LH5164AV

CMOS 64K (8K × 8) Static RAM

FEATURES

- 8,192 × 8 bit organization
- Access time: 200 ns (MAX.)
- Supply current (MAX.):
  - Operating: 248 mW
    - 55 mW (t_{RC}, t_{WC} = 1 µs)
  - Standby: 5.5 µW
  - Data retention:
    - 0.6 µW (V_{CC} = 3 V, t_A = 25°C)
- Wide operating voltage range:
  - 2.7 V to 5.5 V
- Fully-static operation
- TTL compatible I/O
- Three-state outputs
- Packages:
  - 28-pin, 450-mil SOP
  - 28-pin, 8 × 13 mm^2 TSOP (Type I)

DESCRIPTION

The LH5164AV is a static RAM organized as 8,192 × 8 bits. It is fabricated using silicon-gate CMOS process technology.

PIN CONNECTIONS

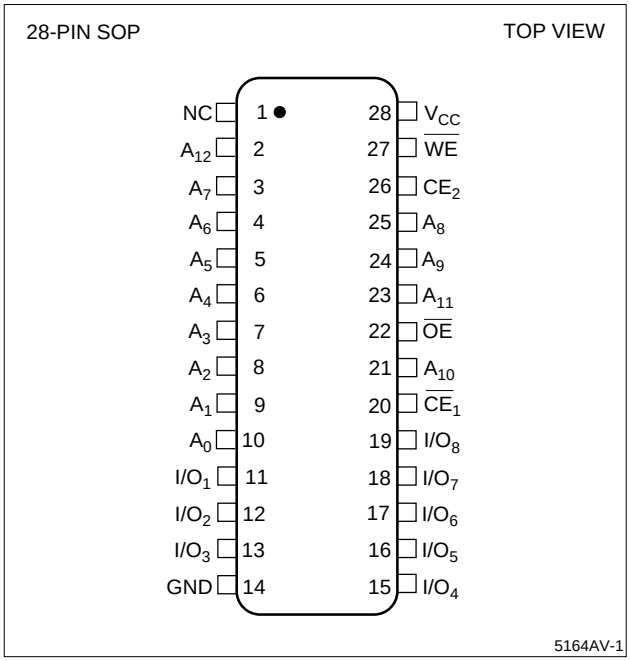


Figure 1. Pin Connections for SOP Package

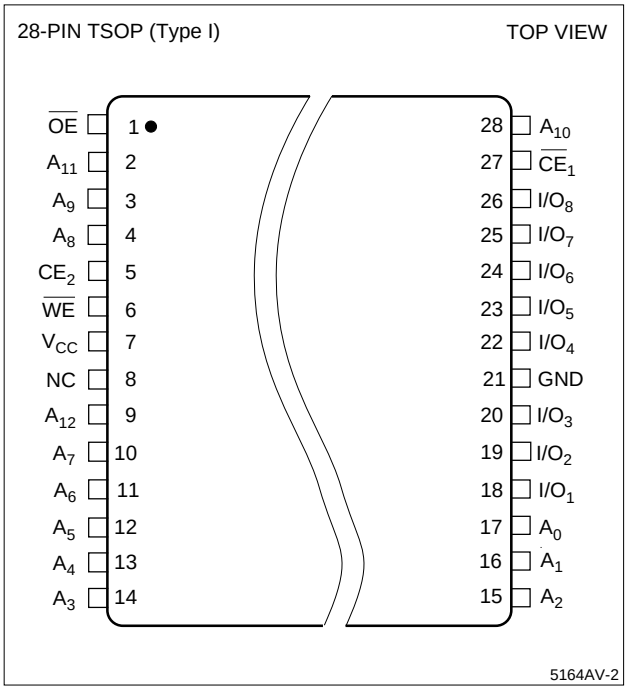


