LH5168

CMOS 64K (8K × 8) Static Ram

FEATURES

- 8,192 × 8 bit organization
- Access times: 80/100 ns (MAX.)
- Low-power consumption:
  Operating:
  303 mW (MAX.) LH5168/D/N
  @ 80 ns
  248 mW (MAX.) LH5168/D/N/T/TR
  @ 100 ns
  275 mW (MAX.) LH5168H/HD/HN
  @ 100 ns
  Standby:
  5.5 µW (MAX.) LH5168/D/N/T/TR
  16.5 µW (MAX.) LH5168H/HD/HN
- Fully-static operation
- Three-state outputs
- Single +5 V power supply
- TTL compatible I/O
- Pin compatible to 64K bit EPROM
- Wide temp. range available
  LH5168: -10 to +70°C
  LH5168H: -40 to +85°C
- Packages:
  28-pin, 600-mil DIP
  28-pin, 300-mil SK-DIP
  28-pin, 450-mil SOP
  28-pin, 8 × 13 mm^2 TSOP (Type I)

DESCRIPTION

The LH5168 is a static RAM organized as 8,192 × 8 bits. It is fabricated using silicon-gate CMOS process technology.

The LH5168H is designed for wide temperature range from -40 to +85°C.

PIN CONNECTIONS

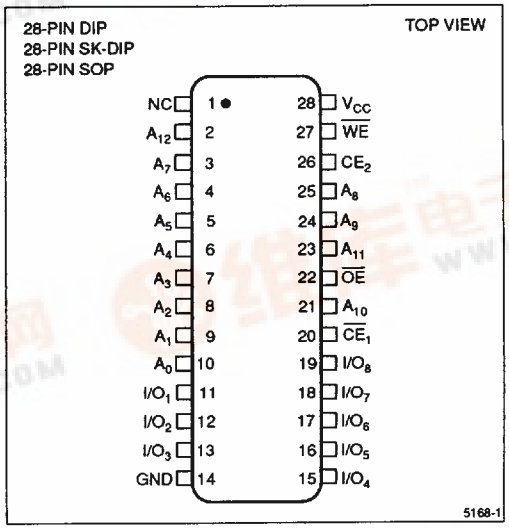


Figure 1. Pin Connections for DIP, SK-DIP, and SOP Packages

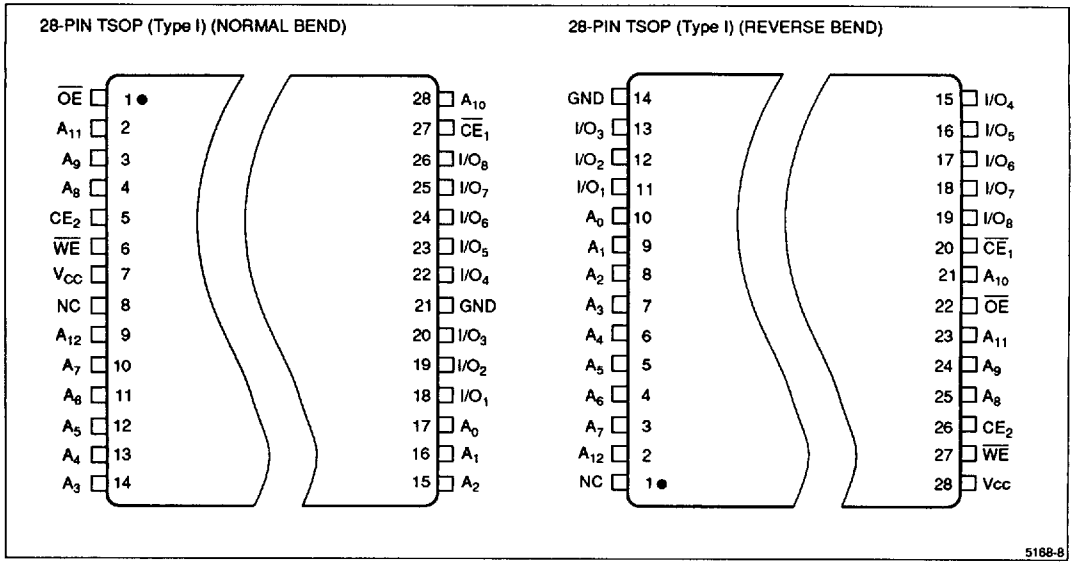


Figure 2. Pin Connections for TSOP Packages

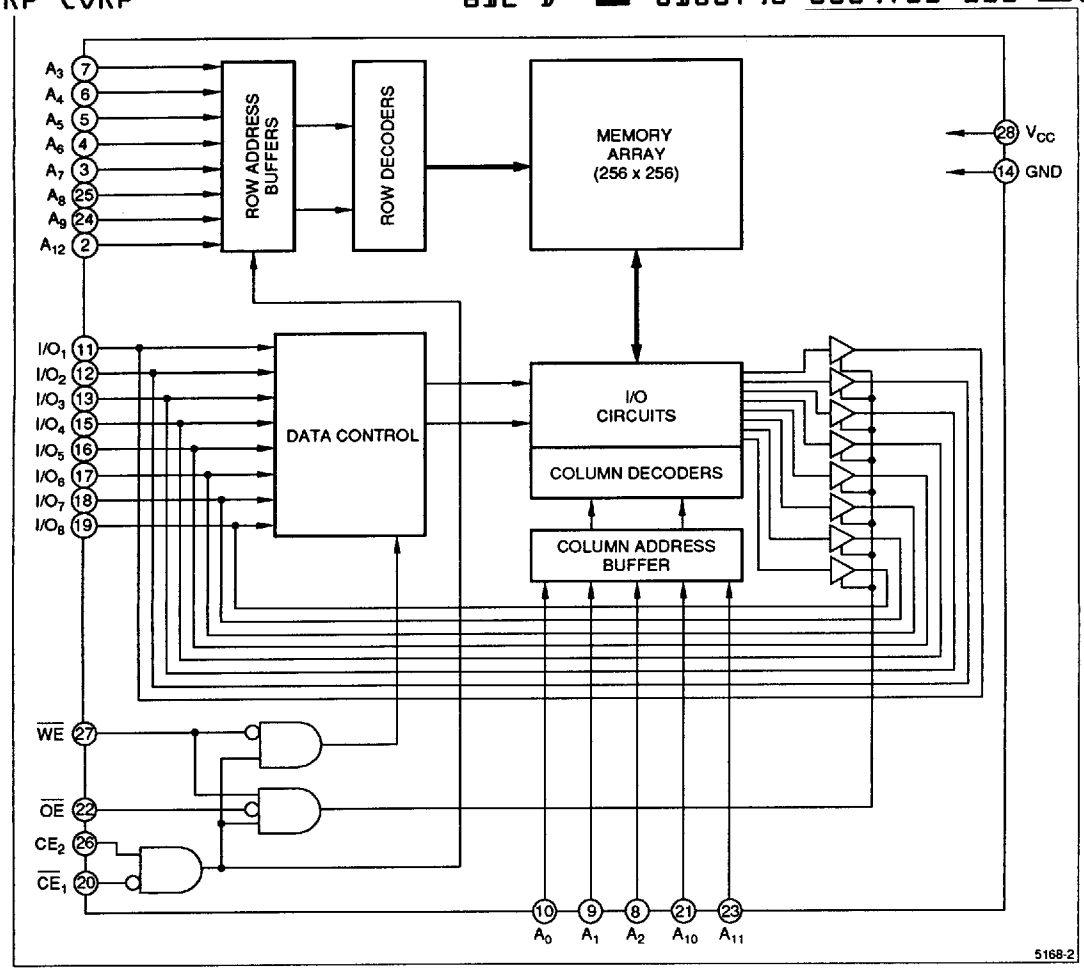


Figure 3. LH5168 Block Diagram

PIN DESCRIPTION

SIGNAL	PIN NAME
A_0 - A_{12}	Address inputs
$\overline{CE}_1$ - CE_2	Chip Enable input
$\overline{WE}$	Write Enable input
$\overline{OE}$	Output Enable input

