OKI Semiconductor

This version: Jan. 1998
Previous version: Dec. 1996

MSM548512L

524,288-Word × 8-Bit High-Speed PSRAM

DESCRIPTION

The MSM548512L is fabricated using OKI's CMOS silicon gate process technology. This process, coupled with single-transister memory storage cells, permits maximum circuit density, minimum chip size and high speed.
MSM548512L has Self-refresh mode in addition to Address-refresh mode and Auto-refresh mode. In the Self-refresh mode the internal refresh timer and address counter refresh the dynamic memory cells automatically. This series allows low power consumption when using standby mode with Self-refresh.
The MSM548512L also features a static RAM-like write function that writes the data into the memory cell at the rising edge of $\overline{WE}$.

FEATURES

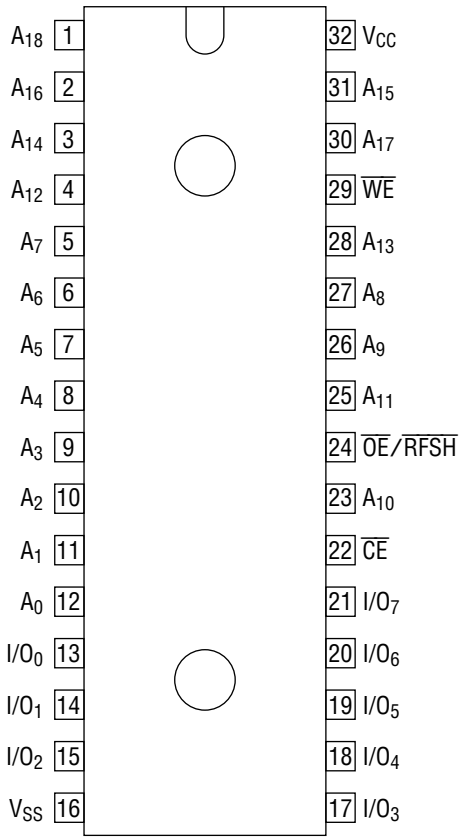
- Large capacity : 4-Mbit (524,288-word × 8 bits)
- Fast access time : 80 ns max.
- Low power : 200 µA max. (standby with Self-refresh)
- Refresh free : Self refresh
- Logic compatible : SRAM $\overline{WE}$ pin, no address multiplex
- Single power supply : 5 V ±10%
- Refresh : 2048 cycle/32 ms auto-address refresh
- Package compatible : SRAM standard package
- Package options:

32-pin 600 mil plastic DIP	(DIP32-P-600-2.54)	(Product : MSM548512L-xxRS)
32-pin 525 mil plastic SOP	(SOP32-P-525-1.27-K)	(Product : MSM548512L-xxGS-K)
		xx indicates speed rank.

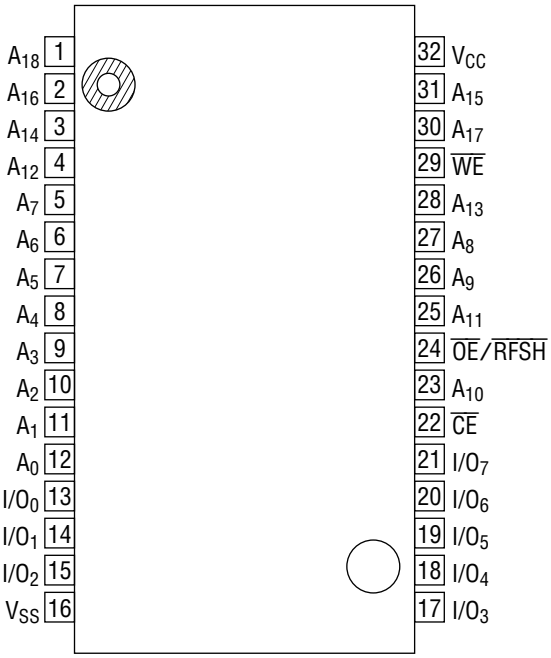
PRODUCT FAMILY

Family	Access Time (Max.)	Package
MSM548512L-80RS	80 ns	600 mil 32-pin Plastic DIP
MSM548512L-10RS	100 ns	
MSM548512L-12RS	120 ns	
MSM548512L-80GS-K	80 ns	525 mil 32-pin Plastic SOP
MSM548512L-10GS-K	100 ns	
MSM548512L-12GS-K	120 ns	