Figure 2. Pin Connections for TSOP Package

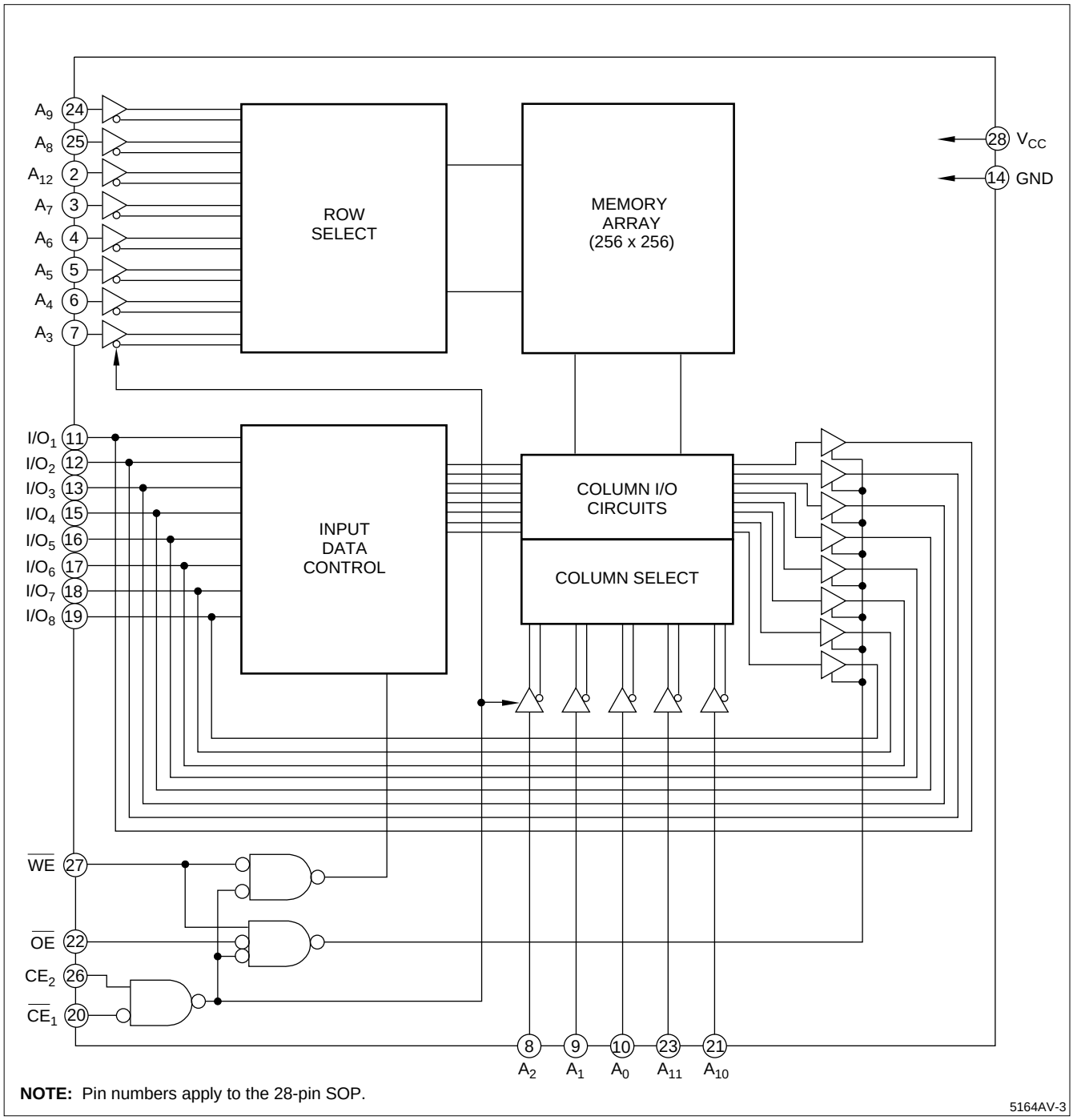


Figure 3. LH5164AV Block Diagram

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	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	Topr	–10 to +70	°C	
Storage temperature	Tstg	–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 = –10°C to +70°C)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Supply voltage	V_{CC}	2.7		5.5	V	
Input voltage (V_{CC} = 2.7 V to 3.6 V)	V_{IH}	V_{CC} – 0.5		V_{CC} + 0.3	V	
	V_{IL}	–0.3		0.2	V	1
Input voltage (V_{CC} = 4.5 V to 5.5 V)	V_{IH}	2.2		V_{CC} + 0.3	V	
	V_{IL}	–0.3		0.8	V	1

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

DC CHARACTERISTICS [1] (T_A = –10°C to +70°C, V_{CC} = 2.7 V to 5.5 V)

