

LH5164AVH

CMOS 64K (8K × 8) Static RAM

FEATURES

- 8,192 × 8 bit organization
- Access time: 200 ns (MAX.)
- Supply current (MAX.):
 - Operating: 90 mW
 - 29 mW (t_{RC} , $t_{WC} = 1 \mu s$)
 - Standby: 3.6 μW (MAX.) @ 70°C
 - 10.8 μW (MAX.) @ 85°C
- Data retention:
 - 0.6 μW ($V_{CC} = 3 V$, $t_A = 25^\circ C$)
- Low voltage operation: 3.3 V $\pm 0.3 V$
- Fully-static operation
- TTL compatible I/O
- Three-state outputs
- Packages:
 - 28-pin, 450-mil SOP
 - 28-pin, 8 × 13 mm² TSOP (Type I)

DESCRIPTION

The LH5164AVH is a static RAM organized as 8,192 × 8 bits. It is fabricated using silicon-gate CMOS process technology.

PIN CONNECTIONS

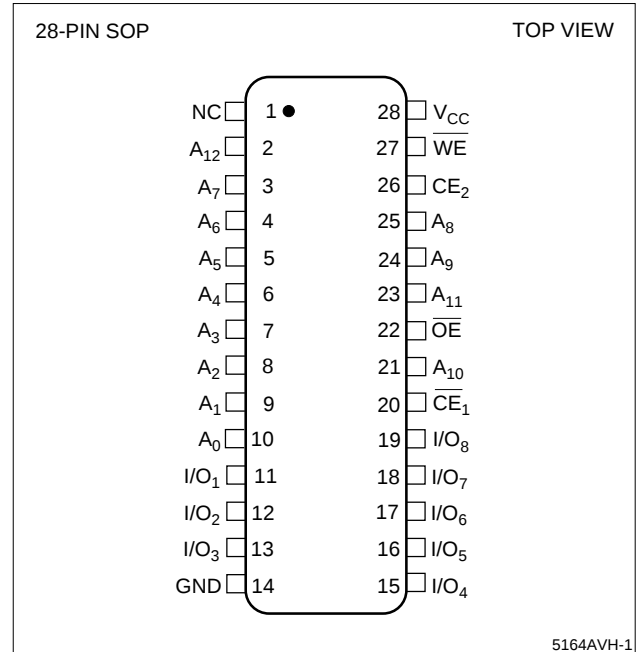


Figure 1. Pin Connections for SOP Package

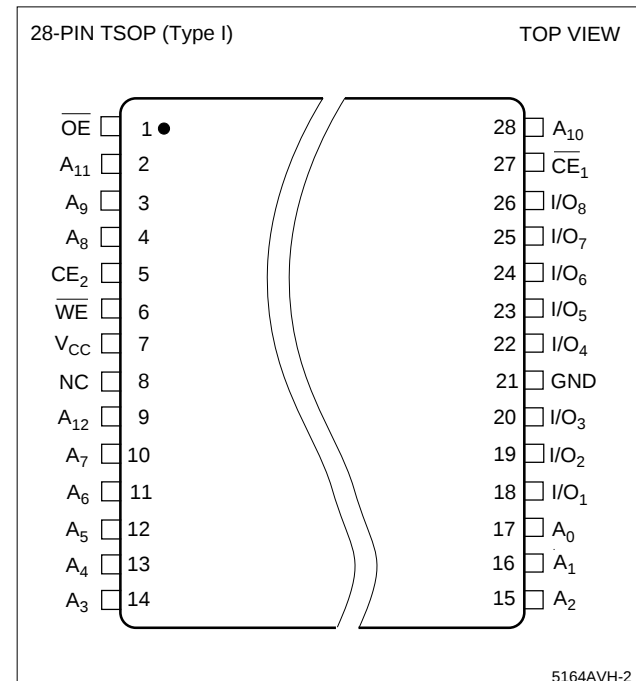


Figure 2. Pin Connections for TSOP Package

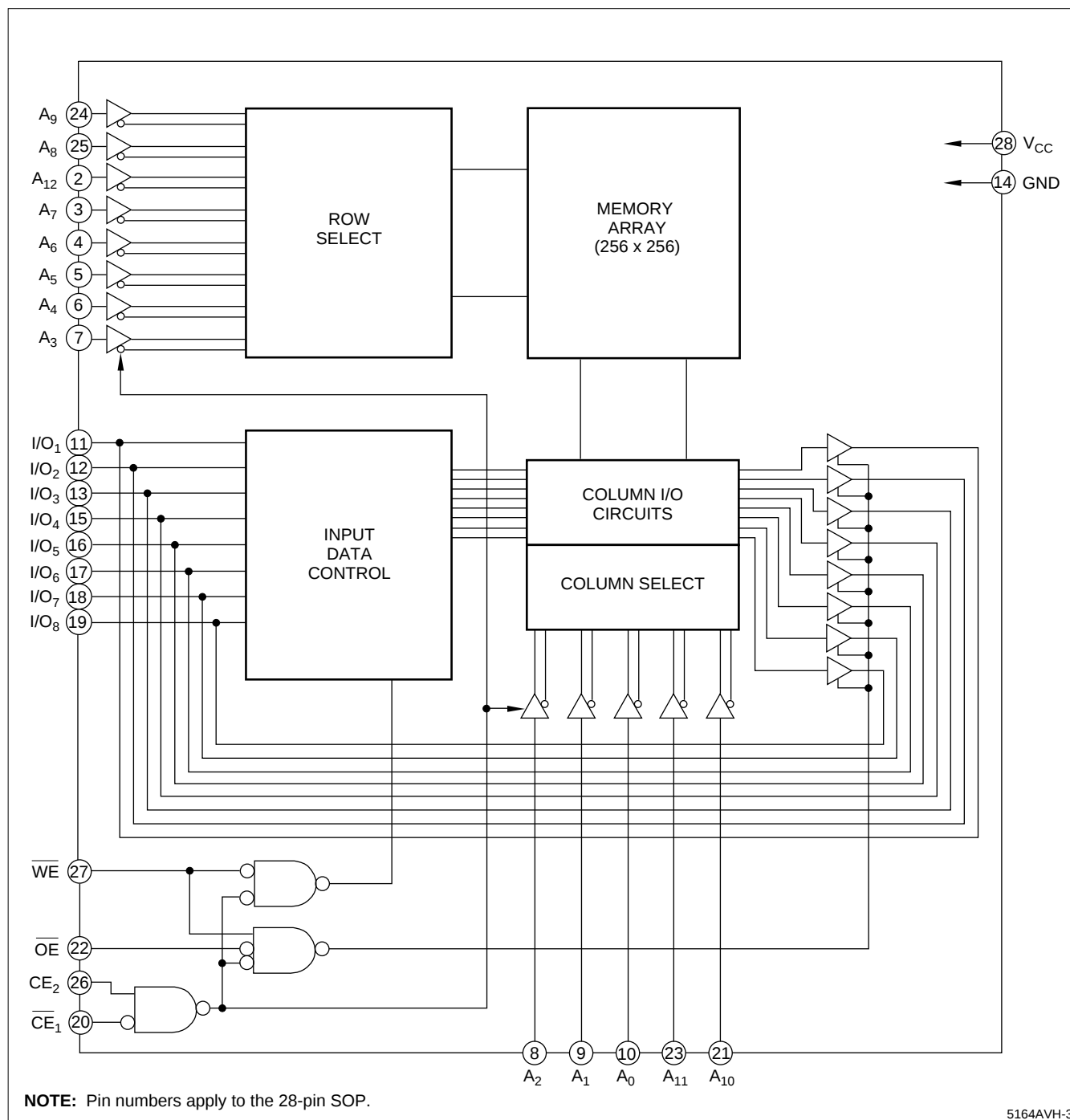


Figure 3. LH5164AVH Block Diagram

PIN DESCRIPTION

SIGNAL	PIN NAME