SIGNAL	PIN NAME
I/O_1 - I/O_8	Data inputs and outputs
V_{CC}	Power supply
GND	Ground
NC	Non-connection

TRUTH TABLE

$\overline{CE_1}$	CE_2	$\overline{WE}$	$\overline{OE}$	MODE	I/O_1 - I/O_8	SUPPLY CURRENT	NOTE
H	X	X	X	Deselect	High-Z	Standby (I_{SB})	1
X	L	X	X	Deselect	High-Z	Standby (I_{SB})	1
L	H	L	X	Write	D_{IN}	Operating (I_{CC})	
L	H	H	L	Read	D_{OUT}	Operating (I_{CC})	
L	H	H	H	Output disable	High-Z	Operating (I_{CC})	

NOTE:
1. X = H or L

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	80 ns RATING	100 ns RATING	UNIT	NOTE
Supply voltage	V_{CC}	-0.3 to +7.0	-0.3 to +7.0	V	1
Input voltage	V_{IN}	-0.5 to V_{CC} +0.5	-0.3 to V_{CC} +0.3	V	1
Operating temperature	Topr	-10 to +70	-10 to +70	°C	2
			-40 to +85	°C	3
Storage temperature	Tstg	-55 to +150	-55 to +150	°C	

NOTES:
1. The maximum applicable voltage on any pin with respect to GND.
2. LH5168/D/N
3. LH5168H/HD/HN

RECOMMENDED OPERATING CONDITIONS (Note 1)

PARAMETER	SYMBOL	80 ns			100 ns			UNIT
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Supply voltage	V_{CC}	4.5	5.0	5.5	4.5	5.0	5.5	V
Input voltage	V_{IH}	2.2		V_{CC} + 0.5	2.2		V_{CC} + 0.3	V
	V_{IL}	-0.5		0.8	-0.3		0.8	V

NOTE:
1. T_A = -10 to +70°C (LH5168/D/N), T_A = -40 to +85°C (LH5168H/HD/HN).

DC CHARACTERISTICS [1] (V_{CC} = 5 V ± 10%)

PARAMETER	SYMBOL	CONDITIONS		MIN.	MAX.	UNIT	NOTE
Input leakage current	I_{LI}	V_{IN} = 0 to V_{CC}			1.0	µA	
Output leakage current	I_{LO}	$\overline{CE_1}$ = V_{IH} or CE_2 = V_{IL} or $\overline{OE}$ = V_{IH} or $\overline{WE}$ = V_{IL} $V_{I/O}$ = 0 to V_{CC}			1.0	µA	
Operating current	I_{CC}	$\overline{CE_1}$ = V_{IL}, V_{IN} = V_{IL} to V_{IH} CE_2 = V_{IH}, Outputs open	t_{CYCLE} = 80 ns		55	mA	
		$\overline{CE_1}$ = V_{IL}, V_{IN} = V_{IL} to V_{IH} CE_2 = V_{IH}, Outputs open	t_{CYCLE} = 100 ns		45	mA	2
					50		3
		$\overline{CE_1}$ = V_{IL}, V_{IN} = 0.2 V to V_{CC} - 0.2 V CE_2 = V_{IH}, Outputs open	t_{CYCLE} = 1.0 µs		10		
Standby current	I_{SB1}	$\overline{CE_1}$ = V_{IH} or CE_2 = V_{IL}			10	mA	
	I_{SB}	CE_2 ≤ 0.2 V or $\overline{CE_1}$, CE_2 ≥ V_{CC} - 0.2 V	T_A ≤ 70°C		1.0	µA	2
			T_A ≤ 85°C		3.0	µA	3
Output voltage	V_{OL}	I_{OL} = 2.1 mA			0.4	V	
	V_{OH}	I_{OH} = -1 mA		2.4		V	

