Ordering number : EN5804A

CMOS IC

LC3564B, BS, BM, BT-70/10

64K (8192-word × 8-bit) SRAM with $\overline{OE}$, $\overline{CE1}$, and CE2 Control Pins

Overview

The LC3564B, LC3564BS, LC3564BM, and LC3564BT are 8192-word × 8-bit asynchronous silicon gate CMOS SRAMs. These are full CMOS type SRAMs that adopt a six-transistor memory cell and feature fast access times, low operating power dissipation, and an ultralow standby current. These SRAMs provide three control signal inputs: an $\overline{OE}$ input for high-speed memory access, and two chip enable lines, $\overline{CE1}$ and CE2, for low power mode and device selection. These means that these SRAMs area ideal for systems that require low power and battery backup, and that they support easy memory expansion. The ultralow standby current that is a feature of these SRAMs allows them to be used with capacitor backup as well. Since these SRAMs support 3-V operation, they are also appropriate for use in portable battery operated systems.

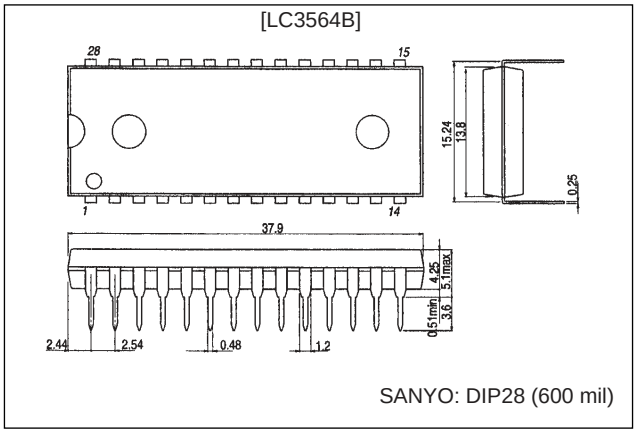
Features

- Supply voltage range: 2.7 to 5.5 V
  - — In 5-V operation mode: 5.0 V ±10%
  - — In 3-V operation mode: 3.0 V ±10%
- Address access time (t_{AA})
  - — In 5-V operation mode:
    LC3564B, BS, BM, and BT-70: 70 ns (max)
    LC3564B, BS, BM, and BT-10: 100 ns (max)
  - — In 3-V operation mode:
    LC3564B, BS, BM, and BT-70: 200 ns (max)
    LC3564B, BS, BM, and BT-10: 500 ns (max)
- Ultralow standby current
  - — In 5-V operation mode: 1.0 µA (Ta ≤ 70°C),
    3.0 µA (Ta ≤ 85°C)
  - — In 3-V operation mode: 0.8 µA (Ta ≤ 70°C),
    2.5 µA (Ta ≤ 85°C)
- Operating temperature range
  - — In 5-V operation mode: –40 to 85°C
  - — In 3-V operation mode: –40 to 85°C
- Data retention supply voltage: 2.0 to 5.5 V
- All input and output levels:
  - — In 5-V operation mode: TTL compatible levels
  - — In 3-V operation mode: V_{CC} –0.2 V/0.2 V
- Three control inputs: $\overline{OE}$, $\overline{CE1}$, and CE2
- Shared input and output pins, three-state outputs
- No clock required
- Packages
  28-pin DIP (600 mil) plastic package: LC3564B
  28-pin DIP (300 mil) plastic package: LC3564BS
  28-pin SOP (450 mil) plastic package: LC3564BM
  28-pin TSOP (8 × 13.4 mm) plastic package: LC3564BT

Package Dimensions

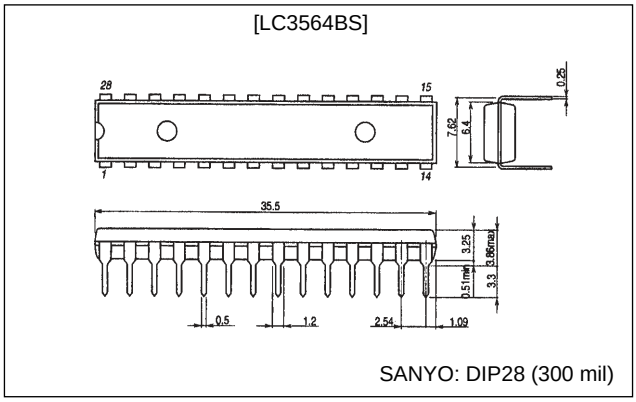
unit: mm

3012A-DIP28 (600 mil)



unit: mm

3133-DIP28 (300 mil)