A ₀ - A ₁₂	Address inputs
CE ₁ /CE ₂	Chip Enable input
WE	Write Enable input
OE	Output Enable input

SIGNAL	PIN NAME
I/O ₁ - I/O ₈	Data inputs and outputs
V _{CC}	Power supply
GND	Ground
NC	No 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	Standby	High-Z	Standby (I_{SB})	1
X	L	X	X				
L	H	L	X	Write	Data input	Operating (I_{CC})	1
L	H	H	L	Read	Data output	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	RATING	UNIT	NOTE
Supply voltage	V_{CC}	-0.3 to +7.0	V	1
Input voltage	V_{IN}	-0.3 to $V_{CC} + 0.3$	V	1, 2
Operating temperature	T_{opr}	-40 to +85	°C	
Storage temperature	T_{stg}	-65 to +150	°C	

NOTES:

1. The maximum applicable voltage on any pin with respect to GND.
 2. V_{IN} (MIN.) = -3.0 V for pulse width ≤ 50 ns.

RECOMMENDED OPERATING CONDITIONS ($T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Supply voltage	V_{CC}	3.0	3.3	3.6	V	
Input voltage	V_{IH}	$V_{CC} - 0.5$		$V_{CC} + 0.3$	V	
	V_{IL}	-0.3		0.2	V	1

