OKI Semiconductor

This version: Apr. 1999
Previous version: Oct. 1998

MSM5118160D/DSL

1,048,576-Word × 16-Bit DYNAMIC RAM : FAST PAGE MODE TYPE

DESCRIPTION

The MSM5118160D/DSL is a 1,048,576-word×16-bit dynamic RAM fabricated in Oki's silicon-gate CMOS technology. The MSM5118160D/DSL achieves high integration, high-speed operation, and low-power consumption because Oki manufactures the device in a quadruple-layer polysilicon/ double-layer metal CMOS process. The MSM5118160D/DSL is available in a 42-pin plastic SOJ or 50/44-pin plastic TSOP. The MSM5118160DSL (the self-refresh version) is specially designed for lower-power applications.

FEATURES

- 1,048,576-word × 16-bit configuration
- Single 5 V power supply, ±10% tolerance
- Input : TTL compatible, low input capacitance
- Output : TTL compatible, 3-state
- Refresh : 1024 cycles/16 ms, 1024 cycles/128 ms (SL version)
- Fast page mode, read modify write capability
- $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh, hidden refresh, $\overline{\text{RAS}}$-only refresh capability
- $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self-refresh capability (SL version)
- Package options:

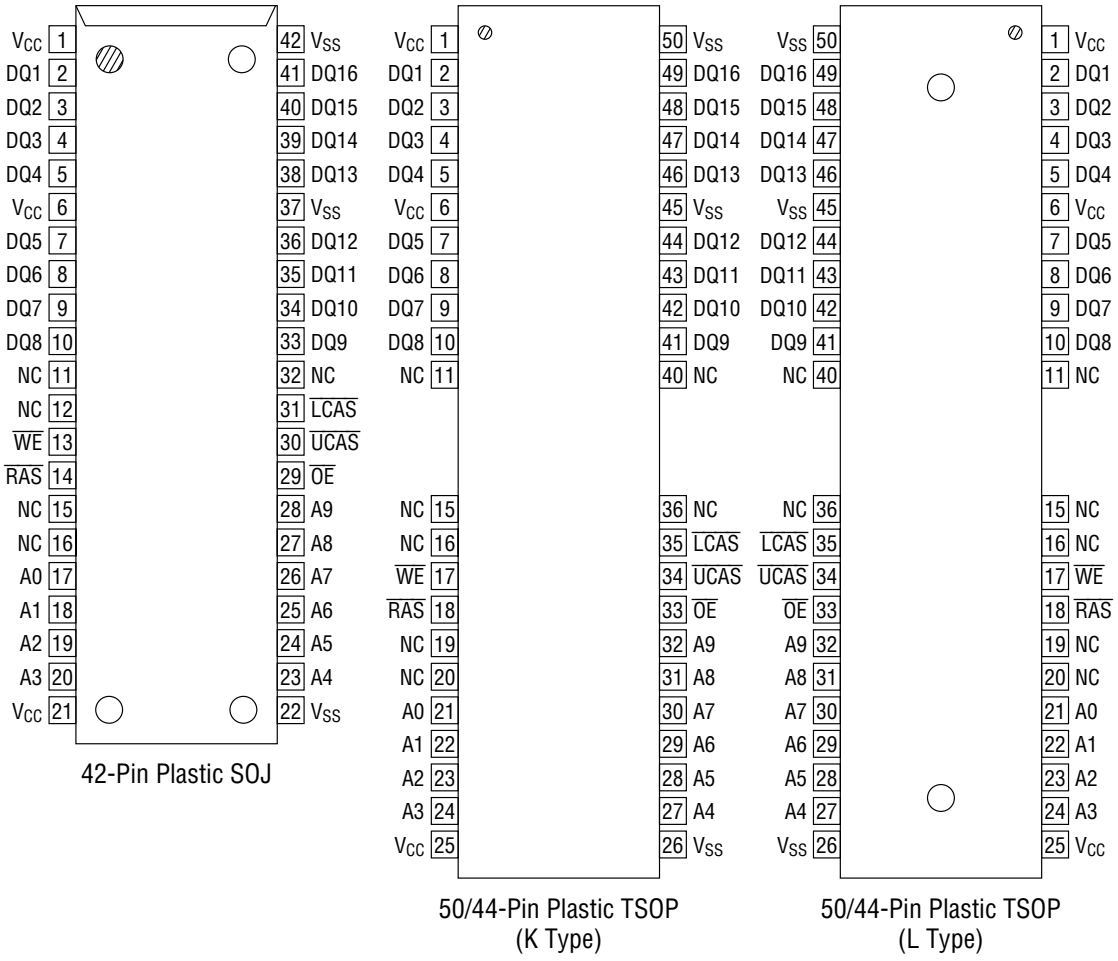
42-pin 400 mil plastic SOJ	(SOJ42-P-400-1.27)	(Product : MSM5118160D/DSL-xxJS)
50/44-pin 400 mil plastic TSOP	(TSOPII50/44-P-400-0.80-K)	(Product: MSM5118160D/DSL-xxTS-K)
	(TSOPII50/44-P-400-0.80-L)	(Product: MSM5118160D/DSL-xxTS-L)

xx indicates speed rank.

PRODUCT FAMILY

Family	Access Time (Max.)				Cycle Time (Min.)	Power Dissipation	
	t_{RAC}	t_{AA}	t_{CAC}	t_{OEA}		Operating (Max.)	Standby (Max.)
MSM5118160D/DSL-50	50 ns	25 ns	13 ns	13 ns	90 ns	743 mW	5.5 mW/ 1.1 mW (SL version)
MSM5118160D/DSL-60	60 ns	30 ns	15 ns	15 ns	110 ns	688 mW	
MSM5118160D/DSL-70	70 ns	35 ns	20 ns	20 ns	130 ns	633 mW	

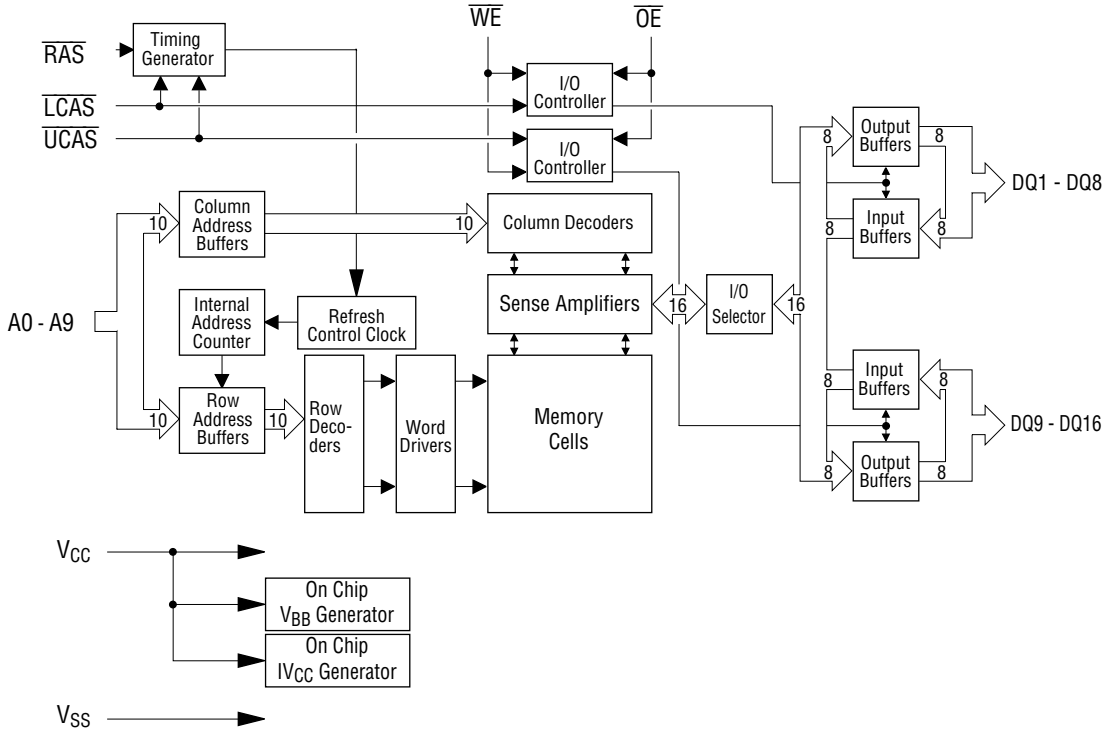
PIN CONFIGURATION (TOP VIEW)



