
 $\overline{WE}$: Write Enable
 $\overline{OE}$: Output Enable
 V_{CC} : Power Supply
 GND : Ground

Block Diagram



Input/Output Pin Functions

The μ PD42S4400, 424400 have input pins $\overline{\text{RAS}}$, $\overline{\text{CAS}}$, $\overline{\text{WE}}$, $\overline{\text{OE}}$, A0 to A9 and input/output pins I/O1 to I/O4.

Pin name	Input/Output	Function
$\overline{\text{RAS}}$ (Row address strobe)	Input	$\overline{\text{RAS}}$ activates the sense amplifier by latching a row address and selecting a corresponding word line. It refreshes memory cell array of one line selected by the row address. It also selects the following function. $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh
$\overline{\text{CAS}}$ (Column address strobe)	Input	$\overline{\text{CAS}}$ activates data input/output circuit by latching column address and selecting a digit line connected with the sense amplifier.
A0 to A9 (Address inputs)	Input	Address bus. Input total 20-bit of address signal, upper 10-bit and lower 10-bit in sequence (address multiplex method). Therefore, one word is selected from 1,048,576-word by 4-bit memory cell array. In actual operation, latch row address by specifying row address and activating $\overline{\text{RAS}}$. Then, switch the address bus to column address and activate $\overline{\text{CAS}}$. Each address is taken into the device when $\overline{\text{RAS}}$ and $\overline{\text{CAS}}$ are activated. Therefore, the address input setup time (t_{ASR}, t_{ASC}) and hold time (t_{RAH}, t_{CAH}) are specified for the activation of $\overline{\text{RAS}}$ and $\overline{\text{CAS}}$.
$\overline{\text{WE}}$ (Write enable)	Input	Write control signal. Write operation is executed by activating $\overline{\text{RAS}}$, $\overline{\text{CAS}}$ and $\overline{\text{WE}}$.
$\overline{\text{OE}}$ (Output enable)	Input	Read control signal. Read operation can be executed by activating $\overline{\text{RAS}}$, $\overline{\text{CAS}}$ and $\overline{\text{OE}}$. If $\overline{\text{WE}}$ is activated during read operation, $\overline{\text{OE}}$ is to be ineffective in the device. Therefore, read operation cannot be executed.
I/O1 to I/O4 (Data inputs/outputs)	Input/Output	4-bit data bus. I/O1 to I/O4 are used to input/output data.

Electrical Specifications

- All voltages are referenced to GND.
- After power up ($V_{CC} \geq V_{CC(MIN.)}$), wait more than 100 μ s ($\overline{RAS}$, $\overline{CAS}$ inactive) and then, execute eight $\overline{CAS}$ before $\overline{RAS}$ or $\overline{RAS}$ only refresh cycles as dummy cycles to initialize internal circuit.

Absolute Maximum Ratings

Parameter	Symbol	Condition	Rating	Unit
Voltage on any pin relative to GND	V_T		-1.0 to +7.0	V
Supply voltage	V_{CC}		-1.0 to +7.0	V
Output current	I_O		50	mA
Power dissipation	P_D		1	W
Operating ambient temperature	T_A		0 to +70	$^{\circ}$ C
Storage temperature	T_{stg}		-55 to +125	$^{\circ}$ C

Caution Exposing the device to stress above those listed in Absolute Maximum Ratings 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}		2.4		$V_{CC} + 1.0$	V
Low level input voltage	V_{IL}		-1.0		+0.8	V
Operating ambient temperature	T_A		0		70	$^{\circ}$ C

Capacitance ($T_A = 25^{\circ}$ C, $f = 1$ MHz)

Parameter	Symbol	Test condition	MIN.	TYP.	MAX.	Unit
Input capacitance	C_{I1}	Address			5	pF
	C_{I2}	$\overline{RAS}$, $\overline{CAS}$, $\overline{WE}$, $\overline{OE}$			7	
Data input/output capacitance	$C_{I/O}$	I/O			7	pF

DC Characteristics (Recommended operating conditions unless otherwise noted)

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Parameter		Symbol	Test condition		MIN.	MAX.	Unit	Notes
Operating current		I _{CC1}	$\overline{\text{RAS}}, \overline{\text{CAS}}$ cycling $t_{\text{RC}} = t_{\text{RC}}(\text{MIN.})$ $I_o = 0 \text{ mA}$	$t_{\text{RAC}} = 60 \text{ ns}$		90	mA	1, 2, 3
				$t_{\text{RAC}} = 70 \text{ ns}$		80		
				$t_{\text{RAC}} = 80 \text{ ns}$		80		
				$t_{\text{RAC}} = 100 \text{ ns}$		80		
Standby current	μ PD42S4400	I _{CC2}	$\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{\text{IH}}(\text{MIN.}), I_o = 0 \text{ mA}$			2.0	mA	
			$\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{\text{CC}} - 0.2 \text{ V}, I_o = 0 \text{ mA}$			0.15		
	μ PD424400		$\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{\text{IH}}(\text{MIN.}), I_o = 0 \text{ mA}$			2.0		
			$\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{\text{CC}} - 0.2 \text{ V}, I_o = 0 \text{ mA}$			1.0		
$\overline{\text{RAS}}$ only refresh current		I _{CC3}	$\overline{\text{RAS}}$ cycling, $\overline{\text{CAS}} \geq V_{\text{IH}}(\text{MIN.})$ $t_{\text{RC}} = t_{\text{RC}}(\text{MIN.}), I_o = 0 \text{ mA}$	$t_{\text{RAC}} = 60 \text{ ns}$		90	mA	1, 2, 3, 4
				$t_{\text{RAC}} = 70 \text{ ns}$		80		
				$t_{\text{RAC}} = 80 \text{ ns}$		80		
				$t_{\text{RAC}} = 100 \text{ ns}$		80		
Operating current (Fast page mode)		I _{CC4}	$\overline{\text{RAS}} \leq V_{\text{IL}}(\text{MAX.}), \overline{\text{CAS}}$ cycling $t_{\text{PC}} = t_{\text{PC}}(\text{MIN.}), I_o = 0 \text{ mA}$	$t_{\text{RAC}} = 60 \text{ ns}$		70	mA	1, 2, 5
				$t_{\text{RAC}} = 70 \text{ ns}$		60		
				$t_{\text{RAC}} = 80 \text{ ns}$		60		
				$t_{\text{RAC}} = 100 \text{ ns}$		60		
$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh current		I _{CC5}	$\overline{\text{RAS}}$ cycling $t_{\text{RC}} = t_{\text{RC}}(\text{MIN.})$ $I_o = 0 \text{ mA}$	$t_{\text{RAC}} = 60 \text{ ns}$		90	mA	1, 2
				$t_{\text{RAC}} = 70 \text{ ns}$		80		
				$t_{\text{RAC}} = 80 \text{ ns}$		80		
				$t_{\text{RAC}} = 100 \text{ ns}$		80		
$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ long refresh current (1,024 cycles / 128 ms, only for the μ PD42S4400)		I _{CC6}	$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh : $t_{\text{RC}} = 125.0 \mu\text{s}$ $\overline{\text{RAS}}, \overline{\text{CAS}}$: $V_{\text{CC}} - 0.2 \text{ V} \leq V_{\text{IH}} \leq V_{\text{IH}}(\text{MAX.})$ $0 \text{ V} \leq V_{\text{IL}} \leq 0.2 \text{ V}$ Standby : $\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{\text{CC}} - 0.2 \text{ V}$ Address : V_{IH} or V_{IL} $\overline{\text{WE}}, \overline{\text{OE}}: V_{\text{IH}}$ $I_o = 0 \text{ mA}$	$t_{\text{RAS}} \leq 200 \text{ ns}$		200	μA	1, 2
				$t_{\text{RAS}} \leq 1 \mu\text{s}$		300	μA	1, 2
$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh current (only for the μ PD42S4400)		I _{CC7}	$\overline{\text{RAS}}, \overline{\text{CAS}}$: $t_{\text{RASS}} = 5 \text{ ms}$ $V_{\text{CC}} - 0.2 \text{ V} \leq V_{\text{IH}} \leq V_{\text{IH}}(\text{MAX.})$ $0 \text{ V} \leq V_{\text{IL}} \leq 0.2 \text{ V}$ $I_o = 0 \text{ mA}$			150	μA	2
Input leakage current		I _{I(L)}	$V_i = 0 \text{ to } 5.5 \text{ V}$ All other pins not under test = 0 V		-10	+10	μA	
Output leakage current		I _{O(L)}	$V_o = 0 \text{ to } 5.5 \text{ V}$ Output is disabled (Hi-Z)		-10	+10	μA	
High level output voltage		V _{OH}	$I_o = -5.0 \text{ mA}$		2.4		V	
Low level output voltage		V _{OL}	$I_o = +4.2 \text{ mA}$			0.4	V	

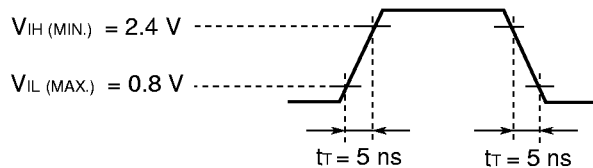
Notes 1. I_{CC1}, I_{CC3}, I_{CC4}, I_{CC5} and I_{CC6} depend on cycle rates (t_{RC} and t_{PC}).

2. Specified values are obtained with outputs unloaded.

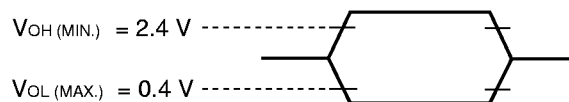
3. I_{CC1} and I_{CC3} are measured assuming that address can be changed once or less during $\overline{RAS} \leq V_{IL(MAX.)}$ and $\overline{CAS} \geq V_{IH(MIN.)}$.
4. I_{CC3} is measured assuming that all column address inputs are held at either high or low.
5. I_{CC4} is measured assuming that all column address inputs are switched only once during each fast page cycle.