NOTE:

1. V_{IL} (MIN.) = -3.0 V for pulse width ≤ 50 ns.

DC CHARACTERISTICS¹ ($T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$, $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$)

PARAMETER	SYMBOL	CONDITIONS	MIN.	MAX.	UNIT	NOTE
Input leakage current	I_{LI}	$V_{IN} = 0\text{ V to }V_{CC}$	-1.0	1.0	μA	
Output leakage current	I_{LO}	$\overline{CE}_1 = V_{IH}$ or $CE_2 = V_{IL}$ or $\overline{OE} = V_{IH}$ or $\overline{WE} = V_{IL}$ $V_{I/O} = 0\text{ to }V_{CC}$	-1.0	1.0	μA	
Operating supply current	I_{CC}	$\overline{CE}_1 = 0.2\text{ V}$, $V_{IN} = 0.2\text{ V}$, or $V_{CC} - 0.2\text{ V}$ $CE_2 = V_{CC} - 0.2\text{ V}$, Outputs open	$t_{CYCLE} = 200\text{ ns}$	25	mA	
			$t_{CYCLE} = 1.0\text{ μs}$	8		
Standby current	I_{SB}	$CE_2 \leq 0.2\text{ V}$ or $\overline{CE}_1 \geq V_{CC} - 0.2\text{ V}$	$T_A \leq +70^\circ\text{C}$	1.0	μA	1
	I_{SB1}	$\overline{CE}_1 = V_{IH}$ or $CE_2 = V_{IL}$	$T_A \leq +85^\circ\text{C}$	3.0	μA	
Output voltage	V_{OL}	$I_{OL} = 500\text{ μA}$		0.4	V	
	V_{OH}	$I_{OH} = -500\text{ μA}$	$V_{CC} - 0.5$		V	

NOTE:

1. CE_2 should be $\geq V_{CC} - 0.2\text{ V}$ or $\leq 0.2\text{ V}$ when $\overline{CE}_1 \geq V_{CC} - 0.2\text{ V}$.

READ CYCLE ($T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$)

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Read cycle time	t_{RC}	200		ns
Address access time	t_{AA}		200	ns
CE ₁ access time	t_{ACE1}		200	ns
CE ₂ access time	t_{ACE2}		200	ns
Output enable access time	t_{OE}		150	ns
Output hold time	t_{OH}	10		ns
CE ₁ Low to output in Low-Z	t_{LZ1}	20		ns
CE ₂ High to output in Low-Z	t_{LZ2}	20		ns
OE Low to output in Low-Z	t_{OLZ}	10		ns
CE ₁ High to output in High-Z	t_{HZ1}	0	60	ns
CE ₂ Low to output in High-Z	t_{HZ2}	0	60	ns
OE High to output in High-Z	t_{OHZ}	0	40	ns

WRITE CYCLE ($T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$)

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Write cycle time	t_{WC}	200		ns
CE Low to end of write	t_{CW}	180		ns
Address valid to end of write	t_{AW}	180		ns
Address setup time	t_{AS}	0		ns
Write pulse width	t_{WP}	150		ns
Write recovery time	t_{WR}	0		ns
Input data setup time	t_{DW}	100		ns
Input data hold time	t_{DH}	0		ns
WE High to output in Low-Z	t_{OW}	20		ns
WE Low to output in High-Z	t_{WZ}	0	60	ns
OE High to output in High-Z	t_{OHZ}	0	40	ns

TEST CONDITIONS

PARAMETER	MODE	NOTE
Input pulse level	0.2 V to $V_{CC} - 0.2\text{ V}$	
Input rise/fall time	10 ns	
Input/output timing level	1.5 V	
Output load	C_L (100 pF)	1

NOTE:

1. Includes scope and jig capacitance.

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

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

NOTE:

1. This parameter is sampled and not production tested.

DATA RETENTION CHARACTERISTICS ($T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$)

PARAMETER	SYMBOL	CONDITIONS	MIN.	MAX.	UNIT	NOTE
Data retention supply voltage	V_{CCDR}	$CE_2 \leq 0.2\text{ V}$ or $CE_1 \geq V_{CCDR} - 0.2\text{ V}$	2.0		V	1
Data retention supply current	I_{CCDR}	$V_{CCDR} = 3\text{ V}$, $CE_2 \leq 0.2\text{ V}$ or $CE_1 \geq V_{CCDR} - 0.2\text{ V}$		0.2	μA	1
		$T_A = 25^{\circ}\text{C}$				
		$T_A = 70^{\circ}\text{C}$		0.6	μA	
Chip disable to data retention	t_{CDR}		0		ns	
Recovery time	t_R		t_{RC}		ns	2

NOTES:

- CE_2 should be $\geq V_{CCDR} - 0.2\text{ V}$ or $\leq 0.2\text{ V}$.
- t_{RC} = Read cycle time.

