

SANYO

No. ✕ 4541B

LC331632M-70/80/10/12**512 K (32768 words × 16 bits) Pseudo-SRAM**

Preliminary

Overview

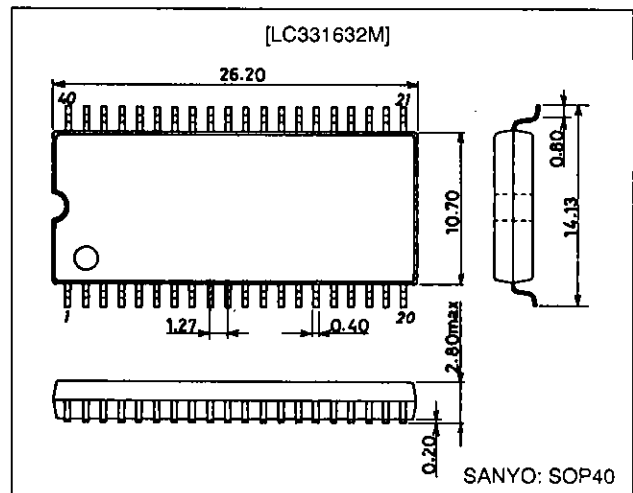
The LC331632 series is composed of pseudo static RAM that operate on a single 5 V power supply and are organized as 32768 words × 16 bits. By using memory cells each composed of a single transistor and capacitor, together with peripheral CMOS circuitry, this series achieves ease of use with high density, high speed, and low power dissipation. The LC331632 series can easily accomplish auto-refresh by means of $\overline{LOE}/\overline{RFSH}$ input. The available package is the 40-pin SOP with a width of 525 mil.

Features

- 32768 words × 16 bits configuration
- \overline{CE} access time/ \overline{OE} access time/Cycle time/Current dissipation

Package Dimensions

unit: mm

3195-SOP40

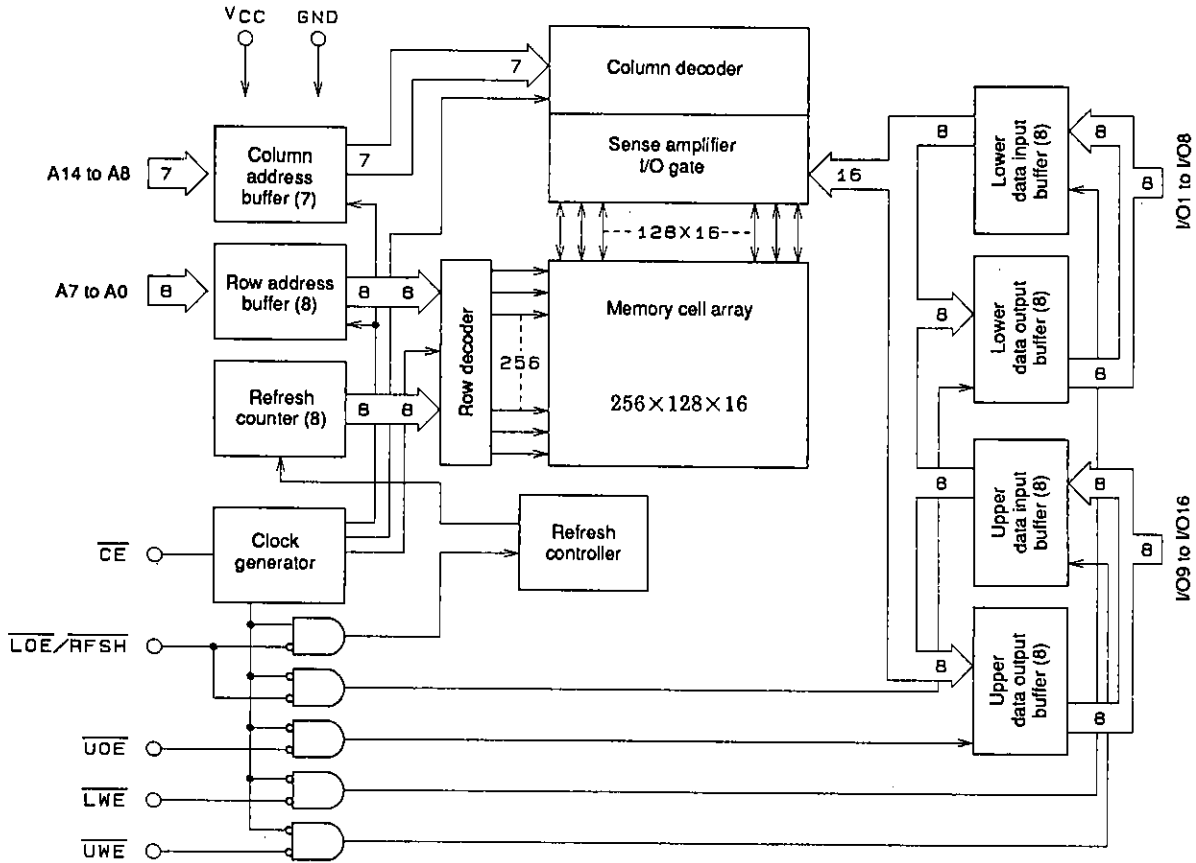
Parameter	LC331632M			
	-70	-80	-10	-12
\overline{CE} access time	70 ns	80 ns	100 ns	120 ns
\overline{OE} access time	35 ns	40 ns	50 ns	75 ns
Cycle time	115 ns	130 ns	160 ns	210 ns
Current dissipation	Operating	100 mA	90 mA	75 mA
	Standby	2 mA		