PIN CONFIGURATION (TOP VIEW)



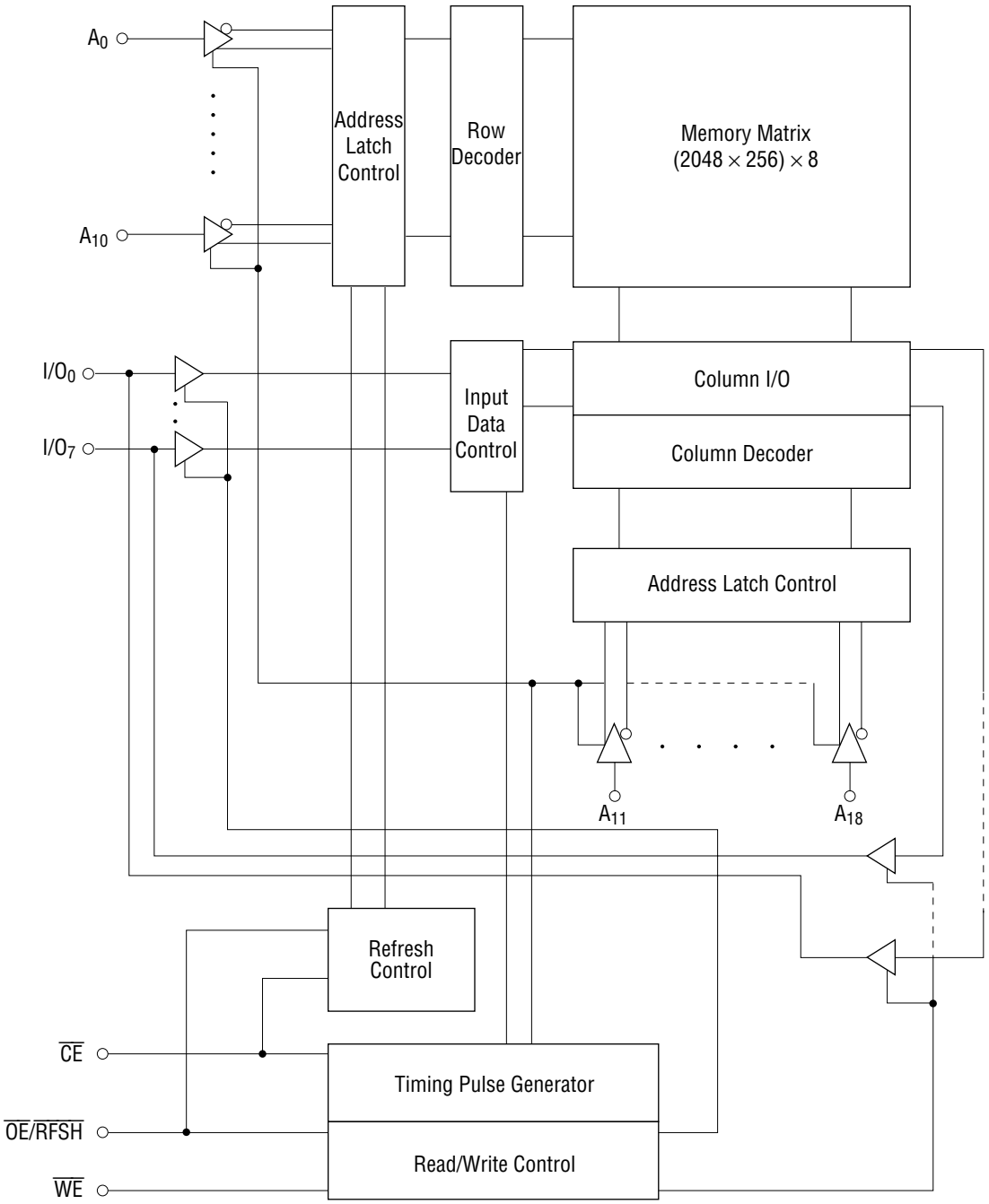
32-Pin Plastic DIP



32-Pin Plastic SOP

Pin Name	Function
A_0 - A_{18}	Address Input
I/O_0 - I/O_7	Data Input/Output
$\overline{CE}$	Chip Enable Input
$\overline{OE}/\overline{RFSH}$	Output Enable / Refresh Input
$\overline{WE}$	Write Enable Input
V_{CC}	Power Voltage (5 V)
V_{SS}	Ground (0 V)