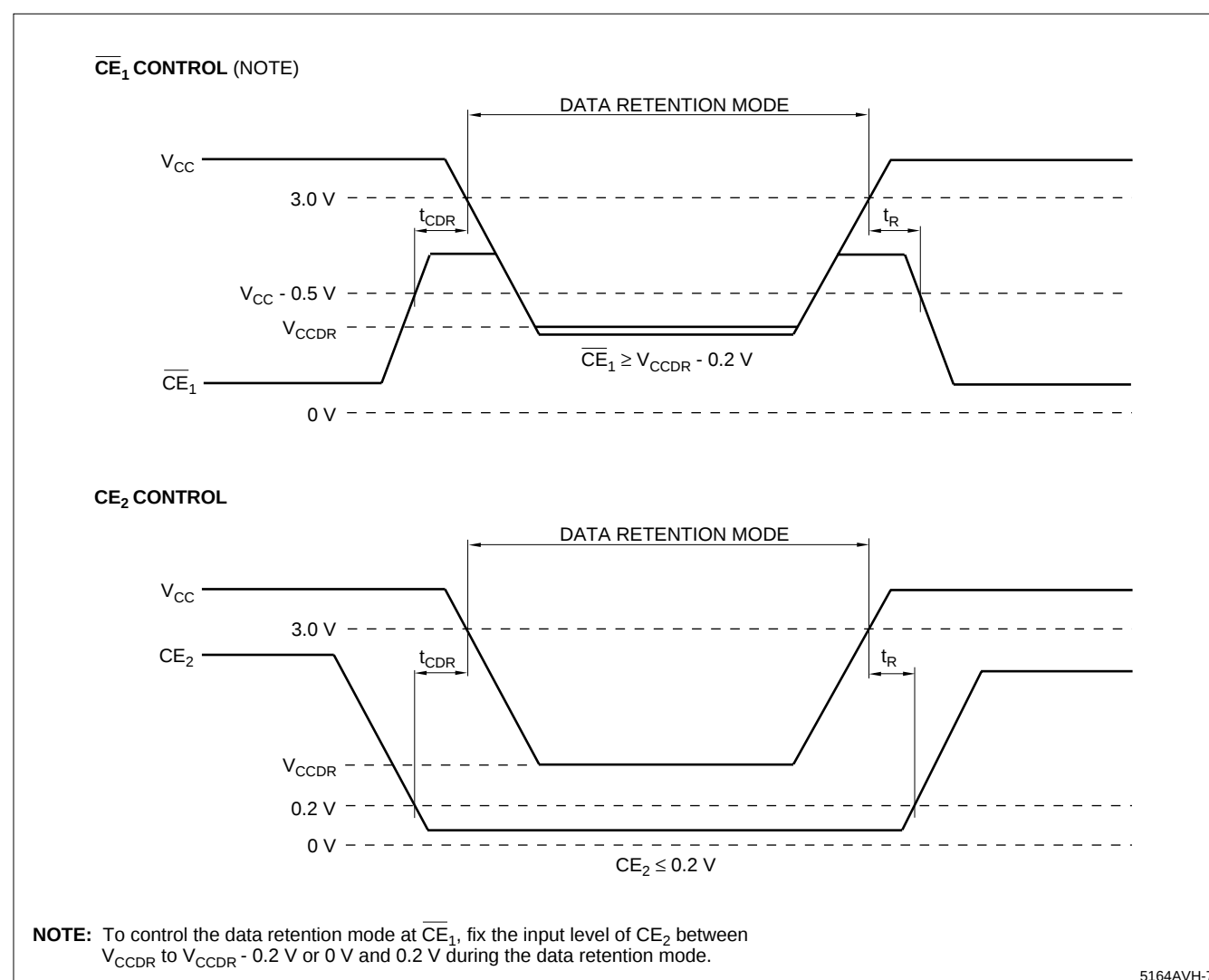


Figure 4. Data