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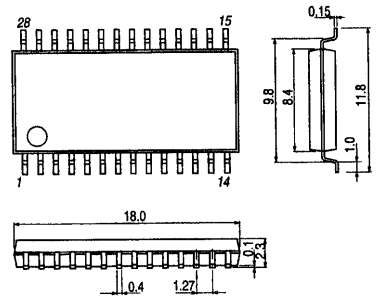
unit: mm

3187-SOP28

[LC3564BM]

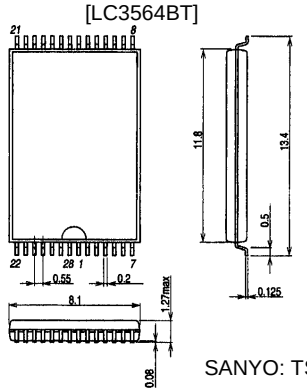


SANYO: SOP28

unit: mm

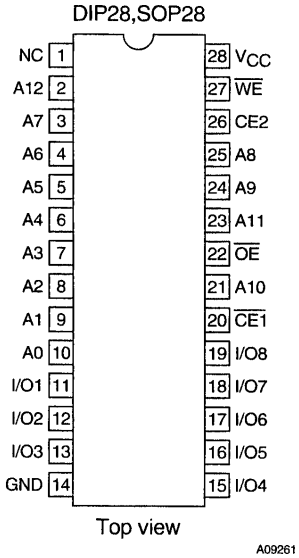
3221-TSOP28 (type I)

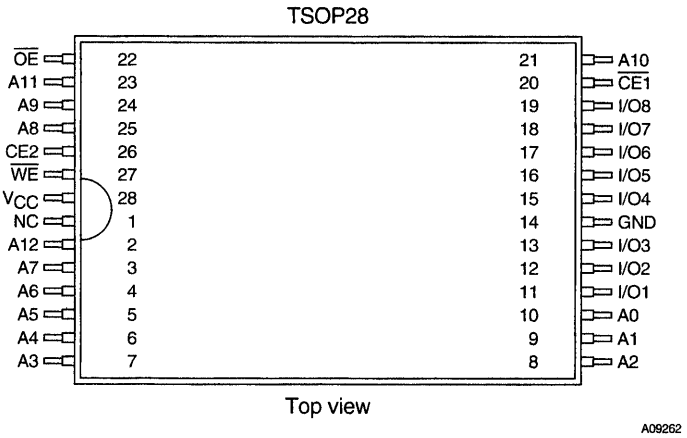
[LC3564BT]



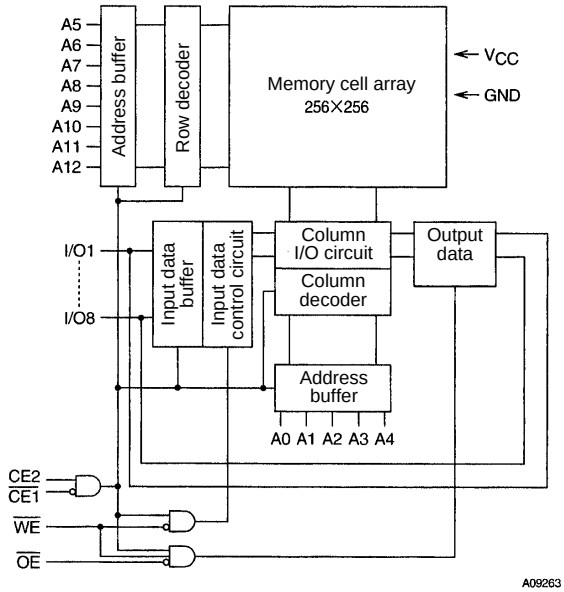
SANYO: TSOP28 (type I)

Pin Assignments





Block Diagram



Pin Functions

A0 to A12	Address inputs
$\overline{WE}$	Read/write control input
$\overline{OE}$	Output enable input
$\overline{CE1}$, CE2	Chip enable inputs
I/O1 to I/O8	Data I/O
V_{CC}, GND	Power supply and ground