NOTES:
1. T_A = -10 to 70°C (LH5168/D/N/T/TR), T_A = -40 to +85°C (LH5168H/HD/HN)
2. LH5168/D/N/T/TR
3. LH5168H/HD/HN

AC CHARACTERISTICS [1]

(1) READ CYCLE (V_{CC} = 5 V ± 10%)

PARAMETER		SYMBOL	80 ns		100 ns		UNIT	NOTE
			MIN.	MAX.	MIN.	MAX.		
Read cycle		t_{RC}	80		100		ns	
Address access time		t_{AA}		80		100	ns	
Chip enable access time	($\overline{CE}_1$)	t_{ACE1}		80		100	ns	
	(CE_2)	t_{ACE2}		80		100	ns	
Output enable access time		t_{OE}		40		40	ns	
Output hold time		t_{OH}	10		10		ns	
Chip enable to output in Low-Z	($\overline{CE}_1$)	t_{LZ1}	10		10		ns	2
	(CE_2)	t_{LZ2}	10		10		ns	2
Output enable to output in Low-Z		t_{OLZ}	5		5		ns	2
Chip enable to output in High-Z	($\overline{CE}_1$)	t_{HZ1}	0	30	0	30	ns	2
	(CE_2)	t_{HZ2}	0	30	0	30	ns	2
Output disable to output in High-Z		t_{OHZ}	0	20	0	20	ns	2

NOTES:

1. T_A = -10 to +70°C (LH5168/D/N/T/TR), T_A = -40 to +85°C (LH5168H/HD/HN)
2. Active output to high-impedance and high-impedance to output active tests specified for a ±500 mV transition from steady state levels into the test load. C_{LOAD} = 5 pF.

(2) WRITE CYCLE (V_{CC} = 5 V ± 10%)

PARAMETER	SYMBOL	80 ns		100 ns		UNIT	NOTE
		MIN.	MAX.	MIN.	MAX.		
Write cycle time	t_{WC}	80		100		ns	
Chip enable to end of write	t_{CW}	70		80		ns	
Address valid to end of write	t_{AW}	70		80		ns	
Address setup time	t_{AS}	0		0		ns	
Write pulse width	t_{WP}	60		60		ns	
Write recovery time	t_{WR}	0		0		ns	
Data valid to end of write	t_{DW}	40		40		ns	
Data hold time	t_{DH}	0		0		ns	
Output active from end of write	t_{OW}	10		10		ns	1
$\overline{WE}$ to output in High-Z	t_{WZ}	0	30	0	30	ns	1
$\overline{OE}$ to output in High-Z	t_{OHZ}	0	20	0	20	ns	1

NOTE:

1. Active output to high-impedance and high-impedance to output active tests specified for a ±500 mV transition from steady state levels into the test load. C_{LOAD} = 5 pF.

AC TEST CONDITIONS

PARAMETER	MODE
Input voltage amplitude	0.6 to 2.4 V
Input rise/fall time	10 ns
Timing reference level	1.5 V
Output load conditions	(1TTL + C_L = 100 pF)

CAPACITANCE [1] (T_A = 25°C, f = 1MHz)