Retention Characteristics

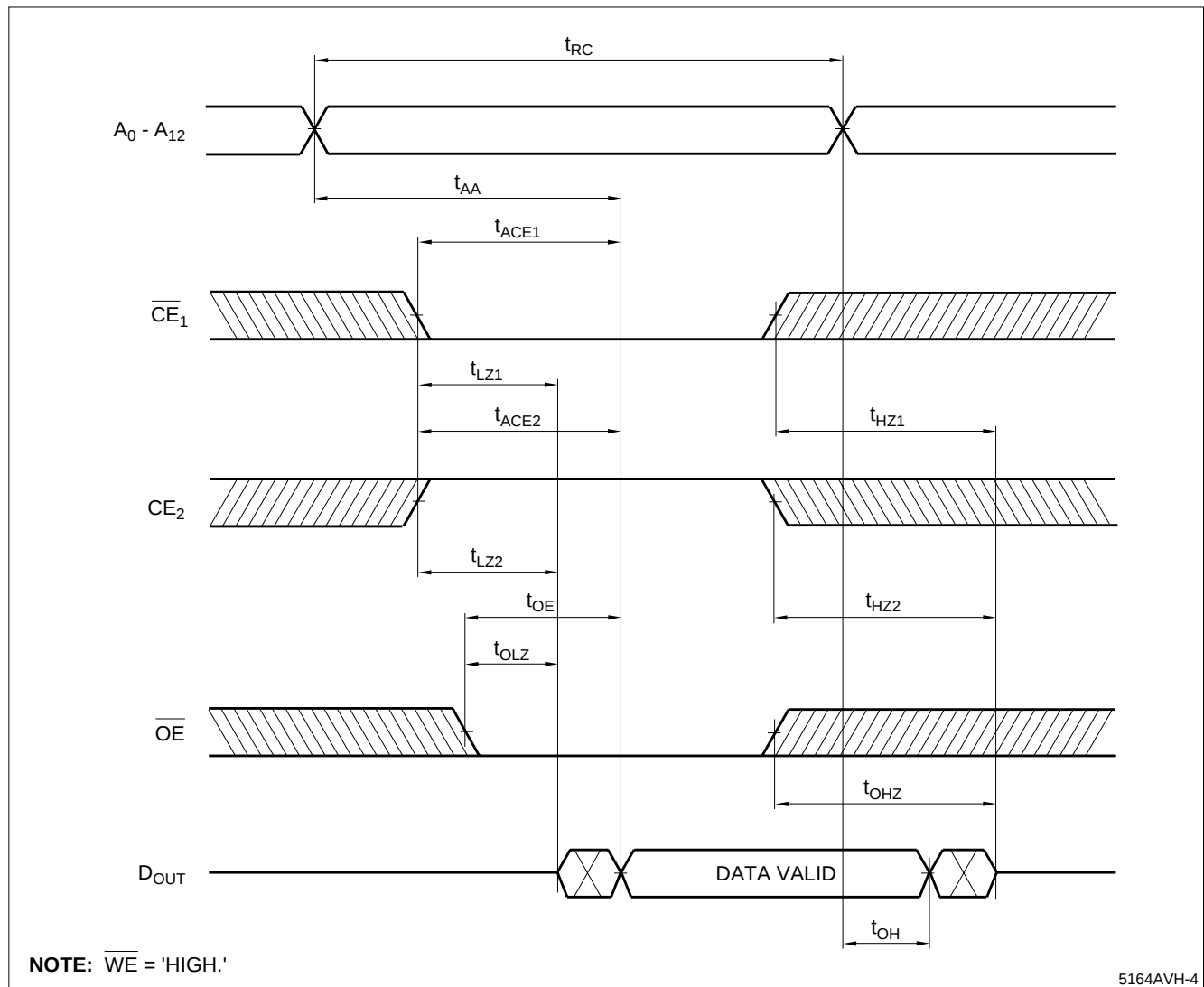
