

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 dynamic CMOS 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	660 mW	60 ns	120 ns	40 ns
μ PD42S4400-70, 424400-70	550 mW	70 ns	140 ns	45 ns
μ PD424400-80	495 mW	80 ns	160 ns	50 ns
μ PD424400-10	440 mW	100 ns	190 ns	60 ns

- 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

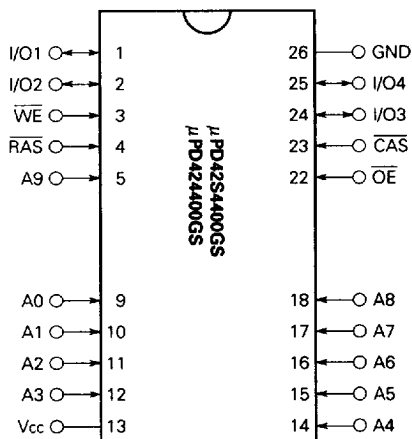
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Ordering Information

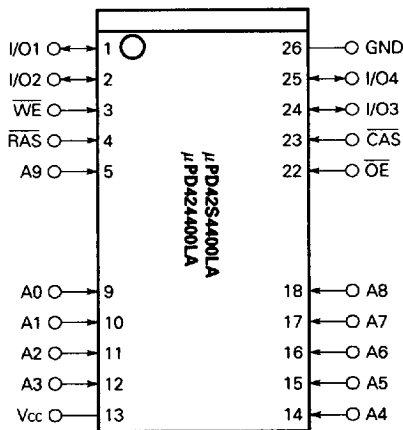
Part number	Access time (MAX.)	Package	Refresh
μ PD42S4400GS-60	60 ns	26-pin Plastic TSOP (II) (300 mil)	$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh
μ PD42S4400GS-70	70 ns		$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh
μ PD42S4400LA-60	60 ns	26-pin Plastic SOJ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

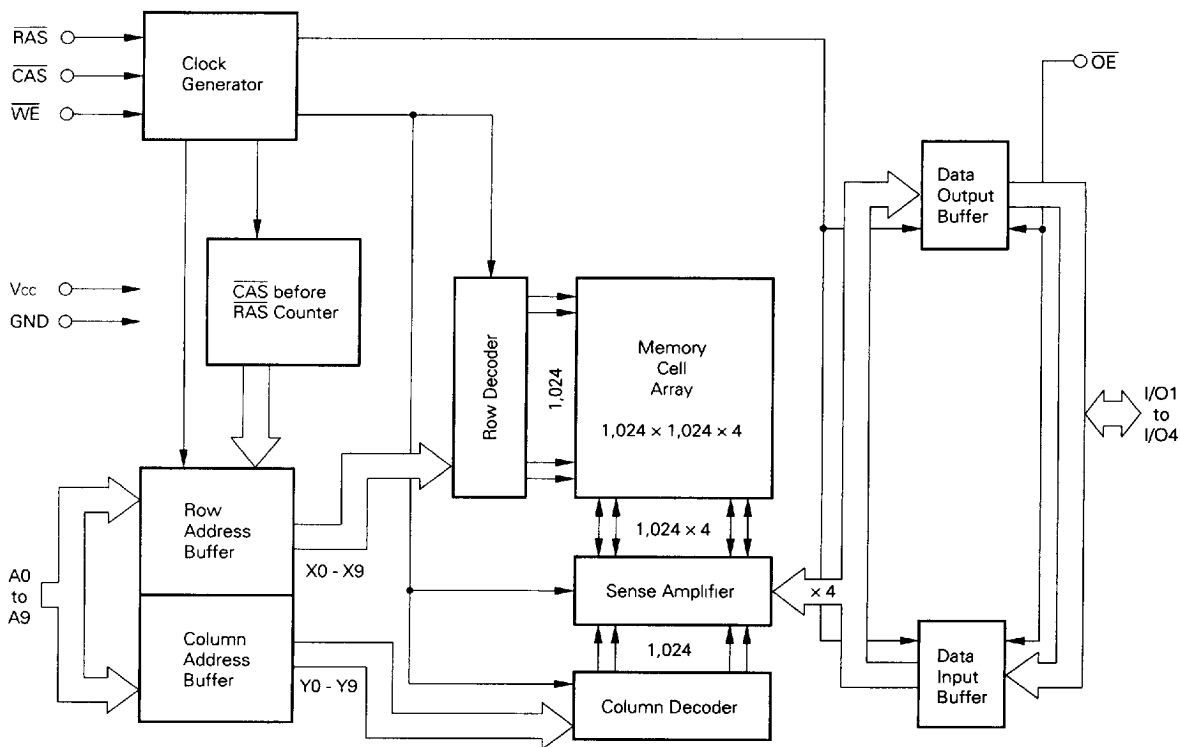


26-pin Plastic SOJ (300 mil)



- 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
- Vcc : Power Supply
- GND : Ground

