NEC

MOS INTEGRATED CIRCUIT

μPD42S4400, 424400

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

Description

The μPD42S4400, 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 μPD42S4400 can execute $\overline{CAS}$ before $\overline{RAS}$ 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
- Fast page mode
- Fast access and cycle time
- Single +5.0 V ± 10 % power supply

Part number	Power consumption Active (MAX.)	Access time (MAX.)	R/W cycle time (MIN.)	Fast page mode cycle time (MIN.)	
μPD42S4400-60, 424400-60	495 mW	60 ns	120 ns	40 ns	★
μPD42S4400-70, 424400-70	440 mW	70 ns	140 ns	45 ns	★
μPD424400-80	440 mW	80 ns	160 ns	50 ns	★
μPD424400-10	440 mW	100 ns	190 ns	60 ns	

- The μPD42S4400 can execute $\overline{CAS}$ before $\overline{RAS}$ self refresh

Part number	Refresh cycle	Refresh	Power consumption at standby (MAX.)
μPD42S4400	1,024 cycles/128 ms	$\overline{CAS}$ before $\overline{RAS}$ self refresh, $\overline{CAS}$ before $\overline{RAS}$ refresh, $\overline{RAS}$ only refresh, Hidden refresh	0.825 mW (CMOS level input)
μPD424400	1,024 cycles/16 ms	$\overline{CAS}$ before $\overline{RAS}$ refresh, $\overline{RAS}$ 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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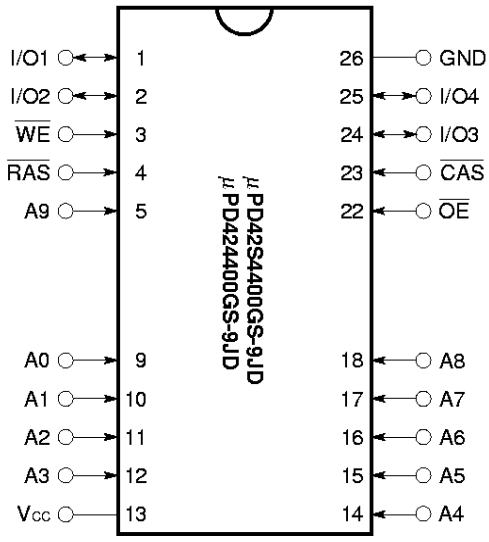
The mark ★ shows major revised points.

Ordering Information

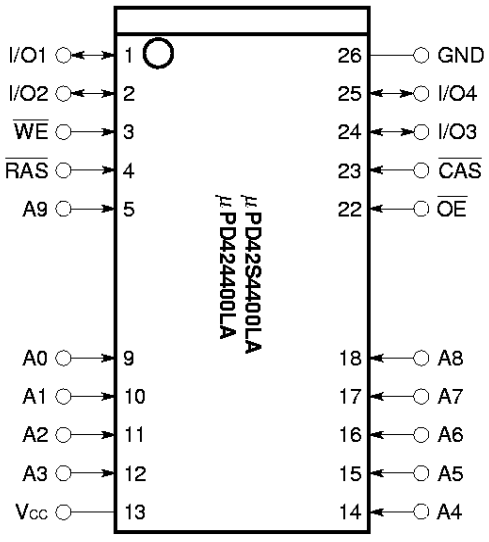
Part number	Access time (MAX.)	Package	Refresh
μPD42S4400GS-60-9JD	60 ns	26-pin plastic TSOP (II) (300 mil)	$\overline{CAS}$ before $\overline{RAS}$ self refresh $\overline{CAS}$ before $\overline{RAS}$ refresh $\overline{RAS}$ only refresh Hidden refresh
μPD42S4400GS-70-9JD	70 ns		
μPD42S4400LA-60	60 ns	26-pin plastic SOJ (300 mil)	
μPD42S4400LA-70	70 ns		
μPD424400GS-60-9JD	60 ns	26-pin plastic TSOP (II) (300 mil)	$\overline{CAS}$ before $\overline{RAS}$ refresh $\overline{RAS}$ only refresh Hidden refresh
μPD424400GS-70-9JD	70 ns		
μPD424400GS-80-9JD	80 ns		
μPD424400GS-10-9JD	100 ns		
μPD424400LA-60	60 ns	26-pin plastic SOJ (300 mil)	
μPD424400LA-70	70 ns		
μPD424400LA-80	80 ns		
μPD424400LA-10	100 ns		

Pin Configurations (Marking Side)

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

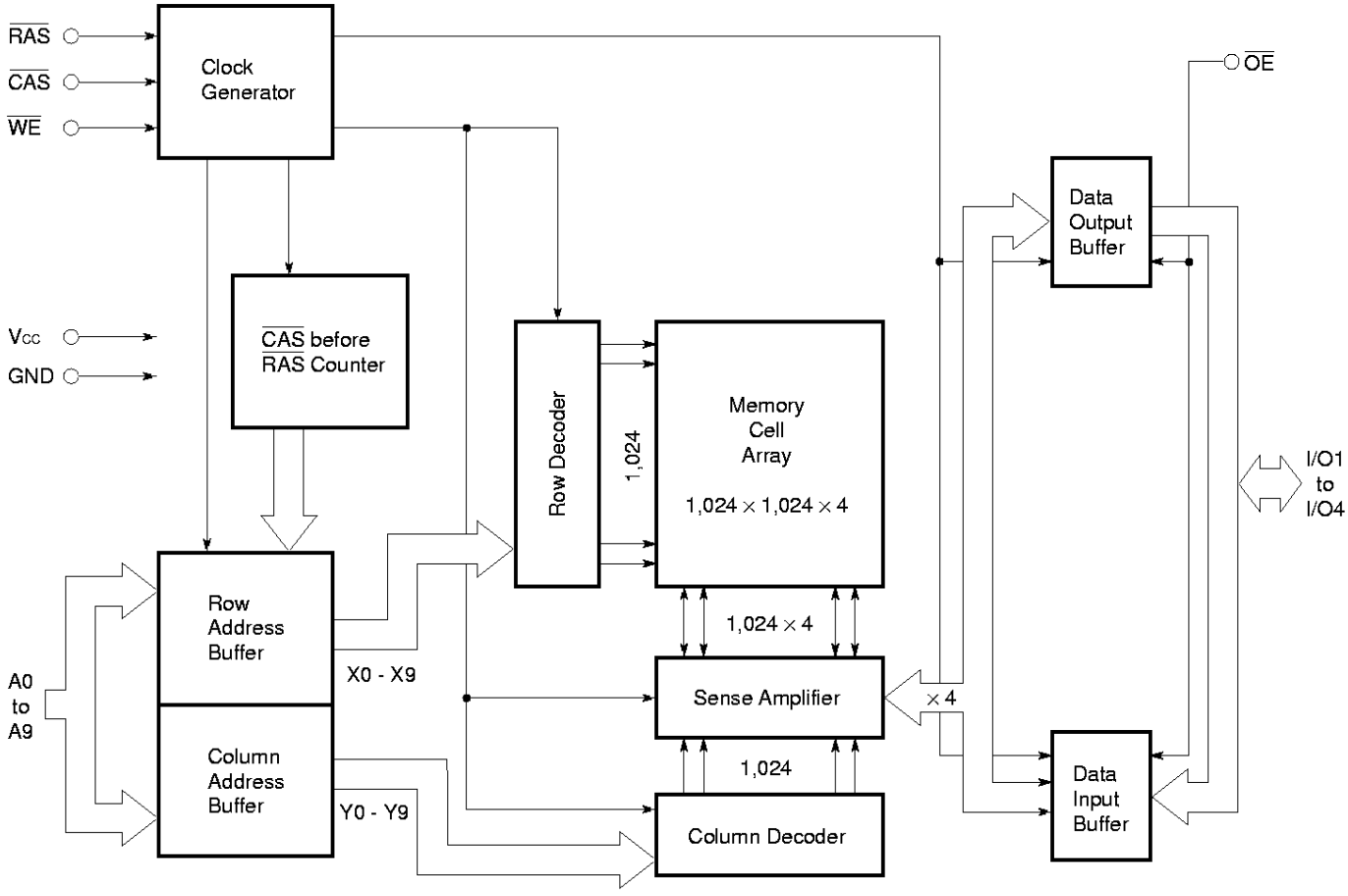


26-pin Plastic SOJ (300 mil)



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
Vcc	:	Power Supply
GND	:	Ground

Block Diagram



Input/Output Pin Functions

The μPD42S4400, 424400 have input pins $\overline{RAS}$, $\overline{CAS}$, $\overline{WE}$, $\overline{OE}$, A0 to A9 and input/output pins I/O1 to I/O4.

