

1 M-BIT DYNAMIC RAM 128K-WORD BY 8-BIT, HYPER PAGE MODE (EDO)

Description

The μPD421805 is a 131,072 words by 8 bits CMOS dynamic RAM with optional hyper page mode (EDO). Hyper page mode (EDO) is a kind of the page mode and is useful for the read operation. The μPD421805 is packaged in 28-pin plastic TSOP (II) and 28-pin plastic SOJ.

Features

- Hyper page mode (EDO)
- 131,072 words by 8 bits organization
- Single +5.0 V ±10 % power supply
- $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh, $\overline{\text{RAS}}$ only refresh, Hidden refresh
- 512 refresh cycles/8 ms

Part number	Power consumption		Access time (MAX.)	R/W cycle time (MIN.)	Hyper page mode (EDO) cycle time (MIN.)
	Active (MAX.)	Standby (MAX.)			
μPD421805-25-A	550 mW	5.5 mW (CMOS level input)	70 ns	124 ns	25 ns
μPD421805-30-A					30 ns
μPD421805-25					25 ns
μPD421805-30					30 ns
μPD421805-35					35 ns

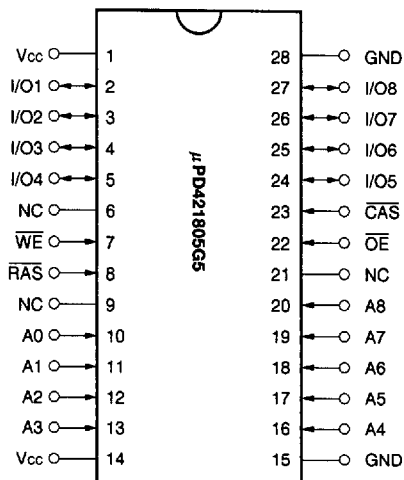
The information in this document is subject to change without notice.

Ordering Information

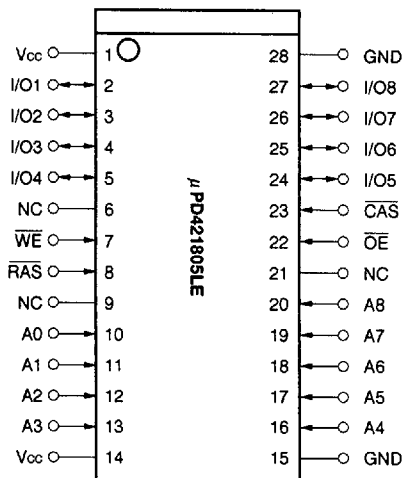
Part number	Access time (MAX.)	Hyper page mode (EDO) cycle time (MIN.)	Package	Refresh
μPD421805G5-25-A	70 ns	25 ns	28-pin plastic TSOP (II) (400 mil)	$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh $\overline{\text{RAS}}$ only refresh Hidden refresh
μPD421805G5-30-A	70 ns	30 ns		
μPD421805G5-25	70 ns	25 ns		
μPD421805G5-30	70 ns	30 ns		
μPD421805G5-35	70 ns	35 ns		
μPD421805LE-25-A	70 ns	25 ns	28-pin plastic SOJ (400 mil)	
μPD421805LE-30-A	70 ns	30 ns		
μPD421805LE-25	70 ns	25 ns		
μPD421805LE-30	70 ns	30 ns		
μPD421805LE-35	70 ns	35 ns		

Pin Configurations (Marking Side)

28-pin Plastic TSOP (II) (400 mil)

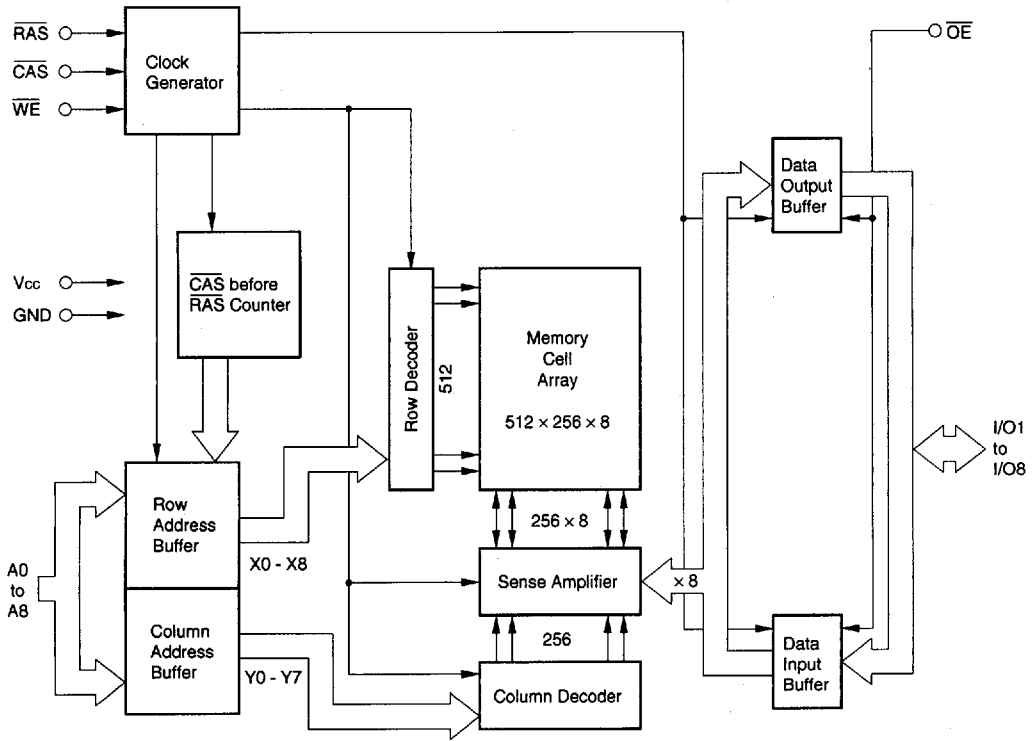


28-pin Plastic SOJ (400 mil)



- A0 to A8 : Address Inputs
- I/O1 to I/O8: Data Inputs/Outputs
- RAS : Row Address Strobe
- CAS : Column Address Strobe
- WE : Write Enable
- OE : Output Enable
- Vcc : Power Supply
- GND : Ground
- NC : No Connection

Block Diagram



Input/Output Pin Functions

The μ PD421805 has input pins $\overline{\text{RAS}}$, $\overline{\text{CAS}}$, $\overline{\text{WE}}$, $\overline{\text{OE}}$, A0 to A8 and input/output pins I/O1 to I/O8.

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 A8 (Address inputs)	Input	Address bus. Input total 17-bit of address signal, upper 9-bit and lower 8-bit in sequence (address multiplex method). Therefore, one word is selected from 131,072-word by 8-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/O8 (Data inputs/outputs)	Input/Output	8-bit data bus. I/O1 to I/O8 are used to input/output data.