Function Table

Mode	$\overline{CE1}$	CE2	$\overline{OE}$	$\overline{WE}$	I/O	Supply current
Read cycle	L	H	L	H	Data output	I_{CCA}
Write cycle	L	H	X	L	Data input	I_{CCA}
Output disable	L	H	H	H	High impedance	I_{CCA}
Not selected	H	X	X	X	High impedance	I_{CCS}
	X	L	X	X	High impedance	I_{CCS}

X : H or L

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		7.0	V
Input voltage	V_{IN}		–0.3* to V_{CC} + 0.3	V
I/O voltage	$V_{I/O}$		–0.3 to V_{CC} + 0.3	V
Operating temperature	Topr		–40 to +85	°C
Storage temperature	Tstg		–55 to +125	°C

Note: For pulse widths less than 30 ns: –3.0 V

Input and Output Capacitances at Ta = 25°C, f = 1 MHz

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
I/O pin capacitance	$C_{I/O}$	$V_{I/O}$ = 0 V		6	10	pF
Input pin capacitance	C_{IN}	V_{IN} = 0 V		6	10	pF

Note: These parameters are sampled, and are not measured for every unit.

[5-V Operation]

DC Allowable Operating Ranges at Ta = –40 to +85°C, V_{CC} = 4.5 to 5.5 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	V_{CC}		4.5	5.0	5.5	V
Input voltage	V_{IH}		2.2		V_{CC} + 0.3	V
	V_{IL}		–0.3*		+0.8	V

Note: For pulse widths less than 30 ns: –3.0 V

DC Electrical Characteristics at Ta = –40 to +85°C, V_{CC} = 4.5 to 5.5 V

Parameter		Symbol	Conditions			Ratings			Unit
						min	typ *	max	
Input leakage current		I_{LI}	V_{IN} = 0 to V_{CC}			–1.0		+1.0	µA
I/O leakage current		I_{LO}	$V_{\overline{CE1}}$ = V_{IH} or V_{CE2} = V_{IL} or $V_{\overline{OE}}$ = V_{IH} or $V_{\overline{WE}}$ = V_{IL}, $V_{I/O}$ = 0 to V_{CC}			–1.0		+1.0	µA
Output high-level voltage		V_{OH}	I_{OH} = –1.0 mA			2.4			V
Output low-level voltage		V_{OL}	I_{OL} = 2.0 mA					0.4	V
Operating supply current	V_{CC} – 0.2 V/0.2 V inputs	I_{CCA1}	$V_{\overline{CE1}} \le 0.2$ V, $V_{CE2} \ge V_{CC} – 0.2$ V, $I_{I/O}$ = 0 mA, $V_{IN} \le 0.2$ V or $V_{IN} \ge V_{CC} – 0.2$ V	Ta ≤ 70°C			0.01	1.0	µA
				Ta ≤ 85°C				3.0	
		I_{CCA4}	$V_{\overline{CE1}} \le 0.2$ V, $V_{CE2} \ge V_{CC} – 0.2$ V, $I_{I/O}$ = 0 mA, DUTY = 100%	min cycle	LC3564B,BS, BM, BT-70			35	mA
					LC3564B,BS,BM,BT-10			30	
				1 µs cycle			4		mA
	TTL inputs	I_{CCA2}	$V_{\overline{CE1}}$ = V_{IL}, V_{CE2} = V_{IH}, $I_{I/O}$ = 0 mA, V_{IN} = V_{IH} or V_{IL}					7	mA
		I_{CCA3}	$V_{\overline{CE1}}$ = V_{IL}, V_{CE2} = V_{IH}, $I_{I/O}$ = 0 mA, DUTY = 100%	min cycle	LC3564B,BS, BM, BT-70			40	mA
					LC3564B,BS,BM,BT-10			35	
				1 µs cycle			7		mA
Standby mode supply current	V_{CC} – 0.2 V/0.2 V inputs	I_{CCS1}	$V_{CE2} \le 0.2$ V or $V_{\overline{CE1}} \ge V_{CC} – 0.2$ V $V_{CE2} \ge V_{CC} – 0.2$ V	Ta ≤ 70°C			0.01	1.0	µA
				Ta ≤ 85°C				3.0	
	TTL inputs	I_{CC2}	V_{CE2} = V_{IL} or $V_{\overline{CE1}}$ = V_{IH}, V_{IN} = 0 to V_{CC}					2.0	mA