Pin Name	Function
A0 - A9	Address Input
$\overline{RAS}$	Row Address Strobe
$\overline{LCAS}$	Lower Byte Column Address Strobe
$\overline{UCAS}$	Upper Byte Column Address Strobe
DQ1 - DQ16	Data Input/Data Output
$\overline{OE}$	Output Enable
$\overline{WE}$	Write Enable
V_{CC}	Power Supply (5 V)
V_{SS}	Ground (0 V)
NC	No Connection

Note : The same power supply voltage must be provided to every V_{CC} pin, and the same GND voltage level must be provided to every V_{SS} pin.

BLOCK DIAGRAM



FUNCTION TABLE

Input Pin					DQ Pin		Function Mode
$\overline{RAS}$	$\overline{LCAS}$	$\overline{UCAS}$	$\overline{WE}$	$\overline{OE}$	DQ1 - DQ8	DQ9 - DQ16	
H	*	*	*	*	High-Z	High-Z	Standby
L	H	H	*	*	High-Z	High-Z	Refresh
L	L	H	H	L	D_{OUT}	High-Z	Lower Byte Read
L	H	L	H	L	High-Z	D_{OUT}	Upper Byte Read
L	L	L	H	L	D_{OUT}	D_{OUT}	Word Read
L	L	H	L	H	D_{IN}	Don't Care	Lower Byte Write
L	H	L	L	H	Don't Care	D_{IN}	Upper Byte Write
L	L	L	L	H	D_{IN}	D_{IN}	Word Write
L	L	L	H	H	High-Z	High-Z	—

*: "H" or "L"

ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Voltage on Any Pin Relative to V_{SS}	V_{IN}, V_{OUT}	–0.5 to V_{CC} + 0.5	V
Voltage on V_{CC} Supply Relative to V_{SS}	V_{CC}	–0.5 to 7	V
Short Circuit Output Current	I_{OS}	50	mA
Power Dissipation	P_D*	1	W
Operating Temperature	T_{opr}	0 to 70	°C
Storage Temperature	T_{stg}	–55 to 150	°C

*: Ta = 25°C

Recommended Operating Conditions

(Ta = 0°C to 70°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power Supply Voltage	V_{CC}	4.5	5.0	5.5	V
	V_{SS}	0	0	0	V
Input High Voltage	V_{IH}	2.4	—	V_{CC} + 0.5*1	V
Input Low Voltage	V_{IL}	–0.5*2	—	0.8	V

Notes : *1. The input voltage is V_{CC} + 2.0 V when the pulse width is less than 20 ns (the pulse width is with respect to the point at which V_{CC} is applied).

*2. The input voltage is V_{SS} – 2.0 V when the pulse width is less than 20 ns (the pulse width is with respect to the point at which V_{SS} is applied).

Capacitance

(V_{CC} = 5 V ±10%, Ta = 25°C, f = 1 MHz)

Parameter	Symbol	Typ.	Max.	Unit
Input Capacitance (A0 - A9)	C_{IN1}	—	5	pF
Input Capacitance ($\overline{RAS}$, $\overline{LCAS}$, $\overline{UCAS}$, $\overline{WE}$, $\overline{OE}$)	C_{IN2}	—	7	pF
Output Capacitance (DQ1 - DQ16)	$C_{I/O}$	—	7	pF

DC Characteristics

(V_{CC} = 5 V ±10%, Ta = 0°C to 70°C)

Parameter	Symbol	Condition	MSM5118160 D/DSL-50		MSM5118160 D/DSL-60		MSM5118160 D/DSL-70		Unit	Note
			Min.	Max.	Min.	Max.	Min.	Max.		
Output High Voltage	V_{OH}	I_{OH} = –5.0 mA	2.4	V_{CC}	2.4	V_{CC}	2.4	V_{CC}	V	
Output Low Voltage	V_{OL}	I_{OL} = 4.2 mA	0	0.4	0	0.4	0	0.4	V	
Input Leakage Current	I_{LI}	0 V ≤ V_I ≤ 6.5 V; All other pins not under test = 0 V	–10	10	–10	10	–10	10	µA	
Output Leakage Current	I_{LO}	DQ disable 0 V ≤ V_O ≤ V_{CC}	–10	10	–10	10	–10	10	µA	
Average Power Supply Current (Operating)	I_{CC1}	$\overline{RAS}$, $\overline{CAS}$ cycling, t_{RC} = Min.	—	135	—	125	—	115	mA	1, 2
Power Supply Current (Standby)	I_{CC2}	$\overline{RAS}$, $\overline{CAS}$ = V_{IH}	—	2	—	2	—	2	mA	1
		$\overline{RAS}$, $\overline{CAS}$	—	1	—	1	—	1		
		≥ V_{CC} –0.2 V	—	200	—	200	—	200	µA	1, 5
Average Power Supply Current ($\overline{RAS}$-only Refresh)	I_{CC3}	$\overline{RAS}$ cycling, $\overline{CAS}$ = V_{IH}, t_{RC} = Min.	—	135	—	125	—	115	mA	1, 2
Power Supply Current (Standby)	I_{CC5}	$\overline{RAS}$ = V_{IH}, $\overline{CAS}$ = V_{IL}, DQ = enable	—	5	—	5	—	5	mA	1
Average Power Supply Current ($\overline{CAS}$ before $\overline{RAS}$ Refresh)	I_{CC6}	$\overline{RAS}$ cycling, $\overline{CAS}$ before $\overline{RAS}$	—	135	—	125	—	115	mA	1, 2
Average Power Supply Current (Fast Page Mode)	I_{CC7}	$\overline{RAS}$ = V_{IL}, $\overline{CAS}$ cycling, t_{PC} = Min.	—	135	—	125	—	115	mA	1, 3
Average Power Supply Current (Battery Backup)	I_{CC10}	t_{RC} = 125 µs, $\overline{CAS}$ before $\overline{RAS}$, t_{RAS} ≤ 1 µs	—	300	—	300	—	300	µA	1, 4, 5
Average Power Supply Current ($\overline{CAS}$ before $\overline{RAS}$ Self-Refresh)	I_{CCS}	$\overline{RAS}$ ≤ 0.2 V, $\overline{CAS}$ ≤ 0.2 V	—	300	—	300	—	300	µA	1, 5

Notes :
1. I_{CC} Max. is specified as I_{CC} for output open condition.
2. The address can be changed once or less while $\overline{RAS}$ = V_{IL}.
3. The address can be changed once or less while $\overline{CAS}$ = V_{IH}.
4. V_{CC} – 0.2 V ≤ V_{IH} ≤ V_{CC} + 0.5 V, –0.5 V ≤ V_{IL} ≤ 0.2 V.
5. SL version.