Block Diagram



Input/Output Pin Functions

The μPD42S4400, 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, wait more than 100 μ s and then, execute eight $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ or $\overline{\text{RAS}}$ 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}	$\overline{\text{RAS}}$, $\overline{\text{CAS}}$, $\overline{\text{WE}}$, $\overline{\text{OE}}$			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 $t_{RC} = t_{RC(MIN)}$ $I_O = 0 \text{ mA}$	$t_{RAC} = 60 \text{ ns}$	120	mA	1, 2, 3
				$t_{RAC} = 70 \text{ ns}$	100		
				$t_{RAC} = 80 \text{ ns}$	90		
				$t_{RAC} = 100 \text{ ns}$	80		
Standby current	μPD42S4400	I _{CC2}	$\overline{RAS}, \overline{CAS} \geq V_{IH(MIN)}, I_O = 0 \text{ mA}$		2.0	mA	
			$\overline{RAS}, \overline{CAS} \geq V_{CC} - 0.2 \text{ V}, I_O = 0 \text{ mA}$		0.15		
	μPD424400		$\overline{RAS}, \overline{CAS} \geq V_{IH(MIN)}, I_O = 0 \text{ mA}$		2.0		
			$\overline{RAS}, \overline{CAS} \geq V_{CC} - 0.2 \text{ V}, I_O = 0 \text{ mA}$		1.0		
RAS only refresh current		I _{CC3}	$\overline{RAS}$ Cycling, $\overline{CAS} \geq V_{IH(MIN)}$ $t_{RC} = t_{RC(MIN)}, I_O = 0 \text{ mA}$	$t_{RAC} = 60 \text{ ns}$	120	mA	1, 2, 3, 4
				$t_{RAC} = 70 \text{ ns}$	100		
				$t_{RAC} = 80 \text{ ns}$	90		
				$t_{RAC} = 100 \text{ ns}$	80		
Operating current (Fast page mode)		I _{CC4}	$\overline{RAS} \leq V_{IL(MAX)}, \overline{CAS}$ Cycling $t_{PC} = t_{PC(MIN)}, I_O = 0 \text{ mA}$	$t_{RAC} = 60 \text{ ns}$	90	mA	1, 2, 5
				$t_{RAC} = 70 \text{ ns}$	80		
				$t_{RAC} = 80 \text{ ns}$	70		
				$t_{RAC} = 100 \text{ ns}$	60		
CAS before RAS refresh current		I _{CC5}	$\overline{RAS}$ Cycling $t_{RC} = t_{RC(MIN)}$ $I_O = 0 \text{ mA}$	$t_{RAC} = 60 \text{ ns}$	120	mA	1, 2
				$t_{RAC} = 70 \text{ ns}$	100		
				$t_{RAC} = 80 \text{ ns}$	90		
				$t_{RAC} = 100 \text{ ns}$	80		
CAS before RAS long refresh current (1,024 Cycles / 128 ms, only for the μPD42S4400)		I _{CC6}	CAS before RAS refresh : $t_{RC} = 125.0 \mu\text{s}$ RAS, CAS : $V_{CC} - 0.2 \text{ V} \leq V_{IH} \leq V_{IH(MAX)}$ $0 \text{ V} \leq V_{IL} \leq 0.2 \text{ V}$ Standby : $\overline{RAS}, \overline{CAS} \geq V_{CC} - 0.2 \text{ V}$ Address : V_{IH} or V_{IL} WE, OE: V_{IH} $I_O = 0 \text{ mA}$	$t_{RAS} \leq 200 \text{ ns}$	200	μA	1, 2
				$t_{RAS} \leq 1 \mu\text{s}$	300	μA	1, 2
CAS before RAS self refresh current (only for the μPD42S4400)		I _{CC7}	$\overline{RAS}, \overline{CAS}$: $t_{RAS} = 5 \text{ ms}$ $V_{CC} - 0.2 \text{ V} \leq V_{IH} \leq V_{IH(MAX)}$ $0 \text{ V} \leq V_{IL} \leq 0.2 \text{ V}$ $I_O = 0 \text{ mA}$		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.

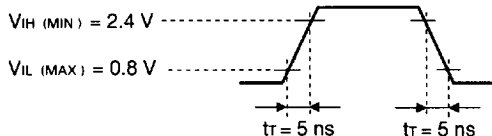
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3. I_{CC1} and I_{CC3} are measured assuming that address can be changed once or less during $\overline{RAS} \leq V_{IL(MAX.)}$ and $\overline{CAS} \geq V_{IH(MIN.)}$.
4. I_{CC3} is measured assuming that all column address inputs are held at either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

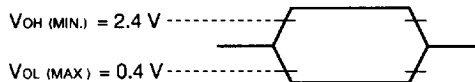
AC Characteristics (Recommended Operating Conditions unless otherwise noted)

AC Characteristics Test Conditions

(1) Input timing specification



(2) Output timing specification



(3) Loading conditions are 100 pF + 2 TTLs.

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 _{RS}	60	10,000	70	10,000	80	10,000	100	10,000	ns	
$\overline{CAS}$ 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	40	20	50	25	60	25	75	ns	1
$\overline{RAS}$ to Column Address Delay Time	t _{RAD}	15	30	15	35	17	40	17	50	ns	1
$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	t _{CRP}	10	–	10	–	10	–	10	–	ns	2
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	3
	μPD424400	t _{REF}	–	16	–	16	–	16	–	ms	

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

Input Conditions	Access Time	Access Time from $\overline{\text{RAS}}$
$\text{trAD} \leq \text{trAD (MAX.)}$ and $\text{trCD} \leq \text{trCD (MAX.)}$	trAC (MAX.)	trAC (MAX.)
$\text{trAD} > \text{trAD (MAX.)}$ and $\text{trCD} \leq \text{trCD (MAX.)}$	tAA (MAX.)	$\text{trAD} + \text{tAA (MAX.)}$
$\text{trCD} > \text{trCD (MAX.)}$	tCAC (MAX.)	$\text{trCD} + \text{tCAC (MAX.)}$

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

- tCRP (MIN.) requirement is applied to $\overline{\text{RAS}}$, $\overline{\text{CAS}}$ cycles preceded by any cycle.
- This specification is applied only to the μ PD42S4400.

Read Cycle

Parameter	Symbol	$\text{trAC} = 60 \text{ ns}$		$\text{trAC} = 70 \text{ ns}$		$\text{trAC} = 80 \text{ ns}$		$\text{trAC} = 100 \text{ ns}$		Unit	Notes
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Access Time from $\overline{\text{RAS}}$	trAC	–	60	–	70	–	80	–	100	ns	1
Access Time from $\overline{\text{CAS}}$	tCAC	–	15	–	20	–	20	–	25	ns	1
Access Time from Column Address	tAA	–	30	–	35	–	40	–	50	ns	1
Access Time from $\overline{\text{OE}}$	tOEA	–	15	–	20	–	20	–	25	ns	
Column Address Lead Time Referenced to $\overline{\text{RAS}}$	trAL	30	–	35	–	40	–	50	–	ns	
Read Command Setup Time	trCS	0	–	0	–	0	–	0	–	ns	
Read Command Hold Time Referenced to $\overline{\text{RAS}}$	trRH	0	–	0	–	10	–	10	–	ns	2
Read Command Hold Time Referenced to $\overline{\text{CAS}}$	trCH	0	–	0	–	0	–	0	–	ns	2
Output Buffer Turn-off Delay Time from $\overline{\text{OE}}$	toEZ	0	15	0	15	0	20	0	25	ns	3
Output Buffer Turn-off Delay Time from $\overline{\text{CAS}}$	toFF	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 $\overline{\text{RAS}}$
$\text{trAD} \leq \text{trAD (MAX.)}$ and $\text{trCD} \leq \text{trCD (MAX.)}$	trAC (MAX.)	trAC (MAX.)
$\text{trAD} > \text{trAD (MAX.)}$ and $\text{trCD} \leq \text{trCD (MAX.)}$	tAA (MAX.)	$\text{trAD} + \text{tAA (MAX.)}$
$\text{trCD} > \text{trCD (MAX.)}$	tCAC (MAX.)	$\text{trCD} + \text{tCAC (MAX.)}$