BLOCK DIAGRAM



FUNCTION TABLE

$\overline{CE}$	$\overline{OE}$/$\overline{RFSH}$	$\overline{WE}$	I/O Pin	Mode
L	L	H	Low-Z	Read
L	X	L	High-Z	Write
L	H	H	High-Z	—
H	L	X	High-Z	Refresh
H	H	X	High-Z	Standby

L : Low Level Input
H : High Level Input
X : Don't Care

ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Voltage on Any Pin from V_{SS} *1	V_T	–1.0 to 7.0	V
Power Dissipation	P_D	1.0	W
Operating Temperature	T_{opr}	0 to 70	°C
Storage Temperature	T_{stg}	–55 to 125	°C
Storage Temperature (biased)	T_{bias}	–10 to 85	°C
Short Circuit Output Current	I_{OS}	50	mA

*1 To V_{SS}

Note: 1. Permanent device damage may occur if ABSOLUTE MAXIMUM RATINGS are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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 Voltage	V_{IH}	2.4	—	6.0	V
	V_{IL}	–0.5	—	0.8	V

DC Characteristics

(V_{CC} = 5 V ±10%, V_{SS} = 0 V, Ta = 0°C to 70°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Operating Current	I_{CC1}	—	50	75	mA	$I_{I/O}$ = Open, t_{cyc} = min.
Standby Current	I_{SB1}	—	1	2	mA	$\overline{CE}$ = V_{IH}, $\overline{OE}/\overline{RFSH}$ = V_{IH}, $V_{IN} \geq 0$ V
	I_{SB2}	—	100	200	µA	$\overline{CE} \geq V_{CC} - 0.2$ V, $V_{IN} \geq 0$ V, $\overline{OE}/\overline{RFSH} \geq V_{CC} - 0.2$ V
Self Refresh Current	I_{CC2}	—	1	2	mA	$\overline{CE}$ = V_{IH}, $\overline{OE}/\overline{RFSH}$ = V_{IL}, $V_{IN} \geq 0$ V
	I_{CC3}	—	100	200	µA	$\overline{CE} \geq V_{CC} - 0.2$ V, $V_{IN} \geq 0$ V, $\overline{OE}/\overline{RFSH} \leq 0.2$ V
Input Leakage Current	I_{LI}	–10	—	10	µA	V_{CC} = 5.5 V, V_{IN} = V_{SS} to V_{CC}
Output Leakage Current	I_{LO}	–10	—	10	µA	$\overline{OE}/\overline{RFSH}$ = V_{IH}, $V_{I/O}$ = V_{SS} to V_{CC}
Output Low Level	V_{OL}	—	—	0.4	V	I_{OL} = 2.1 mA
Output High Level	V_{OH}	2.4	—	—	V	I_{OH} = –1 mA

Capacitance

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input Capacitance	C_{IN}	V_{IN} = 0 V	—	—	8	pF
I/O Pin Capacitance	$C_{I/O}$	$V_{I/O}$ = 0 V	—	—	10	pF

Note: This parameter is periodically sampled and is not 100% tested.

AC Characteristics

Measurement condition:

Input pulse level ..... V_{IH} = 2.4 V, V_{IL} = 0.4 V
Output reference level..... V_{OH} = 2.0 V, V_{OL} = 0.8 V
Rising and falling time..... 5 ns
Output load ..... 1 TTL + 100 pF
Input timing reference level..... High = 2.2 V, Low = 0.8 V