Pin name	Input/Output	Function
$\overline{RAS}$ (Row address strobe)	Input	$\overline{RAS}$ 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. • $\overline{CAS}$ before $\overline{RAS}$ refresh
$\overline{CAS}$ (Column address strobe)	Input	$\overline{CAS}$ 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 $\overline{RAS}$. Then, switch the address bus to column address and activate $\overline{CAS}$. Each address is taken into the device when $\overline{RAS}$ and $\overline{CAS}$ 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 $\overline{RAS}$ and $\overline{CAS}$.
$\overline{WE}$ (Write enable)	Input	Write control signal. Write operation is executed by activating $\overline{RAS}$, $\overline{CAS}$ and $\overline{WE}$.
$\overline{OE}$ (Output enable)	Input	Read control signal. Read operation can be executed by activating $\overline{RAS}$, $\overline{CAS}$ and $\overline{OE}$. If $\overline{WE}$ is activated during read operation, $\overline{OE}$ 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 μs ($\overline{RAS}$, $\overline{CAS}$ 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	°C
Storage temperature	T_{stg}		–55 to +125	°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	°C

Capacitance (T_A = 25 °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) ★

Parameter		Symbol	Test condition		MIN.	MAX.	Unit	Notes
Operating current		I_{CC1}	$\overline{RAS}$, $\overline{CAS}$ cycling $t_{RC} = t_{RC\ (MIN.)}$ I_O = 0 mA	t_{RAC} = 60 ns		90	mA	1, 2, 3
				t_{RAC} = 70 ns		80		
				t_{RAC} = 80 ns		80		
				t_{RAC} = 100 ns		80		
Standby current	μPD42S4400	I_{CC2}	$\overline{RAS}$, $\overline{CAS} \geq V_{IH\ (MIN.)}$, I_O = 0 mA			2.0	mA	
			$\overline{RAS}$, $\overline{CAS} \geq V_{CC}$ – 0.2 V, I_O = 0 mA			0.15		
	μPD424400		$\overline{RAS}$, $\overline{CAS} \geq V_{IH\ (MIN.)}$, I_O = 0 mA			2.0		
			$\overline{RAS}$, $\overline{CAS} \geq V_{CC}$ – 0.2 V, I_O = 0 mA			1.0		
$\overline{RAS}$ only refresh current		I_{CC3}	$\overline{RAS}$ cycling, $\overline{CAS} \geq V_{IH\ (MIN.)}$ $t_{RC} = t_{RC\ (MIN.)}$, I_O = 0 mA	t_{RAC} = 60 ns		90	mA	1, 2, 3 ,4
				t_{RAC} = 70 ns		80		
				t_{RAC} = 80 ns		80		
				t_{RAC} = 100 ns		80		
Operating current (Fast page mode)		I_{CC4}	$\overline{RAS} \leq V_{IL\ (MAX.)}$, $\overline{CAS}$ cycling $t_{PC} = t_{PC\ (MIN.)}$, I_O = 0 mA	t_{RAC} = 60 ns		70	mA	1, 2, 5
				t_{RAC} = 70 ns		60		
				t_{RAC} = 80 ns		60		
				t_{RAC} = 100 ns		60		
$\overline{CAS}$ before $\overline{RAS}$ refresh current		I_{CC5}	$\overline{RAS}$ cycling $t_{RC} = t_{RC\ (MIN.)}$ I_O = 0 mA	t_{RAC} = 60 ns		90	mA	1, 2
				t_{RAC} = 70 ns		80		
				t_{RAC} = 80 ns		80		
				t_{RAC} = 100 ns		80		
$\overline{CAS}$ before $\overline{RAS}$ long refresh current (1,024 cycles / 128 ms, only for the μPD42S4400)		I_{CC6}	$\overline{CAS}$ before $\overline{RAS}$ refresh : t_{RC} = 125.0 μs $\overline{RAS}$, $\overline{CAS}$: V_{CC} – 0.2 V ≤ V_{IH} ≤ $V_{IH\ (MAX.)}$ 0 V ≤ V_{IL} ≤ 0.2 V	$t_{RAS} \leq$ 200 ns		200	μA	1, 2
			Standby : $\overline{RAS}$, $\overline{CAS} \geq V_{CC}$ – 0.2 V Address : V_{IH} or V_{IL} $\overline{WE}$, $\overline{OE}$: V_{IH} I_O = 0 mA	$t_{RAS} \leq$ 1 μs		300	μA	1, 2
$\overline{CAS}$ before $\overline{RAS}$ self refresh current (only for the μPD42S4400)		I_{CC7}	$\overline{RAS}$, $\overline{CAS}$: t_{RASS} = 5 ms V_{CC} – 0.2 V ≤ V_{IH} ≤ $V_{IH(MAX.)}$ 0 V ≤ V_{IL} ≤ 0.2 V I_O = 0 mA			150	μA	2
Input leakage current		$I_{I\ (L)}$	V_I = 0 to 5.5 V All other pins not under test = 0 V		–10	+10	μA	
Output leakage current		$I_{O\ (L)}$	V_O = 0 to 5.5 V Output is disabled (Hi-Z)		–10	+10	μA	
High level output voltage		V_{OH}	I_O = –5.0 mA		2.4		V	
Low level output voltage		V_{OL}	I_O = +4.2 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}).

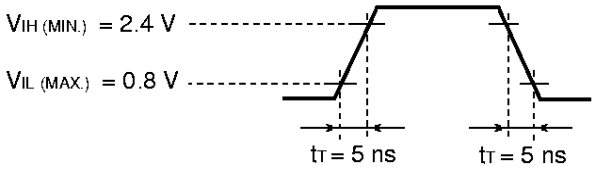
2. Specified values are obtained with outputs unloaded.

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.

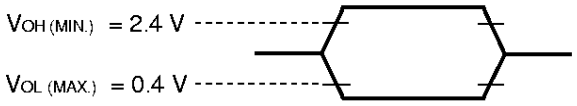
AC Characteristics (Recommended Operating Conditions unless otherwise noted)

AC Characteristics Test Conditions

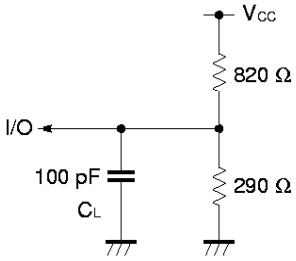
(1) Input timing specification



(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	μPD42S4400	t_{REF}	–	128	–	128	–	–	–	–	ms	4
	μPD424400		–	16	–	16	–	16	–	16	ms	

★ **Notes 1.** In $\overline{CAS}$ before $\overline{RAS}$ refresh cycles, $t_{RAS\,(MAX.)}$ is 100 μs. If 10 μs < t_{RAS} < 100 μs, $\overline{RAS}$ precharge time for $\overline{CAS}$ before $\overline{RAS}$ self refresh (t_{RPS}) is applied.

2. For read cycles, access time is defined as follows:

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

$t_{RAD\,(MAX.)}$ and $t_{RCD\,(MAX.)}$ 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 $t_{RAD} \geq t_{RAD\,(MAX.)}$ and $t_{RCD} \geq t_{RCD\,(MAX.)}$ will not cause any operation problems.

3. $t_{CRP\,(MIN.)}$ requirement is applied to $\overline{RAS}$, $\overline{CAS}$ cycles.

4. This specification is applied only to the μPD42S4400-60, 42S4400-70.

Read 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.		
Access time from $\overline{RAS}$	t_{RAC}	–	60	–	70	–	80	–	100	ns	1
Access time from $\overline{CAS}$	t_{CAC}	–	15	–	20	–	20	–	25	ns	1
Access time from column address	t_{AA}	–	30	–	35	–	40	–	50	ns	1
Access time from $\overline{OE}$	t_{OEA}	–	15	–	20	–	20	–	25	ns	
Column address lead time referenced to $\overline{RAS}$	t_{RAL}	30	–	35	–	40	–	50	–	ns	
Read command setup time	t_{RCS}	0	–	0	–	0	–	0	–	ns	
Read command hold time referenced to $\overline{RAS}$	t_{RRH}	0	–	0	–	10	–	10	–	ns	2
Read command hold time referenced to $\overline{CAS}$	t_{RCH}	0	–	0	–	0	–	0	–	ns	2
Output buffer turn-off delay time from $\overline{OE}$	t_{OEZ}	0	15	0	15	0	20	0	25	ns	3
Output buffer turn-off delay time from $\overline{CAS}$	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 $\overline{RAS}$
$t_{RAD} \leq t_{RAD\,(MAX.)}$ and $t_{RCD} \leq t_{RCD\,(MAX.)}$	$t_{RAC\,(MAX.)}$	$t_{RAC\,(MAX.)}$
$t_{RAD} > t_{RAD\,(MAX.)}$ and $t_{RCD} \leq t_{RCD\,(MAX.)}$	$t_{AA\,(MAX.)}$	$t_{RAD} + t_{AA\,(MAX.)}$
$t_{RCD} > t_{RCD\,(MAX.)}$	$t_{CAC\,(MAX.)}$	$t_{RCD} + t_{CAC\,(MAX.)}$

$t_{RAD\,(MAX.)}$ and $t_{RCD\,(MAX.)}$ 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 $t_{RAD} \geq t_{RAD\,(MAX.)}$ and $t_{RCD} \geq t_{RCD\,(MAX.)}$ will not cause any operation problems.