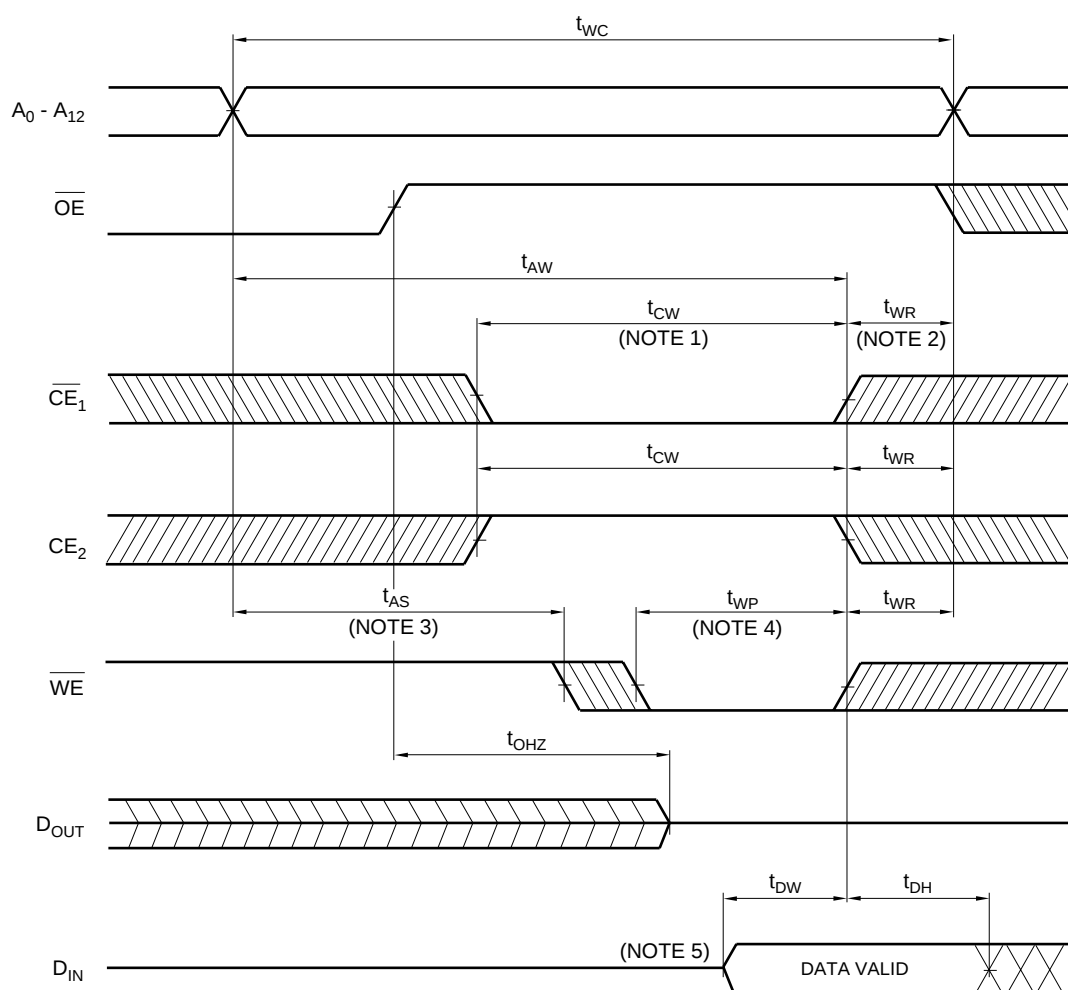