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

- Either trCH (MIN.) or trRH (MIN.) should be met in read cycles.
- toFF (MAX.) and toEZ (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 _{WAC} = 60 ns		t _{WAC} = 70 ns		t _{WAC} = 80 ns		t _{WAC} = 100 ns		Unit	Notes
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
$\overline{WE}$ Hold Time Referenced to $\overline{CAS}$	twch	15	–	15	–	15	–	20	–	ns	1
$\overline{WE}$ Pulse Width	twp	10	–	10	–	15	–	20	–	ns	1
$\overline{WE}$ Lead Time Referenced to $\overline{RAS}$	trwl	15	–	20	–	20	–	25	–	ns	
$\overline{WE}$ Lead Time Referenced to $\overline{CAS}$	tcwl	15	–	15	–	15	–	20	–	ns	
$\overline{WE}$ Setup Time	twcs	0	–	0	–	0	–	0	–	ns	2
$\overline{OE}$ Hold Time	toeh	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_{WAC} (MIN.) is applied to late write cycles or read modify write cycles. In early write cycles, twch (MIN.) should be met.
 2. If twcs $\geq$ twcs (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 _{WAC} = 60 ns		t _{WAC} = 70 ns		t _{WAC} = 80 ns		t _{WAC} = 100 ns		Unit	Note
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Read Modify Write Cycle Time	trwc	150	–	180	–	210	–	250	–	ns	
$\overline{RAS}$ to $\overline{WE}$ Delay Time	trwd	80	–	90	–	105	–	130	–	ns	1
$\overline{CAS}$ to $\overline{WE}$ Delay Time	tcwd	35	–	40	–	45	–	55	–	ns	1
Column Address to $\overline{WE}$ Delay Time	tawd	50	–	55	–	65	–	80	–	ns	1

- Note**
1. If twcs $\geq$ twcs (MIN.), the cycle is an early write cycle and the data out will remain Hi-Z through the entire cycle. If trwd $\geq$ trwd (MIN.), tcwd $\geq$ tcwd (MIN.), tawd $\geq$ tawd (MIN.) and tcpwd $\geq$ tcpwd (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 $\overline{\text{CAS}}$ 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	—	90	—	100	—	120	—	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.

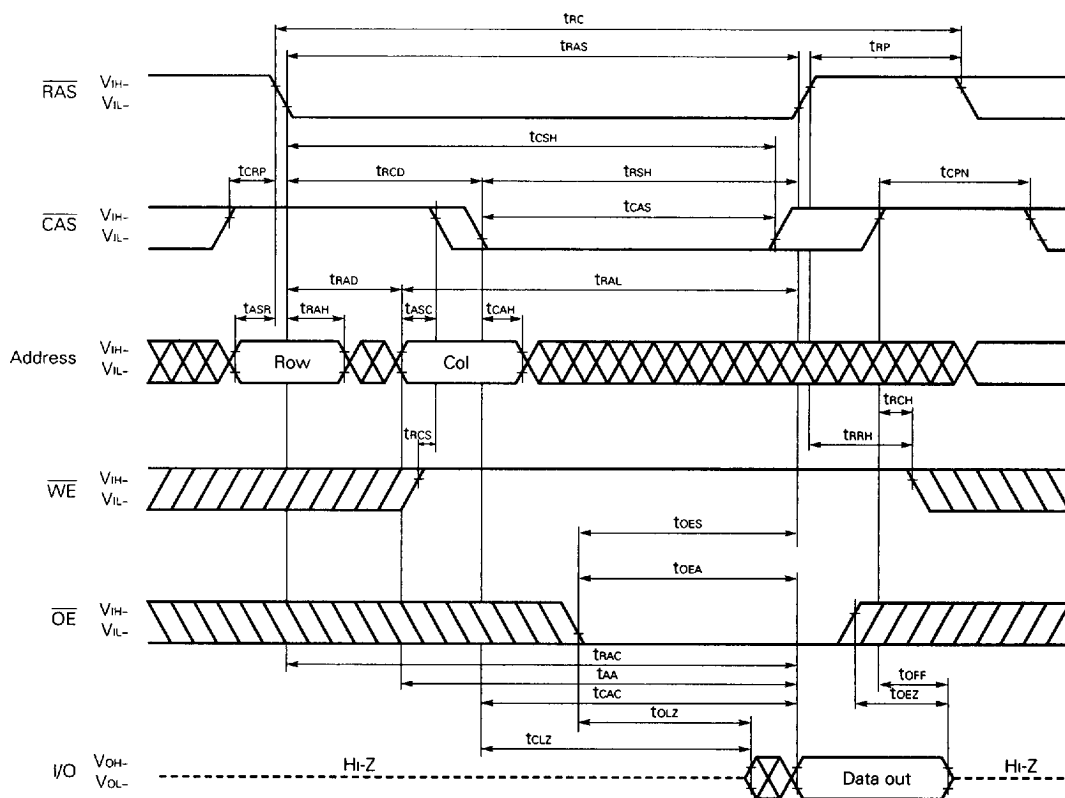
Refresh Cycle

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	—	—	—	—	—	μs	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	