2. Either $t_{RCH\,(MIN.)}$ or $t_{RRH\,(MIN.)}$ should be met in read cycles.

3. $t_{OFF\,(MAX.)}$ and $t_{OEZ\,(MAX.)}$ 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.

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 $\overline{CAS}$ precharge	t_{ACP}	–	35	–	40	–	45	–	55	ns	
$\overline{RAS}$ pulse width	t_{RASP}	60	125,000	70	125,000	80	125,000	100	125,000	ns	
$\overline{CAS}$ precharge time	t_{CP}	10	–	10	–	10	–	10	–	ns	
$\overline{RAS}$ hold time from $\overline{CAS}$ precharge	t_{RHCP}	35	–	40	–	45	–	55	–	ns	
★ Read modify write cycle time	t_{PRWC}	80	–	85	–	95	–	115	–	ns	
$\overline{CAS}$ precharge to $\overline{WE}$ delay time	t_{CPWD}	55	–	60	–	70	–	85	–	ns	1

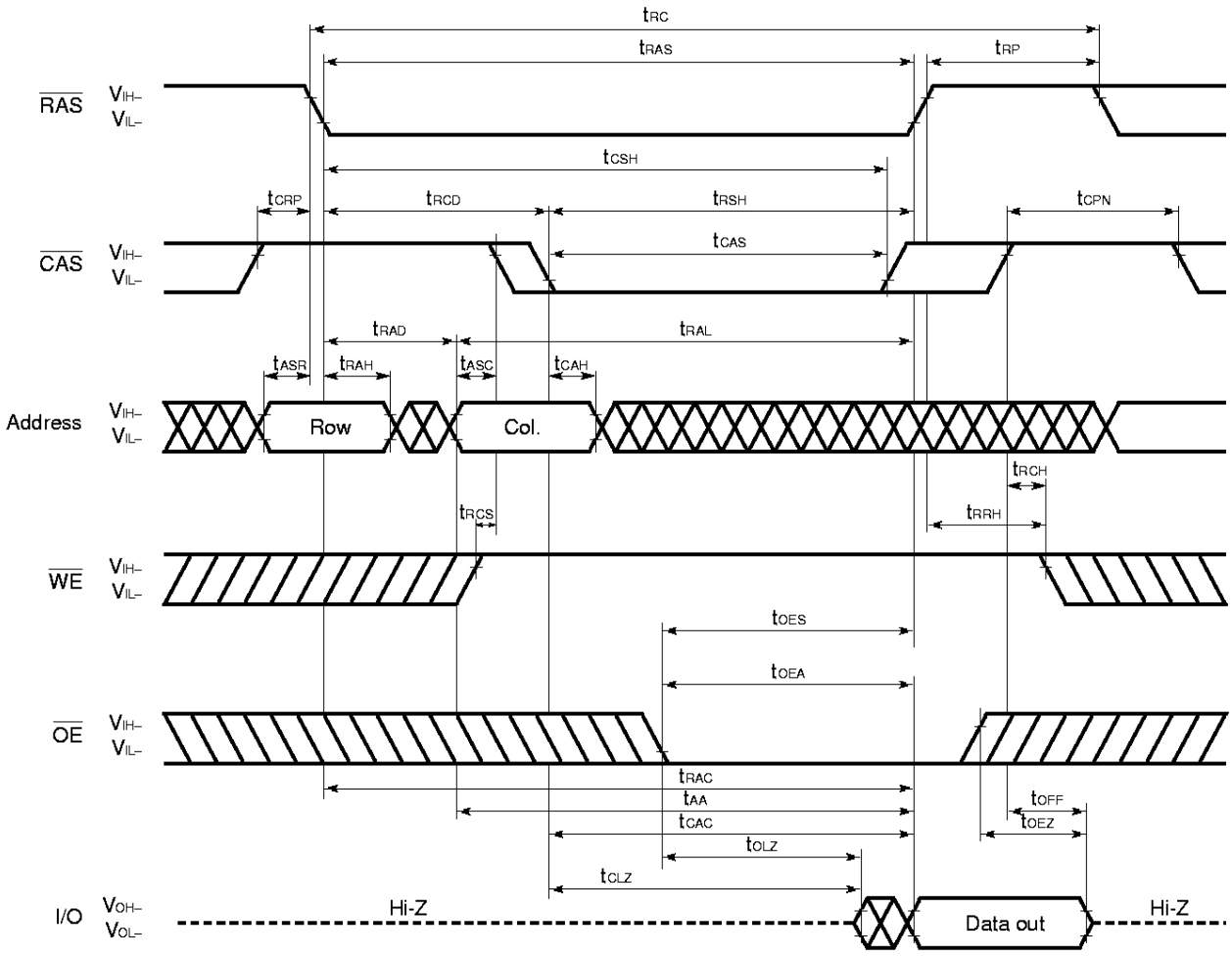
Note 1. If $t_{WCS} \geq t_{WCS\,(MIN.)}$, the cycle is an early write cycle and the data out will remain Hi-Z through the entire cycle. If $t_{RWD} \geq t_{RWD\,(MIN.)}$, $t_{CWD} \geq t_{CWD\,(MIN.)}$, $t_{AWD} \geq t_{AWD\,(MIN.)}$ and $t_{CPWD} \geq t_{CPWD\,(MIN.)}$, the cycle is a read modify write 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.

Refresh Cycle

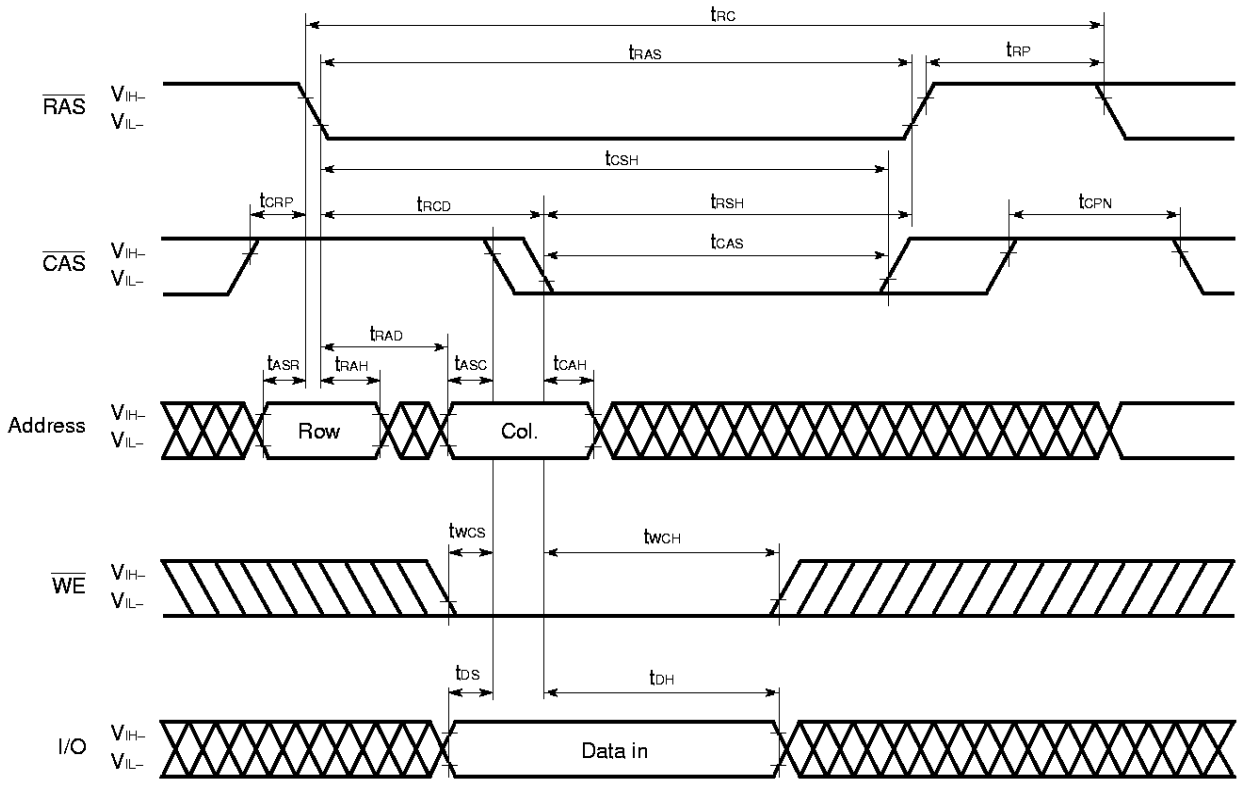
Parameter	Symbol	t_{RAC} = 60 ns		t_{RAC} = 70 ns		t_{RAC} = 80 ns		t_{RAC} = 100 ns		Unit	Note
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
$\overline{CAS}$ setup time	t_{CSR}	10	–	10	–	10	–	10	–	ns	
$\overline{CAS}$ hold time ($\overline{CAS}$ before $\overline{RAS}$ refresh)	t_{CHR}	10	–	10	–	15	–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

Note 1. This specification is applied only to the μPD42S4400-60, 42S4400-70.