AC Characteristics (Recommended Operating Conditions unless otherwise noted)**AC Characteristics Test Conditions**

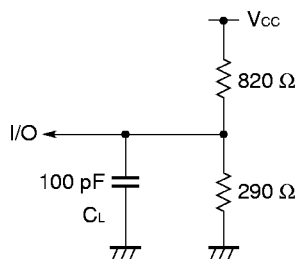
(1) Input timing specification



(2) Output timing specification



(3) Output load condition

**Common to Read, Write, Read Modify Write Cycle**

Parameter	Symbol	$t_{RAC} = 60 ns$		$t_{RAC} = 70 ns$		$t_{RAC} = 80 ns$		$t_{RAC} = 100 ns$		Unit	Notes
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Read / Write cycle time	t_{RC}	110	—	130	—	160	—	190	—	ns	
$\overline{RAS}$ precharge time	t_{RP}	40	—	50	—	70	—	80	—	ns	
$\overline{CAS}$ precharge time	t_{CPN}	10	—	10	—	10	—	10	—	ns	
$\overline{RAS}$ pulse width	t_{RAS}	60	10,000	70	10,000	80	10,000	100	10,000	ns	1
$\overline{CAS}$ pulse width	t_{CAS}	15	10,000	20	10,000	20	10,000	25	10,000	ns	
$\overline{RAS}$ hold time	t_{RSH}	15	—	20	—	20	—	25	—	ns	
$\overline{CAS}$ hold time	t_{CSH}	60	—	70	—	80	—	100	—	ns	
$\overline{RAS}$ to $\overline{CAS}$ delay time	t_{RCD}	20	45	20	50	25	60	25	75	ns	2
$\overline{RAS}$ to column address delay time	t_{RAD}	15	30	15	35	17	40	17	50	ns	2
$\overline{CAS}$ to $\overline{RAS}$ precharge time	t_{CRP}	10	—	10	—	10	—	10	—	ns	3
Row address setup time	t_{ASR}	0	—	0	—	0	—	0	—	ns	
Row address hold time	t_{RAH}	10	—	10	—	12	—	12	—	ns	
Column address setup time	t_{ASC}	0	—	0	—	0	—	0	—	ns	
Column address hold time	t_{CAH}	15	—	15	—	15	—	20	—	ns	
$\overline{OE}$ lead time referenced to $\overline{RAS}$	t_{OES}	0	—	0	—	0	—	0	—	ns	
$\overline{CAS}$ to data setup time	t_{CLZ}	0	—	0	—	0	—	0	—	ns	
$\overline{OE}$ to data setup time	t_{OLZ}	0	—	0	—	0	—	0	—	ns	
$\overline{OE}$ to data delay time	t_{OED}	15	—	15	—	20	—	25	—	ns	
Transition time (rise and fall)	t_T	3	50	3	50	3	50	3	50	ns	
Refresh time	μ PD42S4400	t_{REF}	—	128	—	128	—	—	—	ms	4
	μ PD424400		—	16	—	16	—	16	—	ms	

- ★ **Notes** 1. In $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh cycles, $t_{\text{RAS}}(\text{MAX.})$ is 100 μs . If $10\ \mu\text{s} < t_{\text{RAS}} < 100\ \mu\text{s}$, $\overline{\text{RAS}}$ precharge time for $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh (t_{RPS}) is applied.
2. For read cycles, access time is defined as follows:
- | Input conditions | Access time | Access time from $\overline{\text{RAS}}$ |
|---|-------------------------------|--|
| $t_{\text{RAD}} \leq t_{\text{RAD}}(\text{MAX.})$ and $t_{\text{RCD}} \leq t_{\text{RCD}}(\text{MAX.})$ | $t_{\text{RAC}}(\text{MAX.})$ | $t_{\text{RAC}}(\text{MAX.})$ |
| $t_{\text{RAD}} > t_{\text{RAD}}(\text{MAX.})$ and $t_{\text{RCD}} \leq t_{\text{RCD}}(\text{MAX.})$ | $t_{\text{AA}}(\text{MAX.})$ | $t_{\text{RAD}} + t_{\text{AA}}(\text{MAX.})$ |
| $t_{\text{RCD}} > t_{\text{RCD}}(\text{MAX.})$ | $t_{\text{CAC}}(\text{MAX.})$ | $t_{\text{RCD}} + t_{\text{CAC}}(\text{MAX.})$ |
- $t_{\text{RAD}}(\text{MAX.})$ and $t_{\text{RCD}}(\text{MAX.})$ are specified as reference points only ; they are not restrictive operating parameters. They are used to determine which access time (t_{RAC} , t_{AA} or t_{CAC}) is to be used for finding out when output data will be available. Therefore, the input conditions $t_{\text{RAD}} \geq t_{\text{RAD}}(\text{MAX.})$ and $t_{\text{RCD}} \geq t_{\text{RCD}}(\text{MAX.})$ will not cause any operation problems.
3. $t_{\text{CRP}}(\text{MIN.})$ requirement is applied to $\overline{\text{RAS}}$, $\overline{\text{CAS}}$ cycles.
4. This specification is applied only to the μ PD42S4400-60, 42S4400-70.

Read Cycle

Parameter	Symbol	$t_{\text{RAC}} = 60\ \text{ns}$		$t_{\text{RAC}} = 70\ \text{ns}$		$t_{\text{RAC}} = 80\ \text{ns}$		$t_{\text{RAC}} = 100\ \text{ns}$		Unit	Notes
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Access time from $\overline{\text{RAS}}$	t_{RAC}	—	60	—	70	—	80	—	100	ns	1
Access time from $\overline{\text{CAS}}$	t_{CAC}	—	15	—	20	—	20	—	25	ns	1
Access time from column address	t_{AA}	—	30	—	35	—	40	—	50	ns	1
Access time from $\overline{\text{OE}}$	t_{OEA}	—	15	—	20	—	20	—	25	ns	
Column address lead time referenced to $\overline{\text{RAS}}$	t_{RAL}	30	—	35	—	40	—	50	—	ns	
Read command setup time	t_{RCS}	0	—	0	—	0	—	0	—	ns	
Read command hold time referenced to $\overline{\text{RAS}}$	t_{RRH}	0	—	0	—	10	—	10	—	ns	2
Read command hold time referenced to $\overline{\text{CAS}}$	t_{RCH}	0	—	0	—	0	—	0	—	ns	2
Output buffer turn-off delay time from $\overline{\text{OE}}$	t_{OEZ}	0	15	0	15	0	20	0	25	ns	3
Output buffer turn-off delay time from $\overline{\text{CAS}}$	t_{OFF}	0	15	0	15	0	20	0	25	ns	3

- Notes** 1. For read cycles, access time is defined as follows:

Input conditions	Access time	Access time from $\overline{\text{RAS}}$
$t_{\text{RAD}} \leq t_{\text{RAD}}(\text{MAX.})$ and $t_{\text{RCD}} \leq t_{\text{RCD}}(\text{MAX.})$	$t_{\text{RAC}}(\text{MAX.})$	$t_{\text{RAC}}(\text{MAX.})$
$t_{\text{RAD}} > t_{\text{RAD}}(\text{MAX.})$ and $t_{\text{RCD}} \leq t_{\text{RCD}}(\text{MAX.})$	$t_{\text{AA}}(\text{MAX.})$	$t_{\text{RAD}} + t_{\text{AA}}(\text{MAX.})$
$t_{\text{RCD}} > t_{\text{RCD}}(\text{MAX.})$	$t_{\text{CAC}}(\text{MAX.})$	$t_{\text{RCD}} + t_{\text{CAC}}(\text{MAX.})$

$t_{\text{RAD}}(\text{MAX.})$ and $t_{\text{RCD}}(\text{MAX.})$ are specified as reference points only; they are not restrictive operating parameters. They are used to determine which access time (t_{RAC} , t_{AA} or t_{CAC}) is to be used for finding out when output data will be available. Therefore, the input conditions $t_{\text{RAD}} \geq t_{\text{RAD}}(\text{MAX.})$ and $t_{\text{RCD}} \geq t_{\text{RCD}}(\text{MAX.})$ will not cause any operation problems.

2. Either $t_{\text{RCH}}(\text{MIN.})$ or $t_{\text{RRH}}(\text{MIN.})$ should be met in read cycles.
3. $t_{\text{OFF}}(\text{MAX.})$ and $t_{\text{OEZ}}(\text{MAX.})$ define the time when the output achieves the condition of Hi-Z and is not referenced to V_{OH} or V_{OL} .

Write Cycle

Parameter	Symbol	t _{RAC} = 60 ns		t _{RAC} = 70 ns		t _{RAC} = 80 ns		t _{RAC} = 100 ns		Unit	Notes
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
$\overline{WE}$ hold time referenced to $\overline{CAS}$	t _{WCH}	15	—	15	—	15	—	20	—	ns	1
$\overline{WE}$ pulse width	t _{WP}	10	—	10	—	15	—	20	—	ns	1
$\overline{WE}$ lead time referenced to $\overline{RAS}$	t _{RWL}	15	—	20	—	20	—	25	—	ns	
$\overline{WE}$ lead time referenced to $\overline{CAS}$	t _{CWL}	15	—	15	—	15	—	20	—	ns	
$\overline{WE}$ setup time	t _{WCS}	0	—	0	—	0	—	0	—	ns	2
$\overline{OE}$ hold time	t _{OEH}	0	—	0	—	0	—	0	—	ns	
Data-in setup time	t _{DS}	0	—	0	—	0	—	0	—	ns	3
Data-in hold time	t _{DH}	15	—	15	—	15	—	20	—	ns	3

- Notes**
1. t_{WP} (MIN.) is applied to late write cycles or read modify write cycles. In early write cycles, t_{WCH} (MIN.) should be met.
 2. If t_{WCS} $\geq$ t_{WCS} (MIN.), the cycle is an early write cycle and the data out will remain Hi-Z through the entire cycle.
 3. t_{DS} (MIN.) and t_{DH} (MIN.) are referenced to the $\overline{CAS}$ falling edge in early write cycles. In late write cycles and read modify write cycles, they are referenced to the $\overline{WE}$ falling edge.