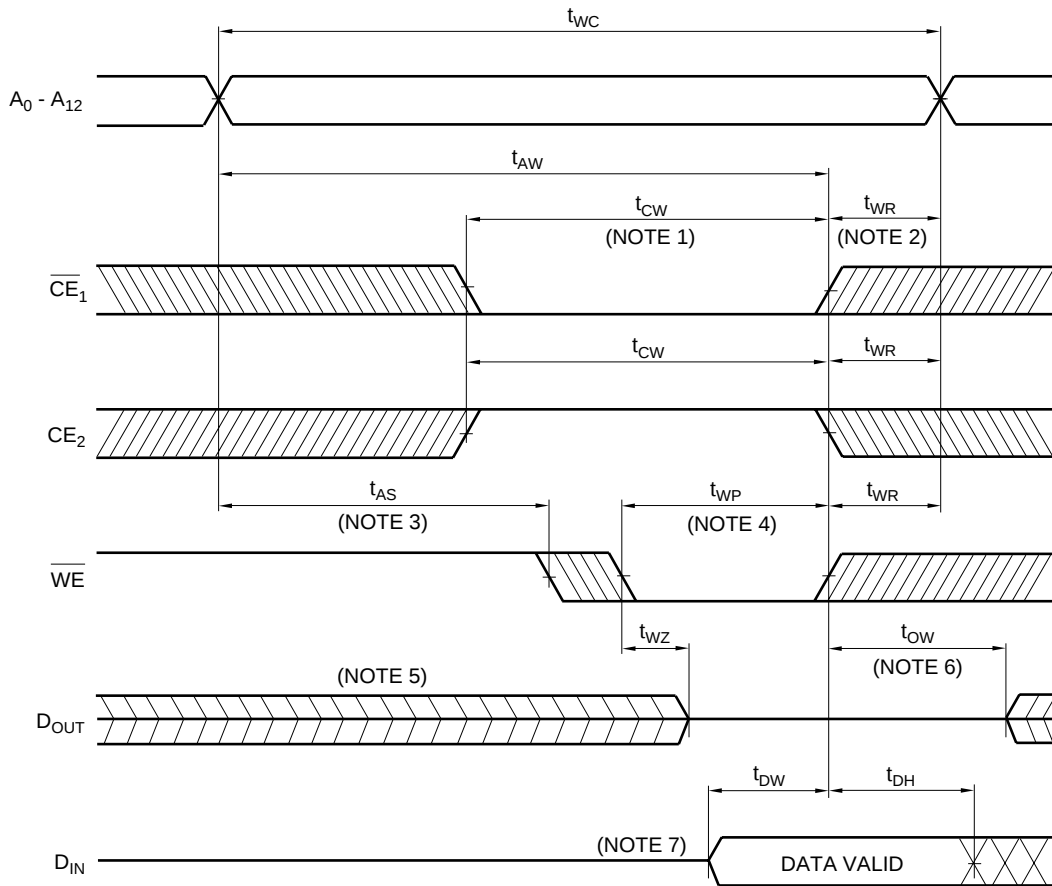
Figure 5. Read Cycle

**NOTES:**

1. t_{CW} is defined as the time from the last occurring transition, either $\overline{CE}_1$ LOW transition or CE_2 HIGH transition, to the time when the writing is finished.
2. t_{WR} is defined as the time from writing finish to address change.
3. t_{AS} is defined as the time from address change to writing start.
4. The writing occurs during an overlapping period of $\overline{CE}_1 = \text{'LOW'}$, $CE_2 = \text{'HIGH'}$, and $\overline{WE} = \text{'LOW'}$ (t_{WP}).
5. When 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 ($\overline{OE}$ Controlled)

**NOTES:**

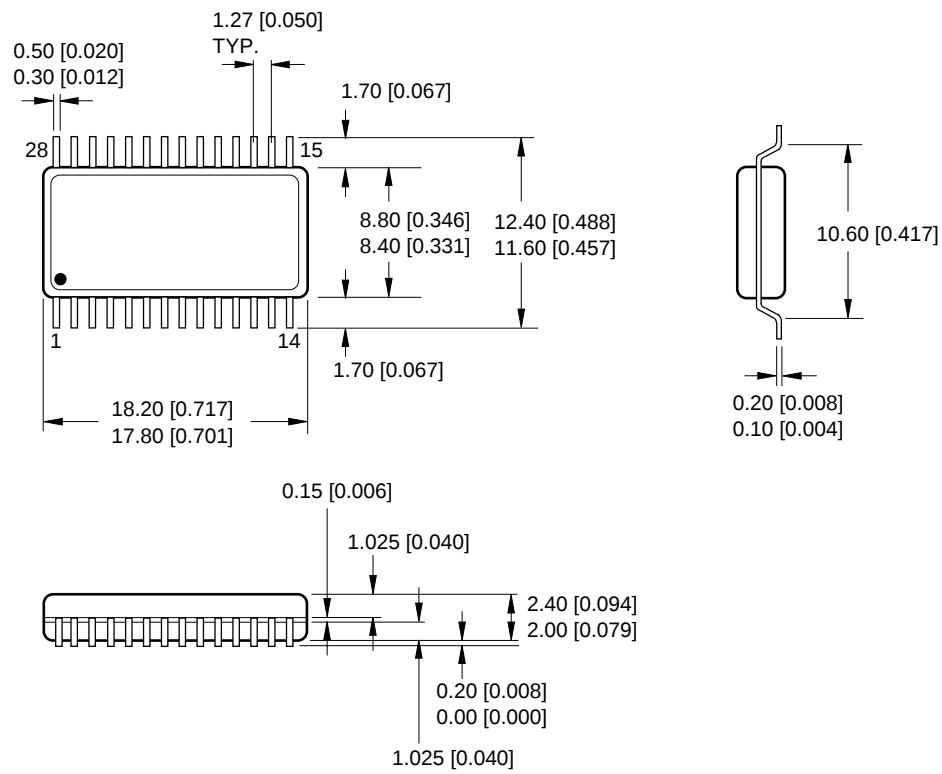
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2. t_{WR} is defined as the time from writing finish to address change.
3. t_{AS} is defined as the time from address change to writing start.
4. The writing occurs during an overlapping period of $\overline{CE}_1 = \text{'LOW'}$, $CE_2 = \text{'HIGH'}$, and $\overline{WE} = \text{'LOW'}$ (t_{WP}).
5. If $\overline{CE}_1$ LOW transition or CE_2 HIGH transition occurs at the same time or after $\overline{WE}$ LOW transition, the outputs 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 outputs will remain high-impedance.
7. When 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 ($\overline{OE}$ Low Fixed)