Read Cycle

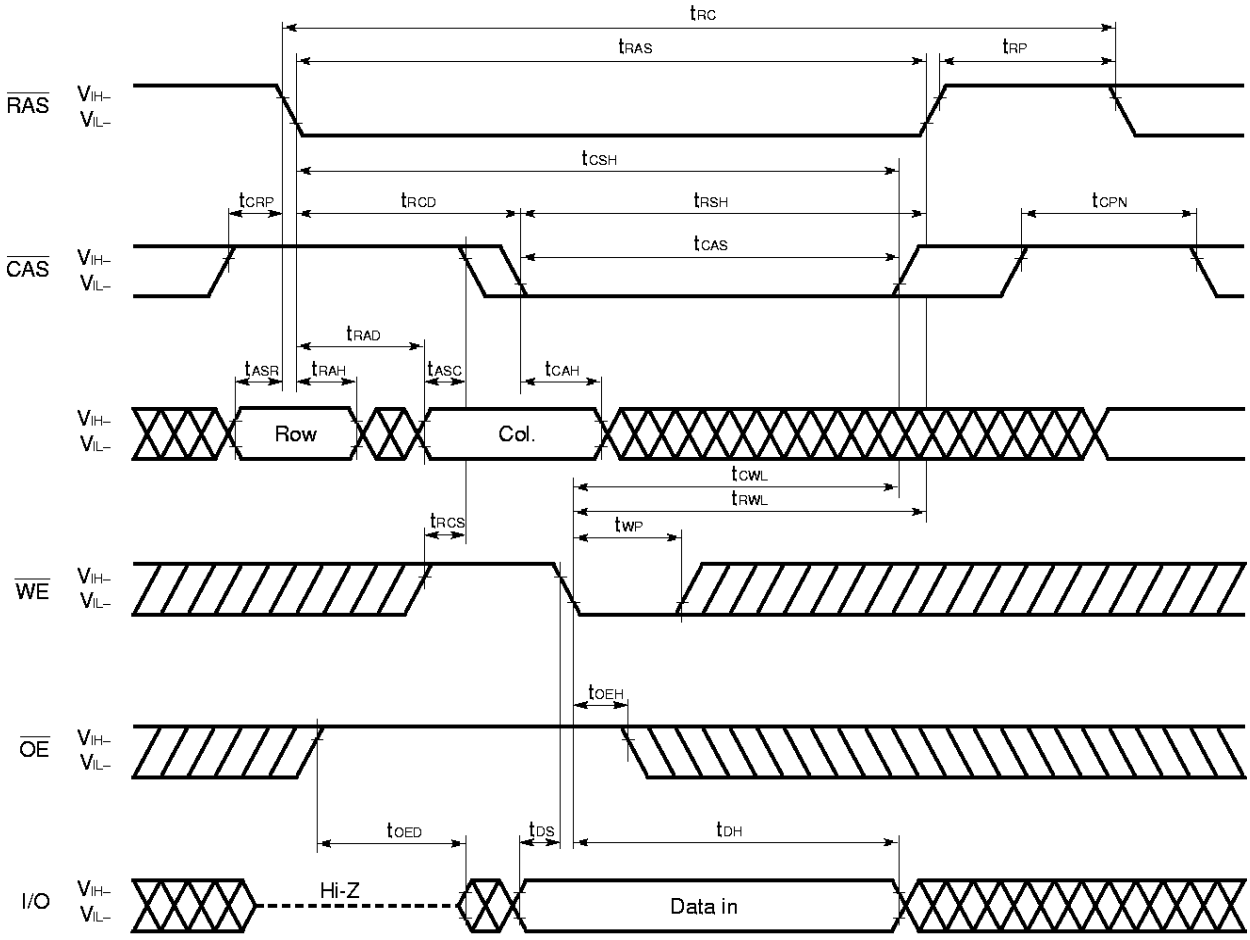

tRC
tRAS
tRP
RAS
VIH–
VIL–
tCSH
tCRP
tRCD
tRSH
tCPN
CAS
tCAS
tRAD
tRAL
tASR
tRAH
tASC
tCAH
Address
Row
Col.
tRCH
tRCS
tRRH
WE
tOES
tOEA
OE
tRAC
tAA
tCAC
tOLZ
tOFF
tOEZ
tCLZ
I/O
VOH–
VOL–
Hi-Z
Data out
Hi-Z