Read Modify Write Cycle

Parameter	Symbol	t _{RAC} = 60 ns		t _{RAC} = 70 ns		t _{RAC} = 80 ns		t _{RAC} = 100 ns		Unit	Note
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Read modify write cycle time	t _{RWC}	150	—	175	—	210	—	250	—	ns	
$\overline{RAS}$ to $\overline{WE}$ delay time	t _{RWD}	80	—	90	—	105	—	130	—	ns	1
$\overline{CAS}$ to $\overline{WE}$ delay time	t _{CWD}	35	—	40	—	45	—	55	—	ns	1
Column address to $\overline{WE}$ delay time	t _{AWD}	50	—	55	—	65	—	80	—	ns	1

- Note**
1. If t_{WCS} $\geq$ t_{WCS} (MIN.), the cycle is an early write cycle and the data out will remain Hi-Z through the entire cycle. If t_{RWD} $\geq$ t_{RWD} (MIN.), t_{CWD} $\geq$ t_{CWD} (MIN.), t_{AWD} $\geq$ t_{AWD} (MIN.) and t_{CPWD} $\geq$ t_{CPWD} (MIN.), the cycle is a read modify write cycle and the data out will contain data read from the selected cell. If neither of the above conditions is met, the state of the data out is indeterminate.

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Fast Page Mode

Parameter	Symbol	t _{RAC} = 60 ns		t _{RAC} = 70 ns		t _{RAC} = 80 ns		t _{RAC} = 100 ns		Unit	Note
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Fast page mode cycle time	t _{PC}	40	—	45	—	50	—	60	—	ns	
Access time from $\overline{\text{CAS}}$ precharge	t _{ACP}	—	35	—	40	—	45	—	55	ns	
$\overline{\text{RAS}}$ pulse width	t _{RASP}	60	125,000	70	125,000	80	125,000	100	125,000	ns	
$\overline{\text{CAS}}$ precharge time	t _{CP}	10	—	10	—	10	—	10	—	ns	
$\overline{\text{RAS}}$ hold time from $\overline{\text{CAS}}$ precharge	t _{RHCP}	35	—	40	—	45	—	55	—	ns	
Read modify write cycle time	t _{PRWC}	80	—	85	—	95	—	115	—	ns	
$\overline{\text{CAS}}$ precharge to $\overline{\text{WE}}$ delay time	t _{CPWD}	55	—	60	—	70	—	85	—	ns	1

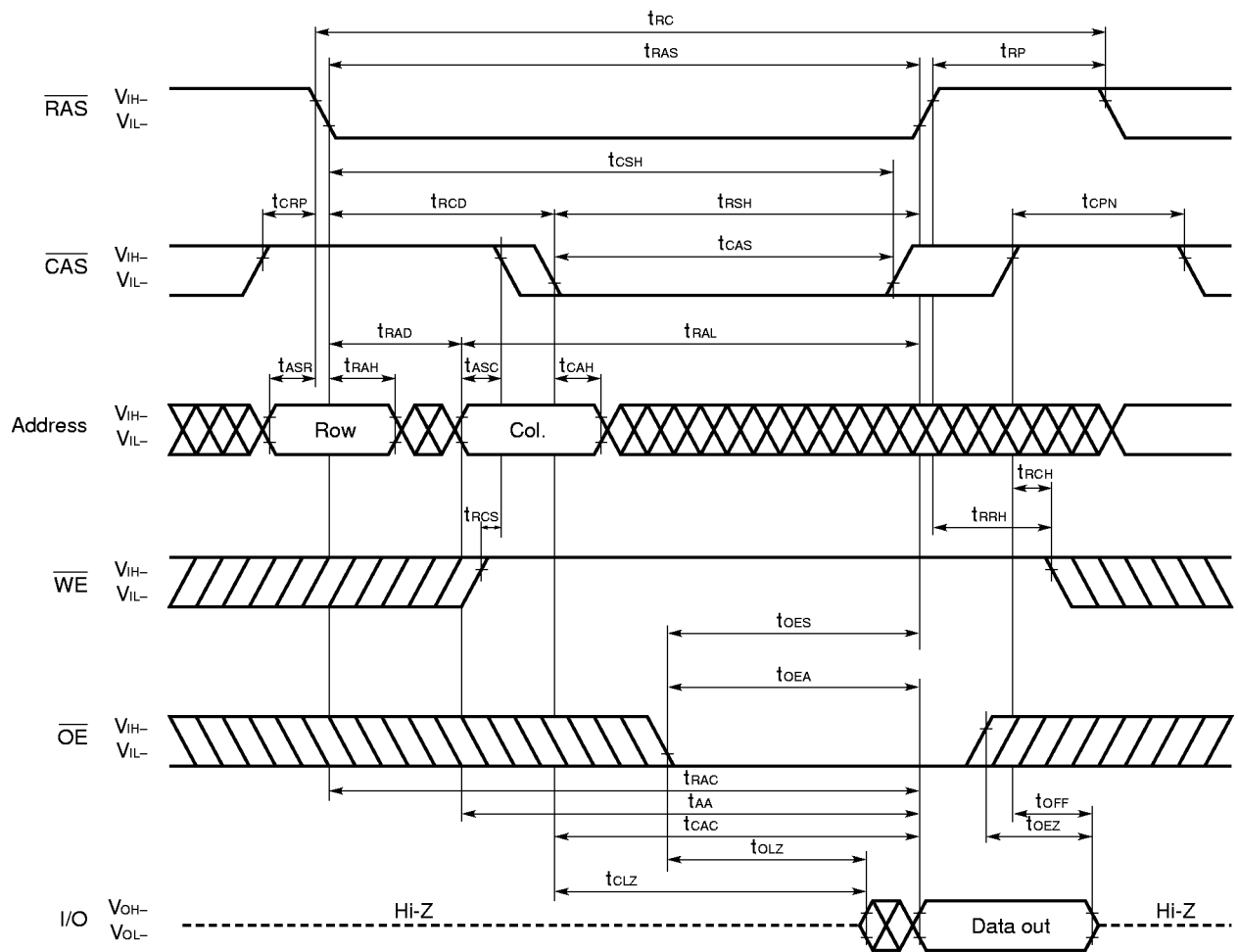
Note 1. If $\text{twcs} \geq \text{twcs}(\text{MIN.})$, the cycle is an early write cycle and the data out will remain Hi-Z through the entire cycle. If $\text{trwd} \geq \text{trwd}(\text{MIN.})$, $\text{tcwd} \geq \text{tcwd}(\text{MIN.})$, $\text{tawd} \geq \text{tawd}(\text{MIN.})$ and $\text{tcpwd} \geq \text{tcpwd}(\text{MIN.})$, the cycle is a read modify write cycle and the data out will contain data read from the selected cell. If neither of the above conditions is met, the state of the data out is indeterminate.

Refresh Cycle

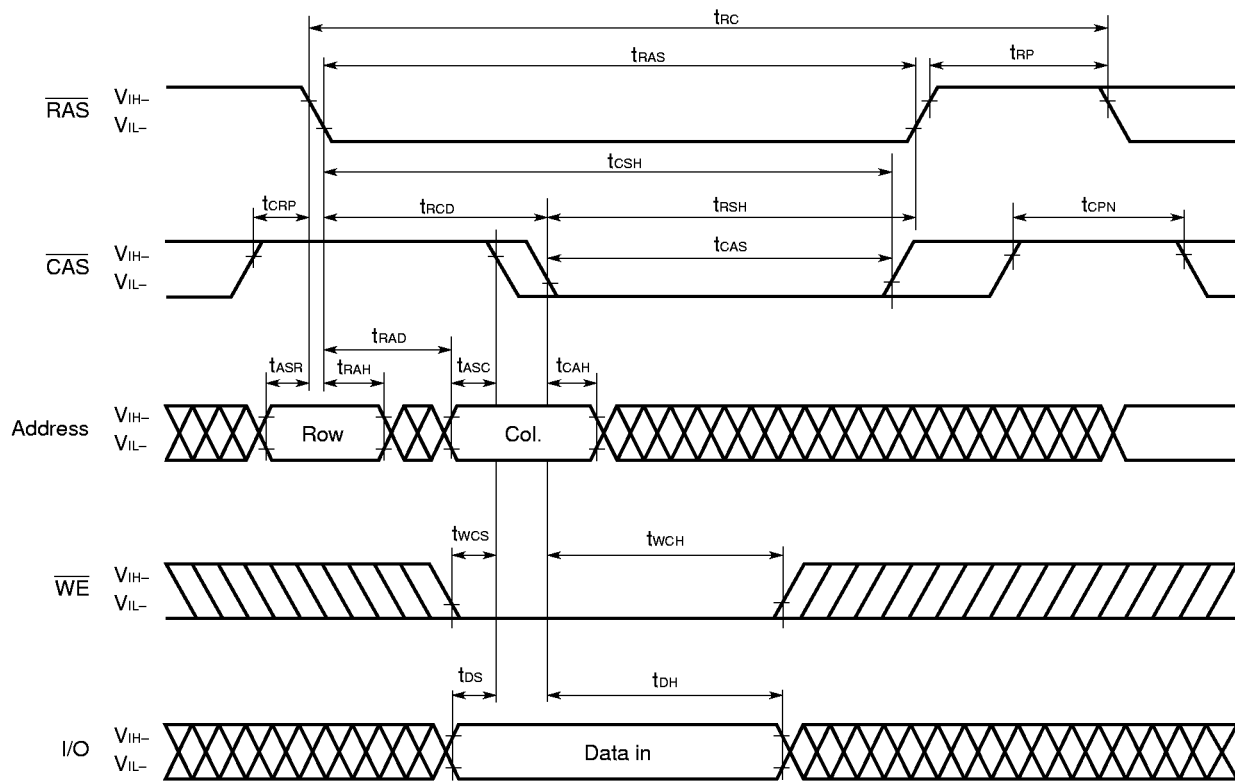
Parameter	Symbol	t _{RAC} = 60 ns		t _{RAC} = 70 ns		t _{RAC} = 80 ns		t _{RAC} = 100 ns		Unit	Note
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
$\overline{\text{CAS}}$ setup time	t _{CSR}	10	—	10	—	10	—	10	—	ns	
$\overline{\text{CAS}}$ hold time ($\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh)	t _{CHR}	10	—	10	—	15	—	20	—	ns	
$\overline{\text{RAS}}$ precharge $\overline{\text{CAS}}$ hold time	t _{RPC}	10	—	10	—	10	—	10	—	ns	
$\overline{\text{RAS}}$ pulse width ($\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh)	t _{RASS}	100	—	100	—	—	—	—	—	μ s	1
$\overline{\text{RAS}}$ precharge time ($\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh)	t _{RPS}	110	—	130	—	—	—	—	—	ns	1
$\overline{\text{CAS}}$ hold time ($\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh)	t _{CHS}	−50	—	−50	—	—	—	—	—	ns	1
$\overline{\text{WE}}$ setup time	t _{WSR}	0	—	0	—	10	—	10	—	ns	
$\overline{\text{WE}}$ hold time	t _{WHR}	10	—	10	—	15	—	20	—	ns	