- Single 5 V ±10% power supply
- All input and output (I/O) TTL compatible
- Fast access time and low power dissipation
- 4 ms refresh using 256 refresh cycles
- Supports \overline{CE} -only refresh and auto-refresh
- Supports byte unit read and write operations using the $\overline{LOE}/\overline{RFSH}$ and \overline{UOE} inputs or the \overline{LWE} and \overline{UWE} inputs.
- Package
SOP 40-pin (525 mil) plastic package: LC331632M

SANYO Electric Co., Ltd. Semiconductor Business Headquarters

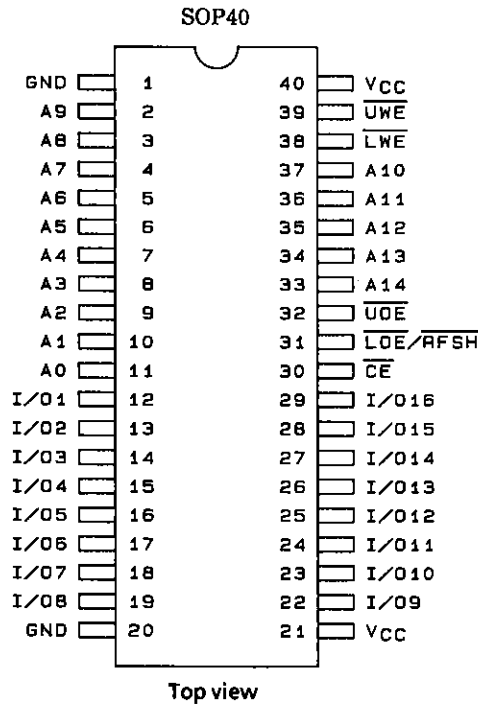
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Block Diagram



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Pin Assignment



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Pin Functions

A0 to A14	Address input
LWE	Lower byte write enable Input
UWE	Upper byte write enable Input
LOE/RFSH	Lower byte output enable Input/refresh Input
UOE	Upper byte output enable Input
CE	Chip enable input
I/O1 to I/O8	Lower byte data input/output
I/O9 to I/O16	Upper byte data input/output
VCC	Power supply
GND	Ground

Functional Logic

CE	LOE/RFSH	UOE	LWE	UWE	A0 to A7	A8 to A14	I/O1 to I/O8	I/O9 to I/O16	State
H	H	X	X	X	X	X	HZ	HZ	Standby
L	L	L	H	H	VX	VX	OUT	OUT	Read (word)
L	L	H	H	H	VX	VX	OUT	HZ	Read (lower byte)
L	H	L	H	H	VX	VX	HZ	OUT	Read (upper byte)
L	H	H	L	L	VX	VX	IN	IN	Write (word)
L	H	H	L	H	VX	VX	IN	HZ	Write (lower byte)
L	H	H	H	L	VX	VX	HZ	IN	Write (upper byte)
L	H	H	H	H	VX	X	HZ	HZ	CE-only refresh
H	NP	X	X	X	X	X	HZ	HZ	Auto-refresh