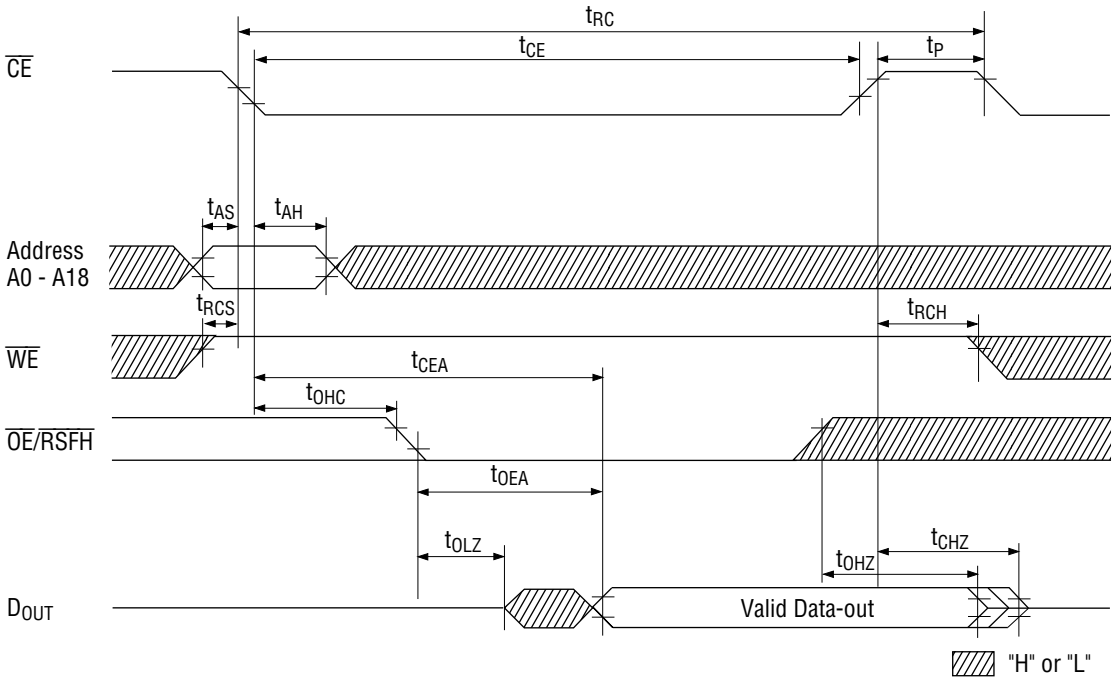
(V_{CC} = 5 V ±10%, Ta = 0°C to 70°C)

Parameter	Symbol	MSM548512L -80		MSM548512L -10		MSM548512L -12		Unit	Note
		Min.	Max.	Min.	Max.	Min.	Max.		
Random Read Write Cycle Time	t_{RC}	160	—	180	—	210	—	ns	
Random Read Modify Write Cycle Time	t_{RWC}	220	—	240	—	280	—	ns	
$\overline{CE}$ Access Time	t_{CEA}	—	80	—	100	—	120	ns	
$\overline{OE}$ Access Time	t_{OEA}	—	30	—	30	—	50	ns	
Chip Disable to Output in High-Z	t_{CHZ}	—	25	—	30	—	30	ns	6
$\overline{CE}$ to Output in Low-Z	t_{CLZ}	20	—	20	—	20	—	ns	
$\overline{OE}$ Disable to Output in High-Z	t_{OHZ}	—	25	—	25	—	30	ns	6
$\overline{OE}$ Output in Low-Z	t_{OLZ}	0	—	0	—	0	—	ns	
$\overline{CE}$ Pulse Width	t_{CE}	80n	10µ	100n	10µ	120n	10µ	s	
$\overline{CE}$ Precharge Time	t_P	70	—	70	—	80	—	ns	
Address Set-up Time	t_{AS}	0	—	0	—	0	—	ns	
Address Hold Time	t_{AH}	20	—	25	—	30	—	ns	
Read Command Set-up Time	t_{RCS}	0	—	0	—	0	—	ns	
Read Command Hold Time	t_{RCH}	0	—	0	—	0	—	ns	
$\overline{OE}$ Command Hold Time	t_{OHC}	15	—	15	—	15	—	ns	
$\overline{OE}$ Delay Time	t_{OCD}	0	—	0	—	0	—	ns	
Write Command Pulse Width	t_{WP}	25	—	30	—	35	—	ns	
Chip Enable Time	t_{CW}	80	—	100	—	120	—	ns	
Input Data Set Time	t_{DW}	20	—	25	—	30	—	ns	
Input Data Hold Time	t_{DH}	0	—	0	—	0	—	ns	
Output Active from End of Write	t_{OW}	5	—	5	—	5	—	ns	
Write Enable to Output in High-Z	t_{WHZ}	—	20	—	25	—	30	ns	6
Transition Time	t_T	3	50	3	50	3	50	ns	11
$\overline{RFSH}$ Delay Time from $\overline{CE}$	t_{RFD}	70	—	70	—	80	—	ns	
$\overline{RFSH}$ Precharge Time	t_{FP}	40	—	40	—	40	—	ns	
$\overline{RFSH}$ Pulse Width (Auto-refresh)	t_{FAP}	80n	8µ	80n	8µ	80n	8µ	s	
Auto-refresh Cycle Time	t_{FC}	160	—	180	—	210	—	ns	
$\overline{RFSH}$ Pulse Width (Self-refresh)	t_{FAS}	8	—	8	—	8	—	µs	
$\overline{CE}$ Delay Time from $\overline{RFSH}$ in Self-refresh Mode	t_{RFS}	600	—	600	—	600	—	ns	
Refresh Period (2048 cycle/32 ms)	t_{REF}	—	32	—	32	—	32	ms	