Note 1. This specification is applied only to the μ PD42S4400-60, 42S4400-70.

Read Cycle

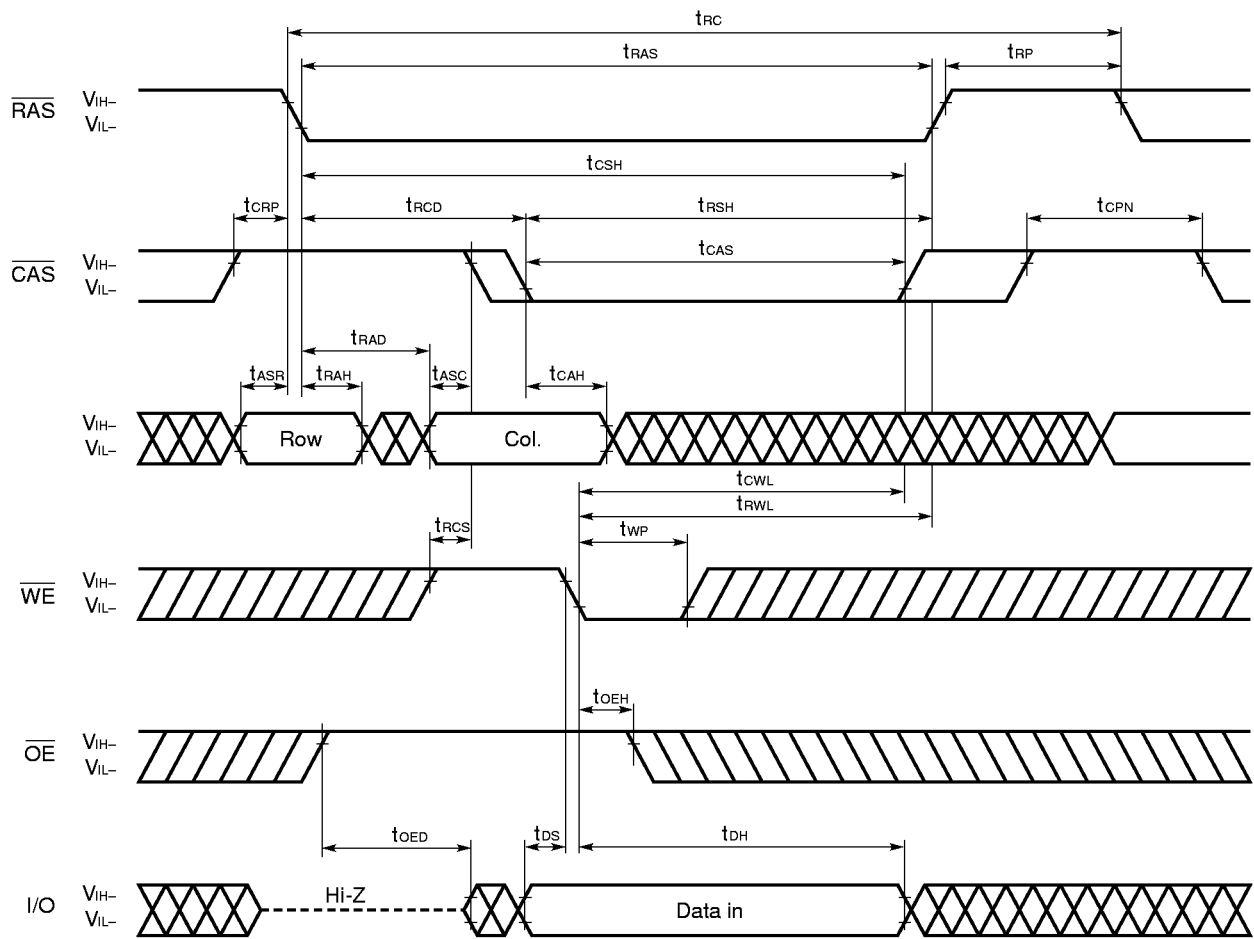


Early Write Cycle

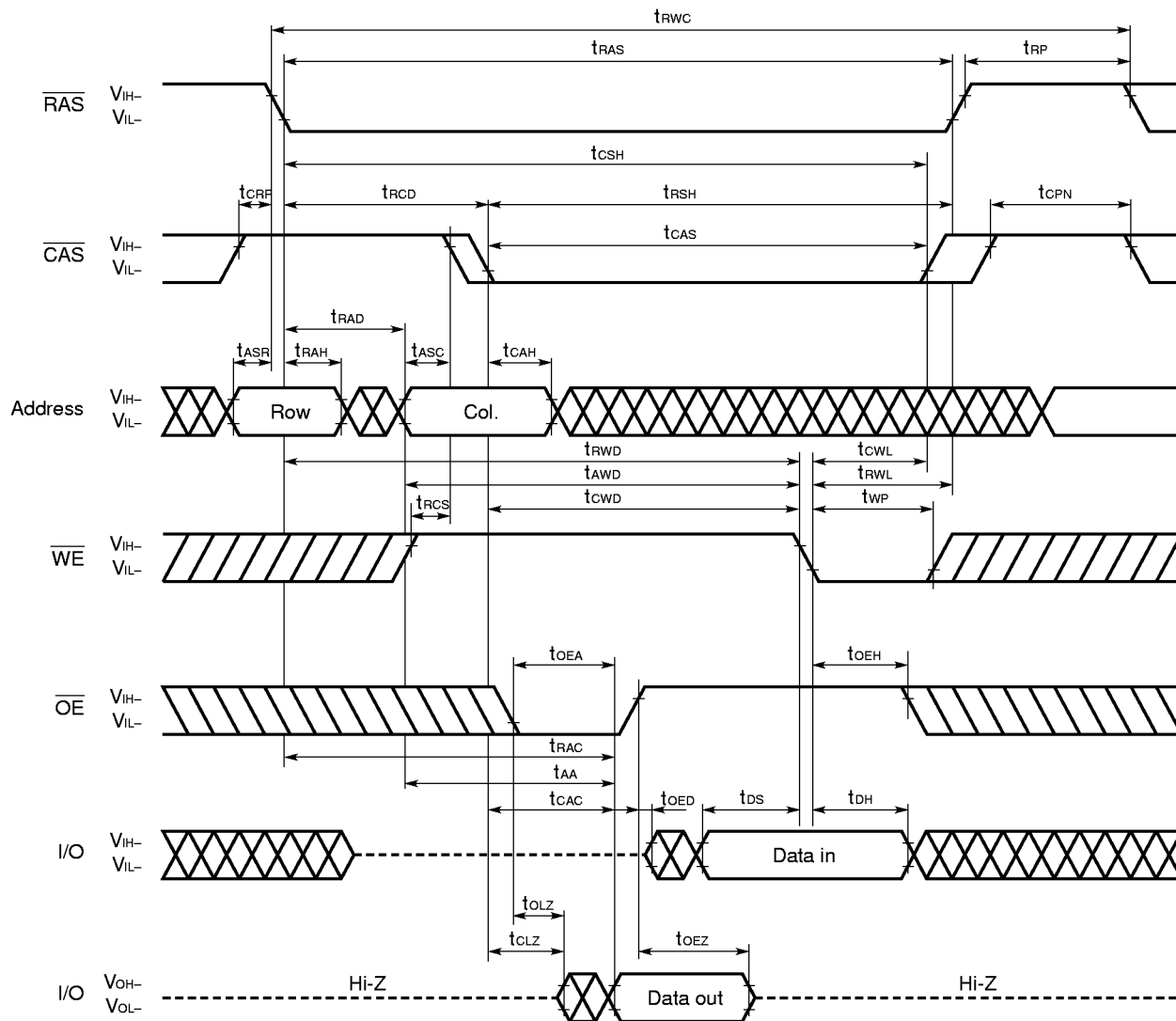


Remark $\overline{\text{OE}}$: Don't care

Late Write Cycle



Read Modify Write Cycle



The diagram illustrates the timing relationships for a 256Kbit DRAM (64K x 16). The signals shown are:

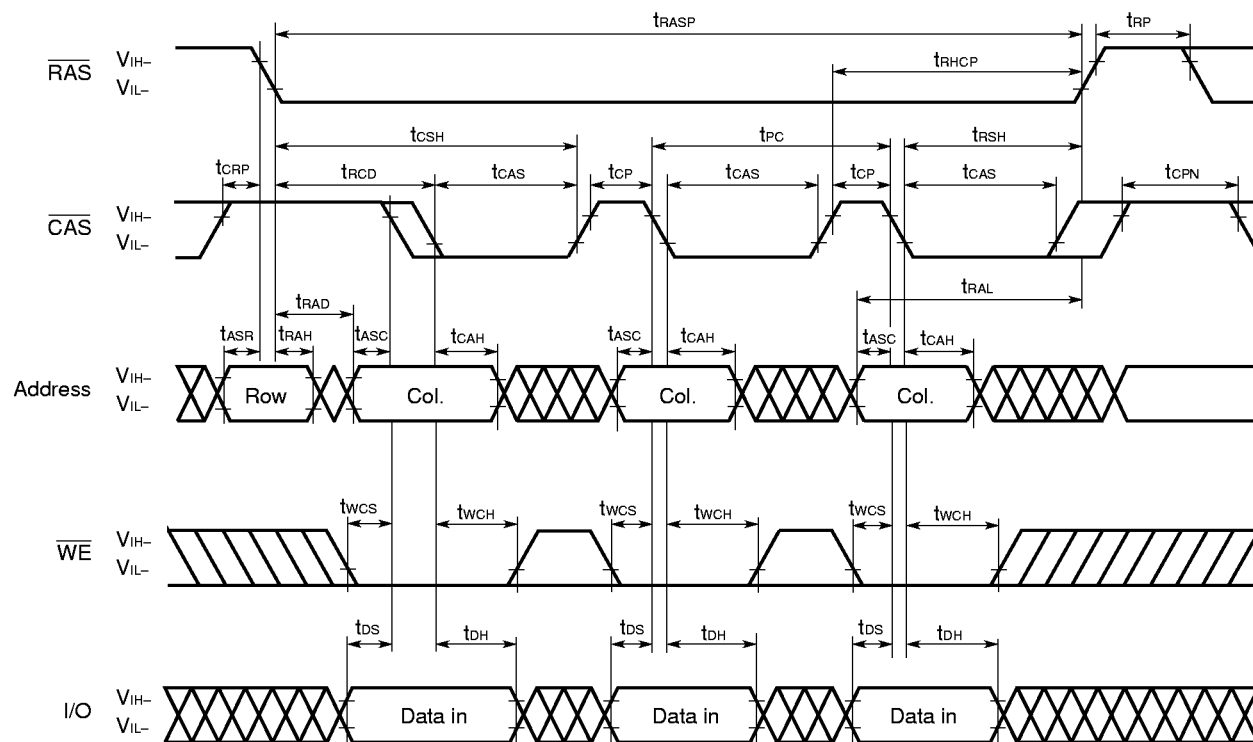
- RAS**: Row Address Strobe, active low.
- CAS**: Column Address Strobe, active low.
- Address**: Input address, showing Row and Column cycles.
- WE**: Write Enable, active low.
- OE**: Output Enable, active low.
- I/O**: Data bus, showing Data out and Hi-Z (High Impedance) states.

Key timing parameters are indicated by arrows and labels:

- trasp**: RAS to CAS delay.
- trhpcp**: RAS to CAS delay (high to low).
- trp**: RAS pulse width.
- tCSH**: CAS to RAS delay.
- tpc**: CAS to RAS delay (low to high).
- trsh**: RAS to CAS delay (low to high).
- tCRP**: RAS to CAS delay (low to high).
- trCD**: RAS to CAS delay (low to high).
- tCAS**: CAS pulse width.
- tCP**: CAS pulse width (low to high).
- tCPN**: CAS to RAS delay (low to high).
- tRAD**: RAS to Data delay.
- tASC**: RAS to Data delay (low to high).
- tCAH**: RAS to Data delay (low to high).
- tASR**: RAS to Data delay (low to high).
- tRAH**: RAS to Data delay (low to high).
- tRCS**: RAS to Data delay (low to high).
- trCH**: RAS to Data delay (low to high).
- trRH**: RAS to Data delay (low to high).
- toES**: RAS to Data delay (low to high).
- tACP**: RAS to Data delay (low to high).
- toEA**: RAS to Data delay (low to high).
- tOLZ**: RAS to Data delay (low to high).
- tRAC**: RAS to Data delay (low to high).
- tAA**: RAS to Data delay (low to high).
- tCAC**: RAS to Data delay (low to high).
- tCLZ**: RAS to Data delay (low to high).
- tOFF**: RAS to Data delay (low to high).
- toEZ**: RAS to Data delay (low to high).

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Fast Page Mode Early Write Cycle



Remarks 1. $\overline{\text{OE}}$: Don't care

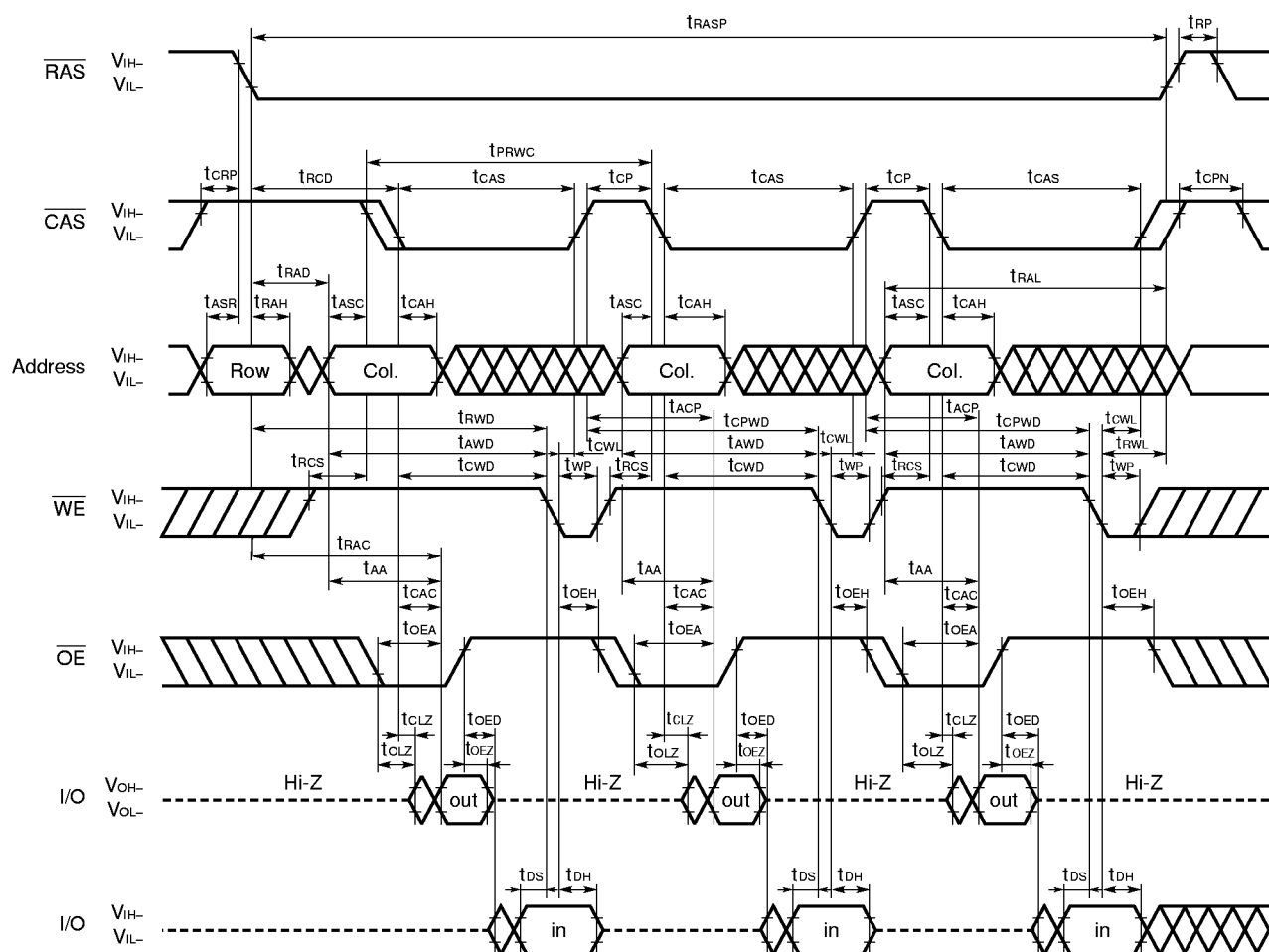
2. In the fast page mode, read, write and read modify write cycles are available for each of the consecutive $\overline{\text{CAS}}$ cycles within the same $\overline{\text{RAS}}$ cycle.