PARAMETER	SYMBOL	CONDITIONS		MIN.	MAX.	UNIT	NOTE
Input leakage current	I_{LI}	V_{IN} = 0 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 to V_{CC}		–1.0	1.0	µA	
Operating supply current	I_{CC}	$\overline{CE_1}$ = 0.2 V, V_{IN} = 0.2 V, or V_{CC} – 0.2 V CE_2 = V_{CC} – 0.2 V, Outputs open, V_{CC} = 2.7 V to 3.6 V	t_{CYCLE} = 200 ns		20	mA	
			t_{CYCLE} = 1.0 µs		8		
		$\overline{CE_1}$ = V_{IL}, V_{IN} = V_{IL} or V_{IH} CE_2 = V_{IH}, Outputs open, V_{CC} = 4.5 V to 5.5 V	t_{CYCLE} = 200 ns		45		
			t_{CYCLE} = 1.0 µs		10		
Standby current	I_{SB}	CE_2 ≤ 0.2 V or $\overline{CE_1}$ ≥ V_{CC} – 0.2 V	V_{CC} = 2.7 V to 3.6 V		0.6	µA	1
			V_{CC} = 4.5 V to 5.5 V		1.0		
	I_{SB1}	$\overline{CE_1}$ = V_{IH} or CE_2 = V_{IL}			5	mA	
Output voltage	V_{OL}	I_{OL} = 500 µA, V_{CC} = 2.7 V to 3.6 V			0.4	V	
		I_{OL} = 2.1 mA, V_{CC} = 4.5 V to 5.5 V			0.4		
	V_{OH}	I_{OH} = –500 µA, V_{CC} = 2.7 V to 3.6 V		V_{CC} – 0.5		V	
		I_{OH} = –1.0 mA, V_{CC} = 4.5 V to 5.5 V		2.4			

NOTE:

1. CE_2 should be ≥ V_{CC} – 0.2 V or ≤0.2 V when $\overline{CE_1}$ ≥ V_{CC} – 0.2 V.

READ CYCLE (T_A = –10°C to +70°C, V_{CC} = 2.7 V to 5.5 V)

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Read cycle time	t_{RC}	200		ns
Address access time	t_{AA}		200	ns
$\overline{CE}_1$ 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
$\overline{CE}_1$ Low to output in Low-Z	t_{LZ1}	20		ns
CE_2 High to output in Low-Z	t_{LZ2}	20		ns
$\overline{OE}$ Low to output in Low-Z	t_{OLZ}	10		ns
$\overline{CE}_1$ High to output in High-Z	t_{HZ1}	0	60	ns
CE_2 Low to output in High-Z	t_{HZ2}	0	60	ns
$\overline{OE}$ High to output in High-Z	t_{OHZ}	0	40	ns

WRITE CYCLE (T_A = –10°C to +70°C, V_{CC} = 2.7 V to 5.5 V)

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Write cycle time	t_{WC}	200		ns
$\overline{CE}$ 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
$\overline{WE}$ High to output in Low-Z	t_{OW}	20		ns
$\overline{WE}$ Low to output in High-Z	t_{WZ}	0	60	ns
$\overline{OE}$ 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 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°C, f = 1 MHz)