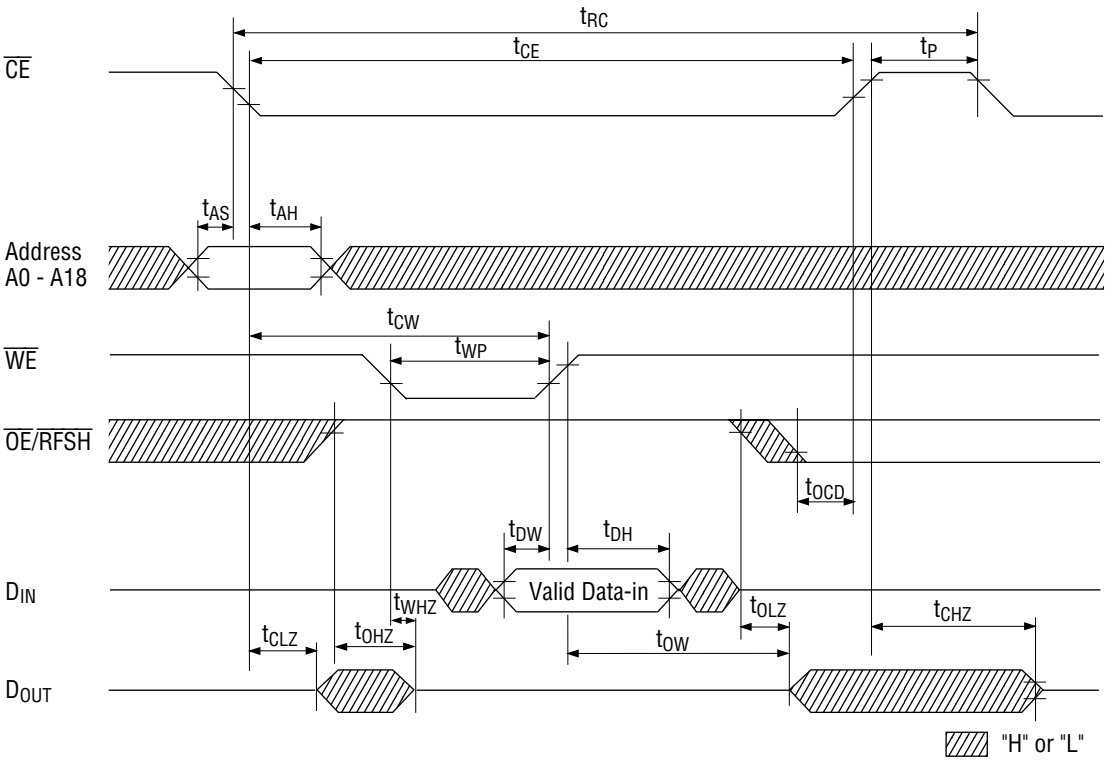
Notes:
1. Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.
2. All voltages are referenced to ground.
3. I_{CC1} depends on output loading. Specified values are obtained with the output open.
4. An initial pause of 100 µs is required after power-up followed by more than 8 initial cycles before proper device operation is achieved.
5. AC measurements assume t_T = 5 ns.
6. t_{CHZ}, t_{WHZ} and t_{OHZ} define the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
7. In write cycles, the input data is latched at the earlier rising point of either $\overline{CE}$ or $\overline{WE}$. Write operation is achieved when both $\overline{CE}$ and $\overline{WE}$ are low.
8. The I/O state remains at high impedance after $\overline{CE}$ goes low if the transition occurs at the same time as or after the falling edge of $\overline{WE}$.
9. Use $\overline{WE}$ or $\overline{OE}$ or both signals to disable the output before input data is applied during a write cycle when the input is not the same.
10. Data input must be set to floating state before I/O becomes low impedance by $\overline{WE}$ or $\overline{OE}$ or both.
11. V_{IH} (Min.) and V_{IL} (Max.) are input timing reference levels for measurement. The transition time is measured between V_{IL} and V_{IH}.
12. 2048-cycle refresh must be applied within 15 µs after the end of self refreshing to satisfy 2048 cycles/32 ms.