PACKAGE DIAGRAMS

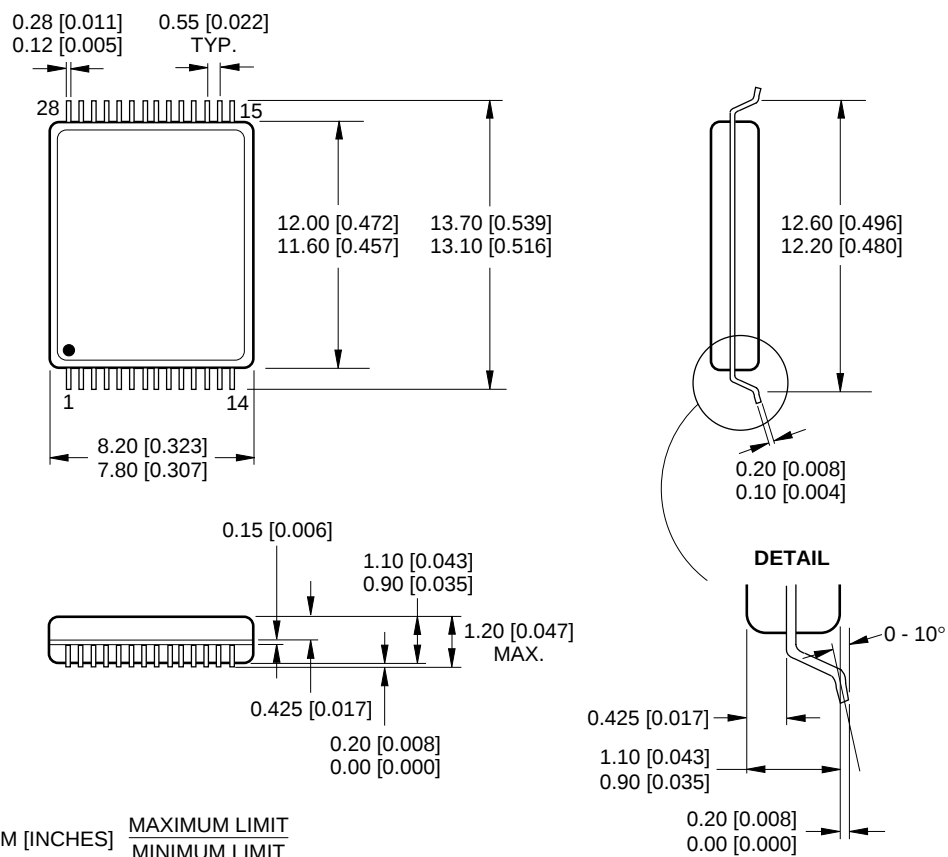
28SOP (SOP028-P-0450)



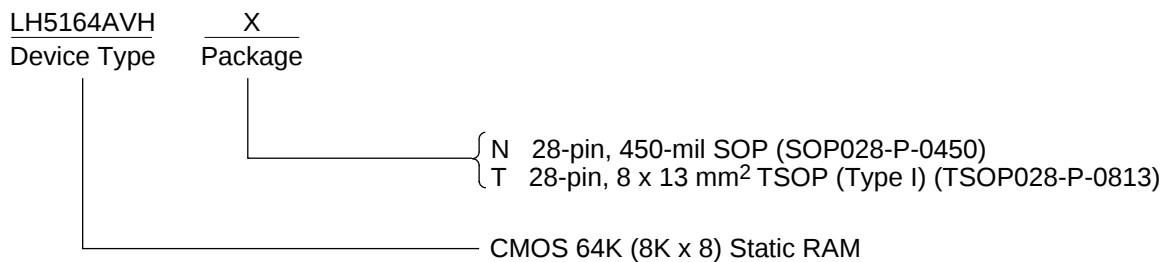
DIMENSIONS IN MM [INCHES] MAXIMUM LIMIT
 MINIMUM LIMIT

28SOP

28-pin, 450-mil SOP

28TSOP (TSOP028-P-0813)

28TSOP

28-pin, 8 × 13 mm² TSOP (Type I)**ORDERING INFORMATION****Example:** LH5164AVHN (CMOS 64K (8K × 8) Static RAM, 28-pin, 450-mil SOP)

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