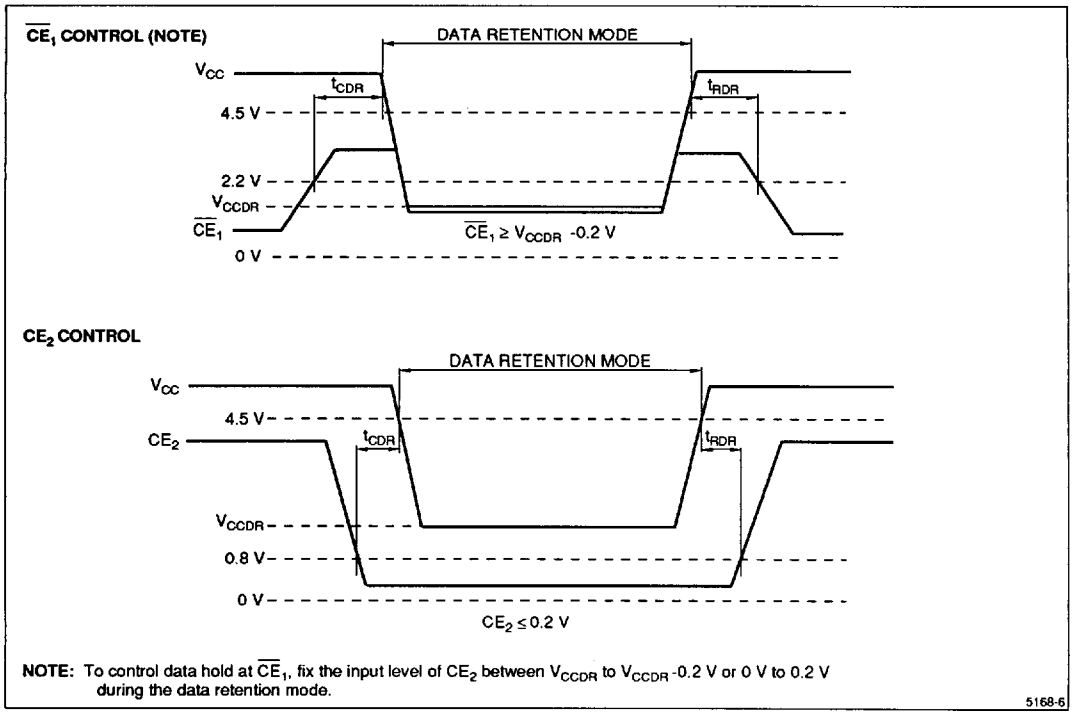
PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Input capacitance	C_{IN}	V_{IN} = 0 V			7	pF
Input/output capacitance	$C_{I/O}$	$V_{I/O}$ = 0 V			10	pF

NOTE:
1. This parameter is sampled and not production tested.

DATA RETENTION CHARACTERISTICS [1]

PARAMETER	SYMBOL	CONDITIONS	MIN.	MAX.	UNIT	NOTE
Data retention voltage	V_{CCDR}	$CE_2 \le 0.2$ V or $\overline{CE}_1$, $CE_2 \ge V_{CC}$ - 0.2 V	2.0		V	
Data retention current	I_{CCDR}	V_{CCDR} = 3 V, $CE_2 \le 0.2$ V or $\overline{CE}_1$, $CE_2 \ge V_{CCDR}$ - 0.2 V		0.6	µA	2
				1.5	µA	3
Chip disable to data retention	t_{CDR}		0		ns	
Recovery time	t_{RDR}		t_{RC}		ns	4

NOTES:
1. T_A = -10 to +70°C (LH5168/D/N/T/TR), T_A = -40 to +85°C (LH5168H/HD/HN)
2. LH5168/D/N/T/TR at $T_A \le 70$°C
3. LH5168H/HD/HN at $T_A \le 85$°C
4. t_{RC} = Read cycle time



NOTE: To control data hold at $\overline{CE}_1$, fix the input level of CE_2 between V_{CCDR} to V_{CCDR} -0.2 V or 0 V to 0.2 V during the data retention mode.

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Figure 4. Low Voltage Data Retention