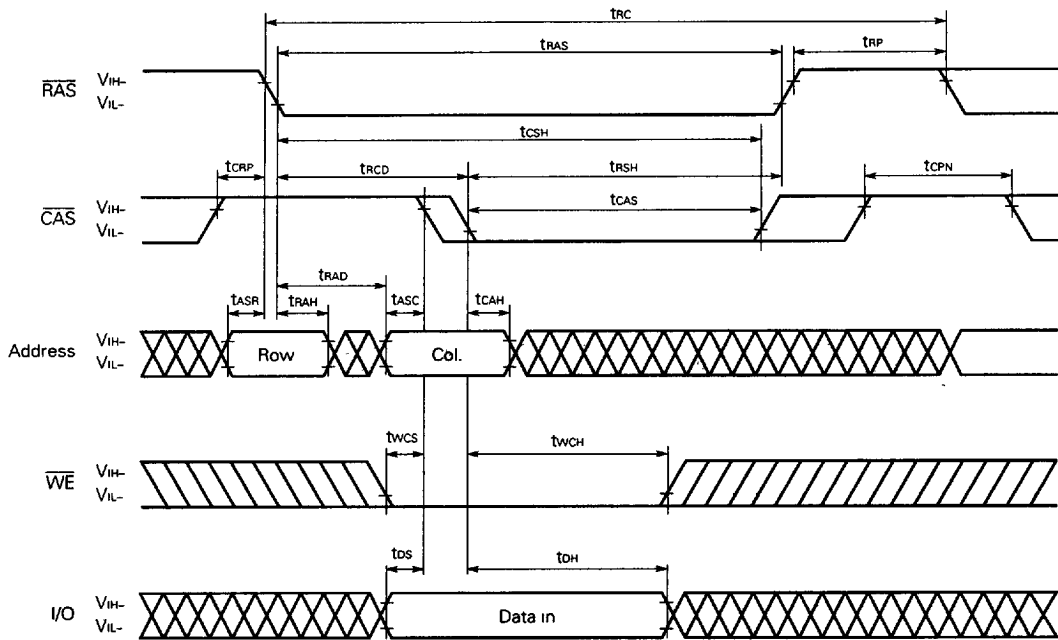
Note 1. This specification is applied only to the μPD42S4400.