AC Characteristics (1/2)

(V_{CC} = 5 V ±10%, Ta = 0°C to 70°C) Note 1, 2, 3

Parameter	Symbol	MSM5118160 D/DSL-50		MSM5118160 D/DSL-60		MSM5118160 D/DSL-70		Unit	Note
		Min.	Max.	Min.	Max.	Min.	Max.		
Random Read or Write Cycle Time	t_{RC}	90	—	110	—	130	—	ns	
Read Modify Write Cycle Time	t_{RWC}	131	—	155	—	185	—	ns	
Fast Page Mode Cycle Time	t_{PC}	35	—	40	—	45	—	ns	
Fast Page Mode Read Modify Write Cycle Time	t_{PRWC}	76	—	85	—	100	—	ns	
Access Time from $\overline{RAS}$	t_{RAC}	—	50	—	60	—	70	ns	4, 5, 6
Access Time from $\overline{CAS}$	t_{CAC}	—	13	—	15	—	20	ns	4, 5
Access Time from Column Address	t_{AA}	—	25	—	30	—	35	ns	4, 6
Access Time from $\overline{CAS}$ Precharge	t_{CPA}	—	30	—	35	—	40	ns	4, 12
Access Time from $\overline{OE}$	t_{OEA}	—	13	—	15	—	20	ns	4
Output Low Impedance Time from $\overline{CAS}$	t_{CLZ}	0	—	0	—	0	—	ns	4
$\overline{CAS}$ to Data Output Buffer Turn-off Delay Time	t_{OFF}	0	13	0	15	0	20	ns	7
$\overline{OE}$ to Data Output Buffer Turn-off Delay Time	t_{OEZ}	0	13	0	15	0	20	ns	7
Transition Time	t_T	3	50	3	50	3	50	ns	3
Refresh Period	t_{REF}	—	16	—	16	—	16	ms	
Refresh Period (SL version)	t_{REF}	—	128	—	128	—	128	ms	15
$\overline{RAS}$ Precharge Time	t_{RP}	30	—	40	—	50	—	ns	
$\overline{RAS}$ Pulse Width	t_{RAS}	50	10,000	60	10,000	70	10,000	ns	
$\overline{RAS}$ Pulse Width (Fast Page Mode)	t_{RASP}	50	100,000	60	100,000	70	100,000	ns	
$\overline{RAS}$ Hold Time	t_{RSH}	13	—	15	—	20	—	ns	
$\overline{RAS}$ Hold Time referenced to $\overline{OE}$	t_{ROH}	13	—	15	—	20	—	ns	
$\overline{CAS}$ Precharge Time (Fast Page Mode)	t_{CP}	7	—	10	—	10	—	ns	14
$\overline{CAS}$ Pulse Width	t_{CAS}	13	10,000	15	10,000	20	10,000	ns	
$\overline{CAS}$ Hold Time	t_{CSH}	50	—	60	—	70	—	ns	
$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	t_{CRP}	5	—	5	—	5	—	ns	12
$\overline{RAS}$ Hold Time from $\overline{CAS}$ Precharge	t_{RHCP}	30	—	35	—	40	—	ns	12
$\overline{RAS}$ to $\overline{CAS}$ Delay Time	t_{RCD}	17	37	20	45	20	50	ns	5
$\overline{RAS}$ to Column Address Delay Time	t_{RAD}	12	25	15	30	15	35	ns	6
Row Address Set-up Time	t_{ASR}	0	—	0	—	0	—	ns	
Row Address Hold Time	t_{RAH}	7	—	10	—	10	—	ns	
Column Address Set-up Time	t_{ASC}	0	—	0	—	0	—	ns	11
Column Address Hold Time	t_{CAH}	7	—	10	—	15	—	ns	11
Column Address to $\overline{RAS}$ Lead Time	t_{RAL}	25	—	30	—	35	—	ns	
Read Command Set-up Time	t_{RCS}	0	—	0	—	0	—	ns	11
Read Command Hold Time	t_{RCH}	0	—	0	—	0	—	ns	8, 11
Read Command Hold Time referenced to $\overline{RAS}$	t_{RRH}	0	—	0	—	0	—	ns	8

AC Characteristics (2/2)

(V_{CC} = 5 V ±10%, Ta = 0°C to 70°C) Note 1, 2, 3

Parameter	Symbol	MSM5118160 D/DSL-50		MSM5118160 D/DSL-60		MSM5118160 D/DSL-70		Unit	Note
		Min.	Max.	Min.	Max.	Min.	Max.		
Write Command Set-up Time	t_{WCS}	0	—	0	—	0	—	ns	9, 11
Write Command Hold Time	t_{WCH}	7	—	10	—	15	—	ns	11
Write Command Pulse Width	t_{WP}	7	—	10	—	10	—	ns	
$\overline{OE}$ Command Hold Time	t_{OEH}	13	—	15	—	20	—	ns	
Write Command to $\overline{RAS}$ Lead Time	t_{RWL}	13	—	15	—	20	—	ns	
Write Command to $\overline{CAS}$ Lead Time	t_{CWL}	13	—	15	—	20	—	ns	13
Data-in Set-up Time	t_{DS}	0	—	0	—	0	—	ns	10, 11
Data-in Hold Time	t_{DH}	7	—	10	—	15	—	ns	10, 11
$\overline{OE}$ to Data-in Delay Time	t_{OED}	13	—	15	—	20	—	ns	
$\overline{CAS}$ to $\overline{WE}$ Delay Time	t_{CWD}	36	—	40	—	50	—	ns	9
Column Address to $\overline{WE}$ Delay Time	t_{AWD}	48	—	55	—	65	—	ns	9
$\overline{RAS}$ to $\overline{WE}$ Delay Time	t_{RWD}	73	—	85	—	100	—	ns	9
$\overline{CAS}$ Precharge $\overline{WE}$ Delay Time	t_{CPWD}	53	—	60	—	70	—	ns	9
$\overline{CAS}$ Active Delay Time from $\overline{RAS}$ Precharge	t_{RPC}	5	—	5	—	5	—	ns	11
$\overline{RAS}$ to $\overline{CAS}$ Set-up Time ($\overline{CAS}$ before $\overline{RAS}$)	t_{CSR}	10	—	10	—	10	—	ns	11
$\overline{RAS}$ to $\overline{CAS}$ Hold Time ($\overline{CAS}$ before $\overline{RAS}$)	t_{CHR}	10	—	10	—	10	—	ns	12
$\overline{RAS}$ Pulse Width ($\overline{CAS}$ before $\overline{RAS}$ Self-Refresh)	t_{RASS}	100	—	100	—	100	—	µs	15
$\overline{RAS}$ Precharge Time ($\overline{CAS}$ before $\overline{RAS}$ Self-Refresh)	t_{RPS}	90	—	110	—	130	—	ns	15
$\overline{CAS}$ Hold Time ($\overline{CAS}$ before $\overline{RAS}$ Self-Refresh)	t_{CHS}	–50	—	–50	—	–50	—	ns	15

Notes:

1. A start-up delay of 200 µs is required after power-up, followed by a minimum of eight initialization cycles ($\overline{RAS}$-only refresh or $\overline{CAS}$ before $\overline{RAS}$ refresh) before proper device operation is achieved.