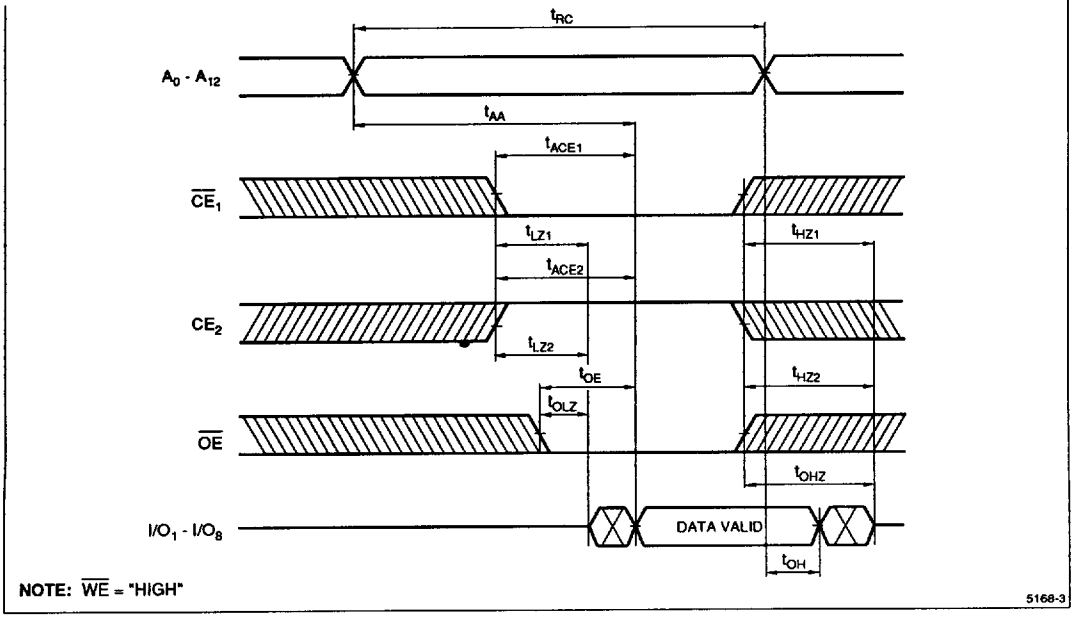
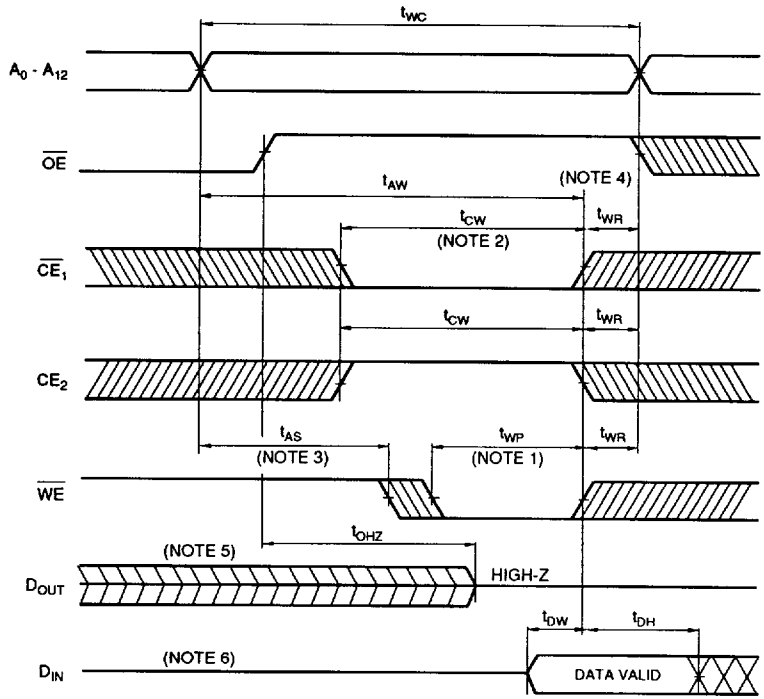


Figure 5. Read Cycle



NOTES:

1. The writing occurs during the overlap (t_{WP}) of $\overline{CE_1}$ ="LOW", CE_2 = "HIGH", and $\overline{WE}$ = "LOW".
2. t_{CW} is defined as the time from the last occuring transition, either $\overline{CE_1}$ LOW transition or CE_2 HIGH transition, to the time when the writing is finished.
3. t_{AS} is defined as the time from address change to writing start.
4. t_{WR} is defined as the time from writing finish to address change.
5. If $\overline{CE_1}$ LOW transition or CE_2 HIGH transition occurs at the same time or after $\overline{WE}$ LOW transition, the output will remain high-impedance.
6. While the I/O pins are in the output state, input signals with the opposite logic level must not be applied.

