

3.3 V OPERATION 16 M-BIT DYNAMIC RAM

1 M-WORD BY 16-BIT, FAST PAGE MODE, BYTE READ/WRITE MODE

Description

The μ PD42S18160L, 4218160L are 1,048,576 words by 16 bits CMOS dynamic RAMs. The fast page mode and byte read/write mode capability realize high speed access and low power consumption.

These differ in refresh cycle and the μ PD42S18160L can execute $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh.

These are packaged in 50-pin plastic TSOP (III) and 42-pin plastic SOJ.

Features

- 1,048,576 words by 16 bits organization
- Single +3.3 V $\pm$ 0.3 V 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 PD42S18160L-A60, 4218160L-A60	540 mW	60 ns	110 ns	40 ns
μ PD42S18160L-A70, 4218160L-A70	504 mW	70 ns	130 ns	45 ns

- The μ PD42S18160L can execute $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh

Part number	Refresh cycle	Refresh	Power consumption at standby (MAX.)
μ PD42S18160L	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	0.54 mW (CMOS level input)
μ PD4218160L	1,024 cycles/16 ms	$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh, $\overline{\text{RAS}}$ only refresh, Hidden refresh	1.8 mW (CMOS level input)

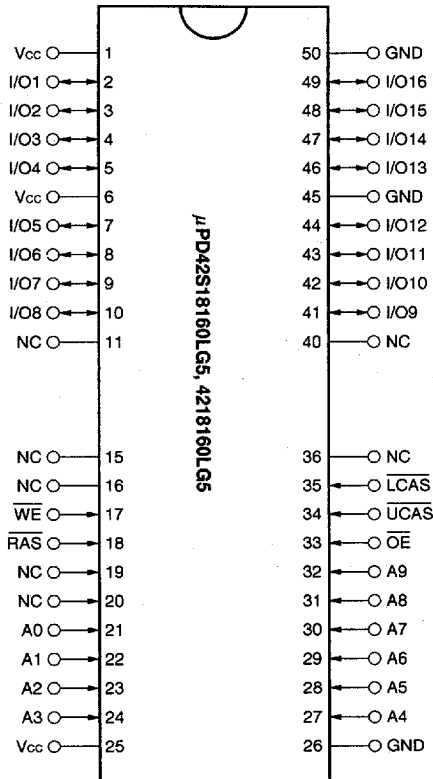
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Ordering Information

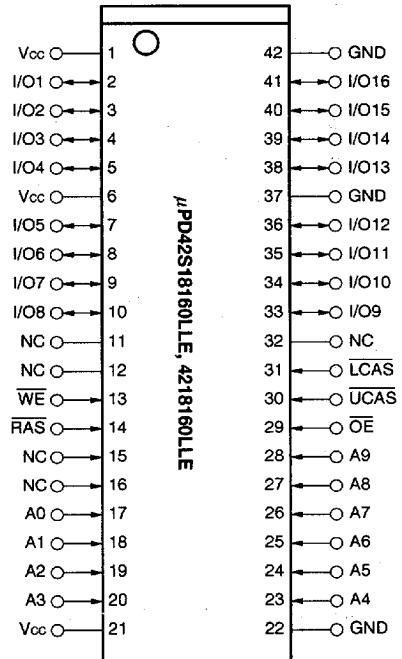
Part number	Access time (MAX.)	Package	Refresh
μPD42S18160LG5-A60 μPD42S18160LG5-A70	60 ns 70 ns	50-pin plastic TSOP (II) (400 mil)	$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh $\overline{\text{RAS}}$ only refresh Hidden refresh
μPD42S18160LLE-A60 μPD42S18160LLE-A70	60 ns 70 ns	42-pin plastic SOJ (400 mil)	
μPD4218160LG5-A60 μPD4218160LG5-A70	60 ns 70 ns	50-pin plastic TSOP (II) (400 mil)	$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh $\overline{\text{RAS}}$ only refresh Hidden refresh
μPD4218160LLE-A60 μPD4218160LLE-A70	60 ns 70 ns	42-pin plastic SOJ (400 mil)	

Pin Configurations (Marking Side)

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



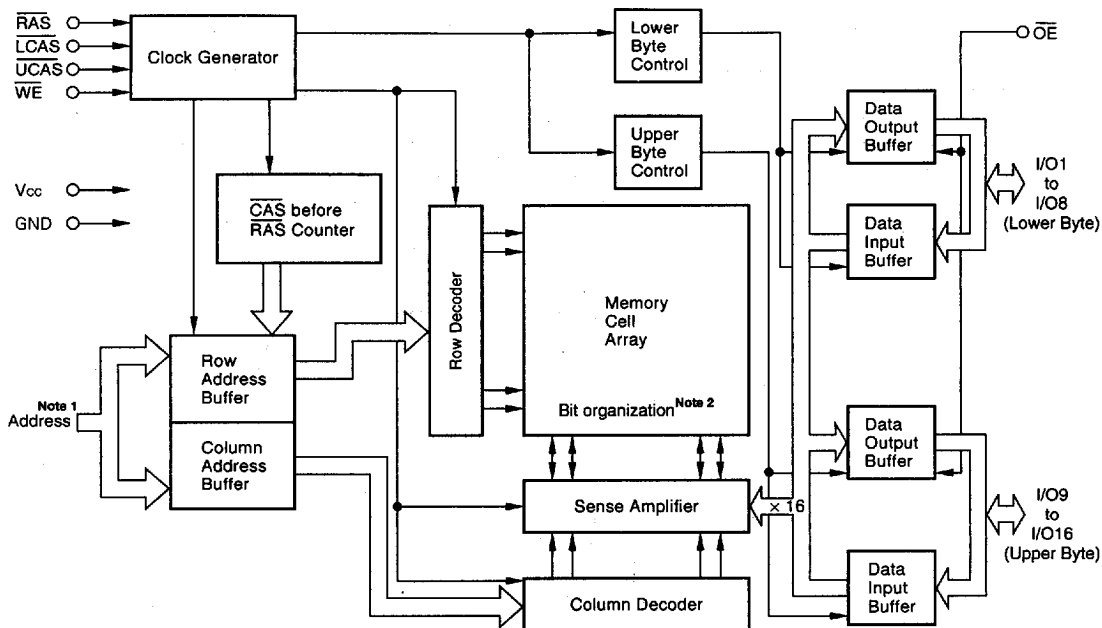
42-pin Plastic SOJ (400 mil)



- A0 to A9 : Address Inputs
- I/O1 to I/O16 : Data Inputs/Outputs
- RAS : Row Address Strobe
- UCAS : Column Address Strobe (upper)
- LCAS : Column Address Strobe (lower)
- WE : Write Enable
- OE : Output Enable
- Vcc : Power Supply
- GND : Ground
- NC : No Connection

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Block Diagram



Notes 1.

Part number	Row address	Column address
μPD42S18160L, 4218160L	A0 - A9	A0 - A9

2. μPD42S18160L, 4218160L ... 1,024 × 1,024 × 16

Input/Output Pin Functions

The μ PD42S18160L, 4218160L have input pins $\overline{\text{RAS}}$, $\overline{\text{CAS}}$ ^{Note 1}, $\overline{\text{WE}}$, $\overline{\text{OE}}$, Address^{Note 2} and input/output pins I/O1 to I/O16.

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 input)	Input	Address bus. Input total 20-bit of address signal, upper bits and lower bits ^{Note 2} in sequence (address multiplex method). Therefore, one word is selected from 1,048,576-word by 16-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/O16 (Data input/ output)	Input/ Output	16-bit data bus. I/O1 to I/O16 are used to input/output data.

Notes 1. $\overline{\text{CAS}}$ means $\overline{\text{UCAS}}$ and $\overline{\text{LCAS}}$.

2.