Note *: Reference values at V_{CC} = 5 V, Ta = 25°C

AC Electrical Characteristics at Ta = –40 to +85°C, V_{CC} = 4.5 to 5.5 V

Parameter	Conditions
[AC Test Conditions]	
Input pulse voltage	V_{IH} = 2.4 V, V_{IL} = 0.6 V
Input rise and fall times	5 ns
Input and output timing level	1.5 V
Output load	LC3564B, BS, BM, and BT-70: 30 pF + 1 TTL gate (Including the jig capacitance.)
	LC3564B, BS, BM, and BT-10: 100 pF + 1 TTL gate (Including the jig capacitance.)

Read Cycle

Parameter	Symbol	LC3564B, BS, BM, BT				Unit
		-70		-10		
		min	max	min	max	
Read cycle time	t_{RC}	70		100		ns
Address access time	t_{AA}		70		100	ns
$\overline{CE1}$ access time	t_{CA1}		70		100	ns
CE2 access time	t_{CA2}		70		100	ns
$\overline{OE}$ access time	t_{OA}		35		50	ns
Output hold time	t_{OH}	10		10		ns
$\overline{CE1}$ output enable time	t_{COE1}	10		10		ns
CE2 output enable time	t_{COE2}	10		10		ns
$\overline{OE}$ output enable time	t_{OOE}	5		5		ns
$\overline{CE1}$ output disable time	t_{COD1}		30		35	ns
CE2 output disable time	t_{COD2}		30		35	ns
$\overline{OE}$ output disable time	t_{OOD}		25		25	ns

Write Cycle

Parameter	Symbol	LC3564B, BS, BM, BT				Unit
		-70		-10		
		min	max	min	max	
Write cycle time	t_{WC}	70		100		ns
Address setup time	t_{AS}	0		0		ns
Write pulse width	t_{WP}	50		55		ns
$\overline{CE1}$ setup time	t_{CW1}	60		65		ns
CE2 setup time	t_{CW2}	60		65		ns
Write recovery time	t_{WR}	0		0		ns
$\overline{CE1}$ write recovery time	t_{WR1}	0		0		ns
CE2 write recovery time	t_{WR2}	0		0		ns
Data setup time	t_{DS}	35		40		ns
Data hold time	t_{DH}	0		0		ns
$\overline{CE1}$ data hold time	t_{DH1}	0		0		ns
CE2 data hold time	t_{DH2}	0		0		ns
$\overline{WE}$ output enable time	t_{WOE}	5		5		ns
$\overline{WE}$ output disable time	t_{WOD}		30		35	ns

[3-V Operation]

DC Allowable Operating Ranges at Ta = –40 to +85°C, V_{CC} = 2.7 to 3.3 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	V_{CC}		2.7	3.0	3.3	V
Input voltage	V_{IH}		V_{CC} – 0.2		V_{CC}	V
	V_{IL}		0		0.2	V

DC Electrical Characteristics at Ta = –40 to +85°C, V_{CC} = 2.7 to 3.3 V

Parameter		Symbol	Conditions			Ratings			Unit
						min	typ *	max	
Input leakage current		I_{LI}	V_{IN} = 0 to V_{CC}			–1.0		+1.0	µA
I/O leakage current		I_{LO}	$V_{\overline{CE1}} = V_{IH}$ or $V_{CE2} = V_{IL}$ or $V_{\overline{OE}} = V_{IH}$ or $V_{\overline{WE}} = V_{IL}$, $V_{I/O}$ = 0 to V_{CC}			–1.0		+1.0	µA
Output high-level voltage		V_{OH}	I_{OH} = –0.5 mA			V_{CC} – 0.2			V
Output low-level voltage		V_{OL}	I_{OL} = 1.0 mA					0.2	V
Operation supply current	V_{CC} – 0.2 V/0.2 V inputs	I_{CCA1}	$V_{\overline{CE1}} \le V_{IL}$, $V_{CE2} \ge V_{IH}$, $I_{I/O}$ = 0 mA, $V_{IN} \le V_{IL}$ or $V_{IN} \ge V_{IH}$		Ta ≤ 70°C		0.01	0.8	µA
					Ta ≤ 85°C			2.5	
		I_{CCA4}	$V_{\overline{CE1}} \le V_{IL}$, $V_{CE2} \ge V_{IH}$, $I_{I/O}$ = 0 mA, DUTY = 100%	min cycle	LC3564B,BS, BM, BT-70			20	mA
					LC3564B,BS,BM,BT-10			10	
				1 µs cycle			3		mA
Standby mode supply current	V_{CC} – 0.2 V/0.2 V inputs	I_{CCS1}	$V_{CE2} \le 0.2$ V or $V_{\overline{CE1}} \ge V_{IH}$ $V_{CE2} \ge V_{IH}$		Ta ≤ 70°C		0.01	0.8	µA
					Ta ≤ 85°C			2.5	