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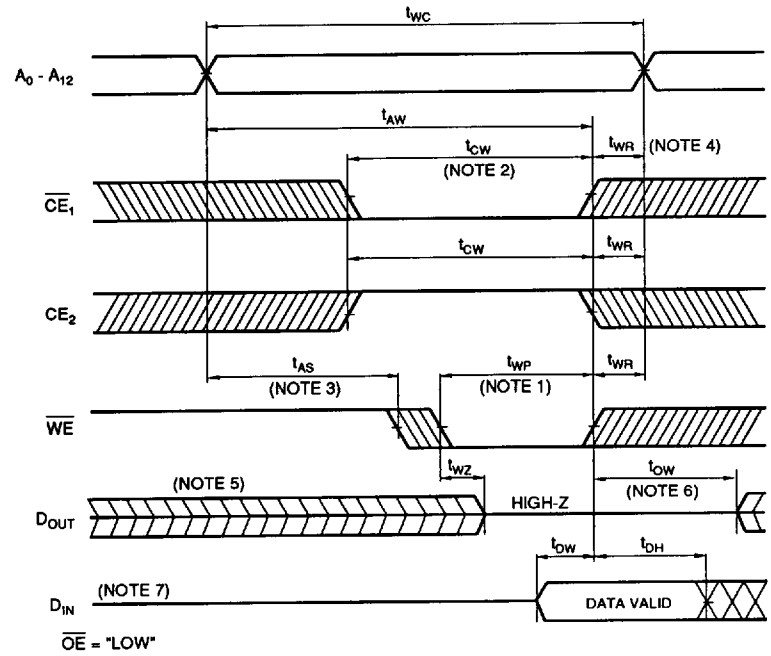
Figure 6. Write Cycle 1



NOTES:

1. The writing occurs during the overlap (t_{WP}) of $\overline{CE_1}$ ="LOW", CE_2 = "HIGH", and $\overline{WE}$ = "LOW".
2. t_{CW} is defined as the time from the last occuring transition, either $\overline{CE_1}$ LOW transition or CE_2 HIGH transition, to the time when the writing is finished.
3. t_{AS} is defined as the time from address change to writing start.
4. t_{WR} is defined as the time from writing finish to address change.
5. If $\overline{CE_1}$ LOW transition or CE_2 HIGH transition occurs at the same time or after $\overline{WE}$ LOW transition, the output will remain high-impedance.
6. If $\overline{CE_1}$ HIGH transition or CE_2 LOW transition occurs at the same time or before $\overline{WE}$ HIGH transition, the output will remain high-impedance.
7. While the I/O pins are in the output state, input signals with the opposite logic level must not be applied.

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Figure 7. Write Cycle 2

ORDERING INFORMATION

LH5168	X	X	- ##
Device Type	Operating Temperature	Package	Speed

- Speed:
  - 10L 100
  - 80L 80
  - Access Time (ns)
- Package:
  - Blank 28 pin, 600-mil DIP (DIP 28-P-600)
  - D 28-pin, 300-mil SK-DIP (SK-DIP28-P-300)
  - N 28-pin, 450-mil SOP (SOP28-P-450)
  - T 28-pin, 8 x 13 mm² TSOP (Type I) (TSOP28-P-0813)
  - TR 28-pin, 8 x 13 mm² TSOP (Type I) Reverse Bend (TSOP28-P-0813)
- Operating Temperature:
  - Blank -10 to 70°C
  - H -40 to +85°C
- Device Type: CMOS 64K (8K x 8) Static RAM

Example: LH5168D-10L (CMOS 64K (8K x 8) Static RAM, 100 ns, 28-pin, 300-mil SK-DIP)

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