2. The AC characteristics assume t_T = 5 ns.

3. V_{IH} (Min.) and V_{IL} (Max.) are reference levels for measuring input timing signals. Transition times (t_T) are measured between V_{IH} and V_{IL}.

4. This parameter is measured with a load circuit equivalent to 2 TTL loads and 100 pF.

5. Operation within the t_{RCD} (Max.) limit ensures that t_{RAC} (Max.) can be met. t_{RCD} (Max.) is specified as a reference point only. If t_{RCD} is greater than the specified t_{RCD} (Max.) limit, then the access time is controlled by t_{CAC}.

6. Operation within the t_{RAD} (Max.) limit ensures that t_{RAC} (Max.) can be met. t_{RAD} (Max.) is specified as a reference point only. If t_{RAD} is greater than the specified t_{RAD} (Max.) limit, then the access time is controlled by t_{AA}.

7. t_{OFF} (Max.) and t_{OEZ} (Max.) define the time at which the output achieves the open circuit condition and are not referenced to output voltage levels.

8. t_{RCH} or t_{RRH} must be satisfied for a read cycle.

9. t_{WCS}, t_{CWD}, t_{RWD}, t_{AWD} and t_{CPWD} are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only. If $t_{WCS} \geq t_{WCS}$ (Min.), then the cycle is an early write cycle and the data out will remain open circuit (high impedance) throughout the entire cycle. If $t_{CWD} \geq t_{CWD}$ (Min.) , $t_{RWD} \geq t_{RWD}$ (Min.), $t_{AWD} \geq t_{AWD}$ (Min.) and $t_{CPWD} \geq t_{CPWD}$ (Min.), then the cycle is a read modify write cycle and data out will contain data read from the selected cell; if neither of the above sets of conditions is satisfied, then the condition of the data out (at access time) is indeterminate.

10. These parameters are referenced to the $\overline{UCAS}$ and $\overline{LCAS}$, leading edges in an early write cycle, and to the $\overline{WE}$ leading edge in an $\overline{OE}$ control write cycle, or a read modify write cycle.

11. These parameters are determined by the falling edge of either $\overline{UCAS}$ or $\overline{LCAS}$, whichever is earlier.

12. These parameters are determined by the rising edge of either $\overline{UCAS}$ or $\overline{LCAS}$, whichever is later.

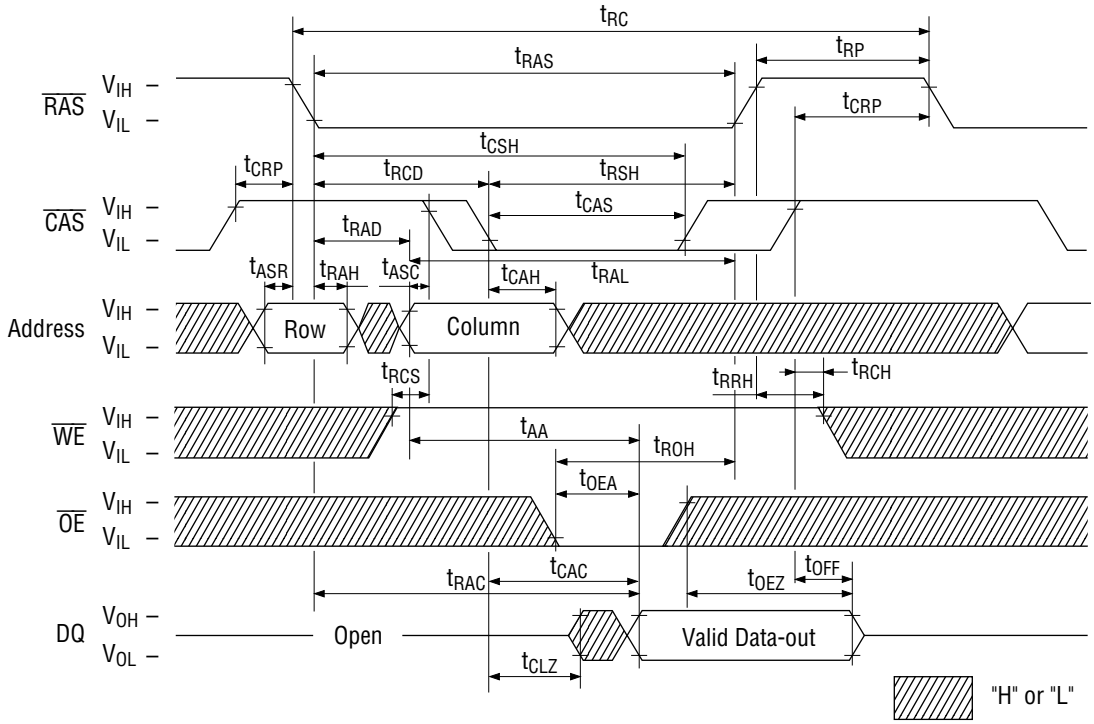
13. t_{CWL} should be satisfied by both $\overline{UCAS}$ and $\overline{LCAS}$.

14. t_{CP} is determined by the time both $\overline{UCAS}$ and $\overline{LCAS}$ are high.