Hyper Page Mode (EDO)

The hyper page mode (EDO) is a kind of page mode with enhanced features. The two major features of the hyper page mode (EDO) are as follows.

1. Data output time is extended.

In the hyper page mode (EDO), the output data is held to the next $\overline{\text{CAS}}$ cycle's falling edge, instead of the rising edge. For this reason, valid data output time in the hyper page mode (EDO) is extended compared with the fast page mode (= data extend function). In the fast page mode, the data output time becomes shorter as the $\overline{\text{CAS}}$ cycle time becomes shorter. Therefore, in the hyper page mode (EDO), the timing margin in read cycle is larger than that of the fast page mode even if the $\overline{\text{CAS}}$ cycle time becomes shorter.

2. The $\overline{\text{CAS}}$ cycle time in the hyper page mode (EDO) is shorter than that in the fast page mode.

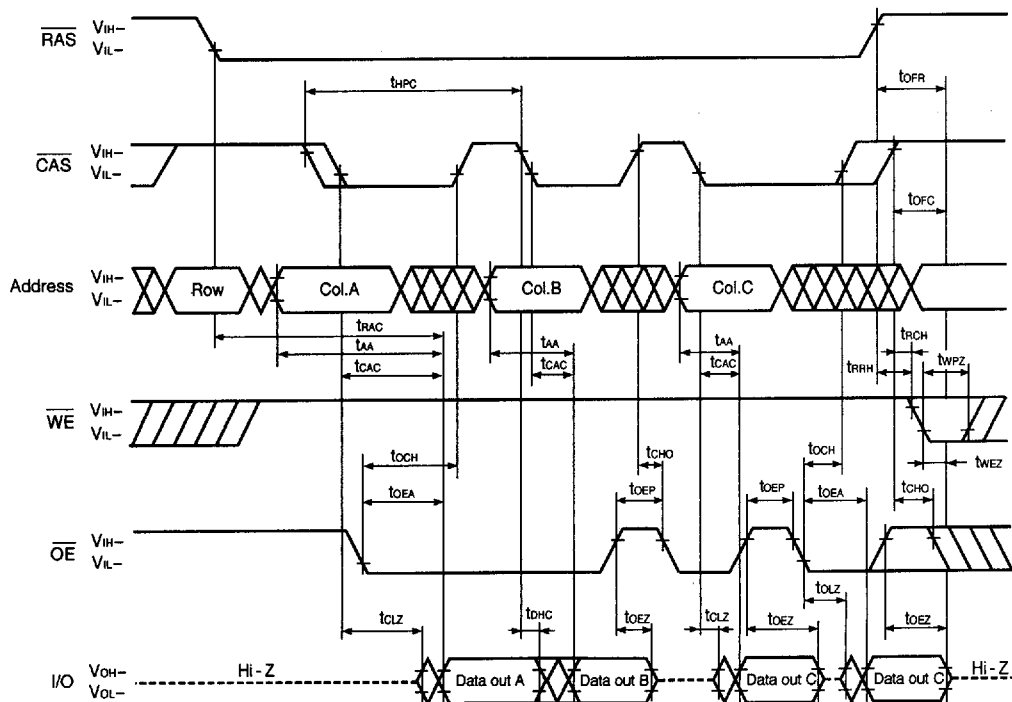
In the hyper page mode (EDO), due to the data extend function, the $\overline{\text{CAS}}$ cycle time can be shorter than in the fast page mode if the timing margin is the same.

Taking a device whose t_{RAC} is 60 ns as an example, the $\overline{\text{CAS}}$ cycle time in the fast page mode is 25 ns while that in the fast page mode is 40 ns.

In the hyper page mode (EDO), read (data out) and write (data in) cycles can be executed repeatedly during one $\overline{\text{RAS}}$ cycle. The hyper page mode (EDO) allows both read and write operations during one cycle, but the performance is equivalent to that of the fast page mode in that case.

The following shows a part of the hyper page mode (EDO) read cycle. Specifications to be observed are described in the next page.

Hyper Page Mode (EDO) Read Cycle



Cautions when using the hyper page mode (EDO)

1. $\overline{\text{CAS}}$ access should be used to operate t_{HPC} at the MIN. value.
2. To make I/Os to Hi-Z in read cycle, it is necessary to control $\overline{\text{RAS}}$, $\overline{\text{CAS}}$, $\overline{\text{WE}}$, $\overline{\text{OE}}$ as follows. The effective specification depends on the state of each signal.
 - (1) Both $\overline{\text{RAS}}$ and $\overline{\text{CAS}}$ are inactive (at the end of read cycle)
 $\overline{\text{WE}}$: inactive, $\overline{\text{OE}}$: active
 t_{OFC} is effective when $\overline{\text{RAS}}$ is inactivated before $\overline{\text{CAS}}$ is inactivated.
 t_{OFF} is effective when $\overline{\text{CAS}}$ is inactivated before $\overline{\text{RAS}}$ is inactivated.
 - (2) Both $\overline{\text{RAS}}$ and $\overline{\text{CAS}}$ are active or either $\overline{\text{RAS}}$ or $\overline{\text{CAS}}$ is active (in read cycle)
 $\overline{\text{WE}}$, $\overline{\text{OE}}$: inactive t_{OZ} is effective.
 - (3) Both $\overline{\text{RAS}}$ and $\overline{\text{CAS}}$ are inactive or $\overline{\text{RAS}}$ is active and $\overline{\text{CAS}}$ is inactive (at the end of read cycle)
 $\overline{\text{WE}}$, $\overline{\text{OE}}$: active and either t_{RAH} or t_{RCH} must be met t_{WEZ} and t_{WPZ} are effective.
3. In read cycle, the effective specification depends on the state of $\overline{\text{CAS}}$ signal when controlling data output with the $\overline{\text{OE}}$ signal.
 - (1) $\overline{\text{CAS}}$: inactive, $\overline{\text{OE}}$: active t_{CH0} is effective.
 - (2) $\overline{\text{CAS}}$, $\overline{\text{OE}}$: active t_{CH} is effective.