The timing diagram illustrates the relationship between several signals and their timing parameters:

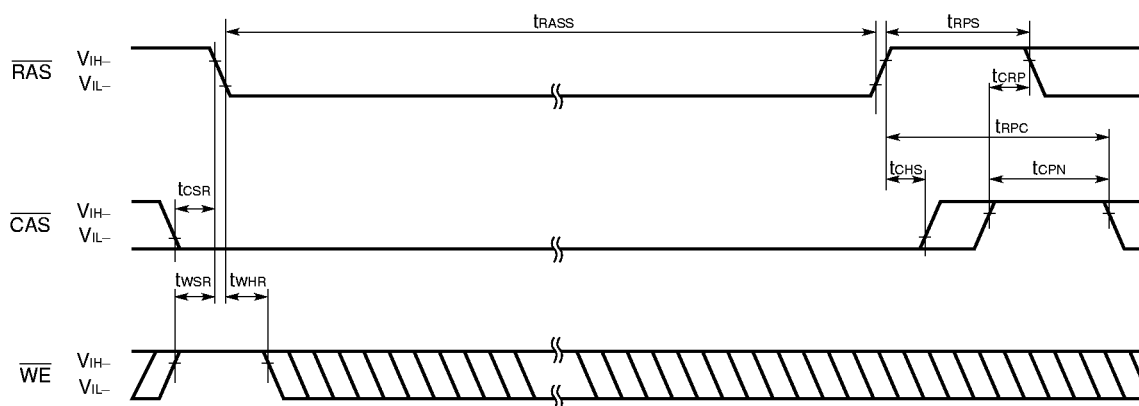
- RAS:** Shows parameters t_{RASP} (total pulse width), t_{RHCP} (high pulse width), and t_{RP} (return time to high).
- CAS:** Shows parameters t_{CRP} , t_{CSD} , t_{CAS} , t_{CP} , t_{CAS} , t_{CP} , t_{CAS} , and t_{CPN} .
- Address:** Shows parameters t_{ASR} , t_{RAH} , t_{ASC} , t_{CAH} , t_{ASC} , t_{CAH} , t_{ASC} , t_{CAH} , and t_{AL} .
- WE:** Shows parameters t_{RCS} , t_{WP} , t_{RCS} , t_{WP} , t_{RCS} , t_{WP} , and t_{RWL} .
- OE:** Shows parameters t_{OEH} (high pulse width).
- I/O:** Shows parameters t_{OED} , t_{DS} , and t_{DH} for data in, and t_{OED} , t_{DS} , and t_{DH} for data out.

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Fast Page Mode Read Modify Write Cycle



Remark In the fast page mode, read, write and read modify write cycles are available for each of the consecutive $\overline{\text{CAS}}$ cycles within the same $\overline{\text{RAS}}$ cycle.

$\overline{\text{CAS}}$ Before $\overline{\text{RAS}}$ Self Refresh Cycle (Only for the μ PD42S4400)

Remark Address, $\overline{\text{OE}}$: Don't care I/O: Hi-Z

Cautions on Use of $\overline{\text{CAS}}$ Before $\overline{\text{RAS}}$ Self Refresh

$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh can be used independently when used in combination with distributed $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ long refresh; However, when used in combination with burst $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ long refresh or with long $\overline{\text{RAS}}$ only refresh (both distributed and burst), the following cautions must be observed.

(1) Normal Combined Use of $\overline{\text{CAS}}$ Before $\overline{\text{RAS}}$ Self Refresh and Burst $\overline{\text{CAS}}$ Before $\overline{\text{RAS}}$ Long Refresh

When $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh and burst $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ long refresh are used in combination, please perform $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh 1,024 times within a 16 ms interval just before and after setting $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh.

(2) Normal Combined Use of $\overline{\text{CAS}}$ Before $\overline{\text{RAS}}$ Self Refresh and Long $\overline{\text{RAS}}$ Only Refresh

When $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh and $\overline{\text{RAS}}$ only refresh are used in combination, please perform $\overline{\text{RAS}}$ only refresh 1,024 times within a 16 ms interval just before and after setting $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh.

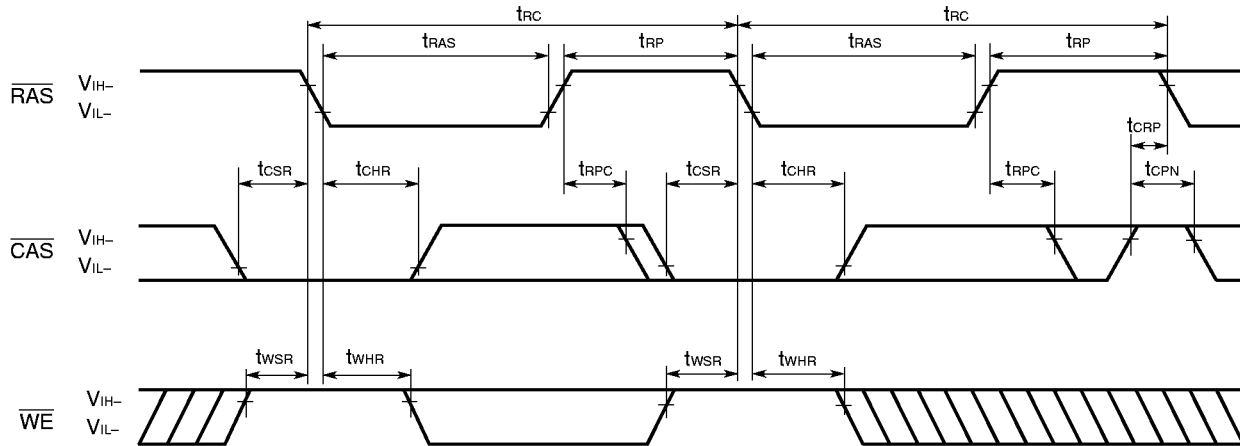
(3) If $t_{\text{RASS (MIN.)}}$ is not satisfied at the beginning of $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh cycles ($t_{\text{RAS}} < 100 \mu\text{s}$), $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh cycles will be executed one time. ★

If $10 \mu\text{s} < t_{\text{RAS}} < 100 \mu\text{s}$, $\overline{\text{RAS}}$ precharge time for $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh (t_{RPS}) is applied.

And refresh cycles (1,024/128 ms) should be met.

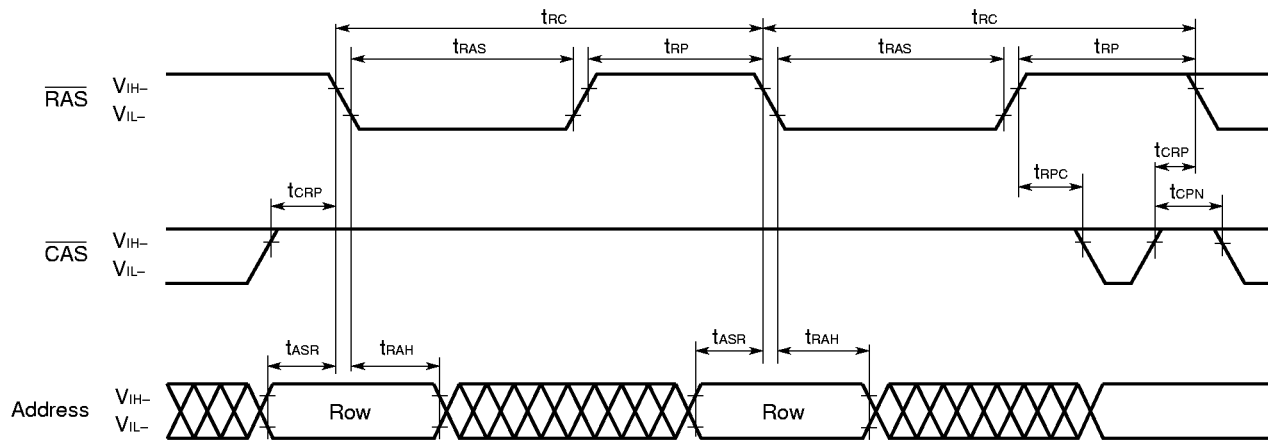
For details, please refer to **How to use DRAM** User's Manual.