H: High-level input of $V_{IN} = 6.5\text{ V}$ to V_{IH} (min)

L: Low-level input of $V_{IN} = V_{IL}$ (max) to -1.0 V

X: High- or low-level input

NP: Negative-polarity pulse input

VX: "IN" when $CE = L$ is confirmed, then "X"

HZ: High impedance

IN: Input state

OUT: Output state

Specifications

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Note
Maximum supply voltage	$V_{CC\text{ max}}$	-1.0 to $+7.0$	V	1
Input voltage	V_{IN}	-1.0 to $+7.0$	V	1
Output voltage	V_{OUT}	-1.0 to $+7.0$	V	1
Allowable power dissipation	$P_{d\text{ max}}$	600	mW	1
Output short current	I_{OUT}	50	mA	1
Operating temperature range	T_{opr}	0 to $+70$	$^{\circ}\text{C}$	1
Storage temperature range	T_{stg}	-55 to $+150$	$^{\circ}\text{C}$	1

Note: 1. Stresses greater than the above listed maximum values may result in damage to the device.

DC Recommended Operating Ranges at $T_a = 0$ to $+70^{\circ}\text{C}$

Parameter	Symbol	min	typ	max	Unit	Note
Power supply voltage	V_{CC}	4.5	5.0	5.5	V	2
Input high level voltage	V_{IH}	2.4		6.5	V	2
Input low level voltage	V_{IL}	-1.0		+0.8	V	2

Note: 2. All voltages are referenced to GND.

DC Electrical Characteristics at $T_a = 0$ to $+70^{\circ}\text{C}$, $V_{CC} = 5\text{V} \pm 10\%$

Parameter	Symbol	Conditions	min	max	Unit	Note	
Operating current (Average current during operation)	I_{CCA}	$t_{RC} = t_{RC}(\text{min})$	Access time	70 ns	100	mA	3, 4
				80 ns	90		
				100 ns	75		
				120 ns	65		
Standby current 1	I_{CCS1}	$\overline{CE} = \overline{LOE/RFSH} = V_{IH}$		3	mA		
Standby current 2	I_{CCS2}	$\overline{CE} = \overline{LOE/RFSH} = V_{CC} - 0.2\text{ V}$		2	mA		
Input leakage current	I_{IL}	$0\text{ V} \leq V_{IN} \leq V_{CC}$, pins other than measuring pin = 0 V	-10	+10	μA		
Output leakage current	I_{OL}	Output disable, $0\text{ V} \leq V_{OUT} \leq V_{CC}$	-10	+10	μA		
Output high level voltage	V_{OH}	$I_{OUT} = -1\text{ mA}$	2.4		V		
Output low level voltage	V_{OL}	$I_{OUT} = 4.2\text{ mA}$		0.4	V		

Note: 3. All current values are measured at minimum cycle rate. Since current flows immoderately, if cycle time is longer than shown here, current value becomes smaller. A bypass capacitor of $0.01\text{ }\mu\text{F}$ or larger should be inserted between V_{CC} and GND for each memory chip to suppress power supply noise (voltage drops) due to transient currents.

4. Dependent on output load. Maximum value is value during free state.

Input/Output Capacitance Characteristics at Ta = 25°C, f = 1 MHz, VCC = 5 V ± 10%

Parameter	Symbol	Measuring Conditions	min	max	Unit
Input capacitance (A0 to A14)	C _{IN1}	V _{IN1} = 0 V		5	pF
Input capacitance (CE, LOE/RFSH, UOE, LWE, UWE)	C _{IN2}	V _{IN2} = 0 V		7	pF
I/O capacitance	C _{I/O}	V _{I/O} = 0 V		10	pF

Sampling inspections, and not full-lot inspections, are carried out for these parameters.