TIMING WAVEFORM

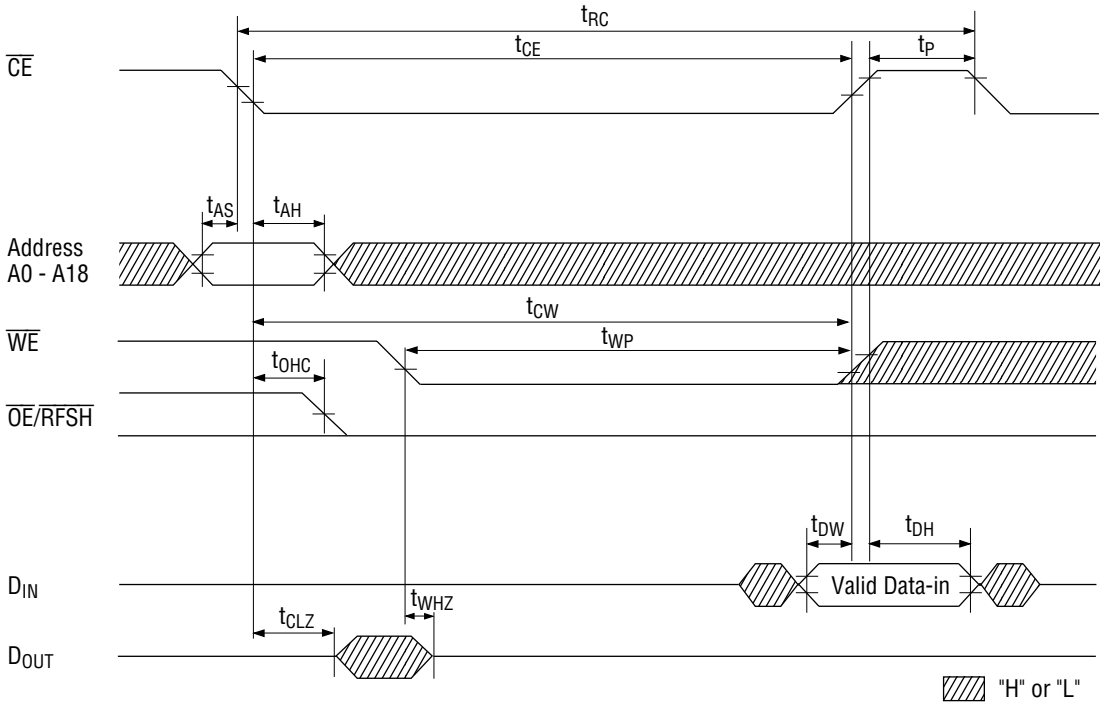
Read Cycle



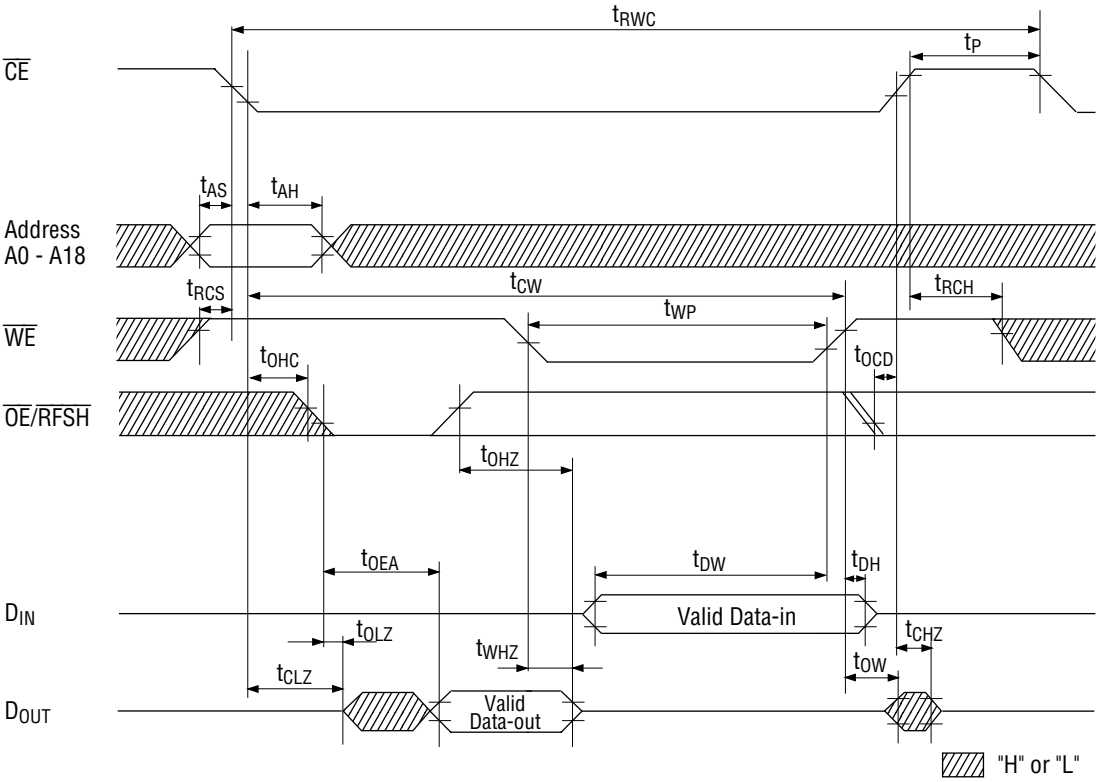
Write Cycle 1 ($\overline{OE}$ High)



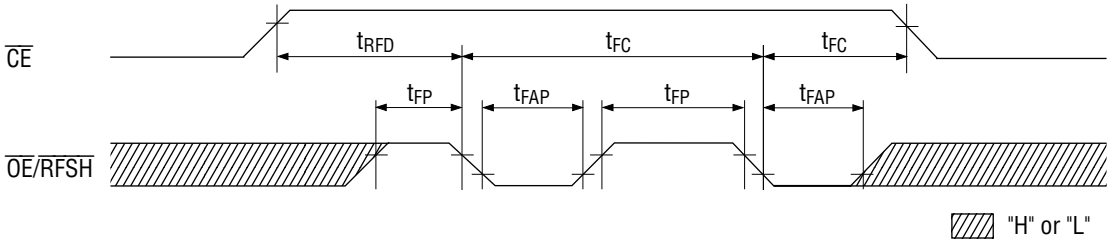
Write Cycle 2 ($\overline{OE}$ Low)