Early Write Cycle

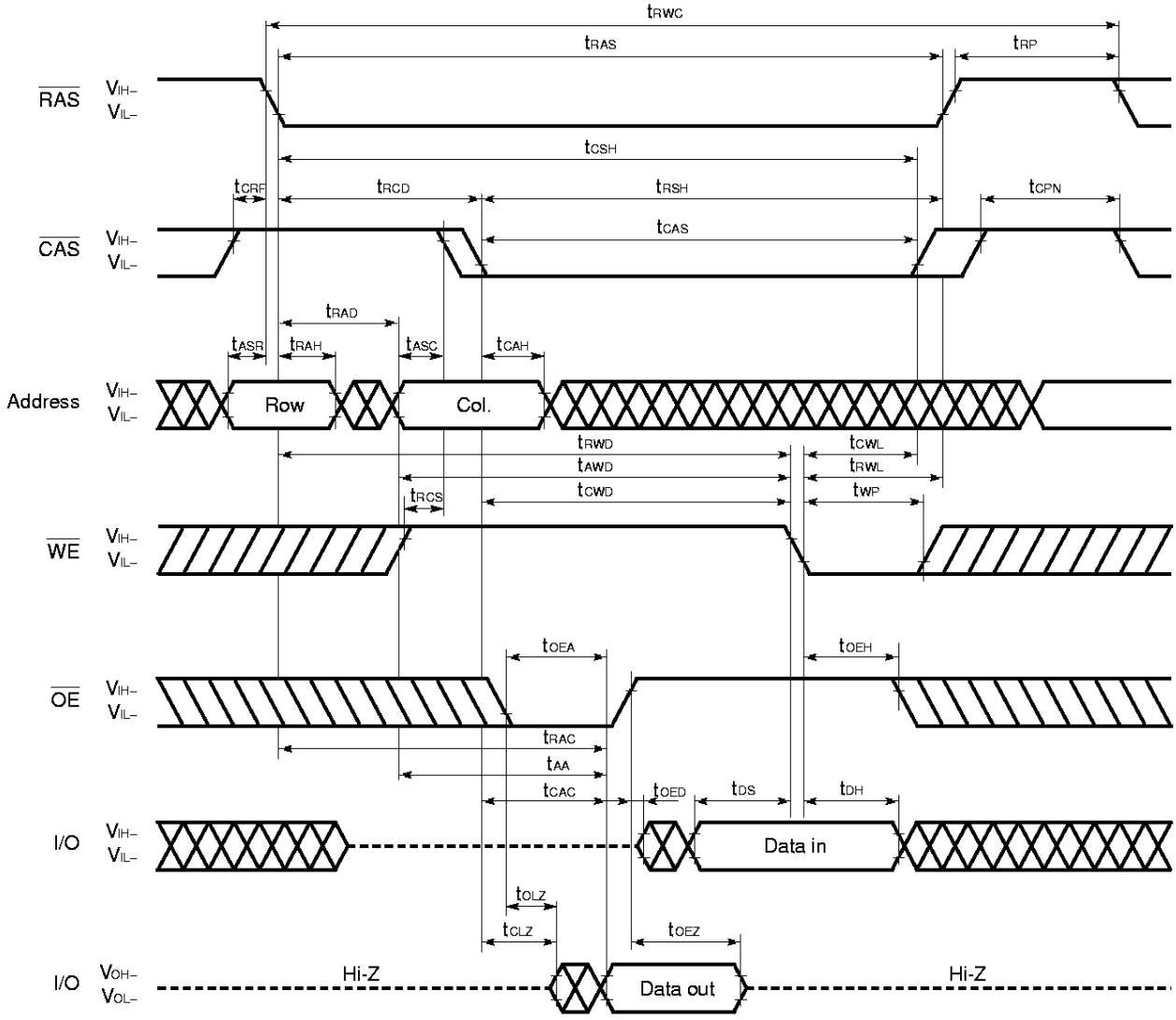


Remark $\overline{OE}$: Don't care

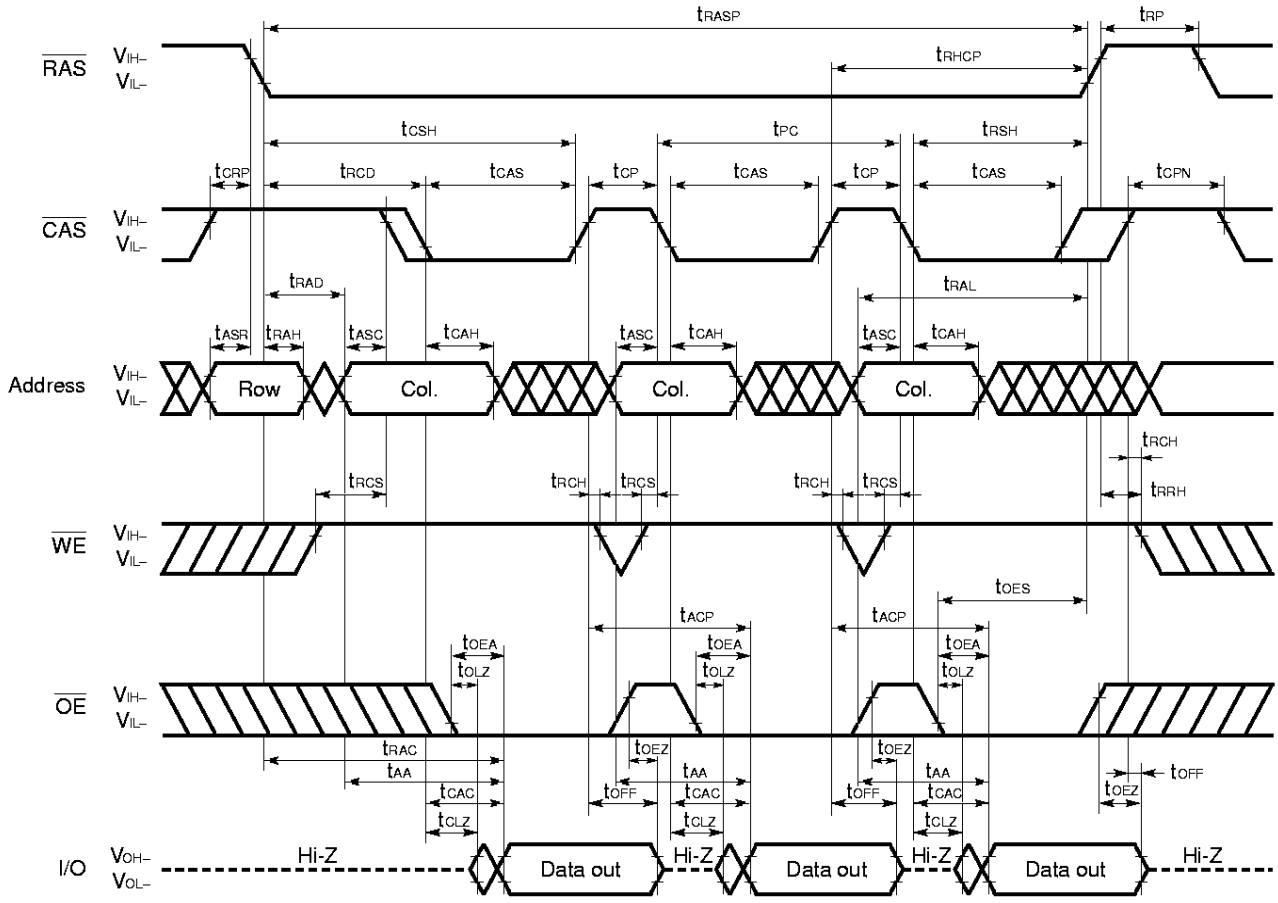
Late Write Cycle



Read Modify Write Cycle

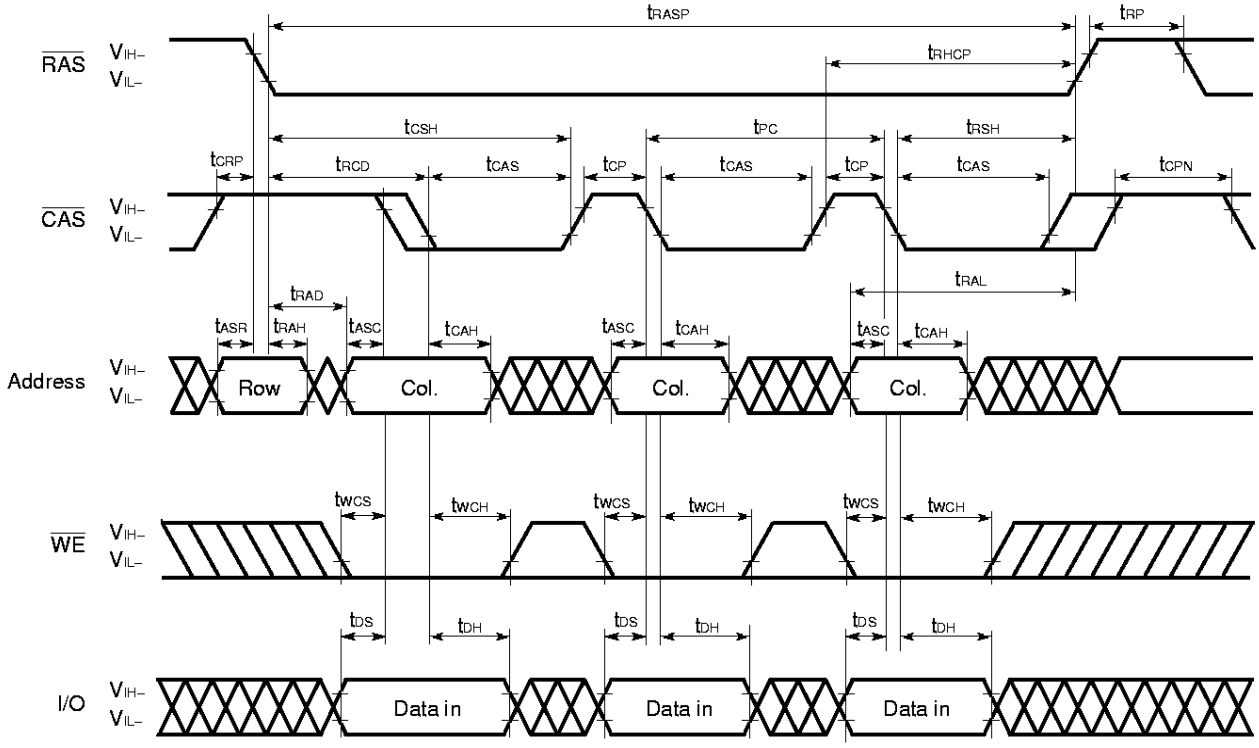


Fast Page Mode Read Cycle



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

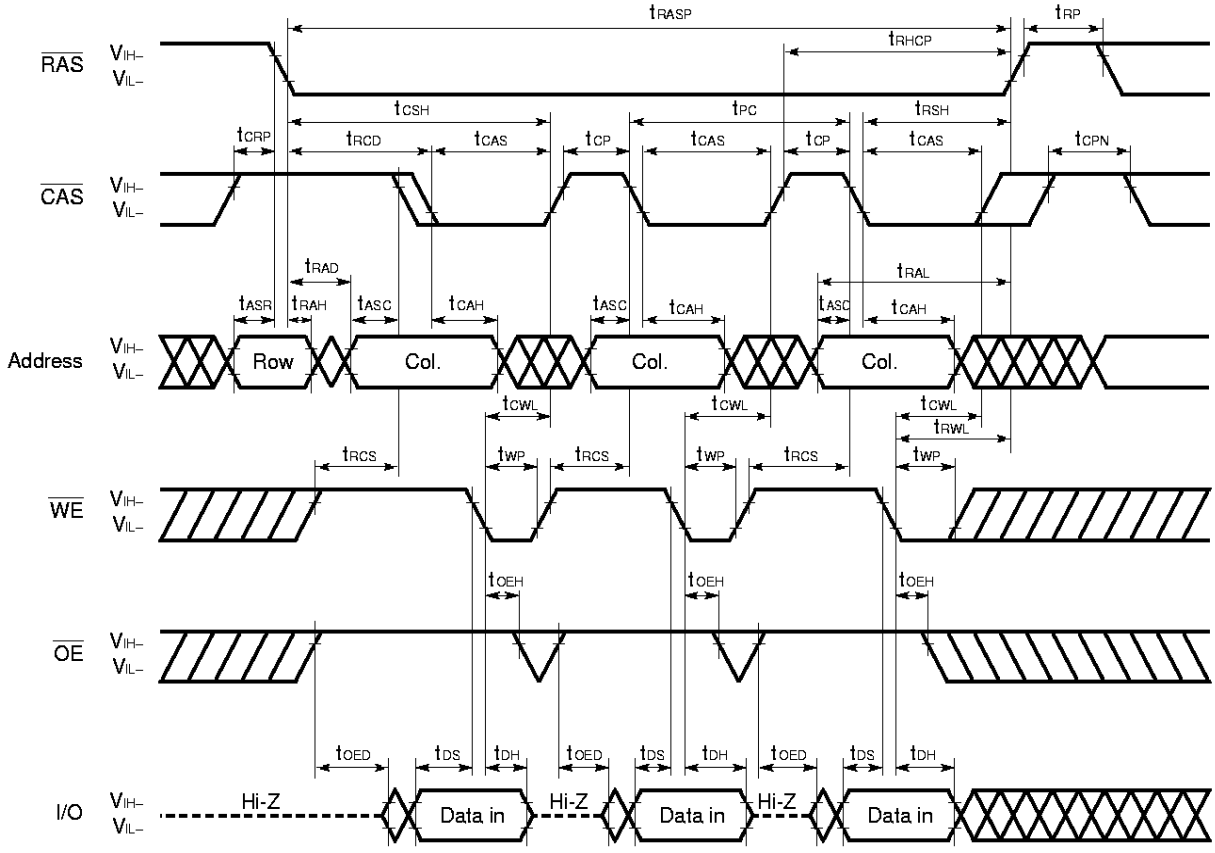
Fast Page Mode Early Write Cycle



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

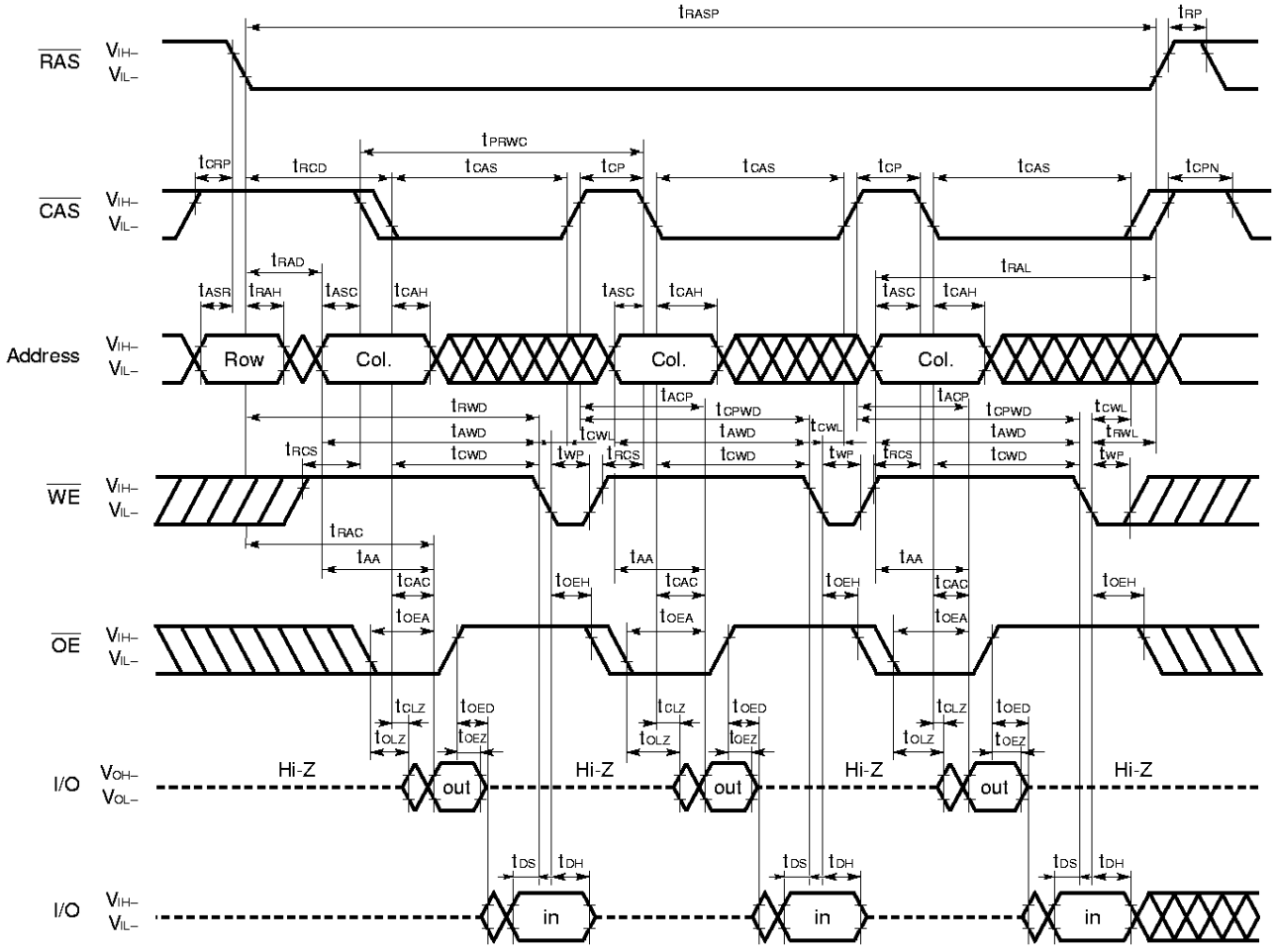
2. In the fast page mode, read, write and read modify write cycles are available for each of the consecutive $\overline{CAS}$ cycles within the same $\overline{RAS}$ cycle.

Fast Page Mode Late Write Cycle



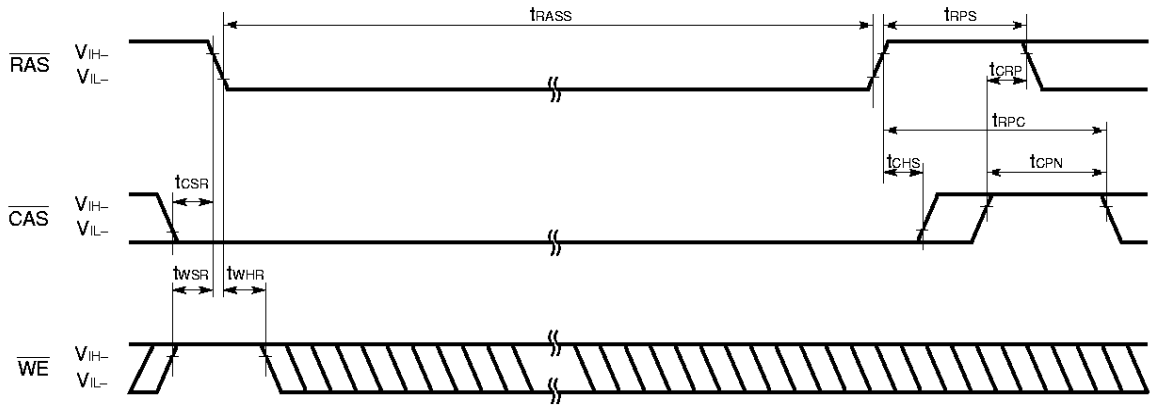
Remark In the fast page mode, read, write and read modify write cycles are available for each of the consecutive $\overline{CAS}$ cycles within the same $\overline{RAS}$ cycle.