AC Electrical Characteristics at Ta = 0 to +70°C, VCC = 5 V ± 10% (Notes 5, 6, 7, 8, 9)

Parameter	Symbol	-70		-80		-10		-12		Unit	Note
		min	max	min	max	min	max	min	max		
Random read or write cycle time	t _{RC}	115		130		160		210		ns	
CE pulse width	t _{CE}	70	10000	80	10000	100	10000	120	10000	ns	
CE precharge time	t _P	35		40		50		80		ns	
CE access time	t _{CEA}		70		80		100		120	ns	
LOE, UOE access time	t _{OEA}		35		40		50		75	ns	
CE output enable time	t _{CLZ}	10		10		10		10		ns	
LOE, UOE output enable time	t _{OLZ}	0		0		0		0		ns	
CE output disable time	t _{CHZ}	0	20	0	25	0	30	0	35	ns	10
LOE, UOE output disable time	t _{OHZ}	0	20	0	25	0	30	0	35	ns	10
LOE, UOE hold time for CE	t _{OHC}	0		0		0		0		ns	
LOE, UOE setup time for CE	t _{OSC}	10		10		10		10		ns	
Read command setup time	t _{RCS}	0		0		0		0		ns	
Read command hold time	t _{RCH}	0		0		0		0		ns	
Write pulse width	t _{WP}	25		30		35		85		ns	
Write command hold time	t _{WCH}	55		60		65		85		ns	
Write command lead time	t _{CWL}	40		45		50		85		ns	
Input data setup time for LWE, UWE	t _{DSW}	25		30		35		50		ns	11
Input data setup time for CE	t _{DSC}	25		30		35		50		ns	11
Input data hold time for LWE, UWE	t _{DHW}	0		0		0		0		ns	11
Input data hold time for CE	t _{DHC}	0		0		0		0		ns	11
Address setup time for CE	t _{ASC}	0		0		0		0		ns	12
Address hold time for CE	t _{AHC}	15		20		25		30		ns	12
Auto-refresh cycle time	t _{FC}	115		130		160		210		ns	
RFSH delay time for CE	t _{RFD}	35		40		50		60		ns	
RFSH pulse width (Auto-refresh)	t _{FAP}	75	8000	80	8000	80	8000	80	8000	ns	13
RFSH precharge time (Auto-refresh)	t _{FP}	30		30		30		30		ns	13
RFSH active CE delay time (Auto-Refresh)	t _{FCE}	135		160		190		225		ns	13
Refresh time	t _{REF}		4		4		4		4	ms	
Rise or fall time	t _T	3	50	3	50	3	50	3	50	ns	

Note: 5. To accomplish internal initialization, CE and LOE/RFSH are fixed at V_{IH} for an interval of 1 ms when V_{CC} reaches the specified voltage after power is switched on. At least eight dummy cycles must be executed following that period.

6. Measured at t_T = 5 ns.

7. When measuring input signal timing, V_{IH} (min) and V_{IL} (max) are reference levels.

8. Measured using an equivalent of 100 pF and two standard TTL loads.

9. LOE/RFSH input functions as lower byte output enable input (LOE) when CE = V_{IL}, and as refresh input (RFSH) when CE = V_{IH}.

10. t_{CHZ} and t_{OHZ} are defined as the time until output enters the open circuit state and the output voltage level becomes immeasurable.