★ **CAS Before RAS Refresh Cycle**



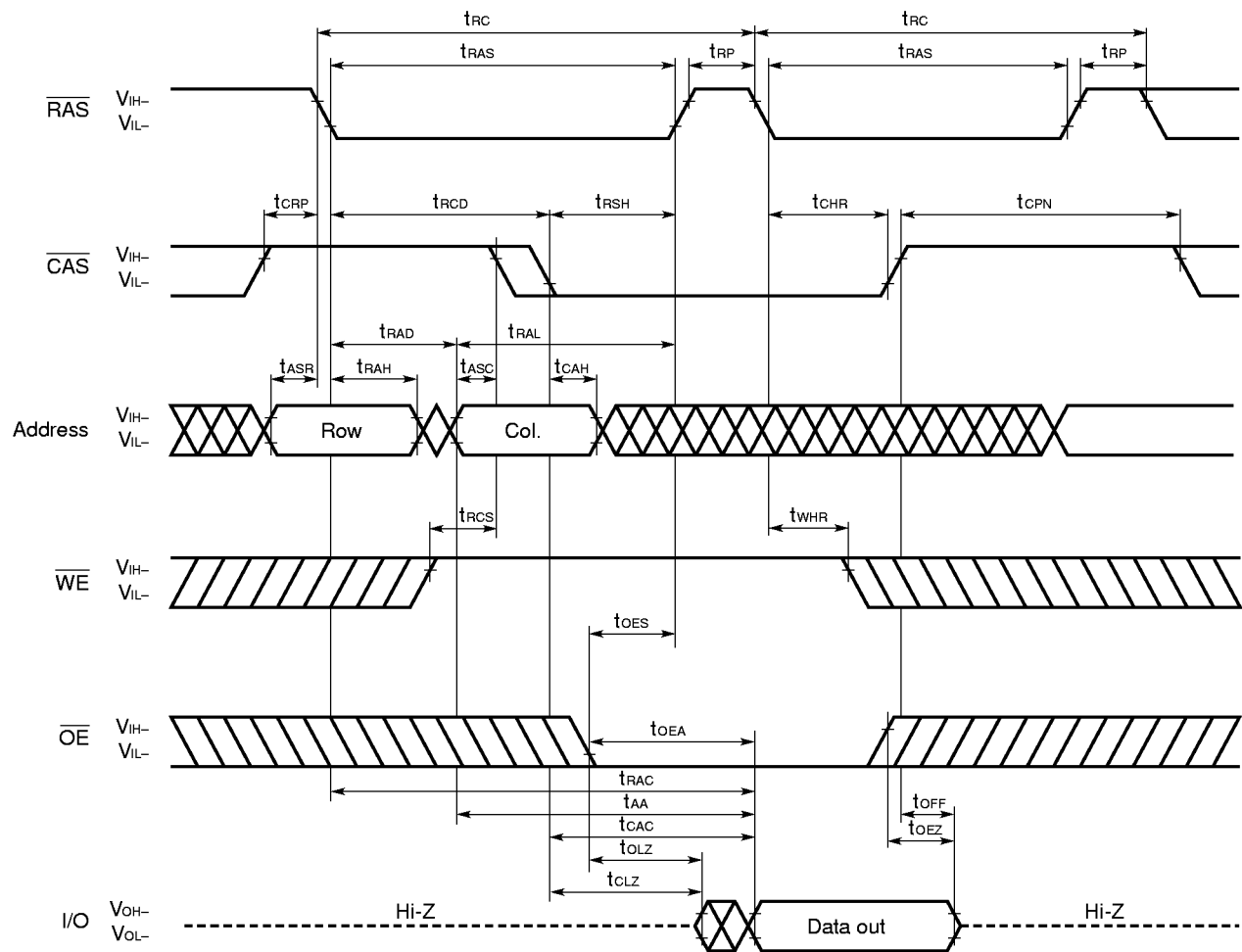
Remark Address, $\overline{\text{OE}}$: Don't care I/O: Hi-Z

RAS Only Refresh Cycle

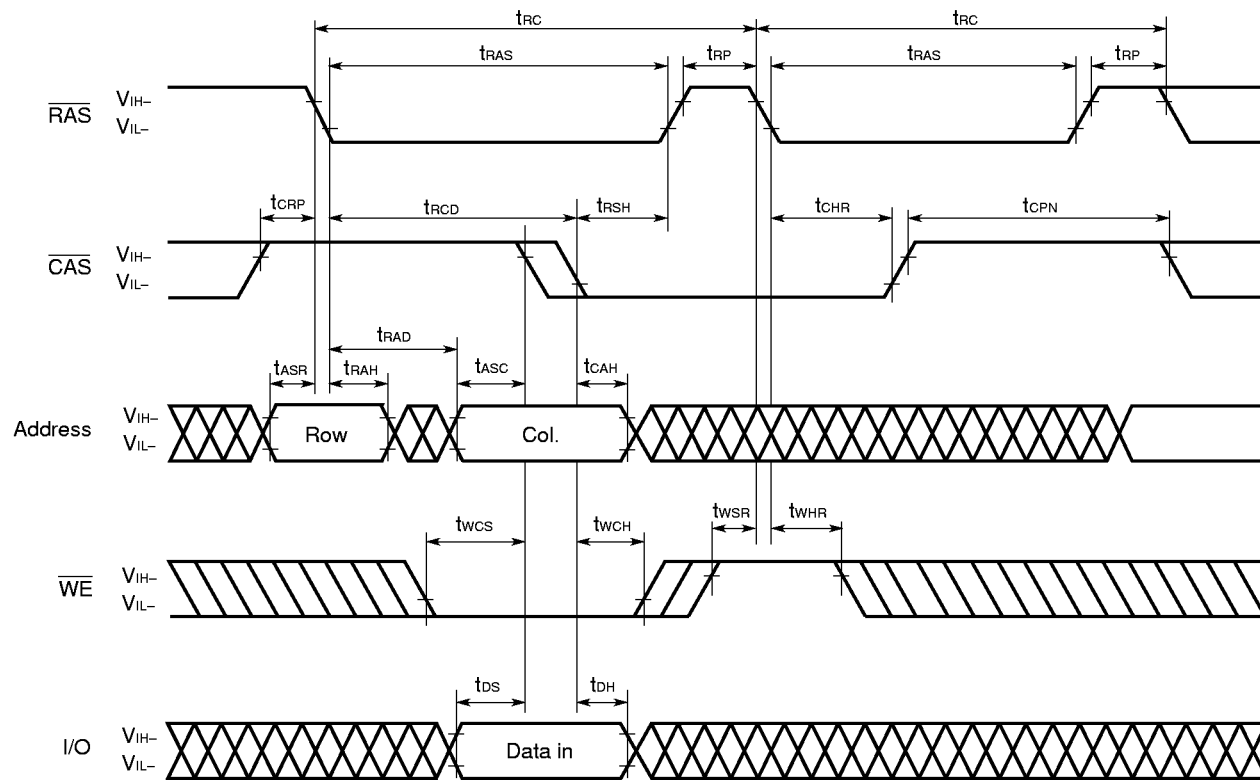


Remark $\overline{\text{WE}}$, $\overline{\text{OE}}$: Don't care I/O: Hi-Z

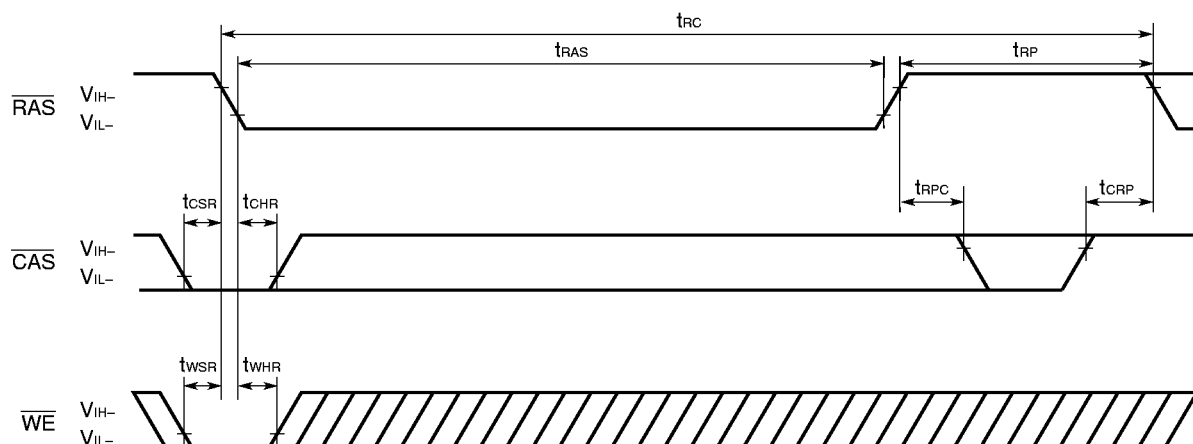
Hidden Refresh Cycle (Read)



★ Hidden Refresh Cycle (Write)



Remark $\overline{\text{OE}}$: Don't care

Test Mode Set Cycle ($\overline{\text{WE}}$, $\overline{\text{CAS}}$ Before $\overline{\text{RAS}}$ Refresh Cycle)

Remark Address, $\overline{\text{OE}}$: Don't care I/O: Hi-Z

Test Mode

By using the test mode, the test time can be reduced. The reason for this is that, the memory emulates the $\times 8$ -bit organization during test mode. Don't care about the input level of the $\overline{\text{CAS}}$ input A0.

(1) Setting the mode

Executing the test mode cycle ($\overline{\text{WE}}$, $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh cycle) sets the test mode.

(2) Write/read operation

When either a "0" or a "1" is written to the input pin in test mode, this data is written to 8 bits of memory cell.

Next, when the data is read from the output pin at the same address, the cell can be checked.

Output = "1": Normal write (all memory cells)

Output = "0": Abnormal write

(3) Refresh

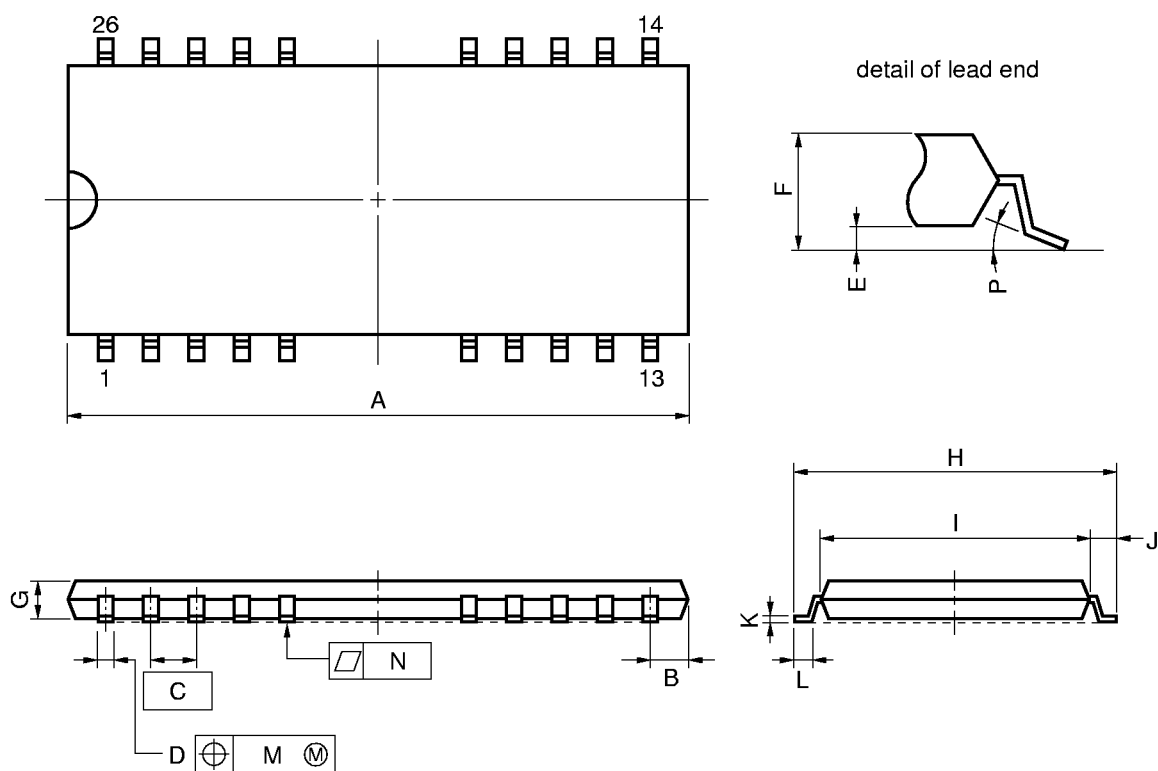
Refresh in the test mode must be performed with the $\overline{\text{RAS}}$ / $\overline{\text{CAS}}$ cycle or with the $\overline{\text{WE}}$, $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh cycle. The $\overline{\text{WE}}$, $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh cycle use the same counter as the $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh's internal counter.