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

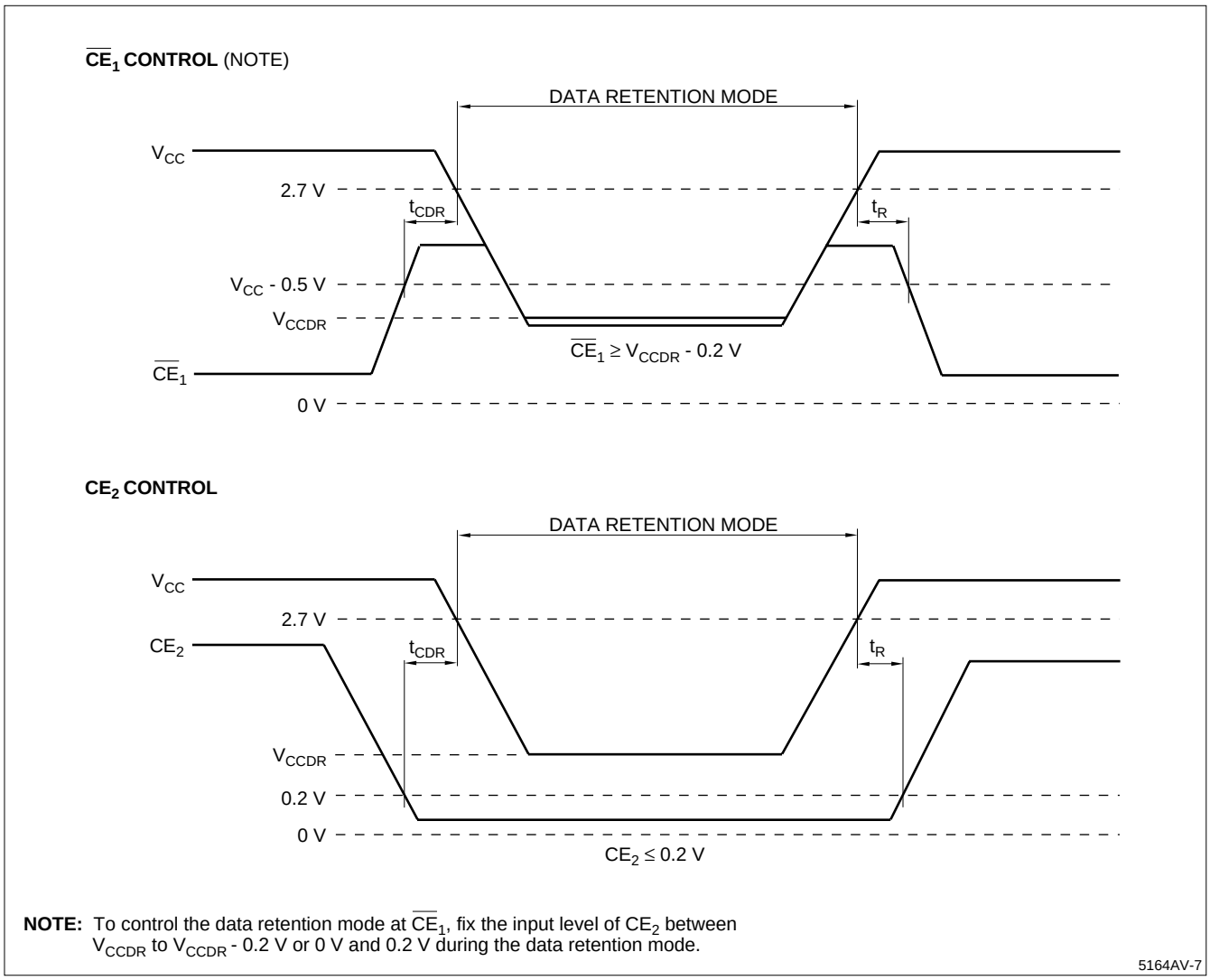
NOTE:
1. This parameter is sampled and not production tested.

DATA RETENTION CHARACTERISTICS (T_A = –10°C to +70°C)

PARAMETER	SYMBOL	CONDITIONS		MIN.	MAX.	UNIT	NOTE
Data retention supply voltage	V_{CCDR}	$CE_2 \le 0.2$ V or $\overline{CE}_1 \ge V_{CCDR} - 0.2$ V		2.0	5.5	V	1
Data retention supply current	I_{CCDR}	V_{CCDR} = 3 V, $CE_2 \le 0.2$ V or $\overline{CE}_1 \ge V_{CCDR} - 0.2$ V	T_A = 25°C		0.2	µA	1
			T_A = 40°C		0.4	µA	
					0.6	µA	
Chip disable to data retention	t_{CDR}			0		ns	
Recovery time	t_R			t_{RC}		ns	2

NOTES:

1. CE_2 should be ≥ V_{CCDR} – 0.2 V or ≤ 0.2 V when $\overline{CE}_1 \ge V_{CCDR} - 0.2$ V.
2. t_{RC} = Read cycle time.