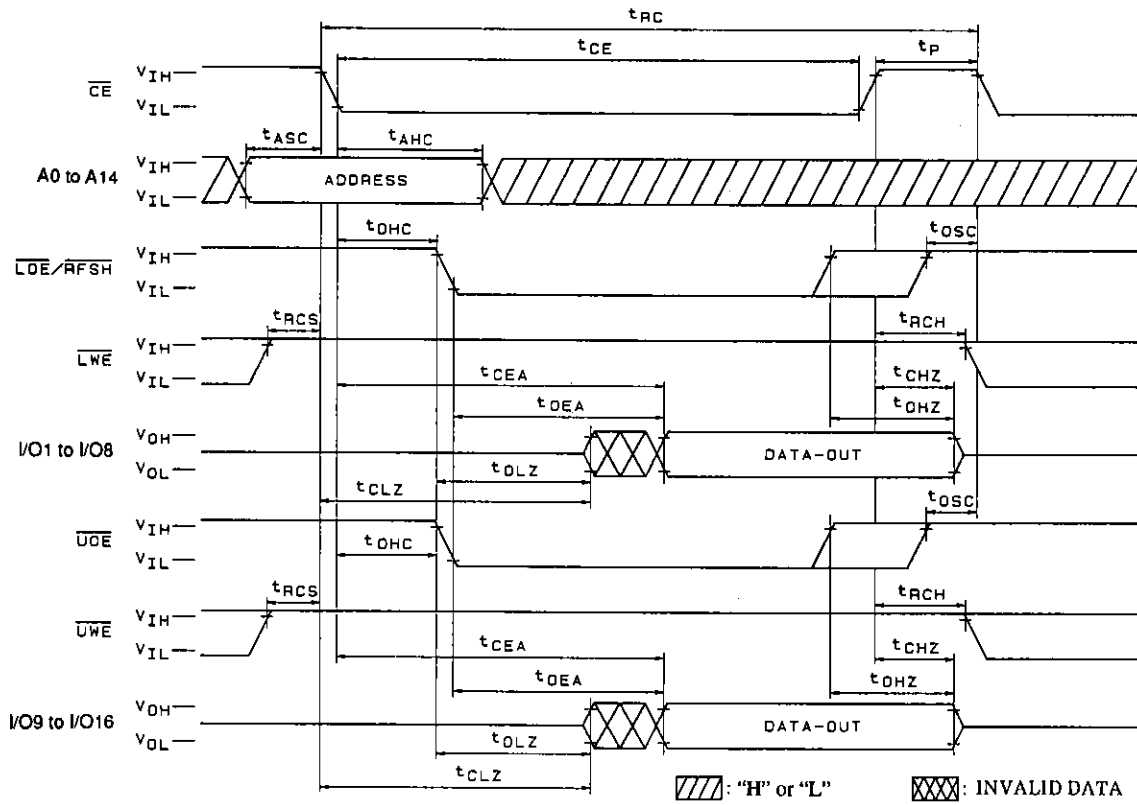
11. As with ordinary static RAM, write data is incorporated at the rise of LWE, UWE input or CE input, whichever is earlier, and write data is therefore held during t_{DSW}, t_{DSC}, t_{DHW}, or t_{DHC}.

12. Because address input is incorporated at the fall of CE, the address is maintained during t_{ASC} or t_{AHC}.

13. After auto-refresh has completed, CE must not be made active until the t_{FCE} period has elapsed.

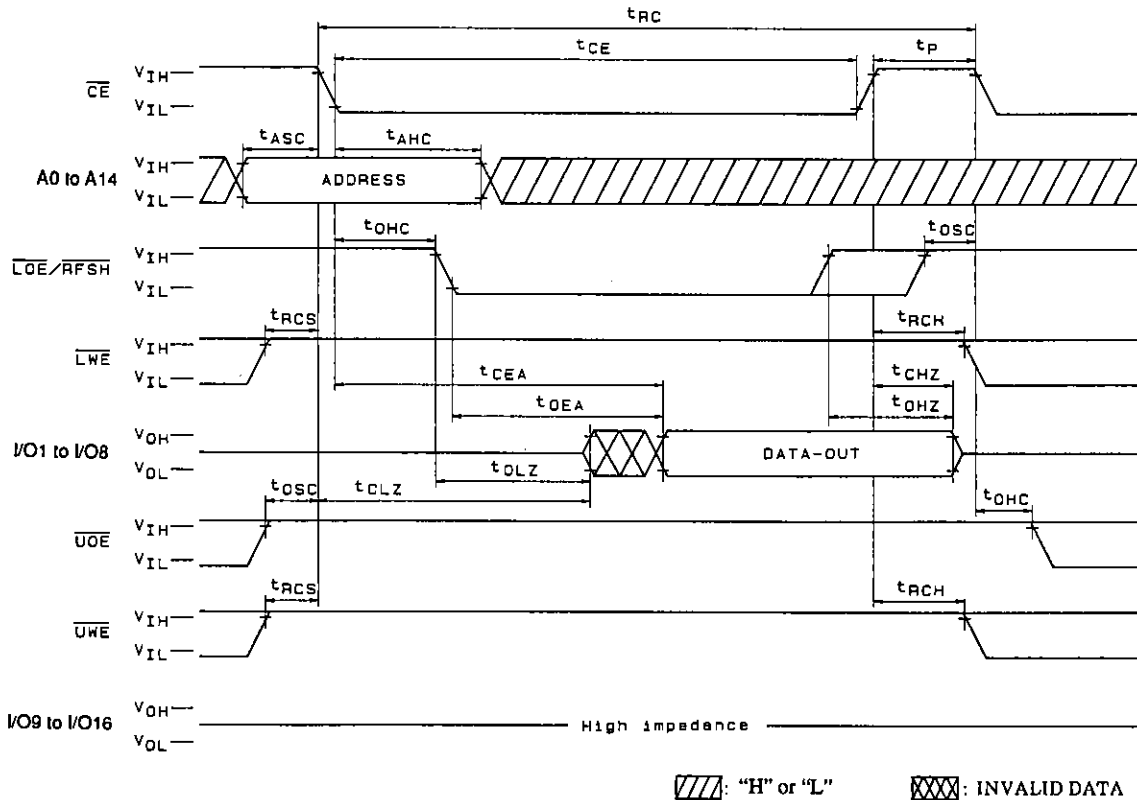
Timing Chart

Read Cycle (word)