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Read Cycle

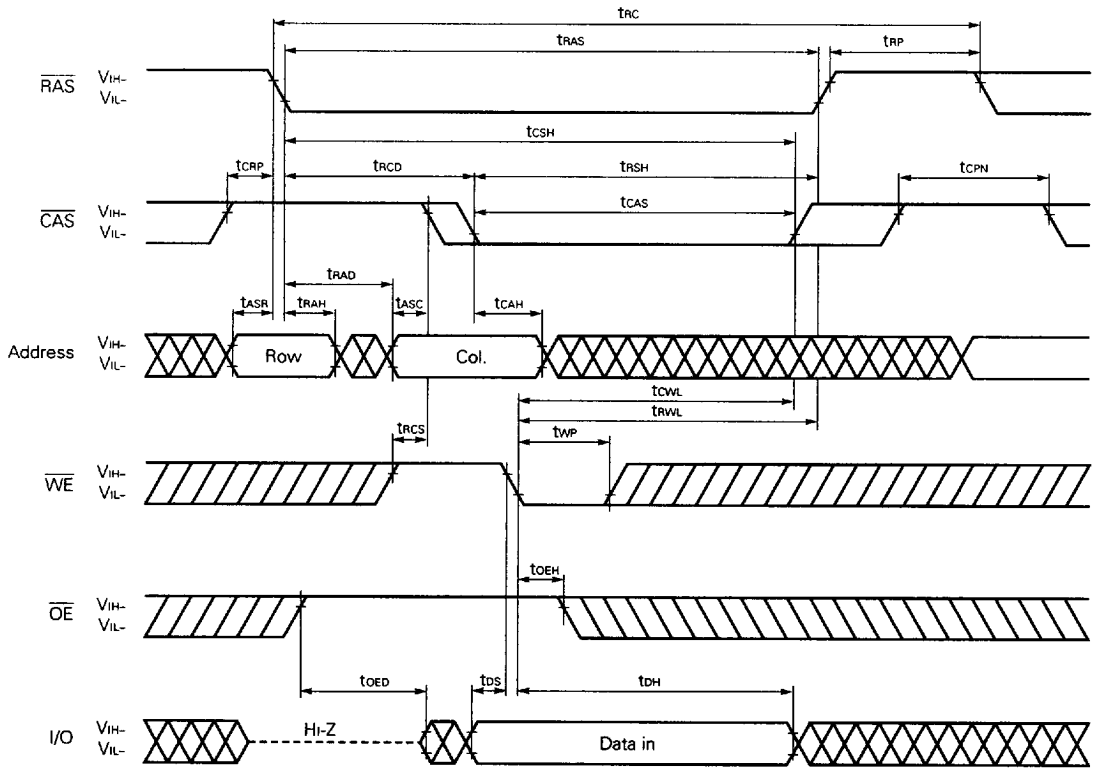


Early Write Cycle

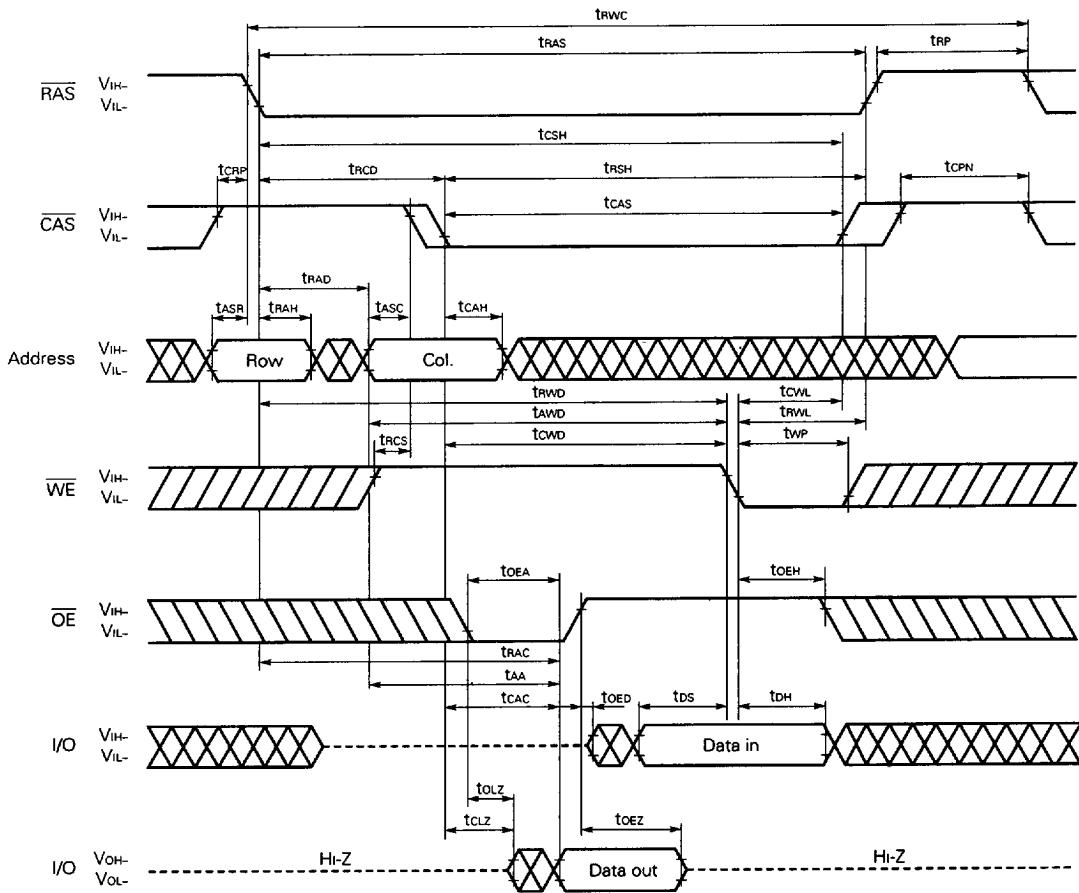


Remark $\overline{\text{OE}}$: Don't care

Late Write Cycle

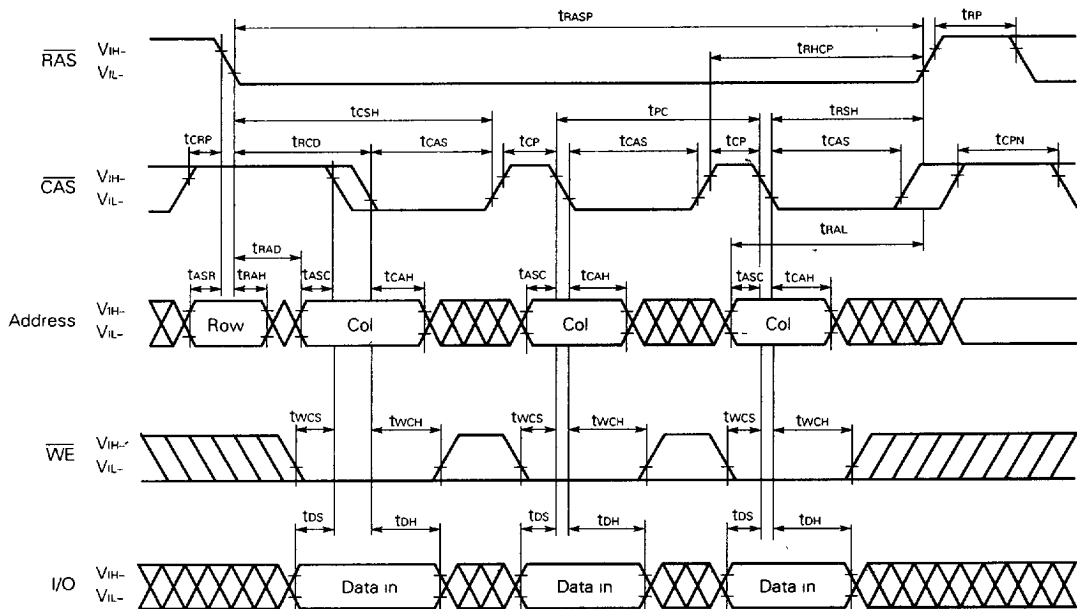


Read Modify Write Cycle



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Fast Page Mode Early Write Cycle



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

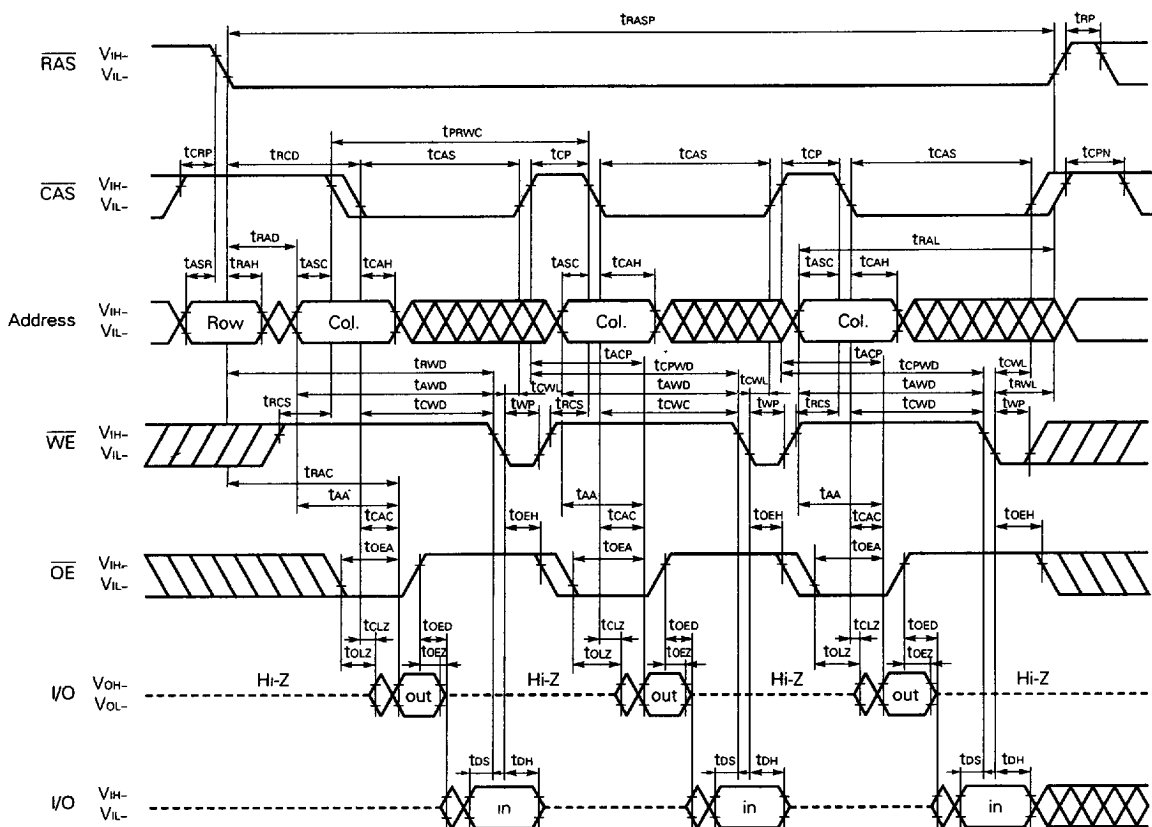
2. In the fast page mode, read, write and read modify write cycles are available for each of the consecutive $\overline{\text{CAS}}$ cycles within the same $\overline{\text{RAS}}$ cycle.