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 $\overline{CAS}$ cycles within the same $\overline{RAS}$ cycle.

$\overline{CAS}$ Before $\overline{RAS}$ Self Refresh Cycle (Only for the μPD42S4400)



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

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

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

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

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

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

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

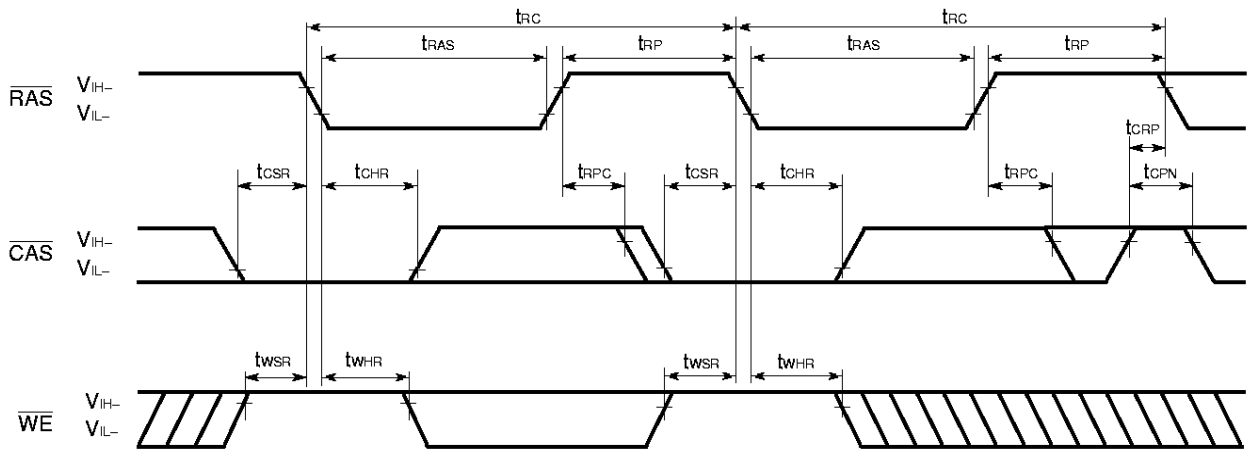
(3) If $t_{RASS\ (MIN.)}$ is not satisfied at the beginning of $\overline{CAS}$ before $\overline{RAS}$ self refresh cycles (t_{RAS} < 100 μs), $\overline{CAS}$ before $\overline{RAS}$ refresh cycles will be executed one time. ★