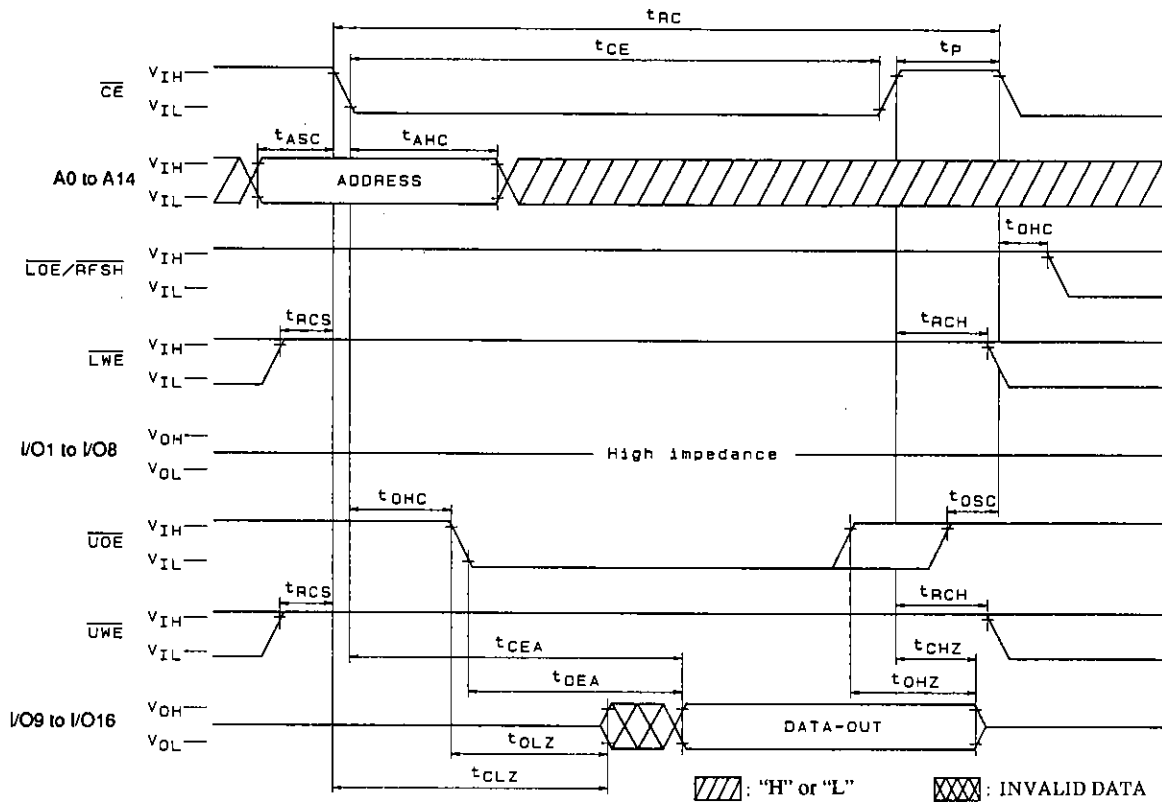
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Read Cycle (lower byte)