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 ($T_A = 25\text{ °C}$, $f = 1\text{ MHz}$)

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)

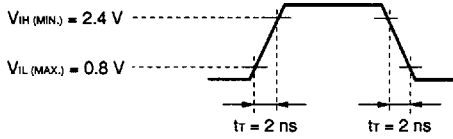
Parameter	Symbol	Test condition	MIN.	MAX.	Unit	Notes
Operating current	I_{CC1}	$\overline{RAS}, \overline{CAS}$ cycling $t_{RC} = t_{RC(MIN.)}, I_O = 0 \text{ mA}$		100	mA	1, 2, 3
Standby current	I_{CC2}	$\overline{RAS}, \overline{CAS} \geq V_{IH(MIN.)}, I_O = 0 \text{ mA}$		2.0	mA	
		$\overline{RAS}, \overline{CAS} \geq V_{CC} - 0.2 \text{ V}, I_O = 0 \text{ mA}$		1.0		
\overline{RAS} only refresh current	I_{CC3}	\overline{RAS} cycling, $\overline{CAS} \geq V_{IH(MIN.)}$ $t_{RC} = t_{RC(MIN.)}, I_O = 0 \text{ mA}$		100	mA	1, 2, 3, 4
Operating current (Hyper page mode (EDO))	I_{CC4}	$\overline{RAS} \leq V_{IL(MAX.)}, \overline{CAS}$ cycling $t_{HPC} = t_{HPC(MIN.)}, I_O = 0 \text{ mA}$	$t_{HPC} = 25 \text{ ns}$	100	mA	1, 2, 5
			$t_{HPC} = 30 \text{ ns}$	90		
			$t_{HPC} = 35 \text{ ns}$	80		
CAS before \overline{RAS} refresh current	I_{CC5}	\overline{RAS} cycling $t_{RC} = t_{RC(MIN.)}, I_O = 0 \text{ mA}$		100	mA	1, 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}	$I_O = -2.5 \text{ mA}$	2.4		V	
Low level output voltage	V_{OL}	$I_O = +2.1 \text{ mA}$		0.4	V	

- Notes**
1. I_{CC1} , I_{CC3} , I_{CC4} and I_{CC5} depend on cycle rates (t_{RC} and t_{HPC}).
 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 hyper page (EDO) cycle.

AC Characteristics (Recommended Operating Conditions unless otherwise noted)

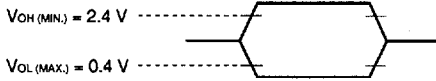
AC Characteristics Test Conditions

(1) Input timing specification

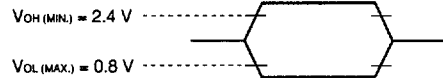


(2) Output timing specification

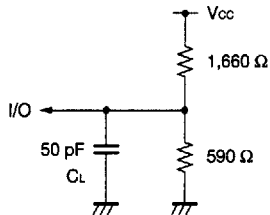
• μ PD421805



μ PD421805-A



(3) Output load condition



Common to Read, Write, Read Modify Write Cycle

Parameter	Symbol	tHPC = 25 ns		tHPC = 30 ns		tHPC = 35 ns		Unit	Notes
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Read / Write cycle time	t _{RC}	124	–	124	–	124	–	ns	
RAS precharge time	t _{RP}	50	–	50	–	50	–	ns	
CAS precharge time	t _{CPN}	10	–	10	–	10	–	ns	
RAS pulse width	t _{RAS}	70	10,000	70	10,000	70	10,000	ns	
CAS pulse width	t _{CAS}	10	10,000	12	10,000	15	10,000	ns	
RAS hold time	t _{RSH}	20	–	20	–	20	–	ns	
CAS hold time	t _{CSH}	70	–	70	–	70	–	ns	
RAS to CAS delay time	t _{RCd}	20	55	20	52	20	50	ns	1
RAS to column address delay time	t _{RAD}	15	40	15	35	15	30	ns	1
CAS to RAS precharge time	t _{CRP}	5	–	5	–	5	–	ns	2
Row address setup time	t _{ASR}	0	–	0	–	0	–	ns	
Row address hold time	t _{RAH}	10	–	10	–	10	–	ns	
Column address setup time	t _{ASC}	0	–	0	–	0	–	ns	
Column address hold time	t _{CAH}	10	–	12	–	15	–	ns	
OE lead time referenced to RAS	t _{OES}	0	–	0	–	0	–	ns	
CAS to data setup time	t _{CLZ}	0	–	0	–	0	–	ns	
OE to data setup time	t _{OLZ}	0	–	0	–	0	–	ns	
OE to data delay time	t _{OED}	15	–	15	–	15	–	ns	
Transition time (rise and fall)	t _{tr}	1	50	1	50	1	50	ns	
Refresh time	t _{REF}	–	8	–	8	–	8	ms	

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

Input conditions	Access time	Access time from RAS
t _{RAD} ≤ t _{RAD} (MAX.) and t _{RCd} ≤ t _{RCd} (MAX.)	t _{RAC} (MAX.)	t _{RAC} (MAX.)
t _{RAD} > t _{RAD} (MAX.) and t _{RCd} ≤ 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} ≥ t_{RAD} (MAX.) and t_{RCd} ≥ t_{RCd} (MAX.) will not cause any operation problems.

2. t_{CRP} (MIN.) requirement is applied to RAS, CAS cycles.

Read Cycle

Parameter	Symbol	t _{HPC} = 25 ns		t _{HPC} = 30 ns		t _{HPC} = 35 ns		Unit	Notes
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Access time from $\overline{\text{RAS}}$	t _{RAC}	-	70	-	70	-	70	ns	1
Access time from $\overline{\text{CAS}}$	μPD421805-A	-	20	-	20	-	-	ns	1
	μPD421805	-	15	-	18	-	20		
Access time from column address	t _{AA}	-	30	-	35	-	40	ns	1
Access time from $\overline{\text{OE}}$	t _{OEa}	-	20	-	20	-	20	ns	
Column address lead time referenced to $\overline{\text{RAS}}$	t _{RAL}	30	-	35	-	40	-	ns	
Read command setup time	t _{RCS}	0	-	0	-	0	-	ns	
Read command hold time referenced to $\overline{\text{RAS}}$	t _{RRH}	0	-	0	-	0	-	ns	2
Read command hold time referenced to $\overline{\text{CAS}}$	t _{RCH}	0	-	0	-	0	-	ns	2
Output buffer turn-off delay time from $\overline{\text{OE}}$	t _{OEZ}	0	15	0	15	0	15	ns	3
$\overline{\text{CAS}}$ hold time to $\overline{\text{OE}}$	t _{CHO}	5	-	5	-	5	-	ns	

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

Input conditions	Access time	Access time from $\overline{\text{RAS}}$
t _{RAD} ≤ t _{RAD} (MAX.) and t _{RCD} ≤ t _{RCD} (MAX.)	t _{RAC} (MAX.)	t _{RAC} (MAX.)
t _{RAD} > t _{RAD} (MAX.) and t _{RCD} ≤ 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} ≥ t_{RAD}(MAX.) and t_{RCD} ≥ 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_{OEZ}(MAX.) defines 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 _{HPC} = 25 ns		t _{HPC} = 30 ns		t _{HPC} = 35 ns		Unit	Notes
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
$\overline{\text{WE}}$ hold time referenced to $\overline{\text{CAS}}$	t _{WCH}	10	–	12	–	15	–	ns	1
$\overline{\text{WE}}$ pulse width	t _{WP}	10	–	12	–	15	–	ns	1
$\overline{\text{WE}}$ lead time referenced to $\overline{\text{RAS}}$	t _{RWL}	20	–	20	–	20	–	ns	
$\overline{\text{WE}}$ lead time referenced to $\overline{\text{CAS}}$	t _{CWL}	10	–	12	–	15	–	ns	
$\overline{\text{WE}}$ setup time	t _{WCS}	0	–	0	–	0	–	ns	2
$\overline{\text{OE}}$ hold time	t _{OEH}	0	–	0	–	0	–	ns	
Data-in setup time	t _{DS}	0	–	0	–	0	–	ns	3
Data-in hold time	t _{DH}	10	–	12	–	15	–	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} ≥ 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 $\overline{\text{CAS}}$ falling edge in early write cycles. In late write cycles and read modify write cycles, they are referenced to the $\overline{\text{WE}}$ falling edge.