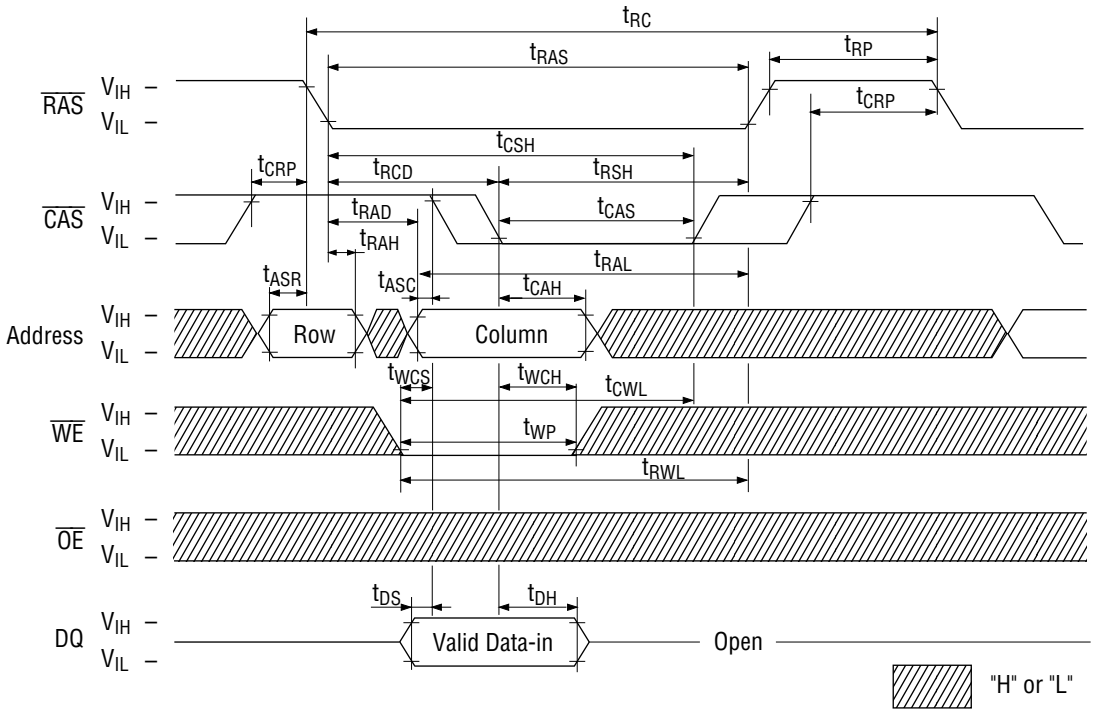
15. Only SL version.

TIMING WAVEFORM

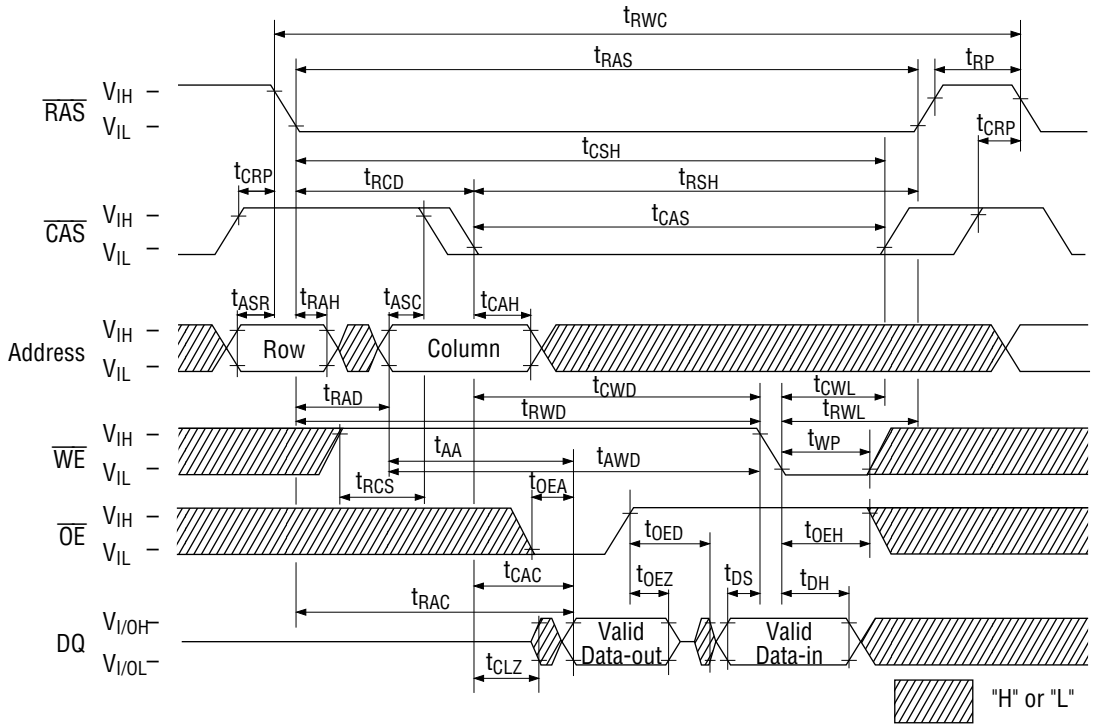
Read Cycle



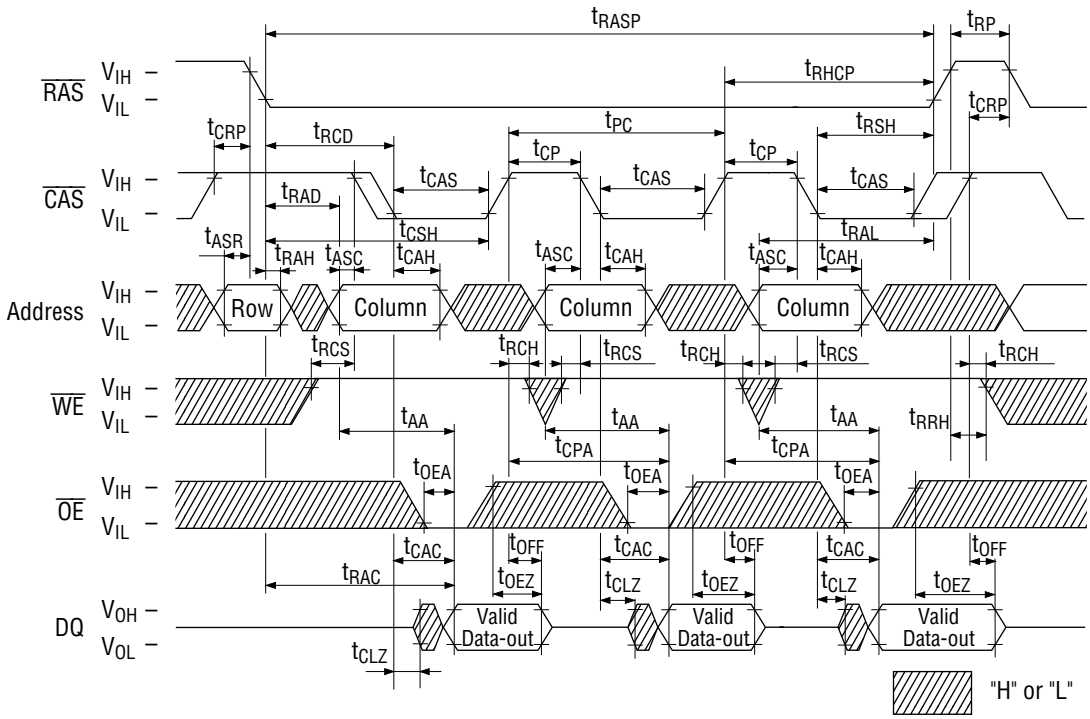
Write Cycle (Early Write)