Part number	Address inputs	Upper bits	Lower bits
μ PD42S18160L, 4218160L	A0 - A9	10 bits	10 bits

Electrical Specifications

- $\overline{\text{CAS}}$ means $\overline{\text{UCAS}}$ and $\overline{\text{LCAS}}$.
- All voltages are referenced to GND.
- After power up ($V_{CC} \geq V_{CC(MIN.)}$), wait more than 100 μs ($\overline{\text{RAS}}$, $\overline{\text{CAS}}$ inactive) 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		-0.5 to +4.6	V
Supply voltage	V_{CC}		-0.5 to +4.6	V
Output current	I_O		20	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}		3.0	3.3	3.6	V
High level input voltage	V_{IH}		2.0		$V_{CC} + 0.3$	V
Low level input voltage	V_{IL}		-0.3		+0.8	V
Operating ambient temperature	T_A		0		70	°C

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

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	pF
Data input/output capacitance	$C_{I/O}$	I/O			7	pF

[MEMO]

DC Characteristics (Recommended Operating Conditions unless otherwise noted)

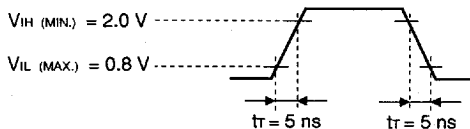
Parameter		Symbol	Test condition		MIN.	MAX.	Unit	Notes
Operating current		I _{CC1}	$\overline{\text{RAS}}, \overline{\text{CAS}}$ cycling $t_{\text{RC}} = t_{\text{RC}}(\text{MIN.}), I_{\text{O}} = 0 \text{ mA}$	$t_{\text{RAC}} = 60 \text{ ns}$		150	mA	1, 2, 3
				$t_{\text{RAC}} = 70 \text{ ns}$		140		
Standby current	$\mu\text{PD42S18160L}$	I _{CC2}	$\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{\text{IH}}(\text{MIN.}), I_{\text{O}} = 0 \text{ mA}$			0.5	mA	
			$\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{\text{CC}} - 0.2 \text{ V}, I_{\text{O}} = 0 \text{ mA}$			0.15		
	$\mu\text{PD4218160L}$		$\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{\text{IH}}(\text{MIN.}), I_{\text{O}} = 0 \text{ mA}$			2.0		
			$\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{\text{CC}} - 0.2 \text{ V}, I_{\text{O}} = 0 \text{ mA}$			0.5		
RAS only refresh current		I _{CC3}	$\overline{\text{RAS}}$ cycling, $\overline{\text{CAS}} \geq V_{\text{IH}}(\text{MIN.})$ $t_{\text{RC}} = t_{\text{RC}}(\text{MIN.}), I_{\text{O}} = 0 \text{ mA}$	$t_{\text{RAC}} = 60 \text{ ns}$		150	mA	1, 2, 3, 4
				$t_{\text{RAC}} = 70 \text{ ns}$		140		
Operating current (Fast page mode)		I _{CC4}	$\overline{\text{RAS}} \leq V_{\text{IL}}(\text{MAX.}), \overline{\text{CAS}}$ cycling $t_{\text{PC}} = t_{\text{PC}}(\text{MIN.}), I_{\text{O}} = 0 \text{ mA}$	$t_{\text{RAC}} = 60 \text{ ns}$		90	mA	1, 2, 5
				$t_{\text{RAC}} = 70 \text{ ns}$		80		
CAS before RAS refresh current		I _{CC5}	$\overline{\text{RAS}}$ cycling $t_{\text{RC}} = t_{\text{RC}}(\text{MIN.}), I_{\text{O}} = 0 \text{ mA}$	$t_{\text{RAC}} = 60 \text{ ns}$		150	mA	1, 2
				$t_{\text{RAC}} = 70 \text{ ns}$		140		
CAS before RAS long refresh current (1,024 cycles / 128 ms, only for the $\mu\text{PD42S18160L}$)		I _{CC6}	$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh: $t_{\text{RC}} = 125.0 \mu\text{s}$ $\overline{\text{RAS}}, \overline{\text{CAS}}$: $V_{\text{CC}} - 0.2 \text{ V} \leq V_{\text{IH}} \leq V_{\text{IH}}(\text{MAX.})$ $0 \text{ V} \leq V_{\text{IL}} \leq 0.2 \text{ V}$ Standby: $\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{\text{CC}} - 0.2 \text{ V}$ Address: V_{IH} or V_{IL} $\overline{\text{WE}}, \overline{\text{OE}}$: V_{IH} $I_{\text{O}} = 0 \text{ mA}$	$t_{\text{RAS}} \leq 1 \mu\text{s}$		180	μA	1, 2
Self refresh current (CAS before RAS self refresh, only for the $\mu\text{PD42S18160L}$)		I _{CC7}	$\overline{\text{RAS}}, \overline{\text{CAS}}$: $t_{\text{RAS}} = 5 \text{ ms}$ $V_{\text{CC}} - 0.2 \text{ V} \leq V_{\text{IH}} \leq V_{\text{IH}}(\text{MAX.})$ $0 \text{ V} \leq V_{\text{IL}} \leq 0.2 \text{ V}$ $I_{\text{O}} = 0 \text{ mA}$			150	μA	2
Input leakage current		I _{I(L)}	$V_{\text{I}} = 0 \text{ to } 3.6 \text{ V}$ All other pins not under test = 0 V	-5	+5	μA		
Output leakage current		I _{O(L)}	$V_{\text{O}} = 0 \text{ to } 3.6 \text{ V}$ Output is disabled (Hi-Z)	-5	+5	μA		
High level output voltage		V _{OH}	$I_{\text{O}} = -2.0 \text{ mA}$	2.4		V		
Low level output voltage		V _{OL}	$I_{\text{O}} = +2.0 \text{ mA}$		0.4	V		

- Notes**
1. I_{CC1}, I_{CC3}, I_{CC4}, I_{CC5} and I_{CC6} depend on cycle rates (t_{RC} and t_{PC}).
 2. Specified values are obtained with outputs unloaded.
 3. I_{CC1} and I_{CC3} are measured assuming that address can be changed once or less during $\overline{RAS} \leq V_{IL}(\text{MAX.})$ and $\overline{CAS} \geq V_{IH}(\text{MIN.})$.
 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.

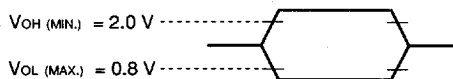
AC Characteristics (Recommended Operating Conditions unless otherwise noted)

AC Characteristics Test Conditions

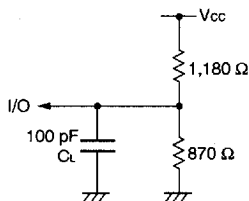
(1) Input timing specification



(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		Unit	Notes
		MIN.	MAX.	MIN.	MAX.		
Read / Write cycle time	t _{RC}	110	—	130	—	ns	
$\overline{\text{RAS}}$ precharge time	t _{RP}	40	—	50	—	ns	
$\overline{\text{CAS}}$ precharge time	t _{CPN}	10	—	10	—	ns	
$\overline{\text{RAS}}$ pulse width	t _{RS}	60	10,000	70	10,000	ns	1
$\overline{\text{CAS}}$ pulse width	t _{CAS}	15	10,000	20	10,000	ns	
$\overline{\text{RAS}}$ hold time	t _{RSH}	15	—	18	—	ns	
$\overline{\text{CAS}}$ hold time	t _{CSH}	60	—	70	—	ns	
$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ delay time	t _{RCD}	20	45	20	50	ns	2
$\overline{\text{RAS}}$ to column address delay time	t _{RAD}	15	30	15	35	ns	2
$\overline{\text{CAS}}$ to $\overline{\text{RAS}}$ precharge time	t _{CRP}	5	—	5	—	ns	3
Row address setup time	t _{ASR}	0	—	0	—	ns	
Row address hold time	t _{RAH}	10	—	10	—	ns	
Column address setup time	t _{ASC}	0	—	0	—	ns	
Column address hold time	t _{CAH}	15	—	15	—	ns	
$\overline{\text{OE}}$ lead time referenced to $\overline{\text{RAS}}$	t _{OES}	0	—	0	—	ns	
$\overline{\text{CAS}}$ to data setup time	t _{CLZ}	0	—	0	—	ns	
$\overline{\text{OE}}$ to data setup time	t _{OLZ}	0	—	0	—	ns	
$\overline{\text{OE}}$ to data delay time	t _{OED}	13	—	15	—	ns	
Masked byte write hold time referenced to $\overline{\text{RAS}}$	t _{MRH}	0	—	0	—	ns	
Transition time (rise and fall)	t _T	3	50	3	50	ns	
Refresh time	μPD42S18160L	t _{REF}	—	128	—	128	ms
	μPD4218160L		—	16	—	16	ms

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- Notes** 1. In $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh cycles, $t_{\text{RAS}}(\text{MAX.})$ is 100 μs .
 If $10 \mu\text{s} < t_{\text{RAS}} < 100 \mu\text{s}$, $\overline{\text{RAS}}$ precharge time for $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self refresh (t_{RPS}) is applied.
 2. For read cycles, access time is defined as follows:

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

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

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

Read Cycle

Parameter	Symbol	$t_{\text{RAC}} = 60 \text{ ns}$		$t_{\text{RAC}} = 70 \text{ ns}$		Unit	Notes
		MIN.	MAX.	MIN.	MAX.		
Access time from $\overline{\text{RAS}}$	t_{RAC}	—	60	—	70	ns	1
Access time from $\overline{\text{CAS}}$	t_{CAC}	—	15	—	20	ns	1
Access time from column address	t_{AA}	—	30	—	35	ns	1
Access time from $\overline{\text{OE}}$	t_{OEA}	—	15	—	20	ns	
Column address lead time referenced to $\overline{\text{RAS}}$	t_{RAL}	30	—	35	—	ns	
Read command setup time	t_{RCS}	0	—	0	—	ns	
Read command hold time referenced to $\overline{\text{RAS}}$	t_{RRH}	0	—	0	—	ns	2
Read command hold time referenced to $\overline{\text{CAS}}$	t_{RCH}	0	—	0	—	ns	2
Output buffer turn-off delay time from $\overline{\text{OE}}$	t_{OEZ}	0	13	0	15	ns	3
Output buffer turn-off delay time from $\overline{\text{CAS}}$	t_{OFF}	0	13	0	15	ns	3

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

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

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

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

Write Cycle

Parameter	Symbol	t _{rac} = 60 ns		t _{rac} = 70 ns		Unit	Notes
		MIN.	MAX.	MIN.	MAX.		
$\overline{\text{WE}}$ hold time referenced to $\overline{\text{CAS}}$	twch	10	—	10	—	ns	1
$\overline{\text{WE}}$ pulse width	twp	10	—	10	—	ns	1
$\overline{\text{WE}}$ lead time referenced to $\overline{\text{RAS}}$	trwl	20	—	20	—	ns	
$\overline{\text{WE}}$ lead time referenced to $\overline{\text{CAS}}$	tcwl	15	—	15	—	ns	
$\overline{\text{WE}}$ setup time	twcs	0	—	0	—	ns	2
$\overline{\text{OE}}$ hold time	toeh	0	—	0	—	ns	
Data-in setup time	t _{ds}	0	—	0	—	ns	3
Data-in hold time	t _{dh}	10	—	15	—	ns	3

- Notes**
1. t_{wp} (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 $\overline{\text{CAS}}$ 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 _{rac} = 60 ns		t _{rac} = 70 ns		Unit	Notes
		MIN.	MAX.	MIN.	MAX.		
Read modify write cycle time	trwc	158	—	180	—	ns	
$\overline{\text{RAS}}$ to $\overline{\text{WE}}$ delay time	trwd	83	—	95	—	ns	1
$\overline{\text{CAS}}$ to $\overline{\text{WE}}$ delay time	tcwd	38	—	40	—	ns	1
Column address to $\overline{\text{WE}}$ delay time	tawd	53	—	60	—	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

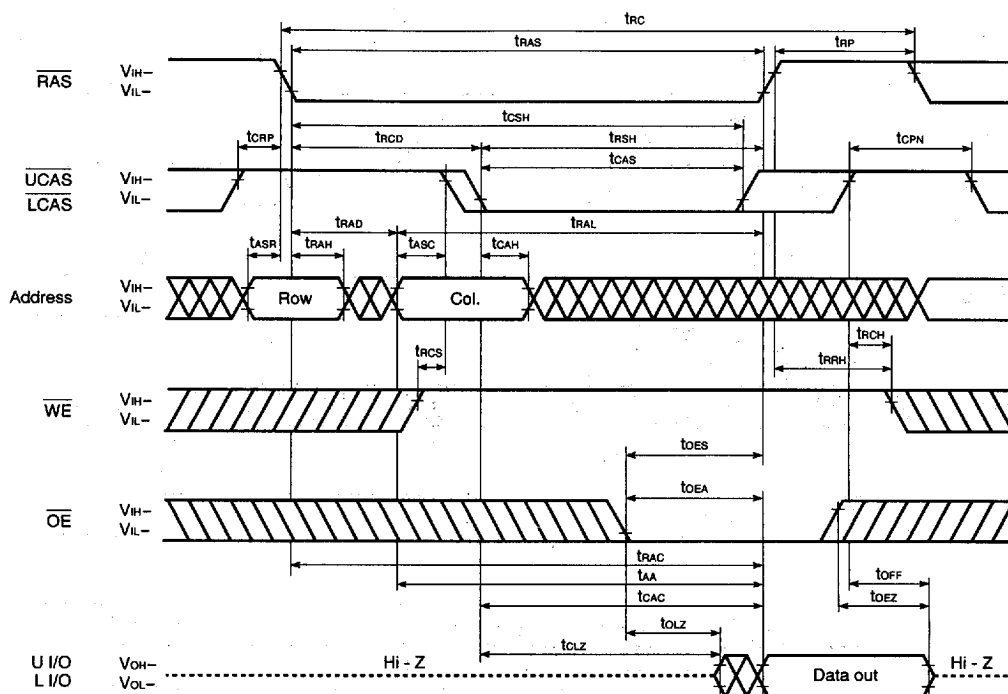
Parameter	Symbol	trac = 60 ns		trac = 70 ns		Unit	Note
		MIN.	MAX.	MIN.	MAX.		
Fast page mode cycle time	tpc	40	—	45	—	ns	
Access time from $\overline{\text{CAS}}$ precharge	tACP	—	35	—	40	ns	
RAS pulse width	trASP	60	125,000	70	125,000	ns	
$\overline{\text{CAS}}$ precharge time	tcp	10	—	10	—	ns	
RAS hold time from $\overline{\text{CAS}}$ precharge	trHCP	35	—	40	—	ns	
Read modify write cycle time	tPRWC	83	—	90	—	ns	
$\overline{\text{CAS}}$ precharge to $\overline{\text{WE}}$ delay time	tcpWD	58	—	65	—	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 $\text{trwo} \geq \text{trwo}(\text{MIN.})$, $\text{tcwd} \geq \text{tcwd}(\text{MIN.})$, $\text{tawd} \geq \text{tawd}(\text{MIN.})$ 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

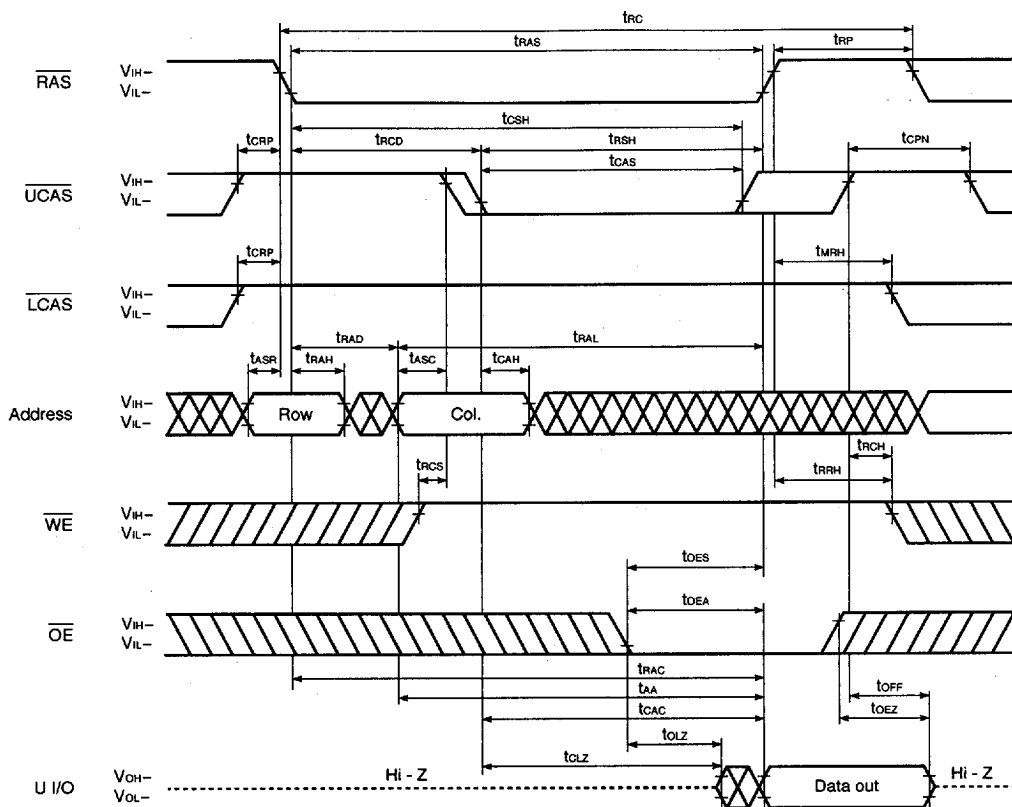
Parameter	Symbol	trac = 60 ns		trac = 70 ns		Unit	Note
		MIN.	MAX.	MIN.	MAX.		
$\overline{\text{CAS}}$ setup time	tCSR	5	—	5	—	ns	
$\overline{\text{CAS}}$ hold time ($\overline{\text{CAS}}$ before RAS refresh)	tCHR	10	—	10	—	ns	
RAS precharge $\overline{\text{CAS}}$ hold time	trPC	5	—	5	—	ns	
RAS pulse width ($\overline{\text{CAS}}$ before RAS self refresh)	trASS	100	—	100	—	μs	1
RAS precharge time ($\overline{\text{CAS}}$ before RAS self refresh)	trPS	110	—	130	—	ns	1
$\overline{\text{CAS}}$ hold time ($\overline{\text{CAS}}$ before RAS self refresh)	tCHS	—50	—	—50	—	ns	1
$\overline{\text{WE}}$ hold time	tWHR	15	—	15	—	ns	

Note 1. This specification is applied only to the μPD42S18160L.