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

5164AV-7

Figure 4. Data Retention Characteristics

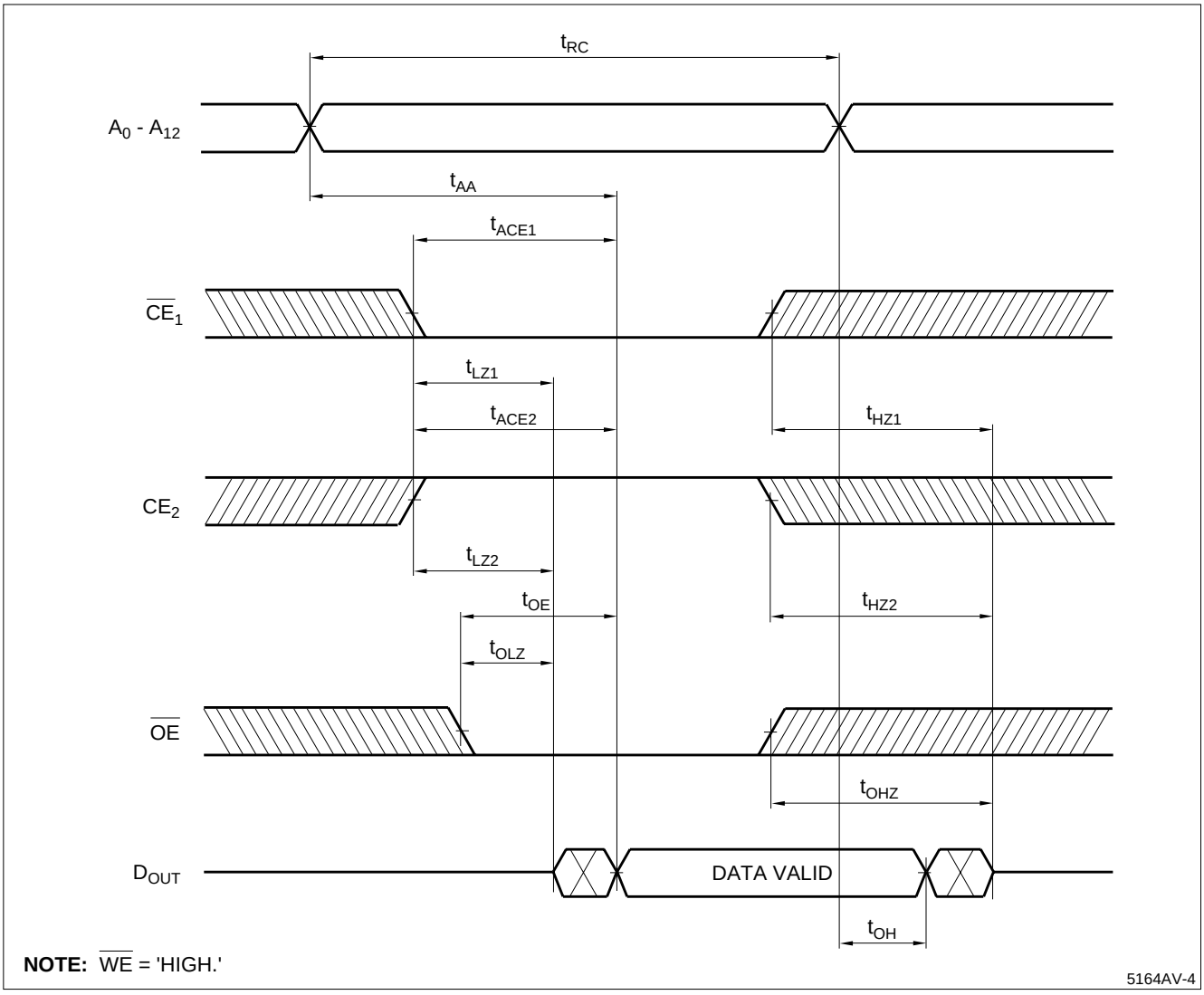
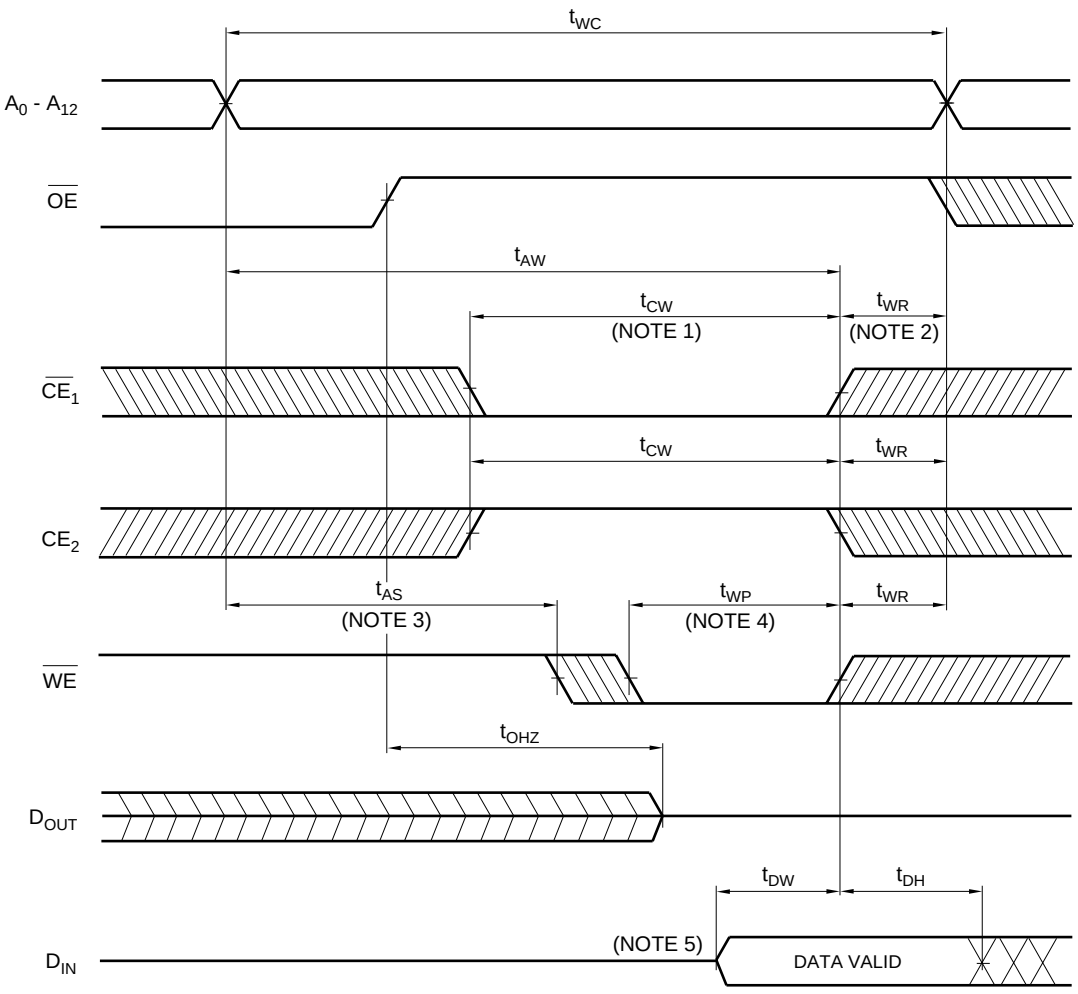