Note *: Reference values at V_{CC} = 3 V, Ta = 25°C

AC Electrical Characteristics at Ta = –40 to +85°C, V_{CC} = 2.7 to 3.3 V

Parameter	Conditions
[AC Test Conditions]	
Input pulse voltage	$V_{IH} = V_{CC} - 0.2$ V, $V_{IL} = 0.2$ V
Input rise and fall times	10 ns
Input and output timing level	1.5 V
Output load	LC3564B, BS, BM, BT-70 : 30pF (Including the jig capacitance.)
	LC3564B, BS, BM, BT-10 : 100pF (Including the jig capacitance.)

Read Cycle

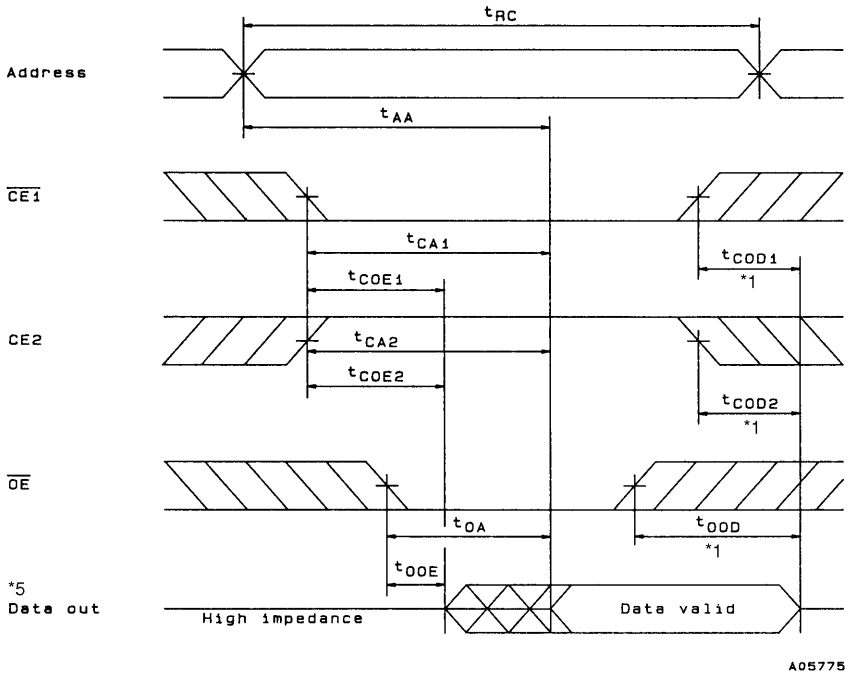
Parameter	Symbol	LC3564B, BS, BM, BT				Unit
		-70		-10		
		min	max	min	max	
Read cycle time	t_{RC}	200		500		ns
Address access time	t_{AA}		200		500	ns
$\overline{CE1}$ access time	t_{CA1}		200		500	ns
CE2 access time	t_{CA2}		200		500	ns
$\overline{OE}$ access time	t_{OA}		100		250	ns
Output hold time	t_{OH}	20		20		ns
$\overline{CE1}$ output enable time	t_{COE1}	20		20		ns
CE2 output enable time	t_{COE2}	20		20		ns
$\overline{OE}$ output enable time	t_{OOE}	10		10		ns
$\overline{CE1}$ output disable time	t_{COD1}		60		120	ns
CE2 output disable time	t_{COD2}		60		120	ns
$\overline{OE}$ output disable time	t_{OOD}		50		100	ns