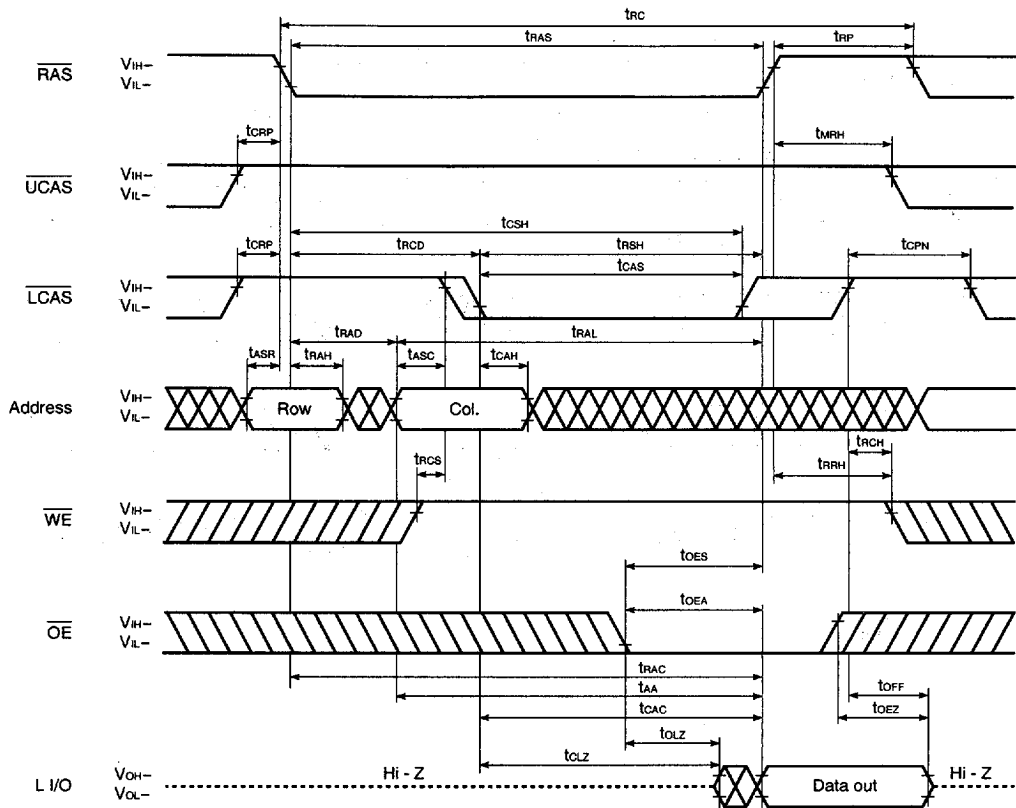
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Upper Byte Read Cycle



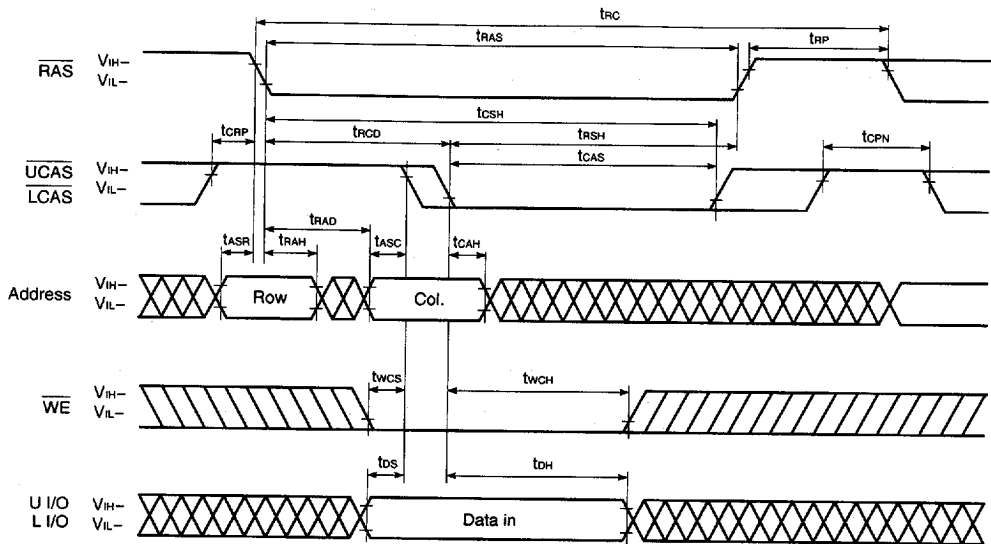
Remark L I/O: Hi-Z

Lower Byte Read Cycle



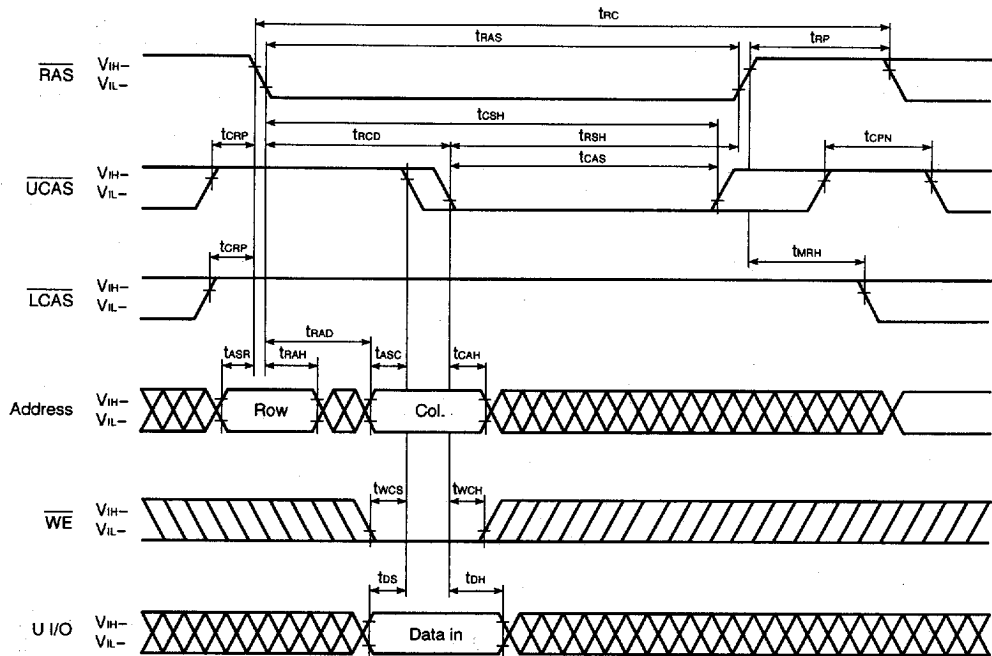
Remark U I/O: Hi-Z

Early Write Cycle



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

Upper Byte Early Write Cycle



Remark $\overline{\text{OE}}$, L I/O: Don't care

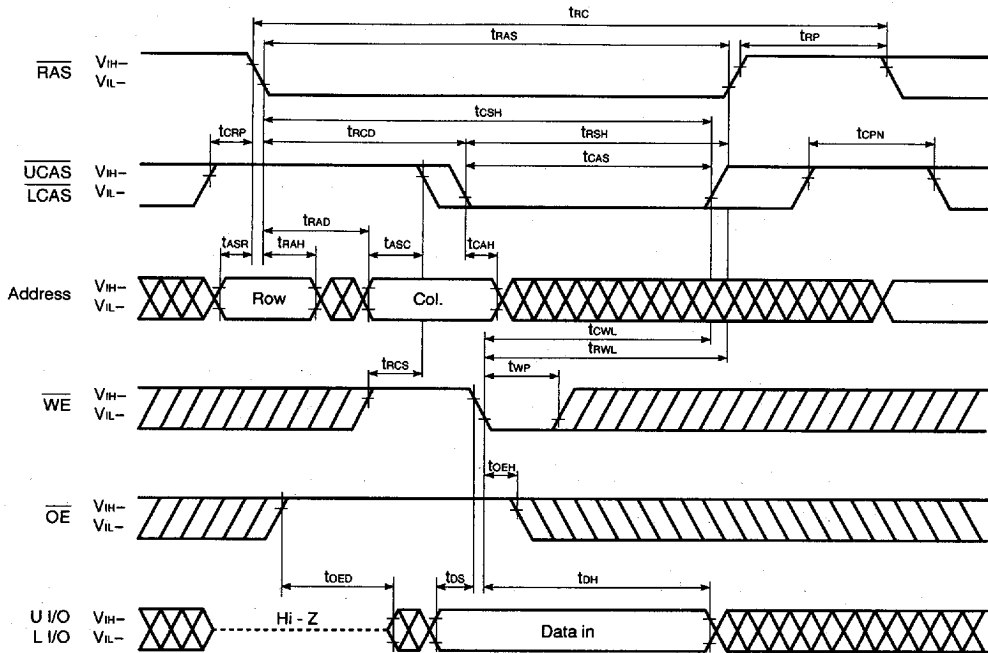
The timing diagram illustrates the relationship between several control and data signals for the 64K16B16000 DRAM. The signals shown are:

- RAS**: Row Address Strobe, active low. Timing parameters include t_{RAS} (pulse width), t_{RC} (period), t_{RP} (return to high), and t_{MRH} (high time after pulse).
- UCAS**: Universal Chip Address Strobe, active low. Timing parameters include t_{CRP} (return to high) and t_{RCD} (row to column delay).
- LCAS**: Local Chip Address Strobe, active low. Timing parameters include t_{CRP} (return to high), t_{RSH} (row to high time), t_{CAS} (column access time), and t_{CPN} (column pulse width).
- Address**: Consists of Row and Column address inputs. Timing parameters include t_{ASR} (address setup), t_{RAH} (row address hold), t_{ASC} (address to column delay), and t_{CAH} (column address hold).
- WE**: Write Enable, active low. Timing parameters include t_{WCS} (write enable setup) and t_{WCH} (write enable hold).
- L I/O**: Data Input/Output. Timing parameters include t_{OS} (output setup) and t_{OH} (output hold).

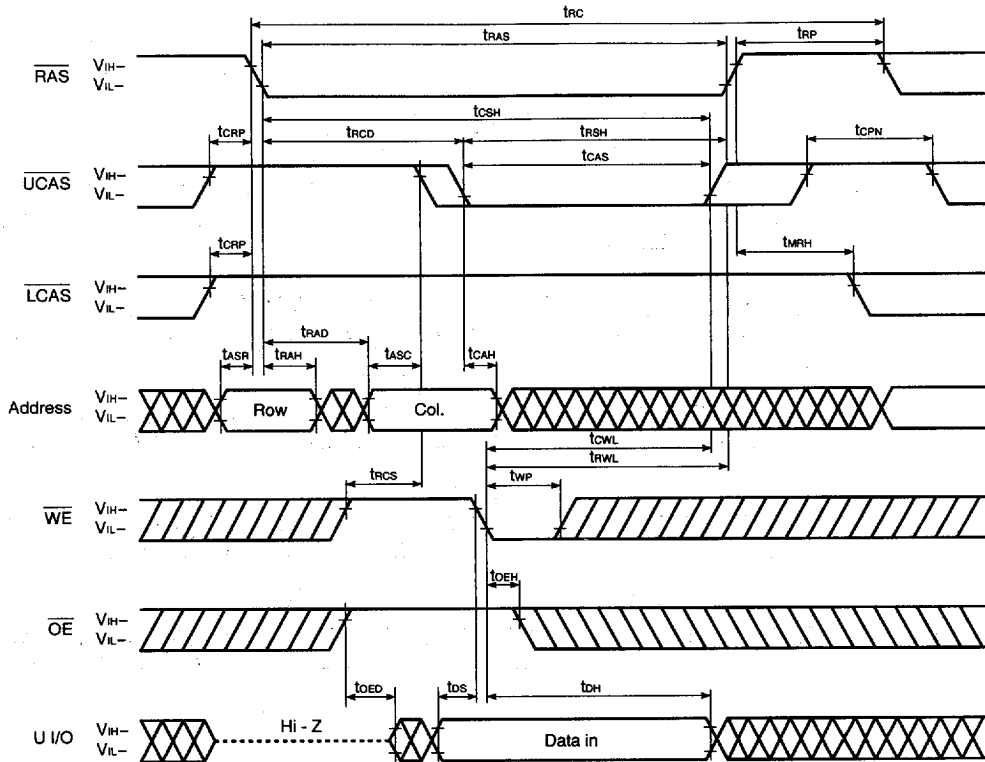
The diagram shows the sequence of operations for a memory access, with the Row and Column address inputs being active during the RAS and UCAS pulses, and the Data Input/Output being active during the WE pulse.