Figure 5. Read Cycle

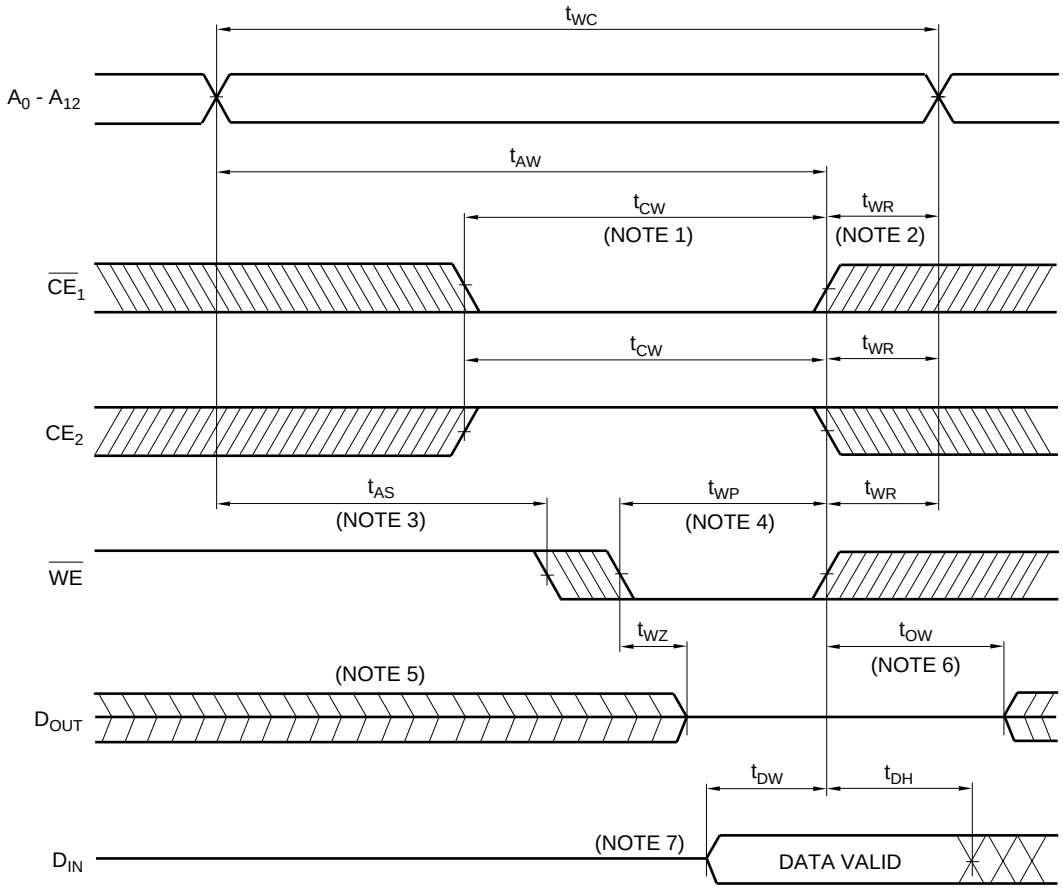


NOTES:

1. 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.
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 $\overline{CE_1}$ = 'LOW,' CE_2 = 'HIGH,' and $\overline{WE}$ = 'LOW' (t_{WP}).
5. When I/O pins are in the output state, input signals with the opposite logic level must not be applied.

5164AV-5

Figure 6. Write Cycle ($\overline{OE}$ Controlled)



NOTES:

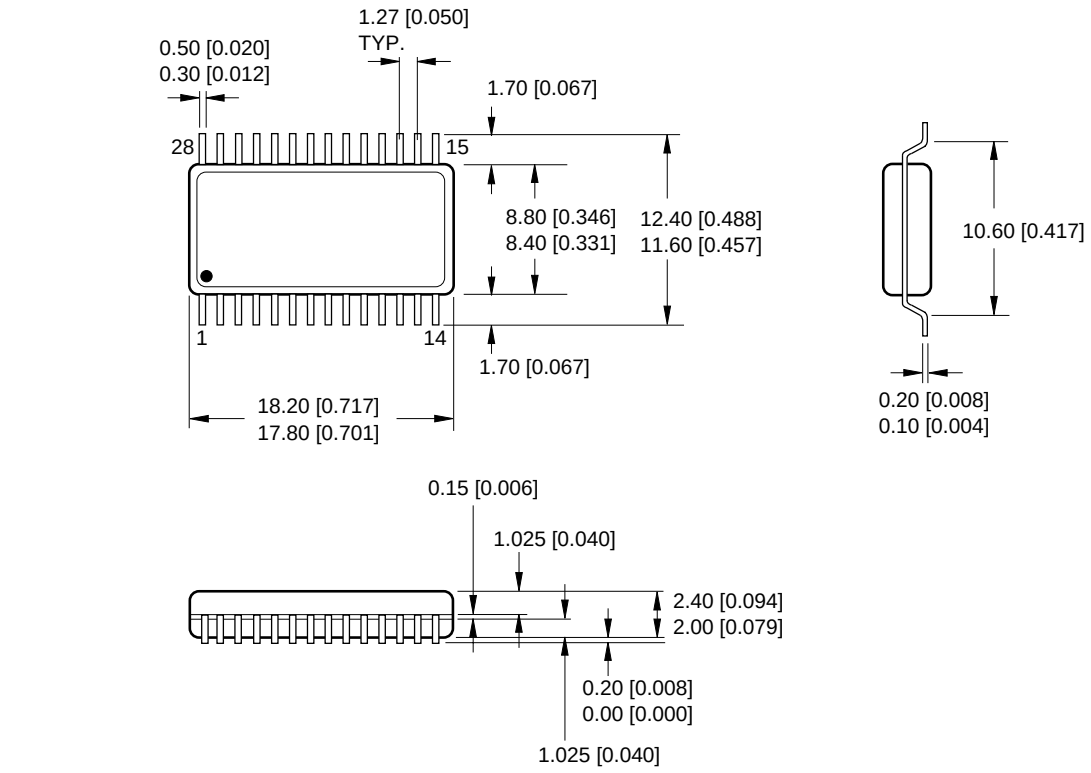
1. t_{CW} is defined as the time from the last occuring transition, either $\overline{CE_1}$ LOW transition or CE_2 HIGH transition, to the time when the writing is finished.
2. t_{WR} is defined as the time from writing finish to address change.
3. t_{AS} is defined as the time from address change to writing start.
4. The writing occurs during an overlapping period of $\overline{CE_1}$ = 'LOW,' CE_2 = 'HIGH,' and $\overline{WE}$ = '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.