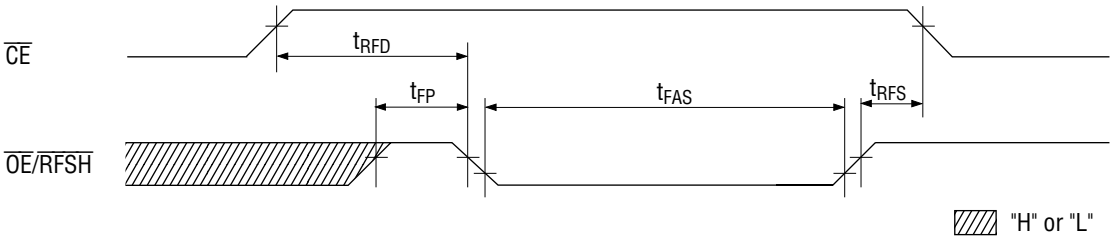
Read Modify Write



Auto Refresh Cycle



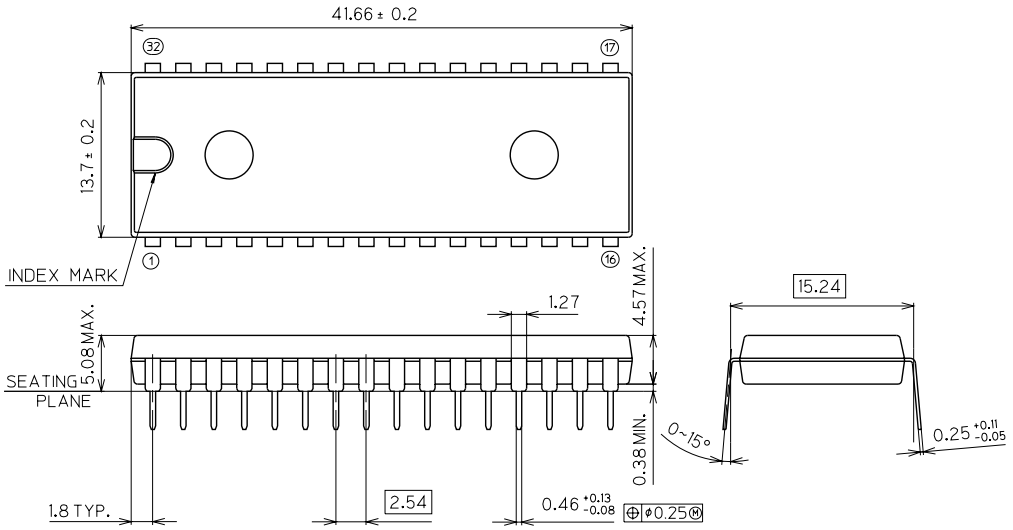
Self Refresh Cycle



PACKAGE DIMENSIONS

(Unit : mm)

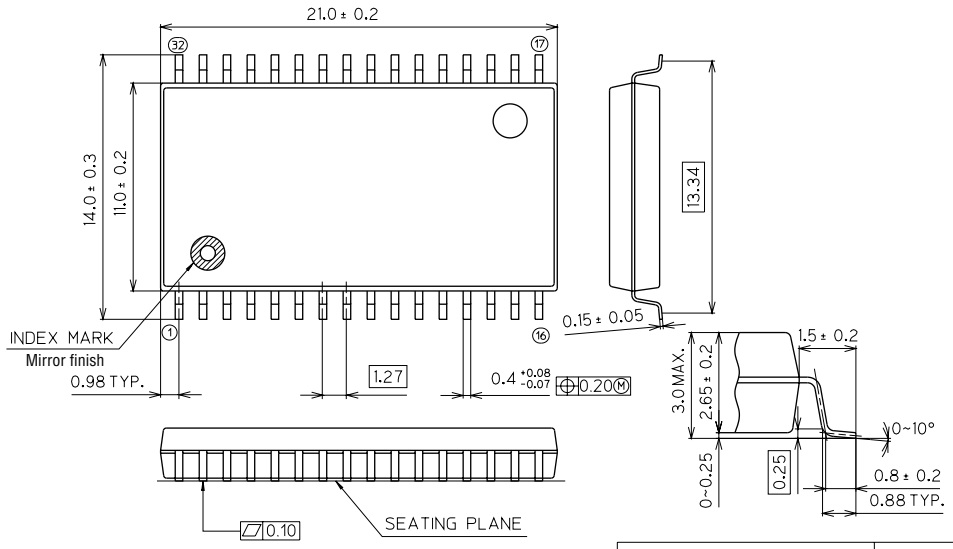
DIP32-P-600-2.54



Package material	Epoxy resin
Lead frame material	42 alloy
Pin treatment	Solder plating
Solder plate thickness	5 μm or more
Package weight (g)	4.70 TYP.

(Unit : mm)

SOP32-P-525-1.27-K



Package material	Epoxy resin
Lead frame material	42 alloy
Pin treatment	Solder plating
Solder plate thickness	5 µm or more
Package weight (g)	1.32 TYP.

Notes for Mounting the Surface Mount Type Package

The SOP, QFP, TSOP, 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 for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).