Read Modify Write Cycle

Parameter	Symbol	t _{HPC} = 25 ns		t _{HPC} = 30 ns		t _{HPC} = 35 ns		Unit	Note
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Read modify write cycle time	t _{RWC}	165	–	165	–	165	–	ns	
$\overline{\text{RAS}}$ to $\overline{\text{WE}}$ delay time	t _{RWD}	89	–	89	–	89	–	ns	1
$\overline{\text{CAS}}$ to $\overline{\text{WE}}$ delay time	t _{CWD}	34	–	37	–	39	–	ns	1
Column address to $\overline{\text{WE}}$ delay time	t _{AWD}	49	–	54	–	59	–	ns	1

- Note**
1. If t_{WCS} ≥ 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} ≥ t_{RWD}(MIN.), t_{CWD} ≥ t_{CWD}(MIN.), t_{AWD} ≥ t_{AWD}(MIN.) and t_{CPWD} ≥ 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.

Hyper Page Mode (EDO)

Parameter	Symbol	t _{HPC} = 25 ns		t _{HPC} = 30 ns		t _{HPC} = 35 ns		Unit	Notes
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Read / Write cycle time	t _{HPC}	25	-	30	-	35	-	ns	1
RAS pulse width	t _{RASP}	70	125,000	70	125,000	70	125,000	ns	
CAS pulse width	t _{HCAS}	10	10,000	12	10,000	15	10,000	ns	
CAS precharge time	t _{CP}	10	-	10	-	10	-	ns	
Access time from CAS precharge	t _{ACP}	-	33	-	40	-	45	ns	
CAS precharge to WE delay time	t _{CPWD}	54	-	59	-	64	-	ns	2
RAS hold time from CAS precharge	t _{RHCP}	35	-	40	-	45	-	ns	
Read modify write cycle time	t _{HPRWC}	68	-	75	-	83	-	ns	
Data output hold time	t _{DHC}	5	-	5	-	5	-	ns	
OE to CAS hold time	t _{OCH}	5	-	5	-	5	-	ns	4
OE precharge time	t _{OEP}	5	-	5	-	5	-	ns	
Output buffer turn-off delay from WE	t _{WEZ}	0	15	0	15	0	15	ns	3,4
WE pulse width	t _{WPZ}	10	-	10	-	10	-	ns	4
Output buffer turn-off delay from RAS	t _{OFR}	0	15	0	15	0	15	ns	3,4
Output buffer turn-off delay from CAS	t _{OFC}	0	15	0	15	0	15	ns	3,4
Access time from previous WE (Hyper page mode (EDO) read and write cycle)	t _{AWE}	-	55	-	65	-	75	ns	
Access time from previous CAS (Hyper page mode (EDO) write and read cycle)	t _{ACE}	-	55	-	65	-	75	ns	

Notes 1. t_{HPC} (MIN.) is applied to $\overline{\text{CAS}}$ access.

2. If $t_{\text{WCS}} \geq t_{\text{WCS}}(\text{MIN.})$, the cycle is an early write cycle and the data out will remain Hi-Z through the entire cycle. If $t_{\text{RW}} \geq t_{\text{RW}}(\text{MIN.})$, $t_{\text{CWD}} \geq t_{\text{CWD}}(\text{MIN.})$, $t_{\text{AWD}} \geq t_{\text{AWD}}(\text{MIN.})$ and $t_{\text{CPWD}} \geq t_{\text{CPWD}}(\text{MIN.})$, 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.

3. t_{OFC} (MAX.), t_{OFR} (MAX.) and t_{WEZ} (MAX.) define the time when the output achieves the conditions of Hi-Z and is not referenced to V_{OH} or V_{OL}.

4. To make I/Os to Hi-Z in read cycle, it is necessary to control $\overline{\text{RAS}}$, $\overline{\text{CAS}}$, $\overline{\text{WE}}$, $\overline{\text{OE}}$ as follows. The effective specification depends on state of each signal.

(1) Both $\overline{\text{RAS}}$ and $\overline{\text{CAS}}$ are inactive (at the end of the read cycle)

$\overline{\text{WE}}$: inactive, $\overline{\text{OE}}$: active

t_{OFC} is effective when $\overline{\text{RAS}}$ is inactivated before $\overline{\text{CAS}}$ is inactivated.

t_{OFR} is effective when $\overline{\text{CAS}}$ is inactivated before $\overline{\text{RAS}}$ is inactivated.

(2) Both $\overline{\text{RAS}}$ and $\overline{\text{CAS}}$ are active or either $\overline{\text{RAS}}$ or $\overline{\text{CAS}}$ is active (in read cycle)

$\overline{\text{WE}}$, $\overline{\text{OE}}$: inactive t_{WEZ} is effective.

(3) Both $\overline{\text{RAS}}$ and $\overline{\text{CAS}}$ are inactive or $\overline{\text{RAS}}$ is active and $\overline{\text{CAS}}$ is inactive (at the end of read cycle)

$\overline{\text{WE}}$, $\overline{\text{OE}}$: active and either t_{RRH} or t_{RCH} must be met t_{WEZ} and t_{WPZ} are effective.