The diagram illustrates the timing relationships for a 16K16B1T1 DRAM. The signals shown are RAS, CAS, Address, WE, OE, and I/O. The timing parameters are defined as follows:

- RAS**: t_{RAS} (RAS to output delay), t_{RCD} (RAS to CAS delay), t_{RSH} (RAS to output delay), t_{RCP} (RAS to output delay).
- CAS**: t_{CAS} (CAS to output delay), t_{CD} (CAS to output delay), t_{CP} (CAS to output delay), t_{CPN} (CAS to output delay).
- Address**: t_{ASR} (Address to output delay), t_{AD} (Address to output delay), t_{AS} (Address to output delay), t_{AH} (Address to output delay), t_{AS} (Address to output delay), t_{AH} (Address to output delay), t_{AS} (Address to output delay), t_{AH} (Address to output delay).
- WE**: t_{WCS} (WE to output delay), t_{WP} (WE to output delay), t_{WCS} (WE to output delay), t_{WP} (WE to output delay), t_{WCS} (WE to output delay), t_{WP} (WE to output delay).
- OE**: t_{OEH} (OE to output delay), t_{OEH} (OE to output delay), t_{OEH} (OE to output delay).
- I/O**: t_{OED} (OE to output delay), t_{DS} (Data to output delay), t_{DH} (Data to output delay), t_{OED} (OE to output delay), t_{DS} (Data to output delay), t_{DH} (Data to output delay), t_{OED} (OE to output delay), t_{DS} (Data to output delay), t_{DH} (Data to output delay).

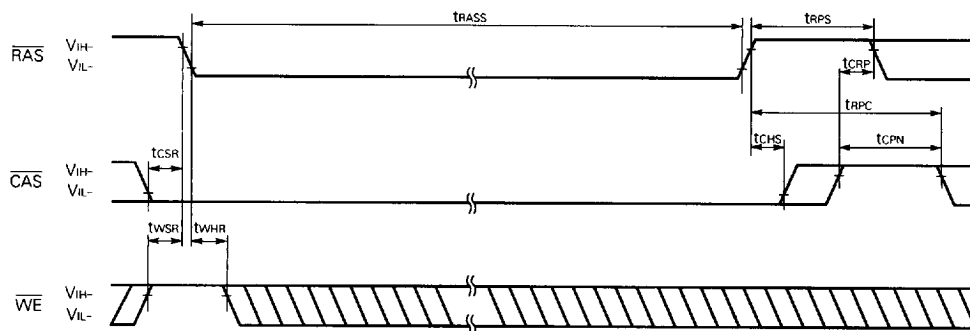
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Fast Page Mode Read Modify Write Cycle



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.

CAS Before RAS Self Refresh Cycle (Only for the μPD42S4400)



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

Cautions on Use of CAS Before RAS Self Refresh

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

(1) Normal Combined Use of CAS Before RAS Self Refresh and Burst CAS Before RAS Long Refresh

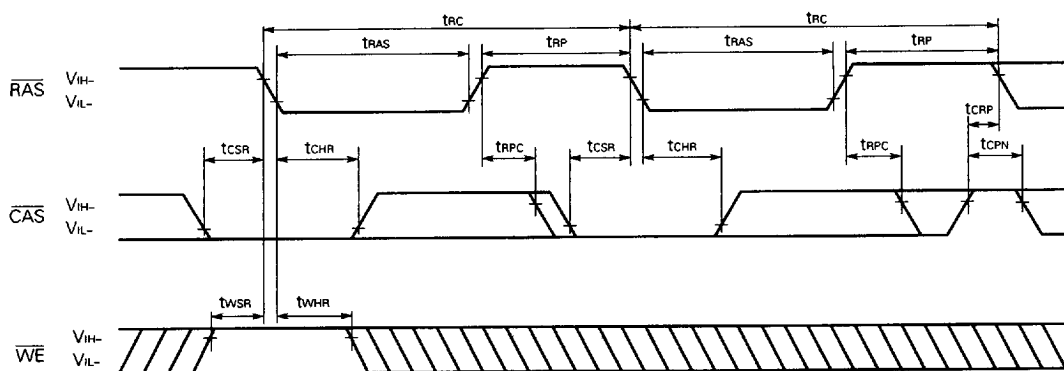
When CAS before RAS self refresh and burst CAS before RAS long refresh are used in combination, please perform CAS before RAS refresh 1,024 times within a 16 ms interval just before and after setting CAS before RAS self refresh.