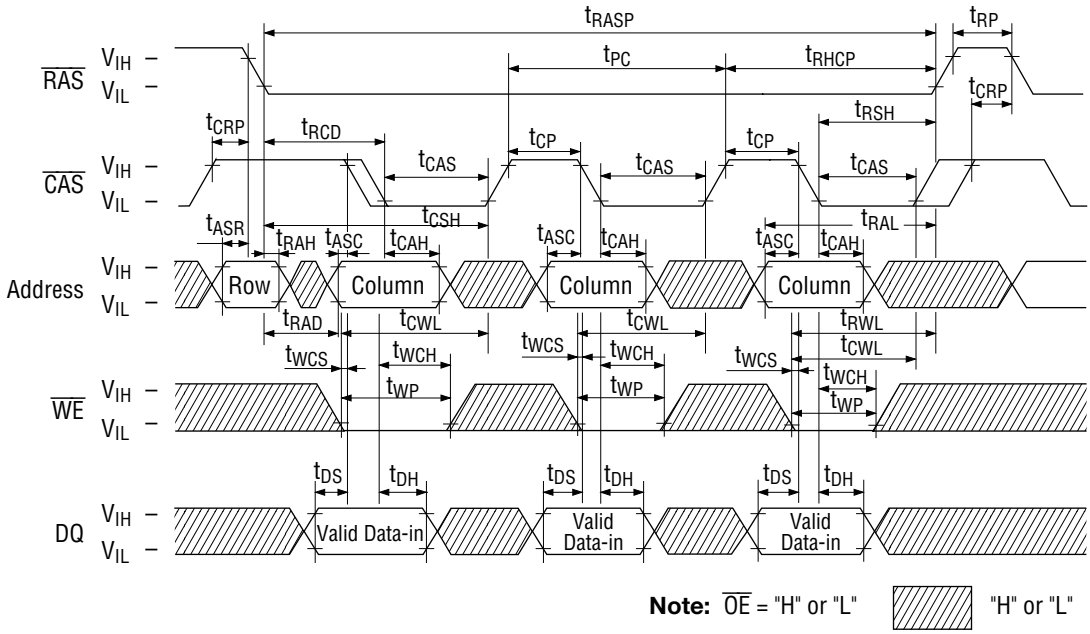
Read Modify Write Cycle



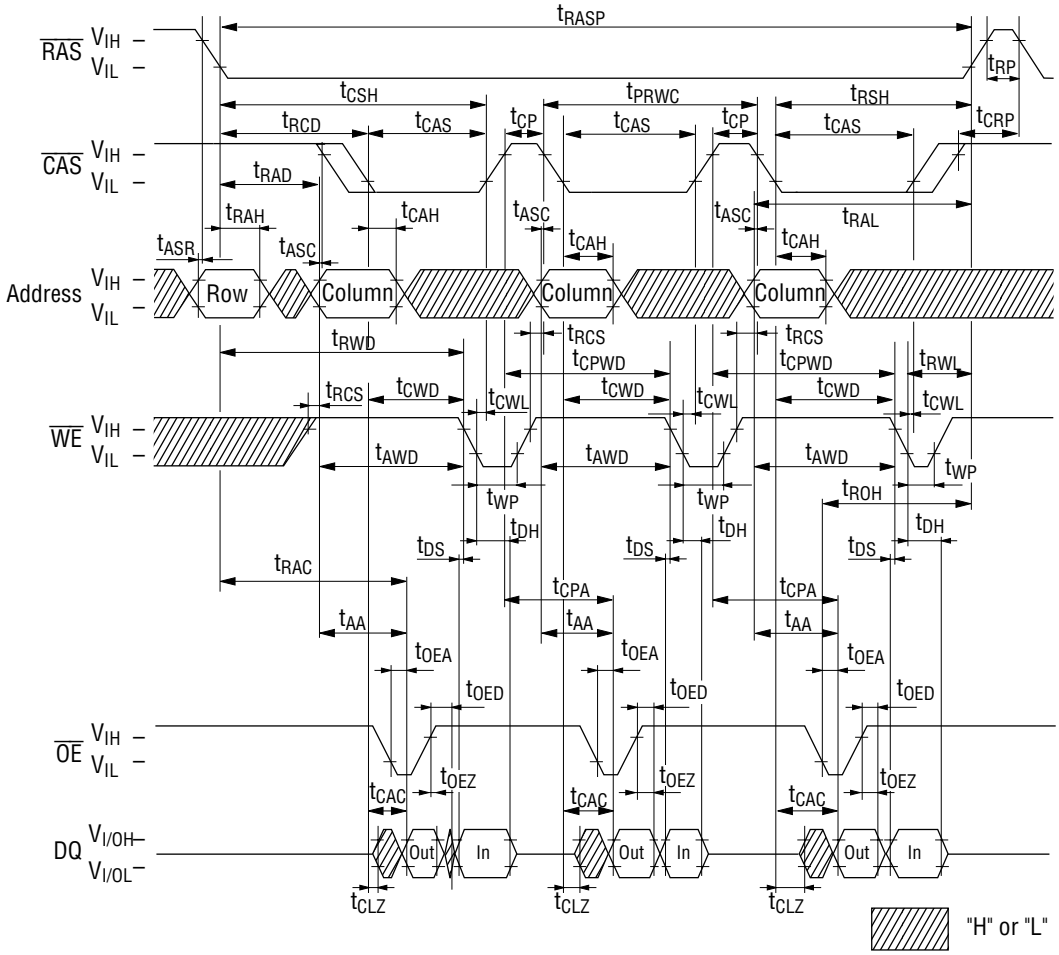
Fast Page Mode Read Cycle



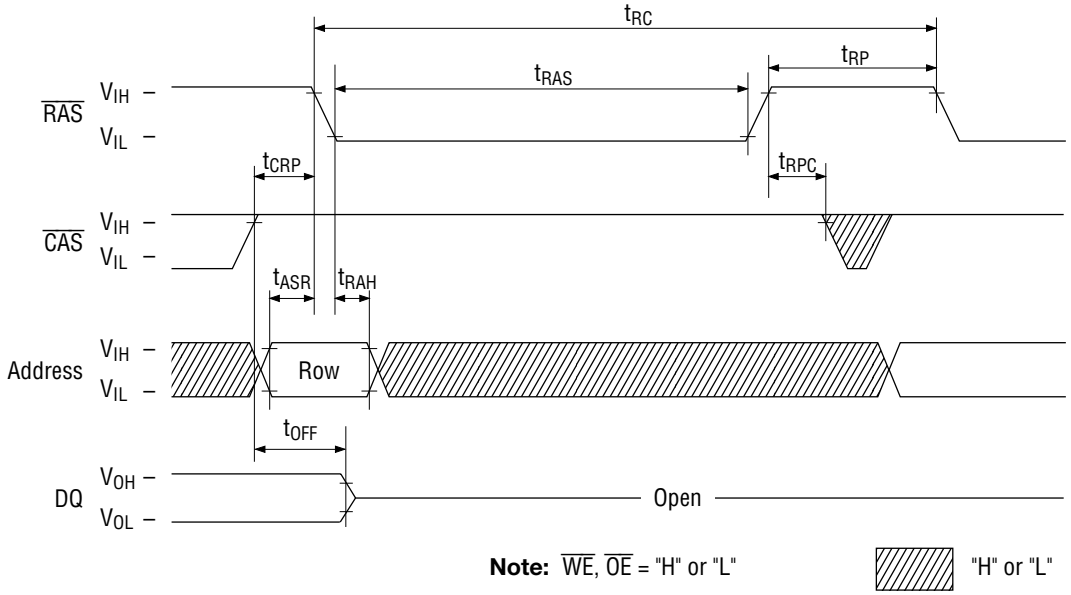
Fast Page Mode Write Cycle (Early Write)