(4) $\overline{\text{WE}}$: inactive (in read cycle)

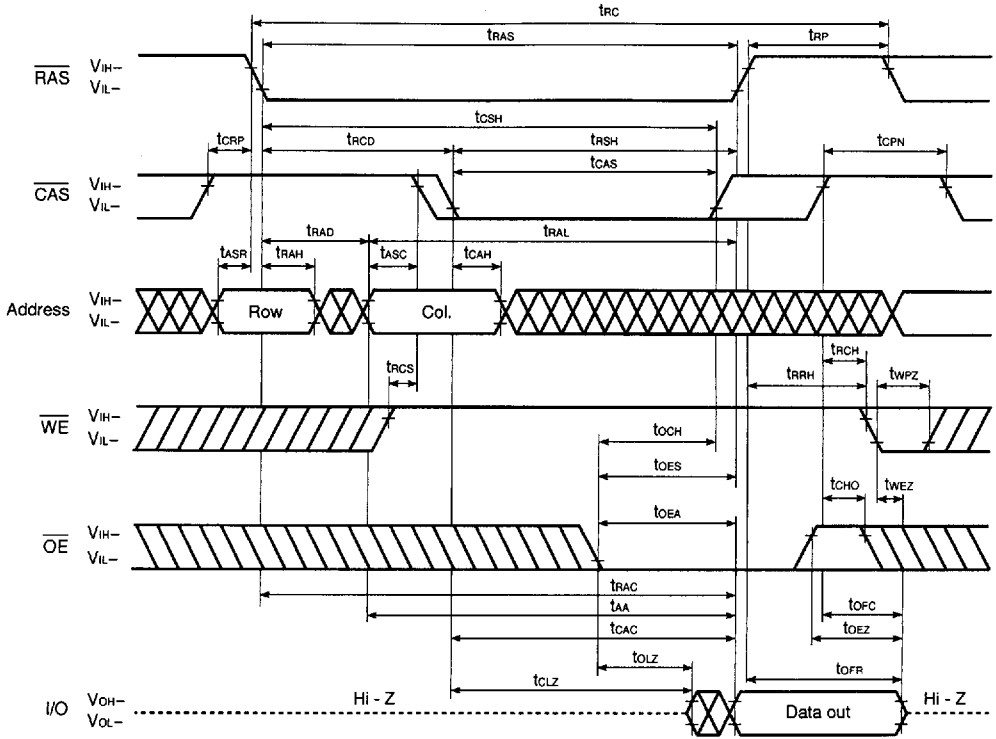
$\overline{\text{CAS}}$: inactive, $\overline{\text{OE}}$: active t_{CHO} is effective.

$\overline{\text{CAS}}$, $\overline{\text{OE}}$: active t_{OCH} is effective.

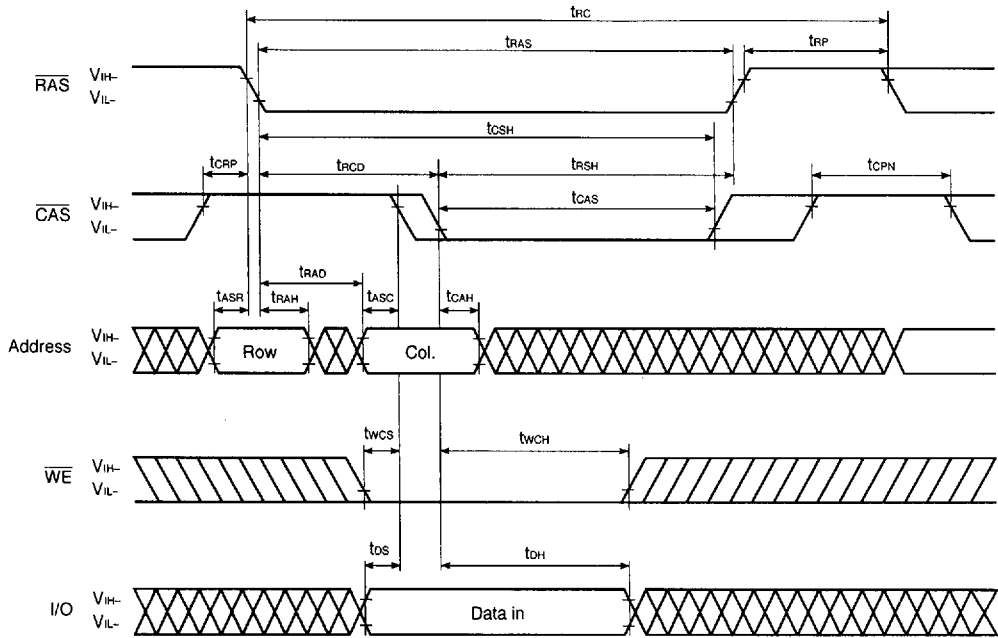
Refresh Cycle

Parameter	Symbol	t _{HPC} = 25 ns		t _{HPC} = 30 ns		t _{HPC} = 35 ns		Unit	Note
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
CAS setup time	t _{CSR}	5	-	5	-	5	-	ns	
CAS hold time (CAS before RAS refresh)	t _{CHR}	10	-	10	-	10	-	ns	
RAS precharge CAS hold time	t _{RPC}	5	-	5	-	5	-	ns	
WE hold time	t _{WHR}	15	-	15	-	15	-	ns	