(4) Mode Cancellation

The test mode is cancelled by executing one cycle of $\overline{\text{RAS}}$ only refresh cycle or $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh cycle.

Package Drawings

26 PIN PLASTIC TSOP (II) (300 mil)



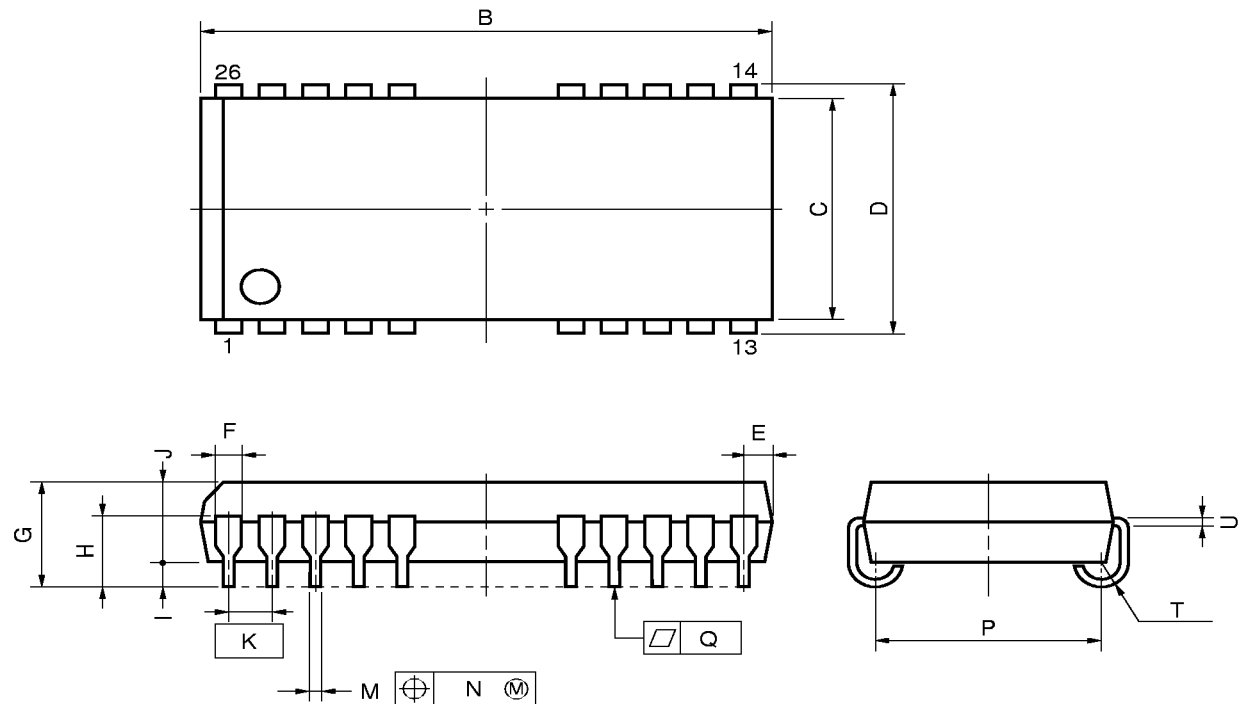
NOTE

Each lead centerline is located within 0.21 mm (0.009 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	17.36 MAX.	0.684 MAX.
B	1.06 MAX.	0.042 MAX.
C	1.27 (T.P.)	0.050 (T.P.)
D	$0.42^{+0.08}_{-0.07}$	0.017 ± 0.003
E	0.1 ± 0.05	0.004 ± 0.002
F	1.2 MAX.	0.048 MAX.
G	1.0	0.039
H	9.22 ± 0.2	0.363 ± 0.008
I	7.62 ± 0.1	0.300 ± 0.004
J	0.8 ± 0.2	$0.031^{+0.009}_{-0.008}$
K	$0.145^{+0.025}_{-0.015}$	0.006 ± 0.001
L	0.5 ± 0.1	$0.020^{+0.004}_{-0.005}$
M	0.21	0.009
N	0.10	0.004
P	$3^{+7}_{-3}^{\circ}$	$3^{+7}_{-3}^{\circ}$

S26G3-50-9JD

26 PIN PLASTIC SOJ (300 mil)



NOTE

Each lead centerline is located within 0.12 mm (0.005 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
B	$17.4^{+0.2}_{-0.35}$	$0.685^{+0.008}_{-0.013}$
C	7.57	0.298
D	8.47 ± 0.2	$0.333^{+0.009}_{-0.008}$
E	1.08 ± 0.15	$0.043^{+0.006}_{-0.007}$
F	0.6	0.024
G	3.5 ± 0.2	0.138 ± 0.008
H	2.4 ± 0.2	$0.094^{+0.009}_{-0.008}$
I	0.8 MIN.	0.031 MIN.
J	2.6	0.102
K	1.27 (T.P.)	0.050 (T.P.)
M	0.40 ± 0.10	$0.016^{+0.004}_{-0.005}$
N	0.12	0.005
P	6.73 ± 0.20	0.265 ± 0.008
Q	0.15	0.006
T	R 0.85	R0.033
U	$0.20^{+0.10}_{-0.05}$	$0.008^{+0.004}_{-0.002}$

P26LA-50A-2

Recommended Soldering Conditions

The following conditions (see tables below and next page) must be met for soldering conditions of the μPD42S4400, 424400.

For more details, refer to our document “SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL” (IEI-1207).

Please consult with our sales offices in case other soldering process is used, or in case the soldering is done under different conditions.

Types of Surface Mount Device

μPD42S4400GS-9JD, 424400GS-9JD: 26-pin plastic TSOP (II) (300 mil)

Soldering process	Soldering conditions	Symbol
Infrared ray reflow	Peak temperature of package surface: 235 °C or lower, Reflow time: 30 seconds or less (210 °C or higher), Number of reflow processes: MAX. 2 Exposure limit: 7 days ^{Note} (10 hours pre-baking is required at 125 °C afterwards) Cautions 1. After the first reflow process, cool the package down to room temperature, then start the second reflow process. 2. After the first reflow process, do not use water to remove residual flux (water can be used in the second process).	IR35-107-2
VPS	Peak temperature of package: 215 °C or lower, Reflow time: 40 seconds or less (200 °C or higher), Number of reflow processes: MAX. 2 Exposure limit: 7 days ^{Note} (10 hours pre-baking is required at 125 °C afterwards) Cautions 1. After the first reflow process, cool the package down to room temperature, then start the second reflow process. 2. After the first reflow process, do not use water to remove residual flux (water can be used in the second process).	VP15-107-2
Partial heating method	Terminal temperature: 300 °C or lower, Time: 3 seconds or lower (Per side of the package).	_____

Note Exposure limit before soldering after dry-pack package is opened.

Storage conditions: 25 °C and relative humidity at 65 % or less.

Caution Do not apply more than one soldering method at any one time, except for “Partial heating method”.

μPD42S4400LA, 424400LA: 26-pin plastic SOJ (300 mil)

Soldering process	Soldering conditions	Symbol
Infrared ray reflow	Peak temperature of package surface: 235 °C or lower, Reflow time: 30 seconds or less (210 °C or higher), Number of reflow processes: MAX. 2 Exposure limit: 7 days^{Note} (20 hours pre-baking is required at 125 °C afterwards) Cautions 1. After the first reflow process, cool the package down to room temperature, then start the second reflow process. 2. After the first reflow process, do not use water to remove residual flux (water can be used in the second process).	IR35-207-2
VPS	Peak temperature of package: 215 °C or lower, Reflow time: 40 seconds or less (200 °C or higher), Number of reflow processes: MAX. 2 Exposure limit: 7 days^{Note} (20 hours pre-baking is required at 125 °C afterwards) Cautions 1. After the first reflow process, cool the package down to room temperature, then start the second reflow process. 2. After the first reflow process, do not use water to remove residual flux (water can be used in the second process).	VP15-207-2
Partial heating method	Terminal temperature: 300 °C or lower, Time: 3 seconds or less (Per side of the package).	_____

Note Exposure limit before soldering after dry-pack package is opened.
Storage conditions: 25 °C and relative humidity at 65 % or less.

Caution Do not apply more than one soldering method at any one time, except for “Partial heating method”.