Remark $\overline{OE}$, U I/O: Don't care

Late Write Cycle

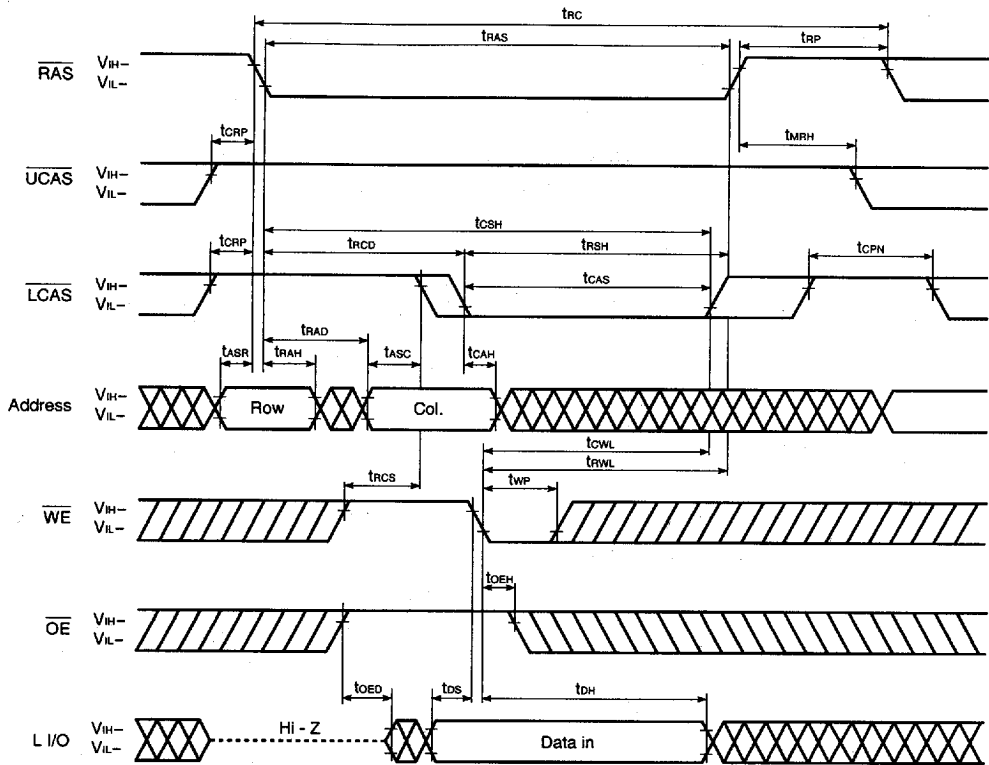


Upper Byte Late Write Cycle



Remark L I/O: Don't care

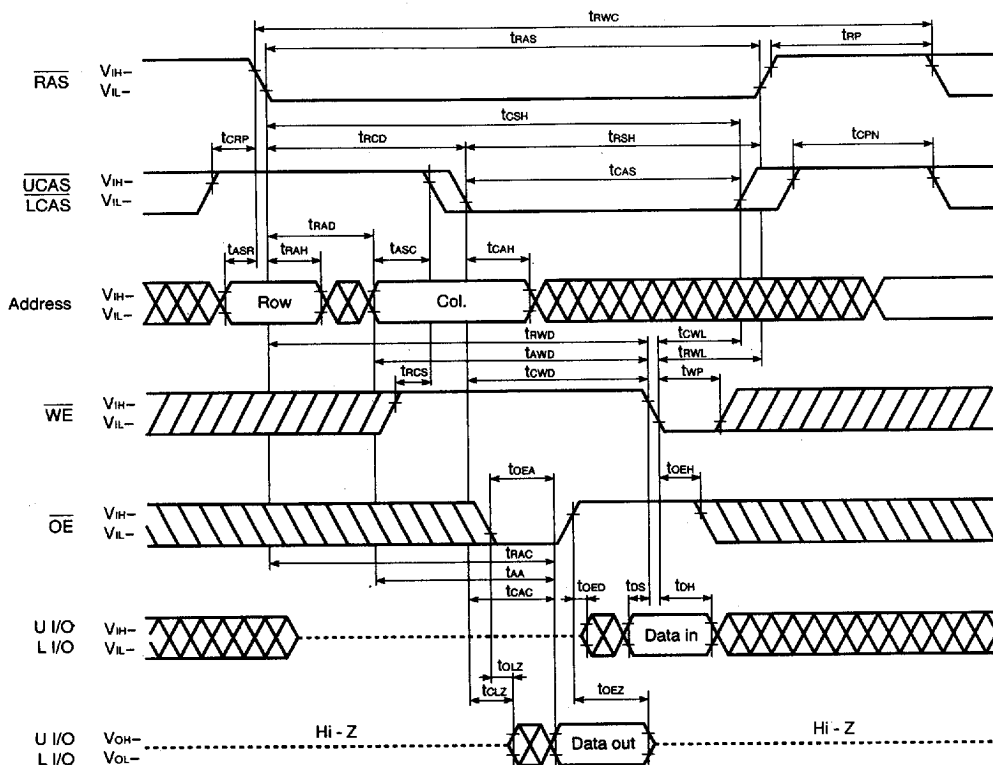
Lower Byte Late Write Cycle



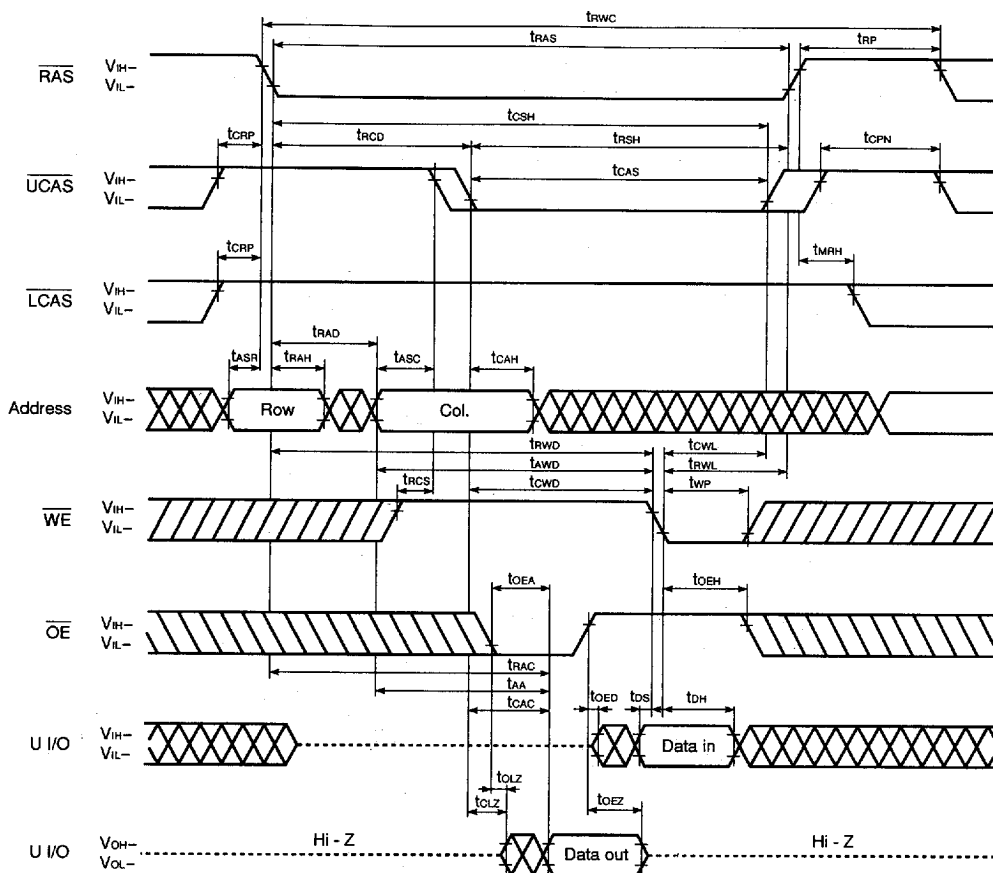
Remark U I/O: Don't care

■ 6427525 0091659 577 ■

Read Modify Write Cycle



Upper Byte Read Modify Write Cycle

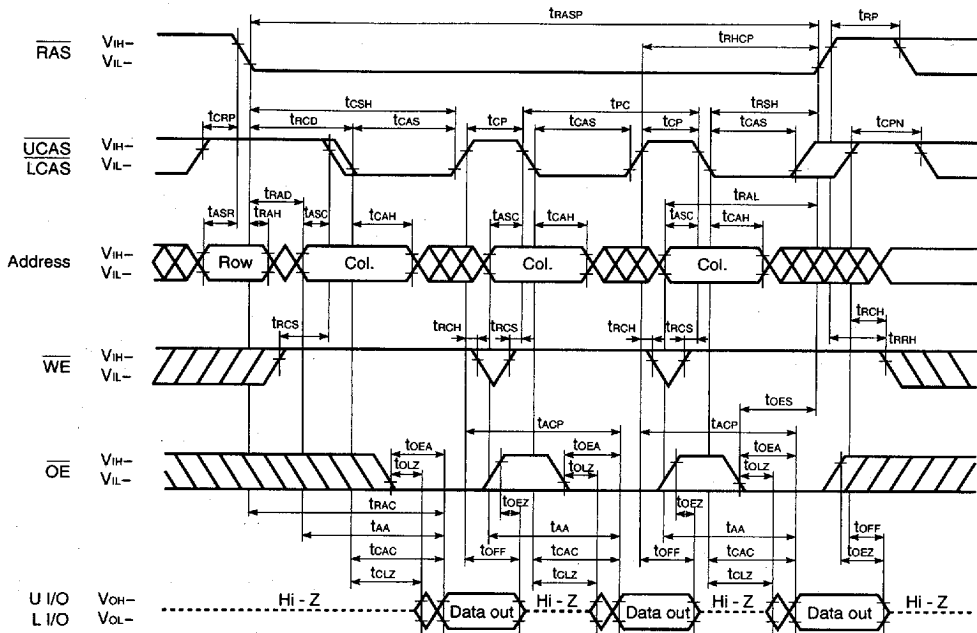


Remark In this cycle, the input data to Lower I/O is ineffective. The data out of that remains Hi-Z.

[illegible]

Remark In this cycle, the input data to Upper I/O is ineffective. The data out of that remains Hi-Z.

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 CAS cycles within the same RAS cycle.

[illegible]

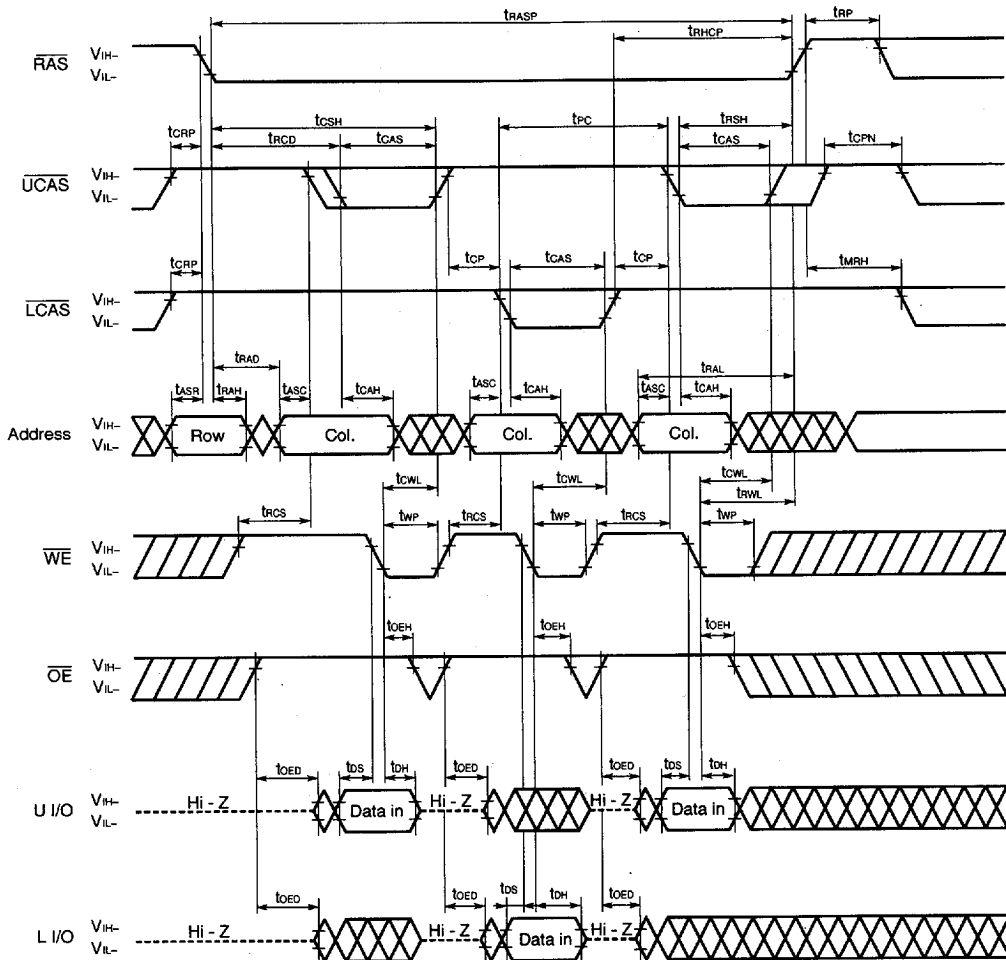
- Remarks**
1. In the fast page mode, read, write and read modify write cycles are available for each of the consecutive $\overline{\text{CAS}}$ cycles within the same $\overline{\text{RAS}}$ cycle.
 2. This cycle can be used to control either $\overline{\text{UCAS}}$ or $\overline{\text{LCAS}}$ only. Or, it can be used to control $\overline{\text{UCAS}}$ or $\overline{\text{LCAS}}$ simultaneously, or at random.