Read Cycle

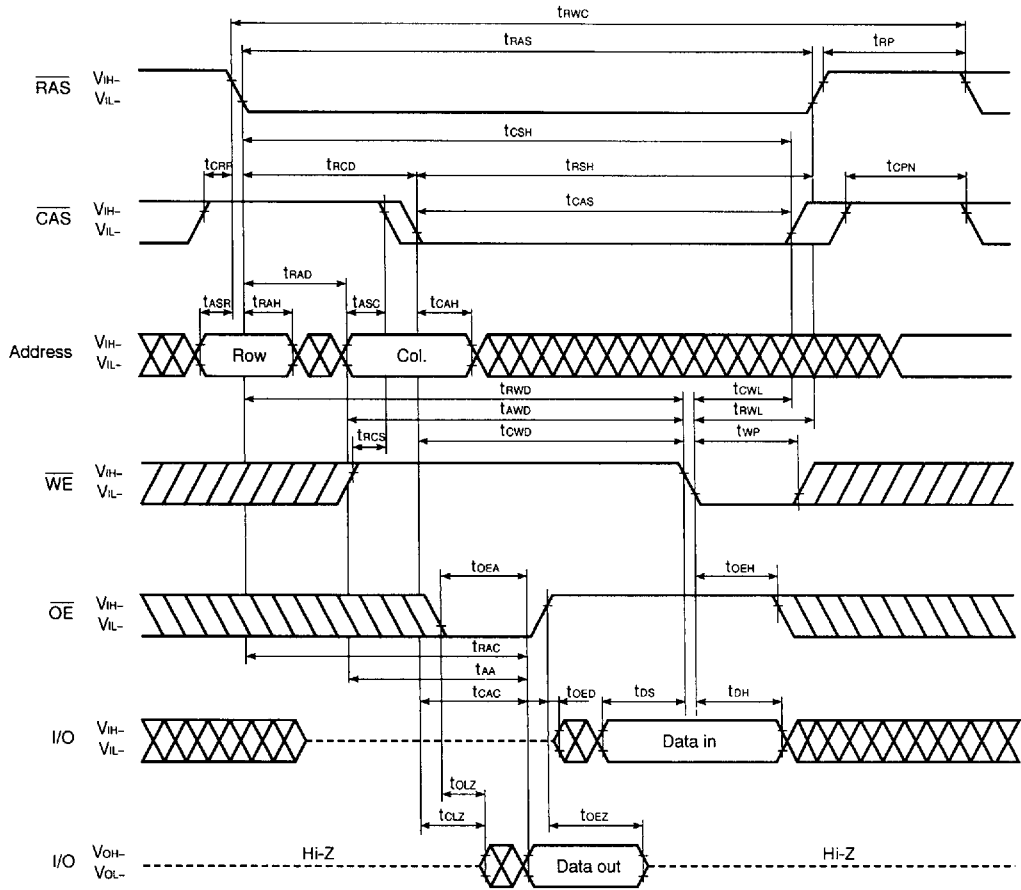


Early Write Cycle

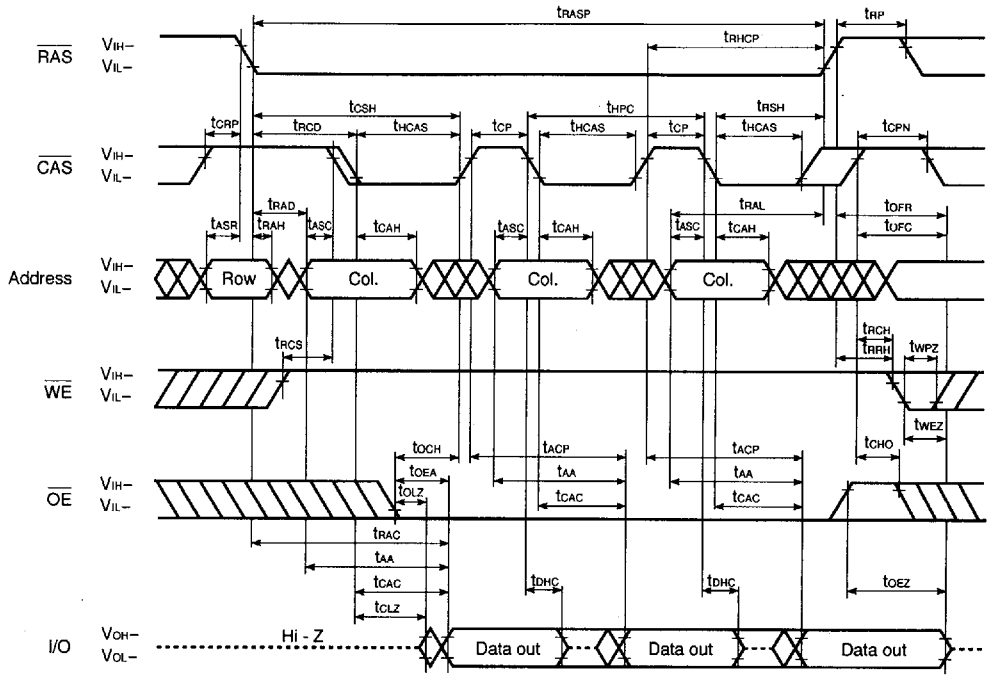


Remark \overline{OE} : Don't care

Read Modify Write Cycle

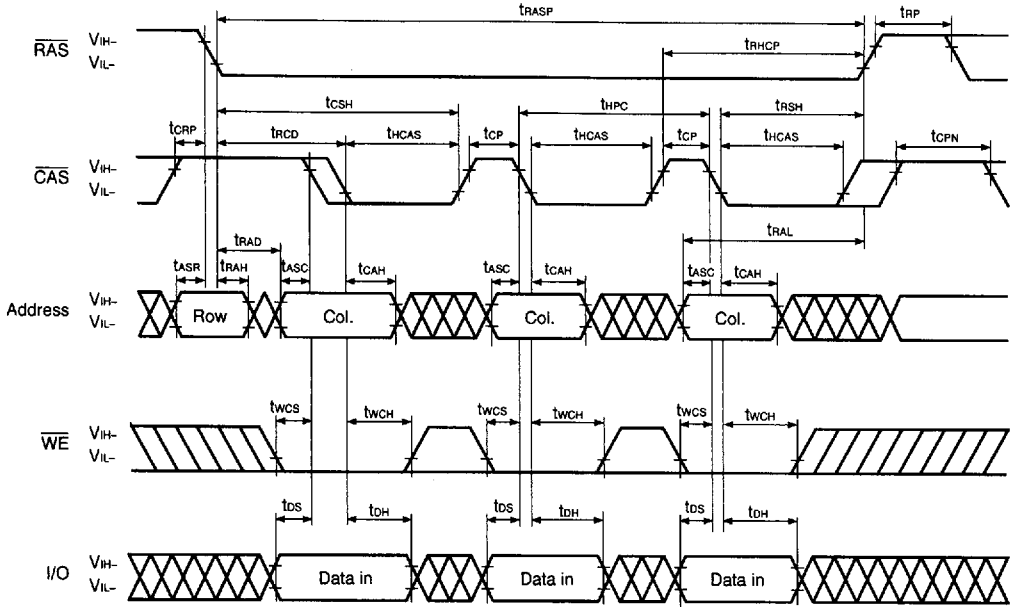


Hyper Page Mode (EDO) Read Cycle



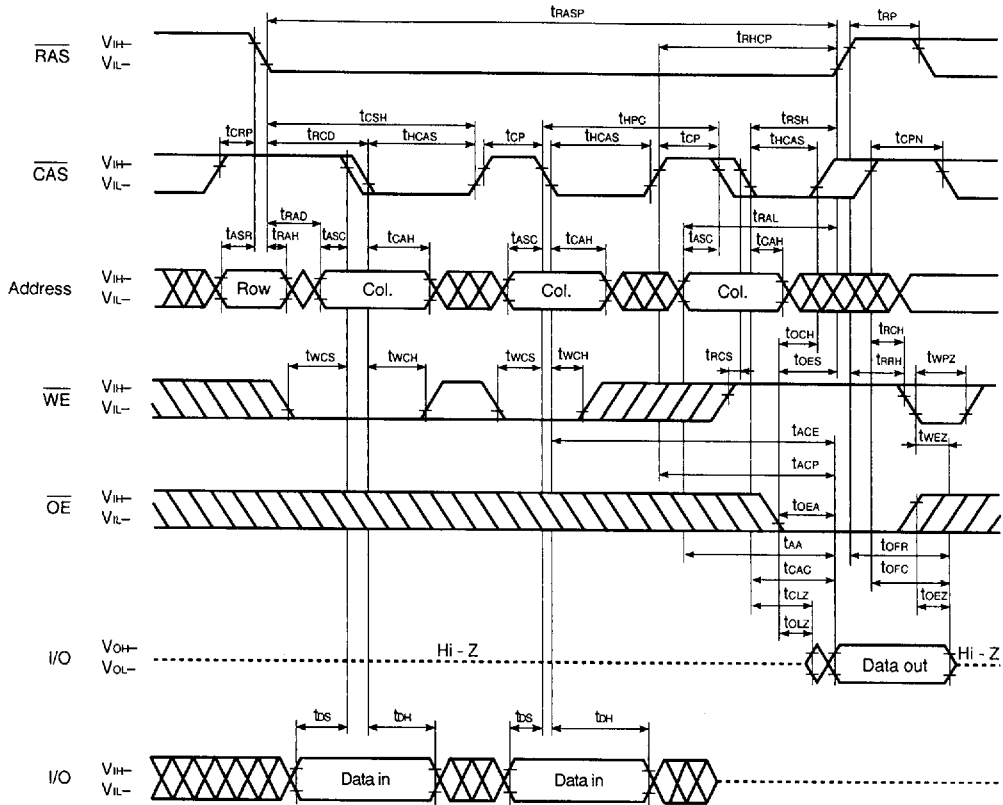
Remark In the hyper page mode (EDO), read, write and read modify write cycles are available for each of the consecutive $\overline{\text{CAS}}$ cycles within the same $\overline{\text{RAS}}$ cycle.