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

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

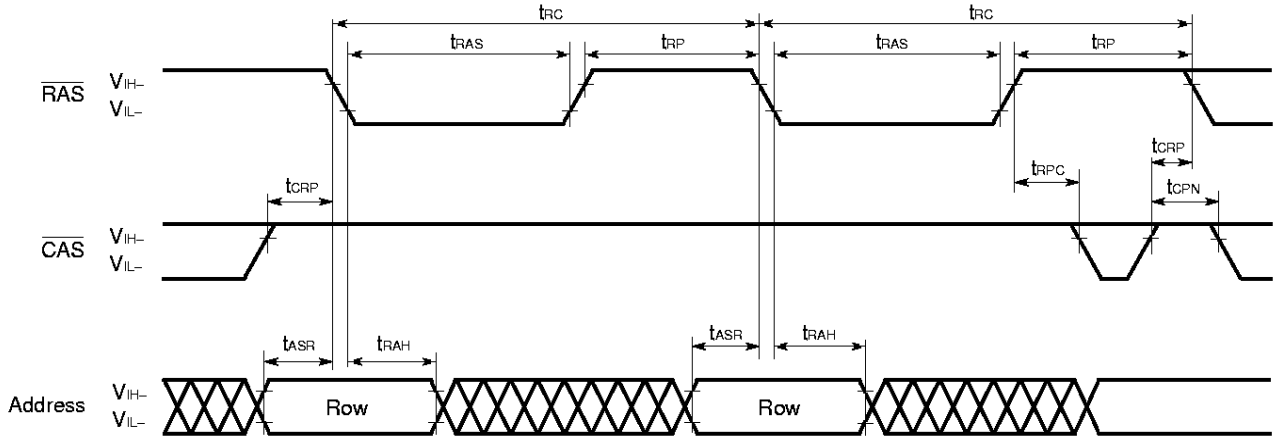
For details, please refer to **How to use DRAM** User's Manual.

★ **$\overline{CAS}$ Before $\overline{RAS}$ Refresh Cycle**



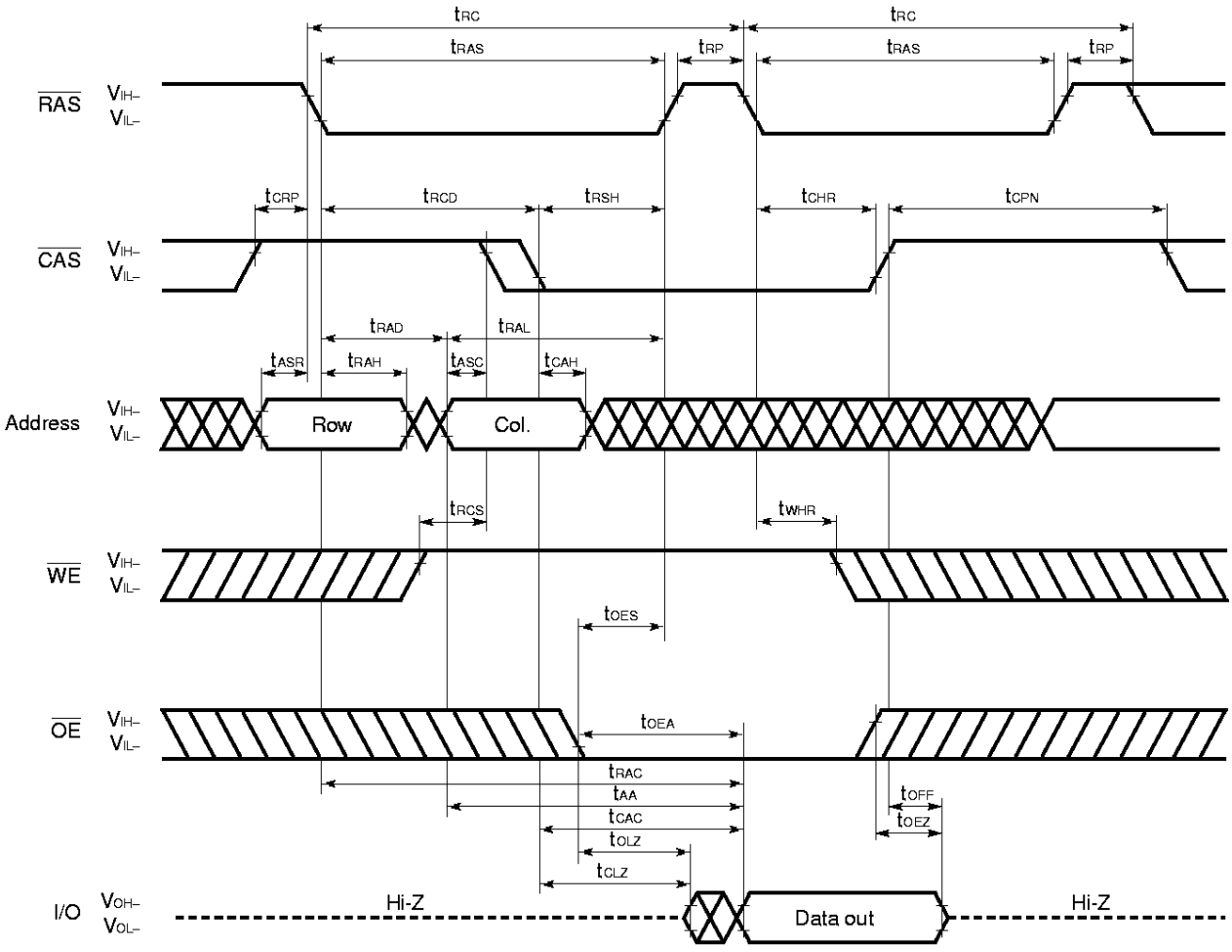
Remark Address, $\overline{OE}$: Don't care I/O: Hi-Z

$\overline{RAS}$ Only Refresh Cycle

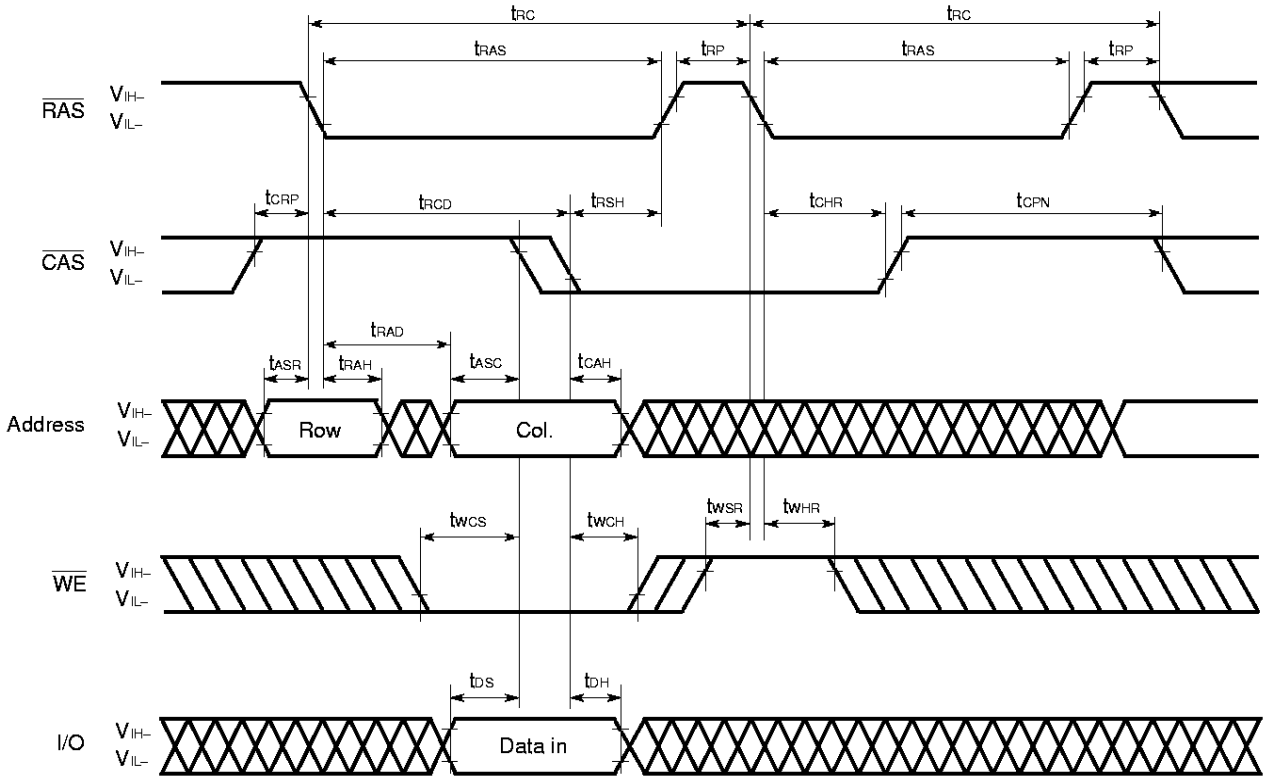


Remark $\overline{WE}$, $\overline{OE}$: Don't care I/O: Hi-Z

Hidden Refresh Cycle (Read)