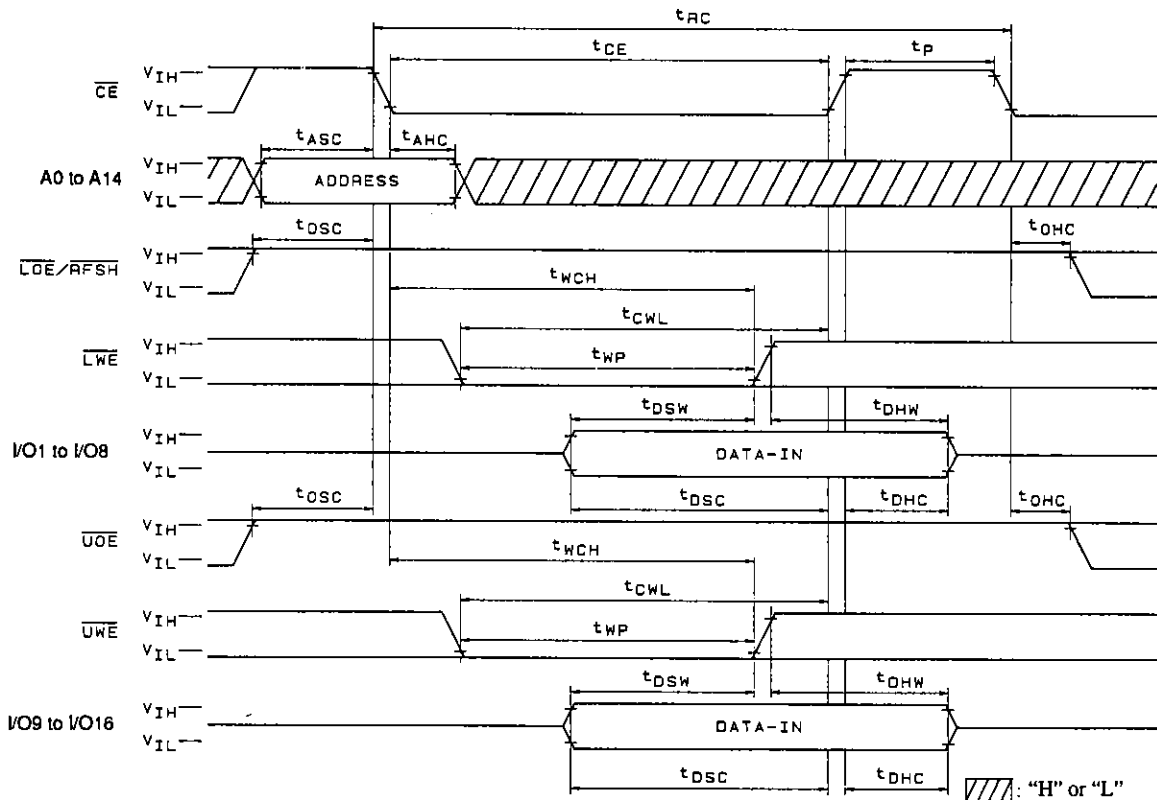
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Read Cycle (upper byte)



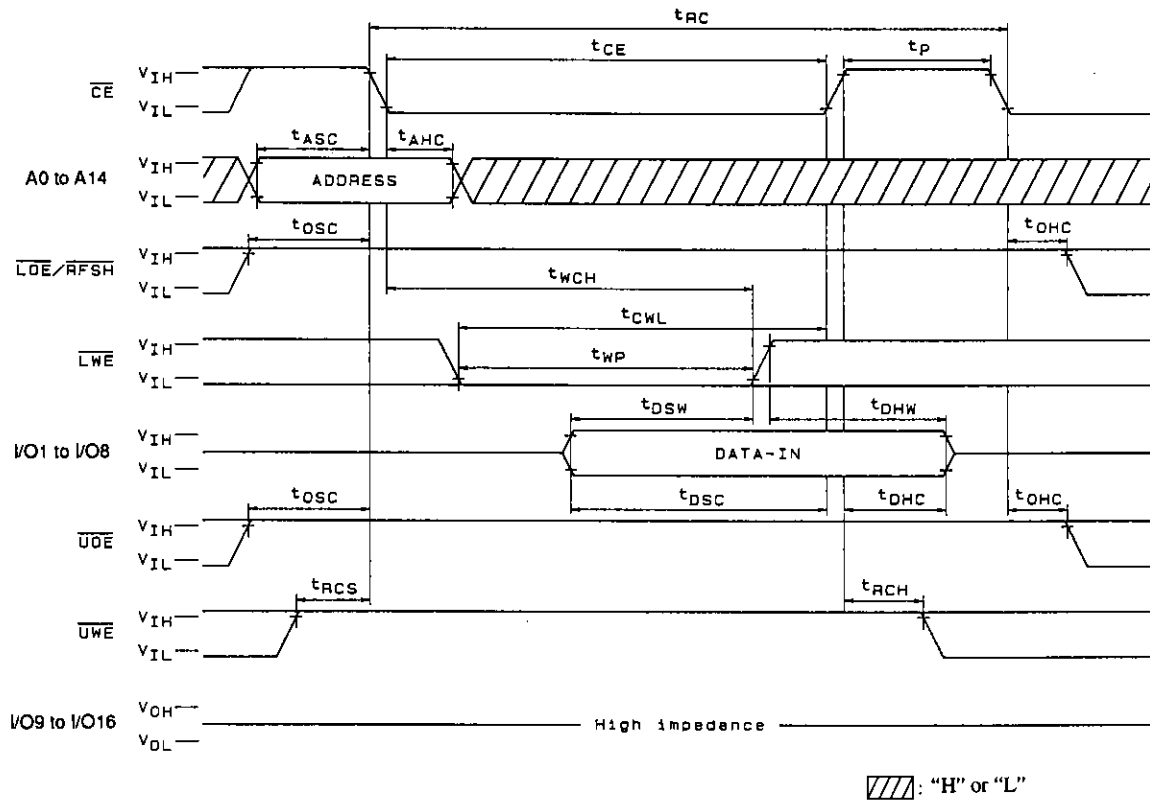
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Write Cycle (word)