Hyper Page Mode (EDO) Early Write Cycle



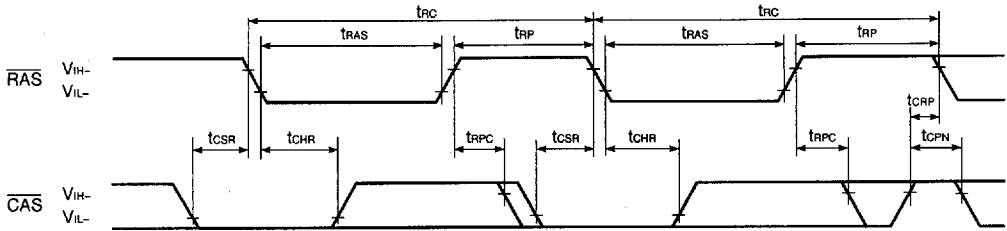
- Remarks**
1. \overline{OE} : Don't care
 2. In the hyper page mode (EDO), read, write and read modify write cycles are available for each of the consecutive CAS cycles within the same RAS cycle.

Hyper Page Mode (EDO) Write and Read Cycle



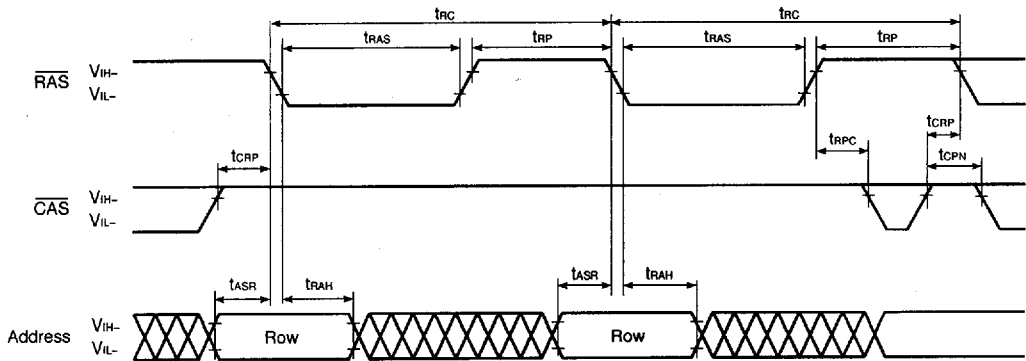
Remark In the hyper page mode (EDO), read, write and read modify write cycles are available for each of the consecutive $\overline{\text{CAS}}$ cycles within the same $\overline{\text{RAS}}$ cycle.

CAS Before RAS Refresh Cycle



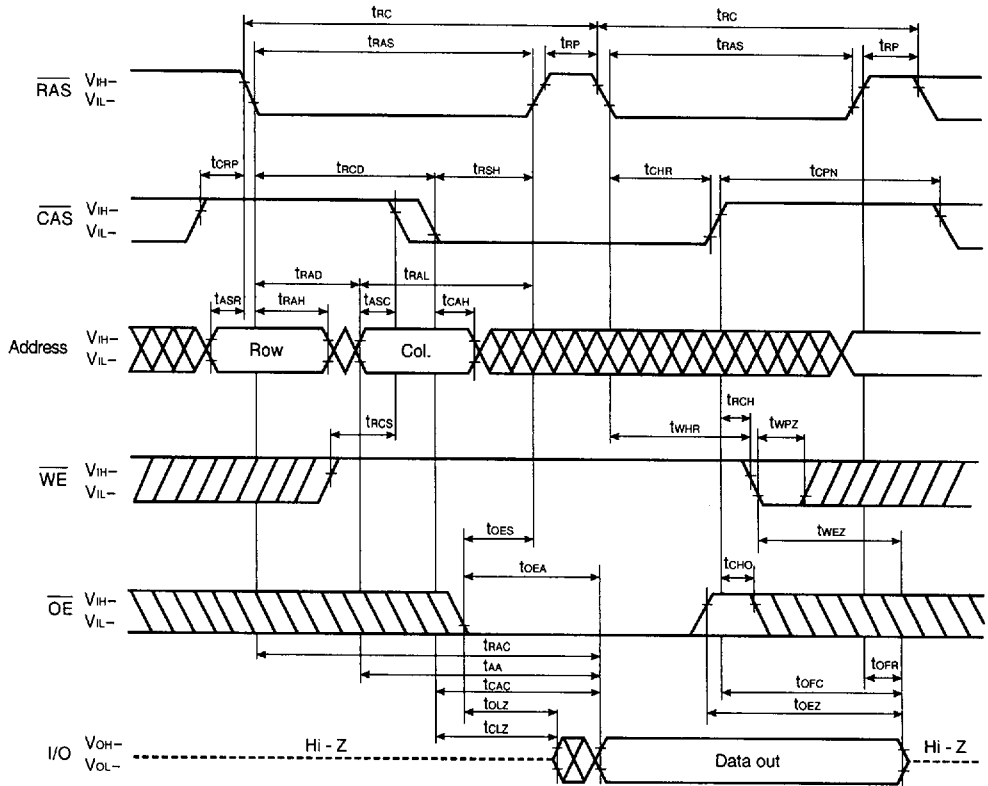
Remark Address, \overline{WE} , \overline{OE} : Don't care I/O: Hi-Z