(2) Normal Combined Use of CAS Before RAS Self Refresh and Long RAS Only Refresh

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

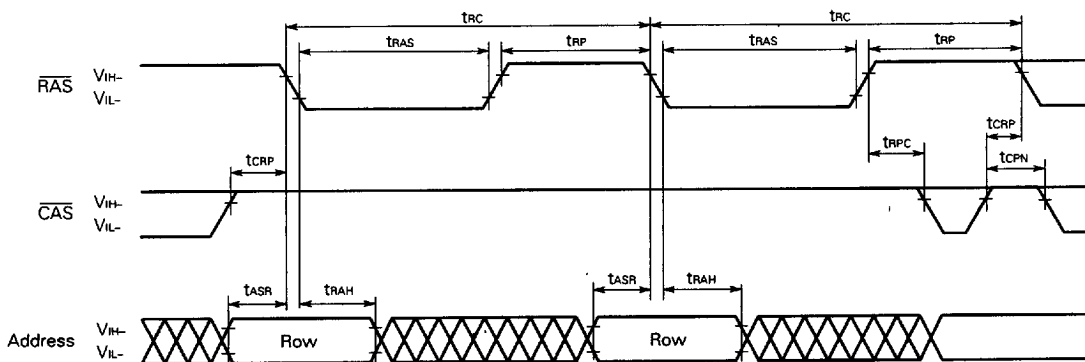
For details, please refer to **How to use DRAM** User's Manual.

CAS Before RAS Refresh Cycle



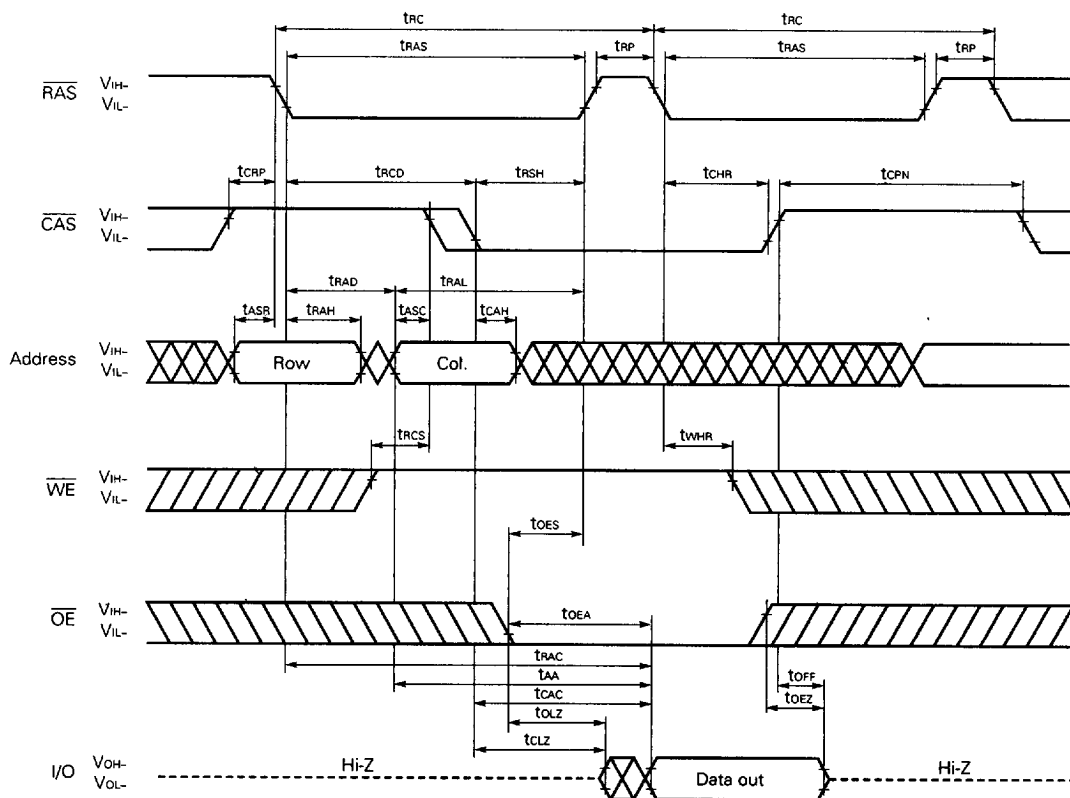
Remark Address, $\overline{OE}$: Don't care I/O: Hi-Z

RAS Only Refresh Cycle

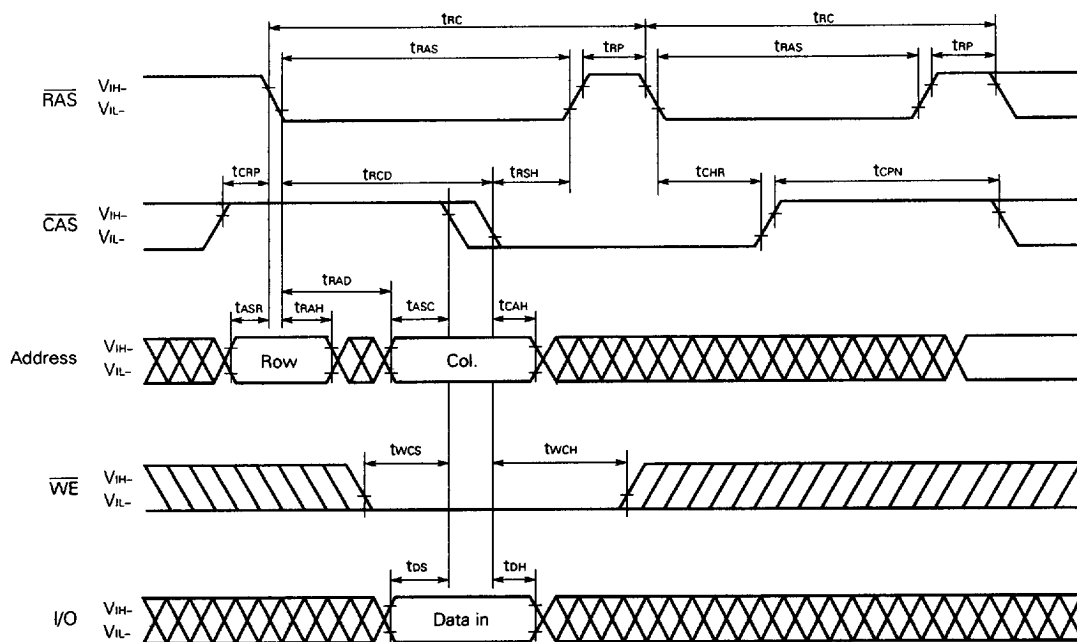


Remark $\overline{WE}$, $\overline{OE}$: Don't care I/O: Hi-Z

Hidden Refresh Cycle (Read)