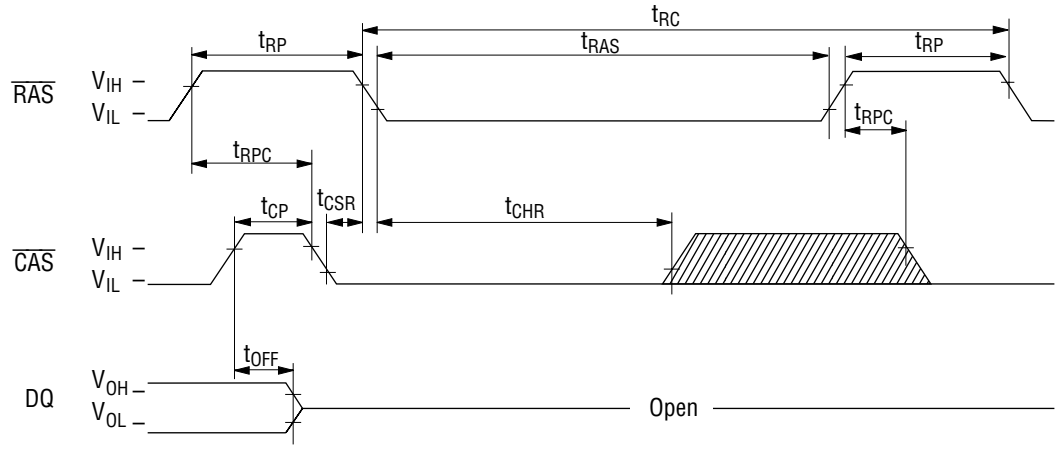
Fast Page Mode Read Modify Write Cycle



RAS-Only Refresh Cycle

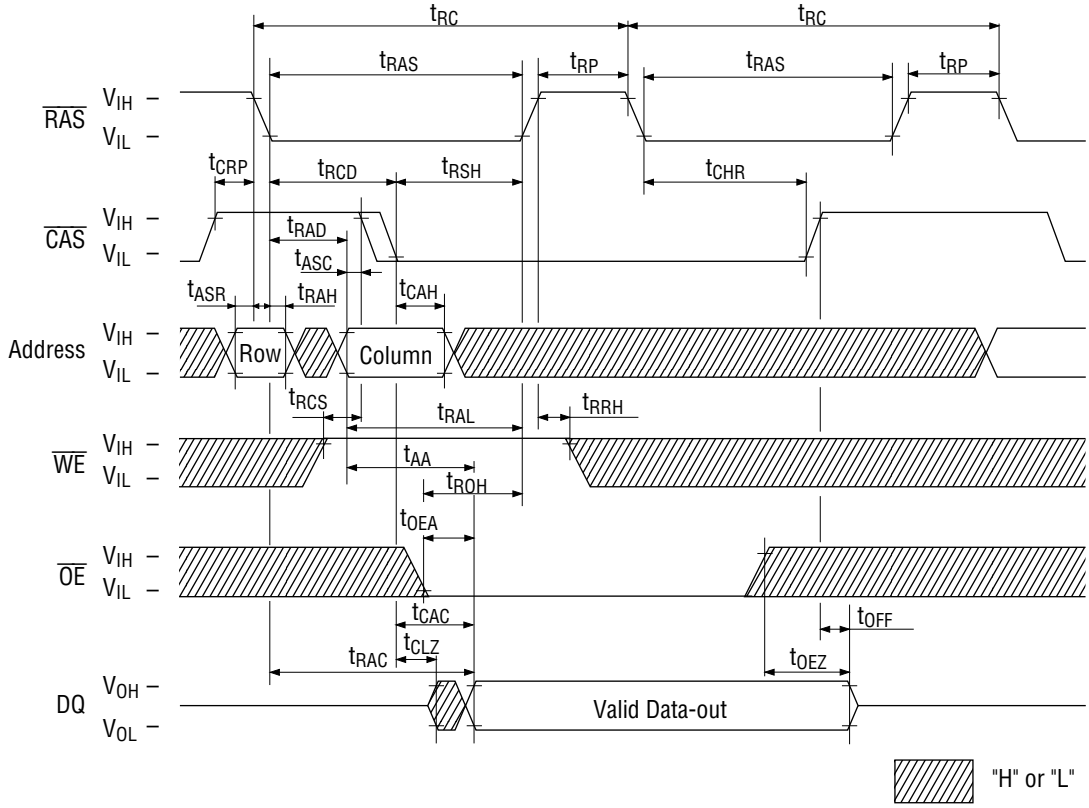


$\overline{CAS}$ before $\overline{RAS}$ Refresh Cycle

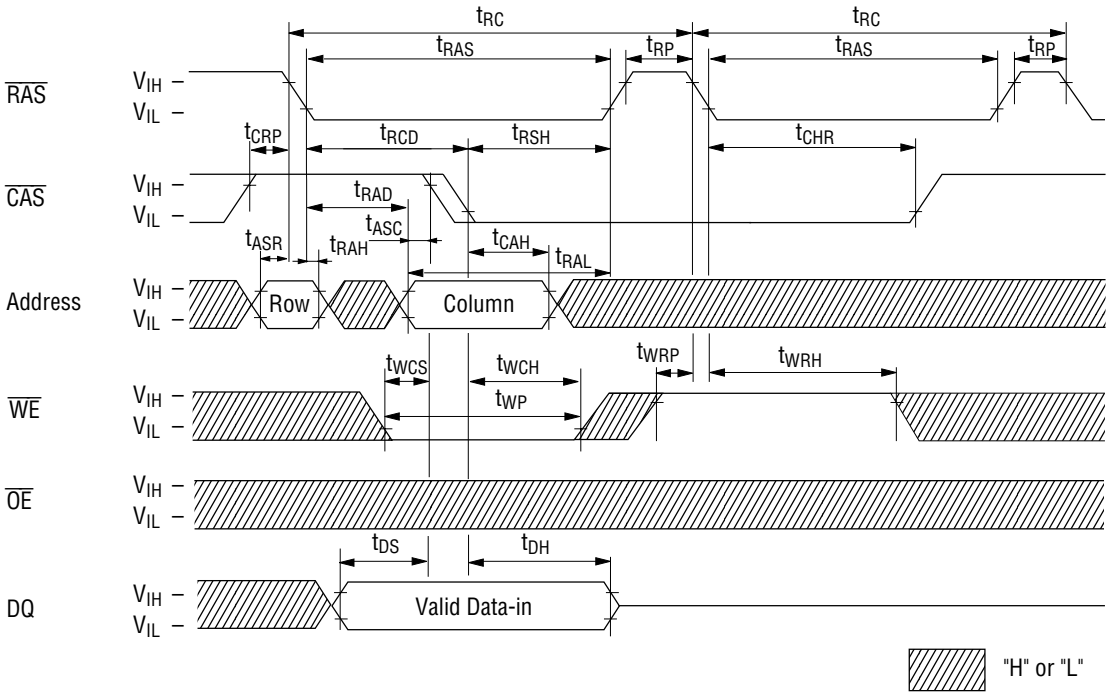


Note: $\overline{WE}$, $\overline{OE}$, Address = "H" or "L" "H" or "L"