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.

- 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.
 3. This cycle can be used to control either $\overline{UCAS}$ or $\overline{LCAS}$ only. Or, it can be used to control $\overline{UCAS}$ or $\overline{LCAS}$ simultaneously, or at random.

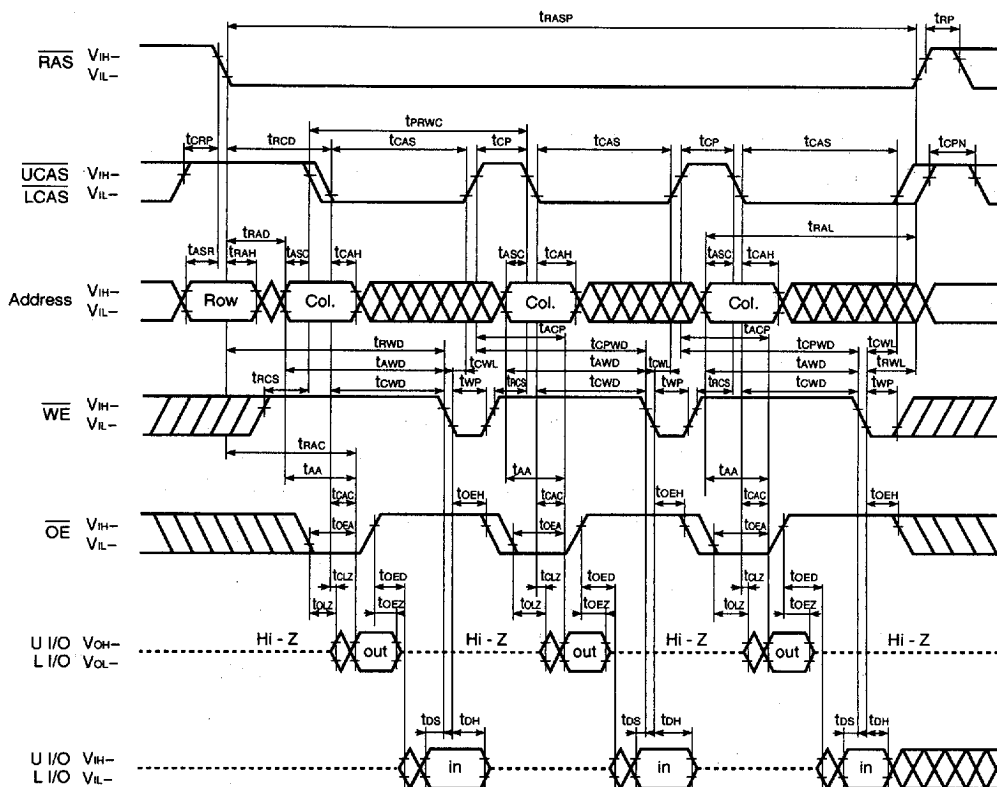
6427525 0091667 643

Fast Page Mode Byte Late Write Cycle



- Remarks**
1. In the fast page mode, read, write and read modify write cycles are available for each of the consecutive CAS cycles within the same $\overline{RAS}$ cycle.
 2. This cycle can be used to control either UCAS or LCAS only. Or, it can be used to control UCAS or LCAS simultaneously, or at random.

Fast Page Mode Read Modify Write Cycle

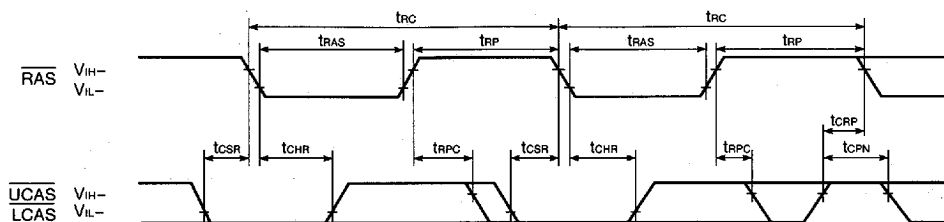


Remark In the fast page mode, read, write and read modify write cycles are available for each of the consecutive CAS cycles within the same RAS cycle.

[illegible]

- 6427525 0091670 138

CAS Before RAS Self Refresh Cycle (Only for the μPD42S18160L)



Remark Address, $\overline{WE}$, $\overline{OE}$: Don't care L I/O, U 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 as follows just before and after setting $\overline{CAS}$ before $\overline{RAS}$ self refresh.

μPD42S18160L: 1,024 times within a 16 ms interval

(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 as follows just before and after setting $\overline{CAS}$ before $\overline{RAS}$ self refresh.

μPD42S18160L: 1,024 times within a 16 ms interval

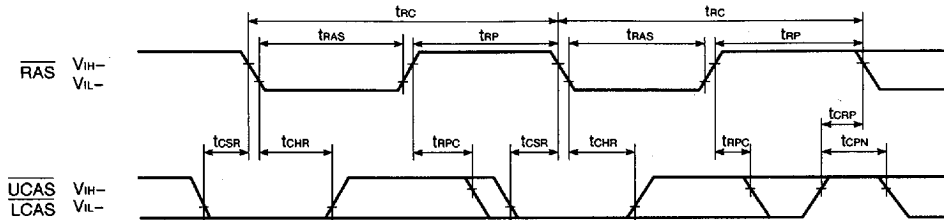
(3) If $t_{RAS(MIN.)}$ is not satisfied at the beginning of $\overline{CAS}$ before $\overline{RAS}$ self refresh cycles ($t_{RAS} < 100 \mu s$), $\overline{CAS}$ before $\overline{RAS}$ refresh cycles will be executed one time.

If $10 \mu s < t_{RAS} < 100 \mu s$, $\overline{RAS}$ precharge time for $\overline{CAS}$ before $\overline{RAS}$ self refresh (t_{RPS}) is applied. And refresh cycles as follows should be met.

μPD42S18160L: 1,024 times within a 128 ms interval

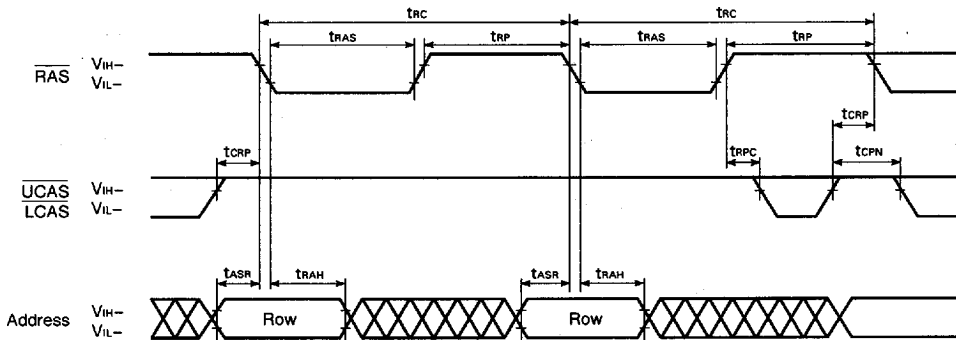
For details, please refer to **How to use DRAM** User's Manual.