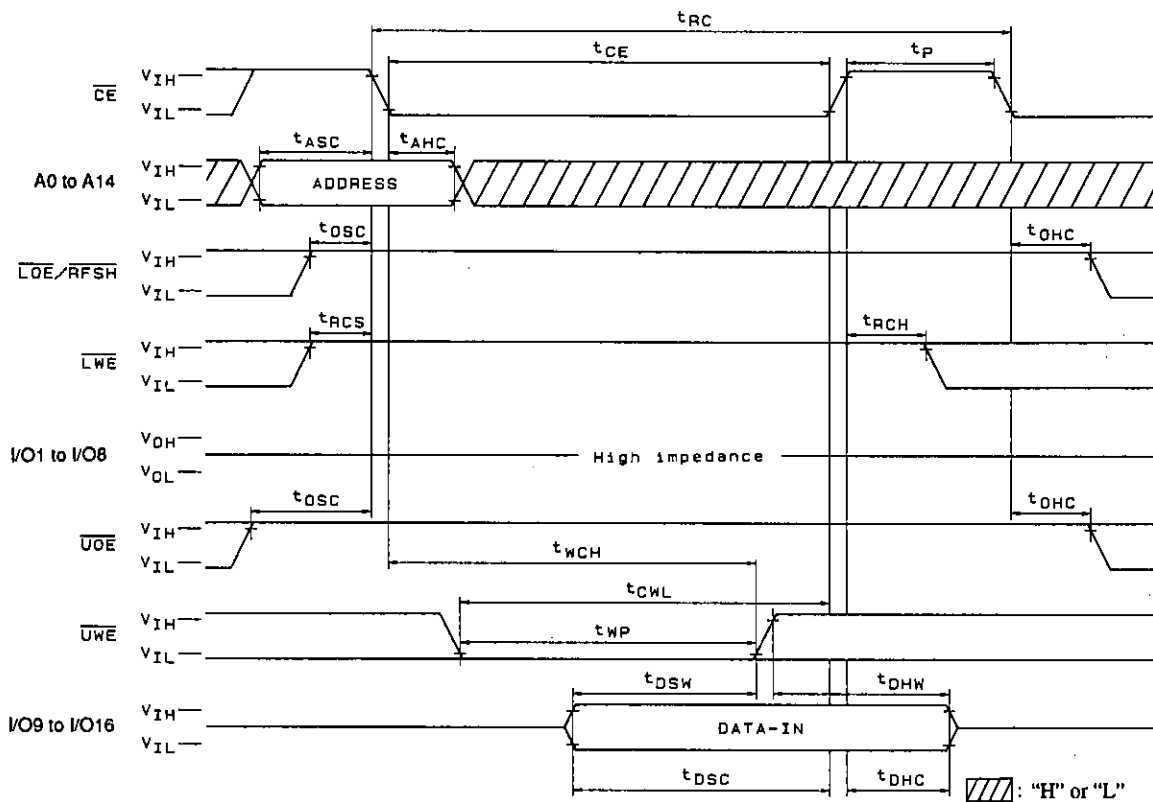
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Write Cycle (lower byte)



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Write Cycle (upper byte)



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