Write Cycle

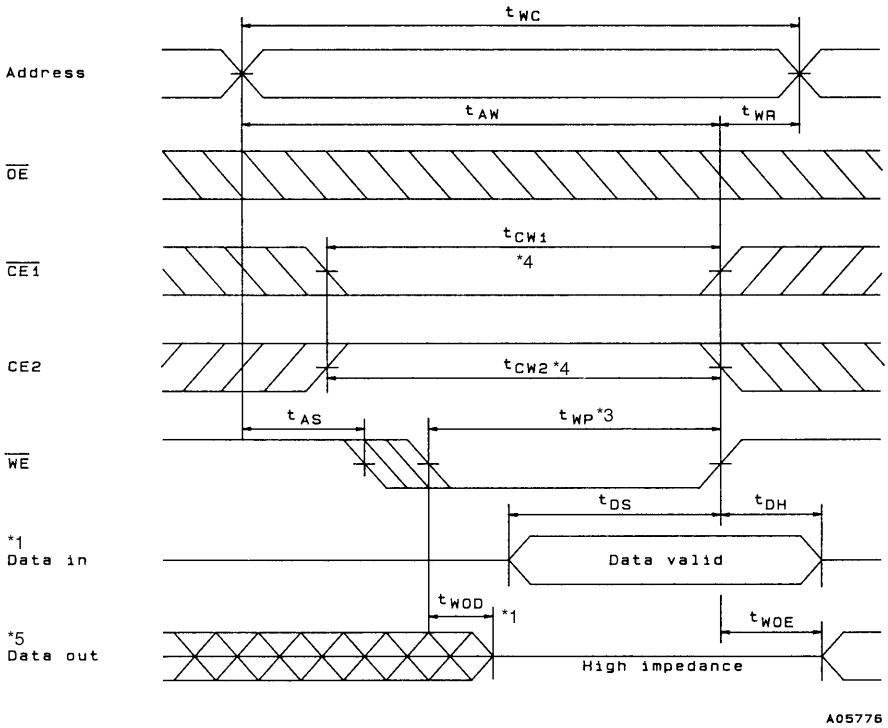
Parameter	Symbol	LC3564B, BS, BM, BT				Unit
		-70		-10		
		min	max	min	max	
Write cycle time	t_{WC}	200		500		ns
Address setup time	t_{AS}	0		0		ns
Write pulse width	t_{WP}	140		200		ns
$\overline{CE1}$ setup time	t_{CW1}	150		250		ns
CE2 setup time	t_{CW2}	0		250		ns
Write recovery time	t_{WR}	0		0		ns
$\overline{CE1}$ write recovery time	t_{WR1}	0		0		ns
CE2 write recovery time	t_{WR2}	130		0		ns
Data setup time	t_{DS}	0		180		ns
Data hold time	t_{DH}	0		0		ns
$\overline{CE1}$ data hold time	t_{DH1}	0		0		ns
CE2 data hold time	t_{DH2}	10		0		ns
$\overline{WE}$ output enable time	t_{WOE}			10		ns
$\overline{WE}$ output disable time	t_{WOD}		60		120	ns