5164AV-6

Figure 7. Write Cycle ($\overline{OE}$ Low Fixed)

PACKAGE DIAGRAMS

28SOP (SOP028-P-0450)

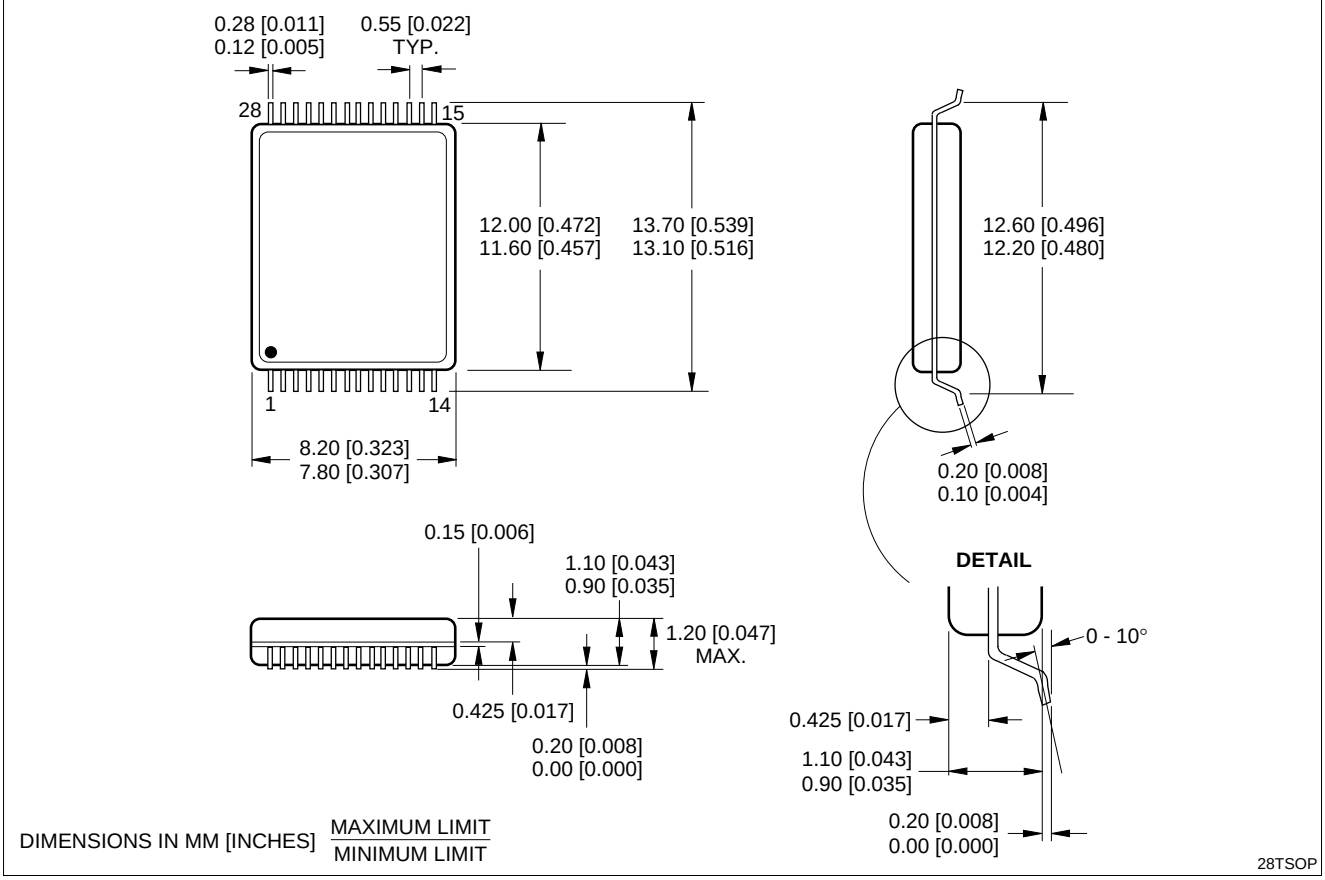


DIMENSIONS IN MM [INCHES] MAXIMUM LIMIT / MINIMUM LIMIT

28SOP

28-pin, 450-mil SOP

28TSOP (TSOP028-P-0813)



28-pin, 8 × 13 mm^2 TSOP (Type I)

ORDERING INFORMATION