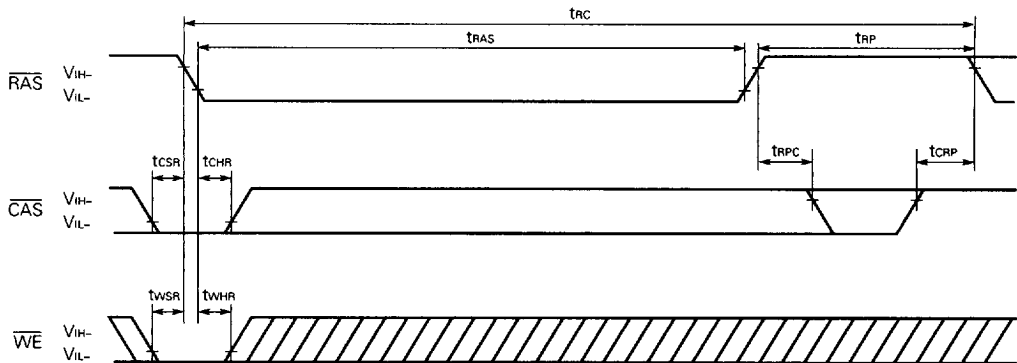


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Hidden Refresh Cycle (Write)

Remark $\overline{\text{OE}}$: 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 structure during test mode.

(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

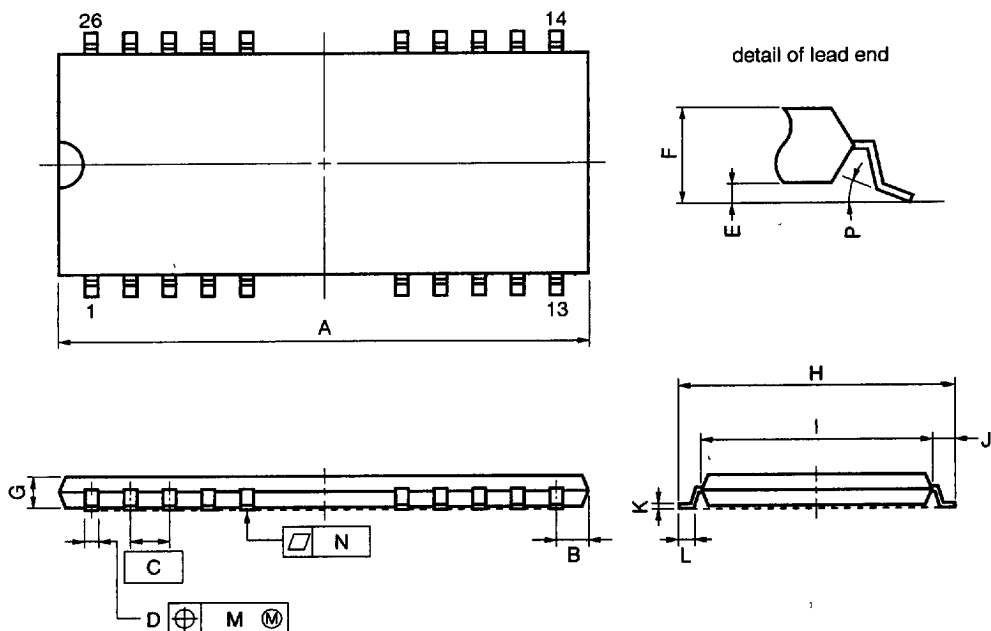
Refresh in the test mode must be performed with the $\overline{RAS}$ / $\overline{CAS}$ cycle or with the $\overline{WE}$, $\overline{CAS}$ before $\overline{RAS}$ refresh cycle. The $\overline{WE}$, $\overline{CAS}$ before $\overline{RAS}$ refresh cycle use the same counter as the $\overline{CAS}$ before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



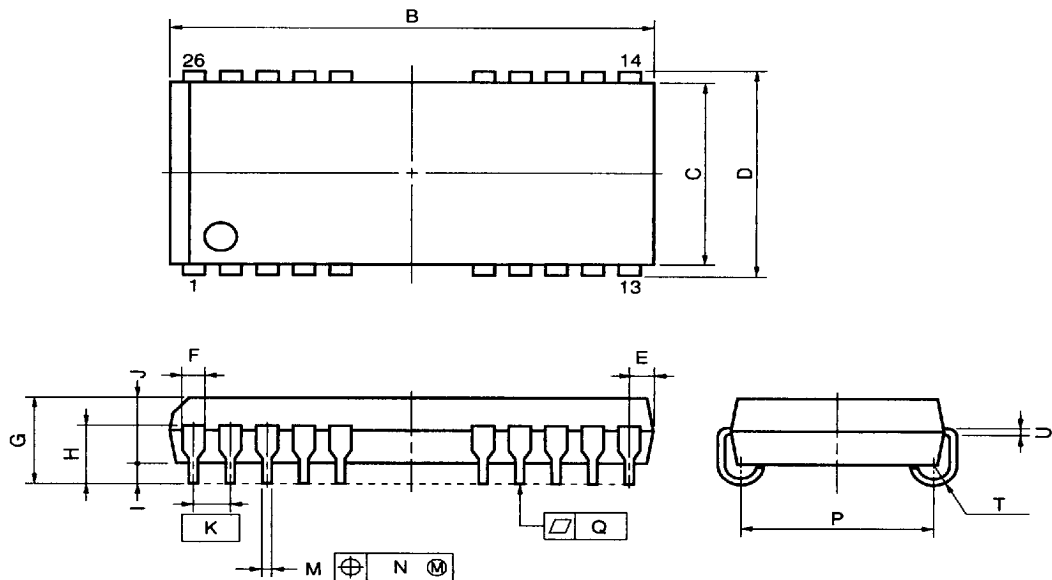
NOTE

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°}

S28G3-50-9JD

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

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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, 424400GS: 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".

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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".