RAS Only Refresh Cycle

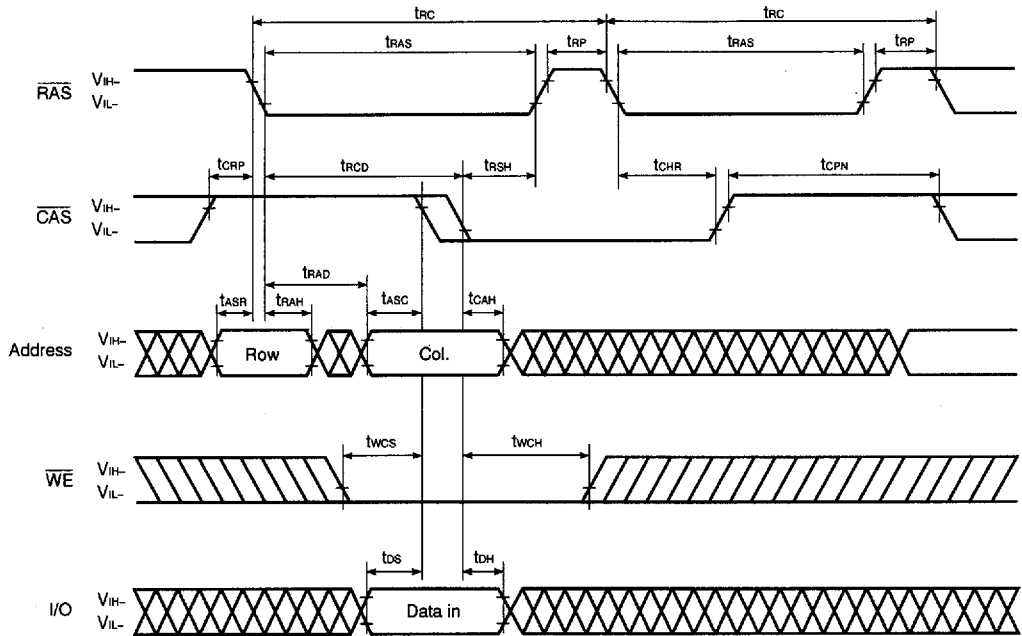


Remark \overline{WE} , \overline{OE} : Don't care I/O: Hi-Z

Hidden Refresh Cycle (Read)



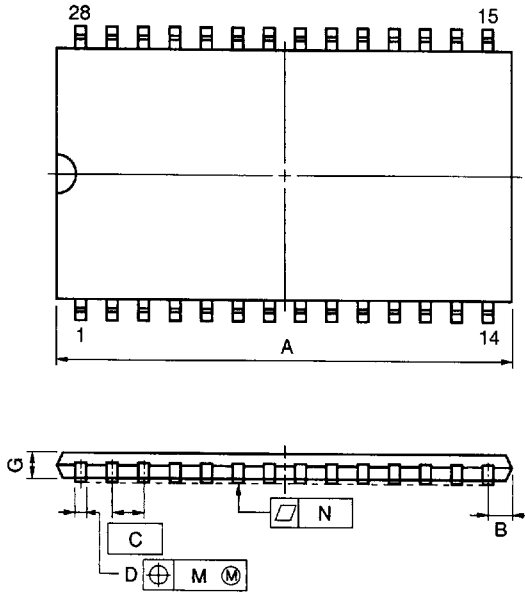
Hidden Refresh Cycle (Write)



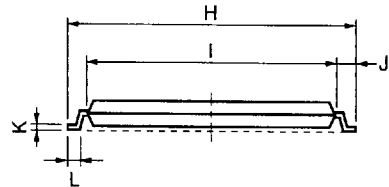
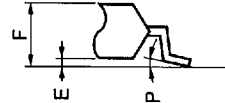
Remark \overline{OE} : Don't care

Package Drawings

28 PIN PLASTIC TSOP(II) (400 mil)



detail of lead end



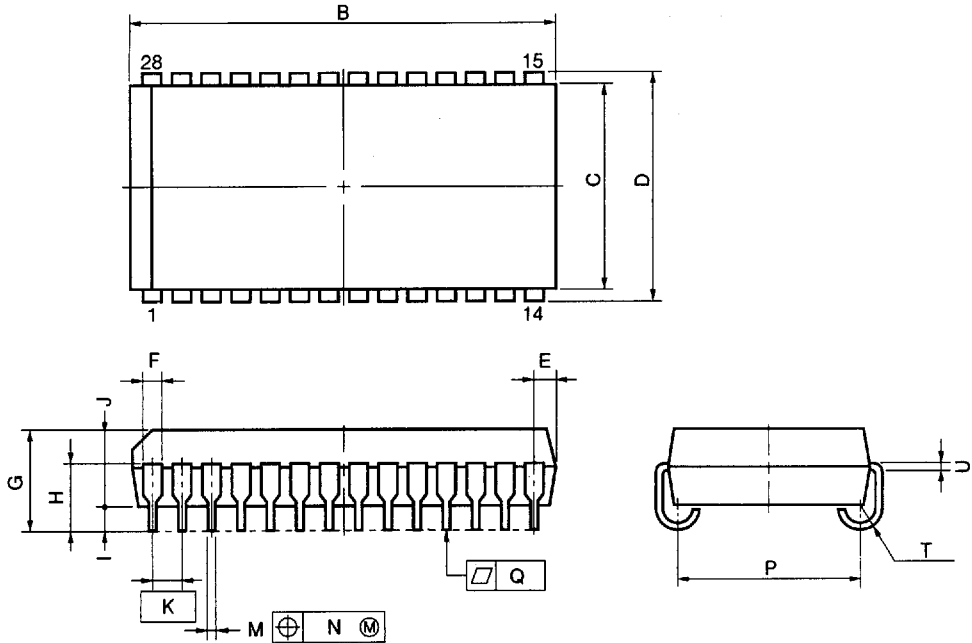
NOTE

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	18.63 MAX.	0.734 MAX.
B	1.075 MAX.	0.043 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	0.97	0.038
H	11.76±0.2	0.463±0.008
I	10.16±0.1	0.400±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°}

S28G5-50-7JD5

28 PIN PLASTIC SOJ (400 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	18.67 ^{+0.2} _{-0.35}	0.735 ^{+0.008} _{-0.013}
C	10.16	0.400
D	11.18±0.2	0.440 ^{+0.008} _{-0.007}
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} _{-0.007}
H	2.4±0.2	0.094 ^{+0.008} _{-0.007}
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	9.40±0.20	0.370 ^{+0.008} _{-0.007}
Q	0.15	0.006
T	R0.85	R0.033
U	0.20 ^{+0.10} _{-0.05}	0.008 ^{+0.004} _{-0.002}

P28LA-400A-2

Recommended Soldering Conditions

Please consult with our sales offices for soldering conditions of the μ PD421805.

Types of Surface Mount Device

μ PD421805G5: 28-pin plastic TSOP (II) (400 mil)

μ PD421805LE: 28-pin plastic SOJ (400 mil)