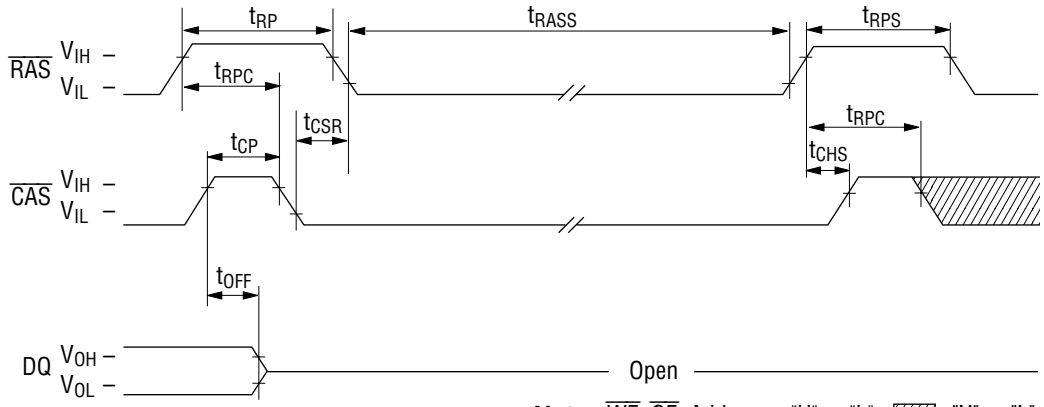
Hidden Refresh Read Cycle



Hidden Refresh Write Cycle



CAS before RAS Self-Refresh Cycle

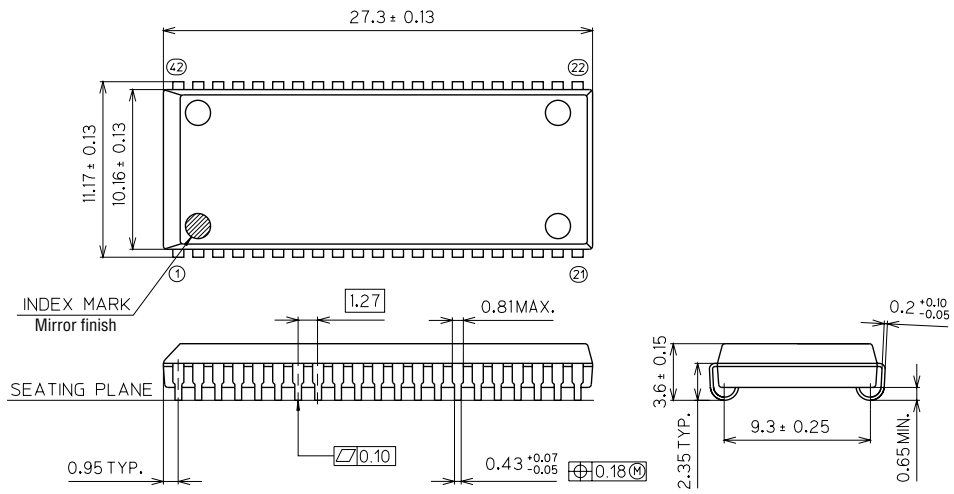


Note: WE, OE, Address = "H" or "L" "H" or "L"
Only SL version

PACKAGE DIMENSIONS

(Unit : mm)

SOJ42-P-400-1.27



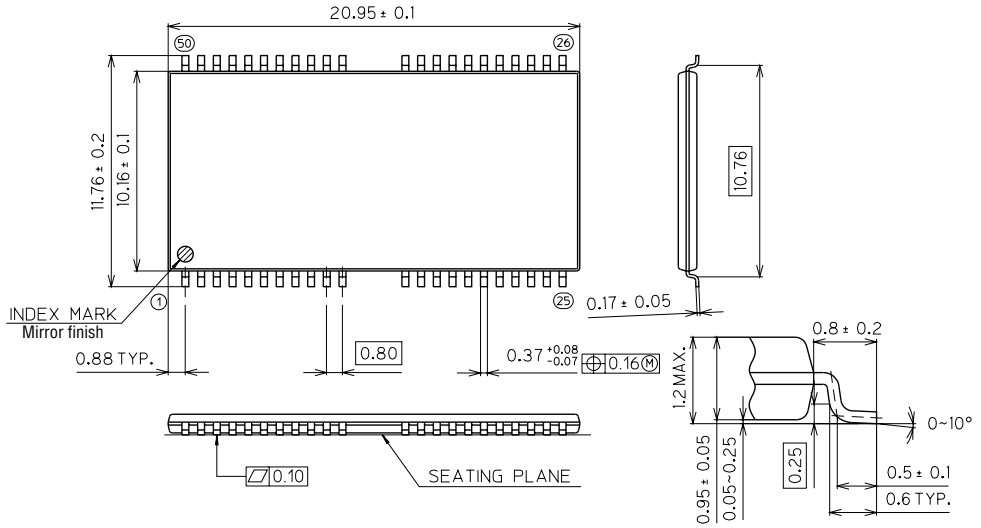
Package material	Epoxy resin
Lead frame material	42 alloy
Pin treatment	Solder plating
Solder plate thickness	5 μm or more
Package weight (g)	1.86 TYP.

Notes for Mounting the Surface Mount Type Package

The SOP, QFP, TSOP, TQFP, LQFP, SOJ, QFJ (PLCC), SHP, and BGA are surface mount type packages, which are very susceptible to heat in reflow mounting and humidity absorbed in storage. Therefore, before you perform reflow mounting, contact Oki's responsible sales person on the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).

(Unit : mm)

TSOPII50/44-P-400-0.80-K



Package material	Epoxy resin
Lead frame material	42 alloy
Pin treatment	Solder plating
Solder plate thickness	5 μm or more
Package weight (g)	0.60 TYP.

Notes for Mounting the Surface Mount Type Package

The SOP, QFP, TSOP, TQFP, LQFP, SOJ, QFJ (PLCC), SHP, and BGA are surface mount type packages, which are very susceptible to heat in reflow mounting and humidity absorbed in storage. Therefore, before you perform reflow mounting, contact Oki's responsible sales person on the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).

NOTICE

1. The information contained herein can change without notice owing to product and/or technical improvements. Before using the product, please make sure that the information being referred to is up-to-date.

2. The outline of action and examples for application circuits described herein have been chosen as an explanation for the standard action and performance of the product. When planning to use the product, please ensure that the external conditions are reflected in the actual circuit, assembly, and program designs.

3. When designing your product, please use our product below the specified maximum ratings and within the specified operating ranges including, but not limited to, operating voltage, power dissipation, and operating temperature.

4. Oki assumes no responsibility or liability whatsoever for any failure or unusual or unexpected operation resulting from misuse, neglect, improper installation, repair, alteration or accident, improper handling, or unusual physical or electrical stress including, but not limited to, exposure to parameters beyond the specified maximum ratings or operation outside the specified operating range.

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Printed in Japan