CAS Before RAS Refresh Cycle



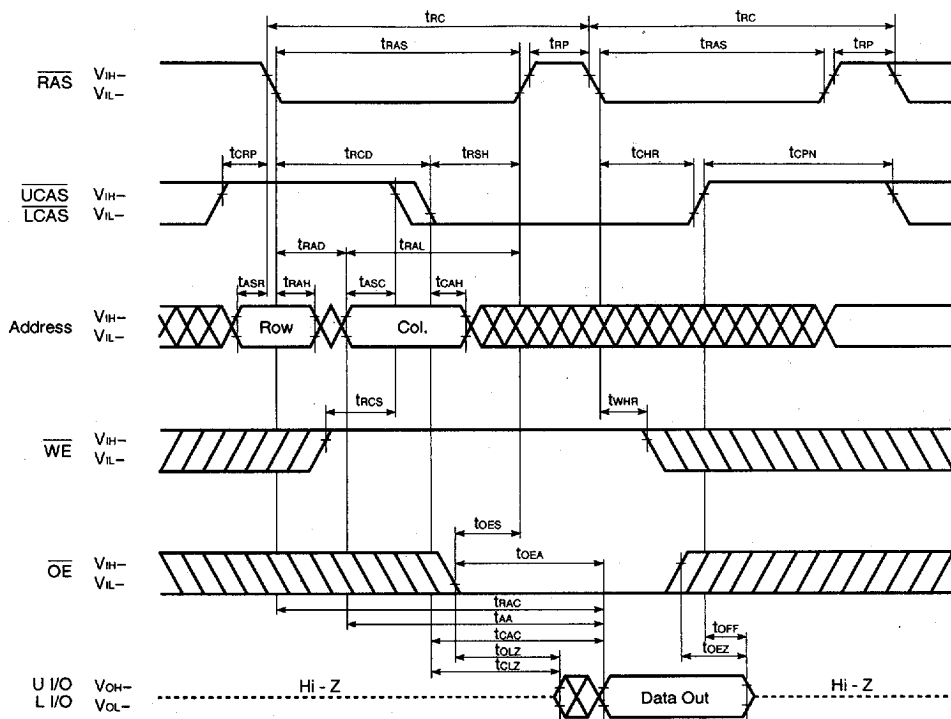
Remark Address, $\overline{WE}$, $\overline{OE}$: Don't care L I/O, U I/O: Hi-Z

RAS Only Refresh Cycle

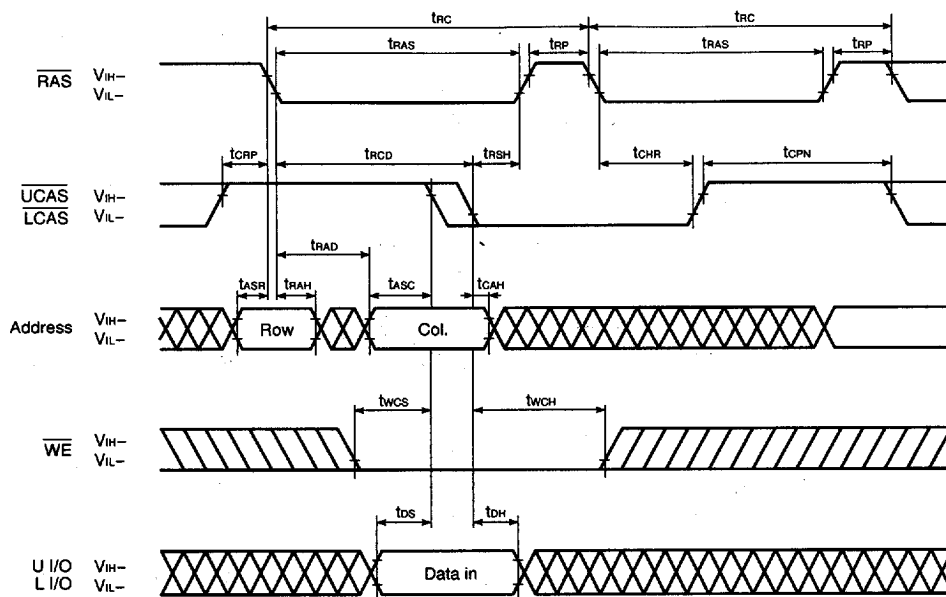


Remark $\overline{WE}$, $\overline{OE}$: Don't care L I/O, U I/O: Hi-Z

Hidden Refresh Cycle (Read)



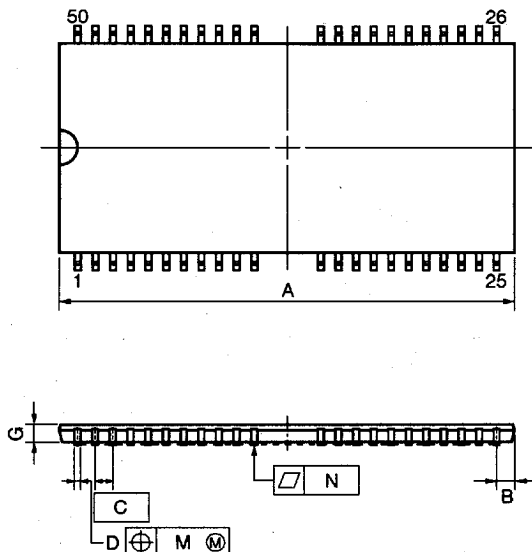
Hidden Refresh Cycle (Write)



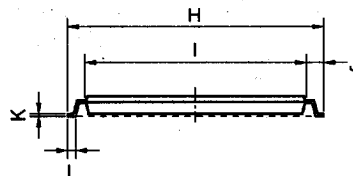
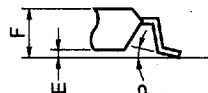
Remark $\overline{\text{OE}}$: Don't care

Package Drawings

50PIN PLASTIC TSOP(II) (400 mil)



detail of lead end



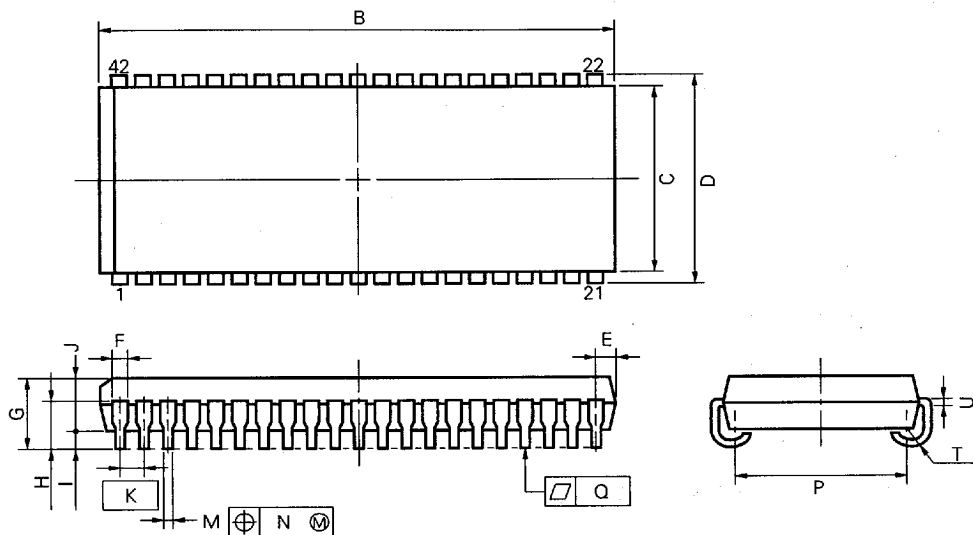
NOTE

Each lead centerline is located within 0.13 mm (0.005 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	21.17 MAX.	0.834 MAX.
B	1.0 MAX.	0.040 MAX.
C	0.8 (T.P.)	0.031 (T.P.)
D	$0.32^{+0.08}_{-0.07}$	0.013 ± 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	0.13	0.005
N	0.10	0.004
P	$3^{\circ} + 7^{\circ}_{-3^{\circ}}$	$3^{\circ} + 7^{\circ}_{-3^{\circ}}$

S50G5-80-7JF4

42 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.

P42LE-400A

ITEM	MILLIMETERS	INCHES
B	27.56 ^{+0.2} _{-0.35}	1.085 ^{+0.008} _{-0.014}
C	10.16	0.400
D	11.18±0.2	0.440±0.008
E	1.08±0.15	0.043 ^{+0.006} _{-0.007}
F	0.74	0.029
G	3.5±0.2	0.138±0.008
H	2.545±0.2	0.100±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	9.4±0.20	0.370±0.008
Q	0.10	0.004
T	R 0.85	R 0.033
U	0.20 ^{+0.10} _{-0.05}	0.008 ^{+0.004} _{-0.002}

Recommended Soldering Conditions

The following conditions (see tables below and next page) must be met when soldering μPD42S18160L, 4218160L.

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

μPD42S18160LG5, 4218160LG5: 50-pin plastic TSOP (II) (400 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 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".

μPD42S18160LLE, 4218160LLE: 42-pin plastic SOJ (400 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".