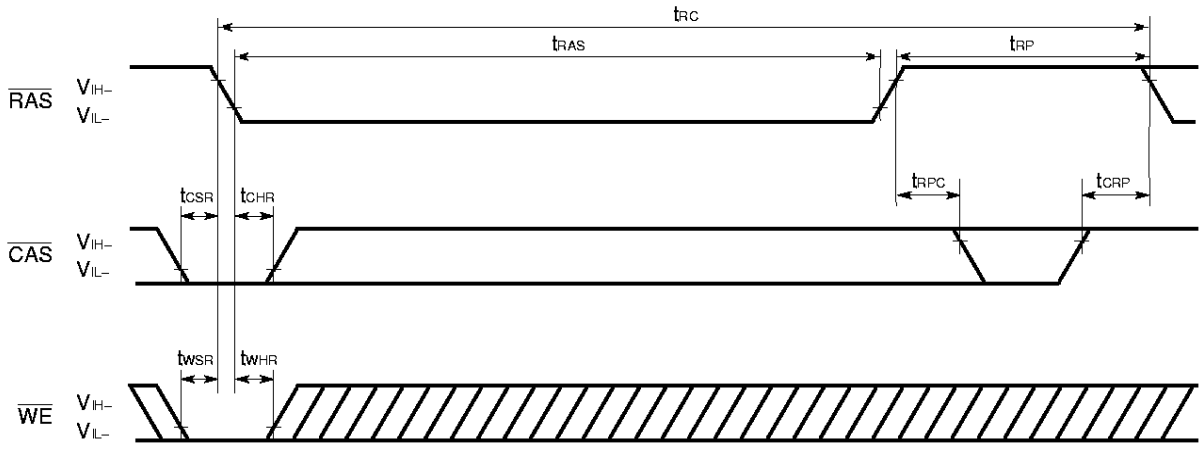


★ **Hidden Refresh Cycle (Write)**



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

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



Remark Address, $\overline{OE}$: 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 × 8-bit organization during test mode. Don't care about the input level of the $\overline{CAS}$ input A0.

(1) Setting the mode

Executing the test mode cycle ($\overline{WE}$, $\overline{CAS}$ before $\overline{RAS}$ 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

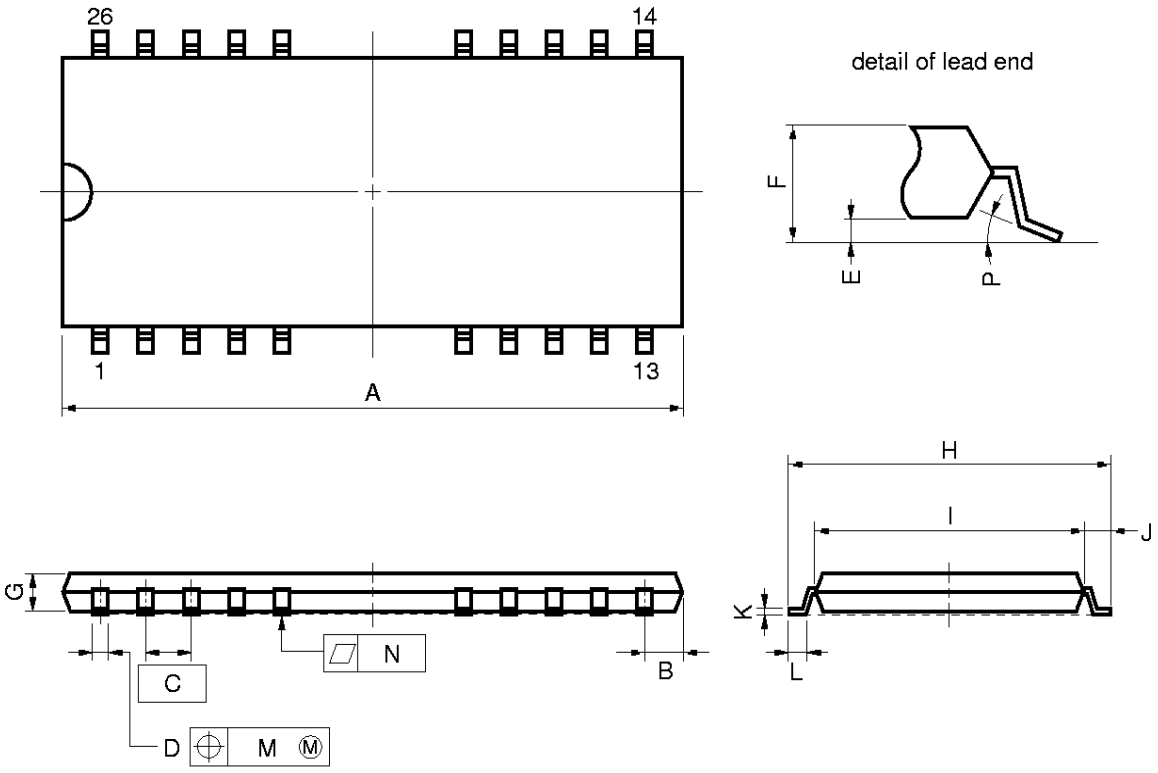
Refresh in the test mode must be performed with the $\overline{RAS}$ / $\overline{CAS}$ cycle or with the $\overline{WE}$, $\overline{CAS}$ before $\overline{RAS}$ refresh cycle. The $\overline{WE}$, $\overline{CAS}$ before $\overline{RAS}$ refresh cycle use the same counter as the $\overline{CAS}$ before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

(4) Mode Cancellation

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

Package Drawings

26 PIN PLASTIC TSOP (II) (300 mil)



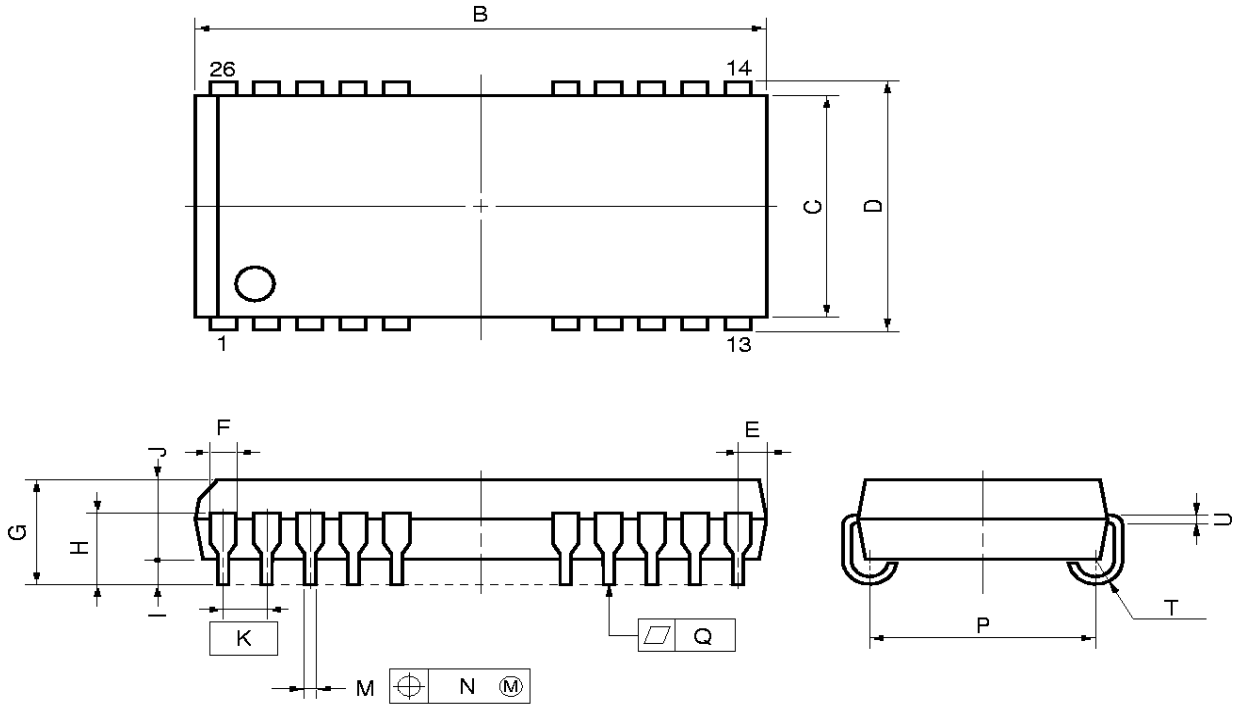
NOTE

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	$3°^{+7°}_{-3°}$	$3°^{+7°}_{-3°}$

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".

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

[MEMO]