Timing Charts

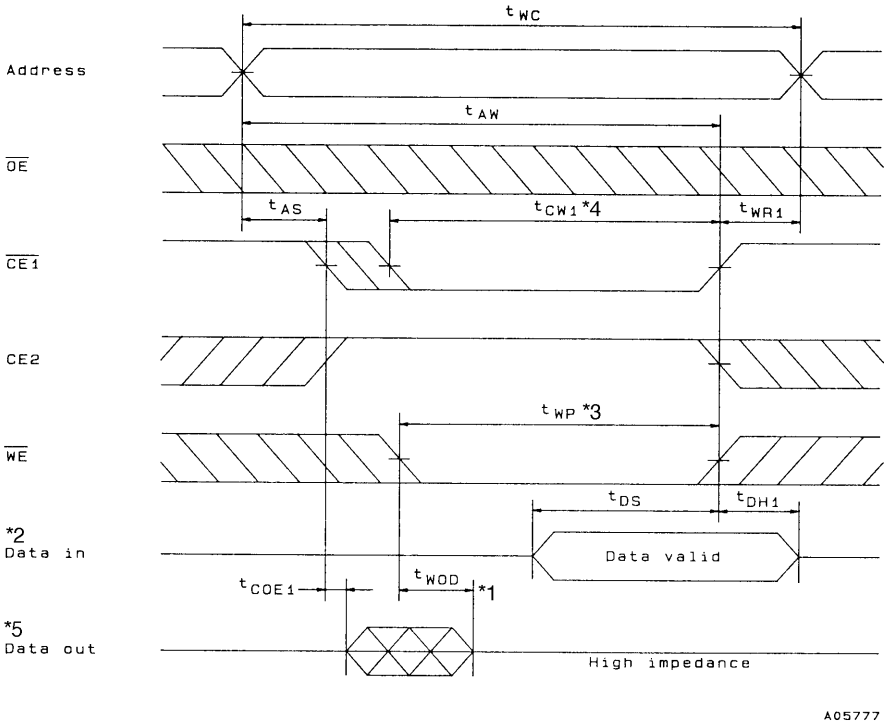
Read Cycle *1



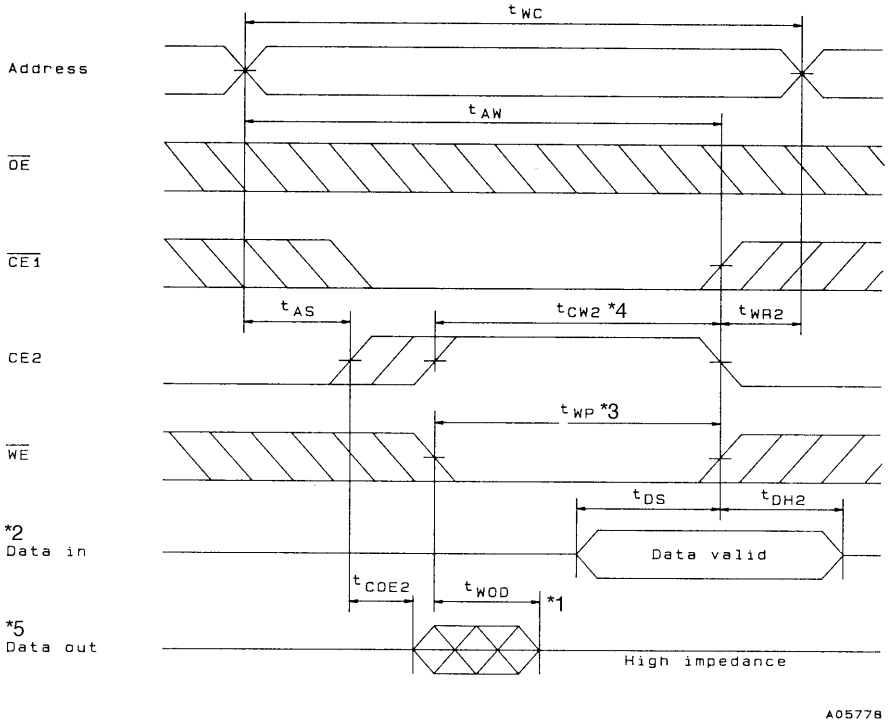
Write Cycle (1): $\overline{WE}$ Write *6



Write Cycle (2): $\overline{CE1}$ Write *6



Write Cycle (3): CE2 Write *6



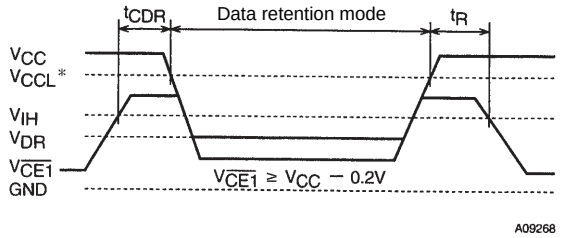
Notes: 1. Hold $\overline{WE}$ high during the read cycle.
2. Applications must not apply reverse phase signals to the D_{OUT} pins when those pins are in the output state.
3. The time tWP is the period when $\overline{CE1}$ and $\overline{WE}$ are low and CE2 is high, and is defined as the time from the fall of $\overline{WE}$ until either $\overline{CE1}$ or $\overline{WE}$ rises, or CE2 falls, whichever occurs first.
4. The times t_{CW1} and t_{CW2} are periods when $\overline{CE1}$ and $\overline{WE}$ are low and CE2 is high. They are defined as the times from the fall of $\overline{CE1}$ or the rise of CE2 to the rise of $\overline{CE1}$ and $\overline{WE}$, or the fall of CE2, whichever occurs first.
5. The D_{OUT} pins will be in the high-impedance state if either $\overline{OE}$ is high, $\overline{CE1}$ is high, CE2 is low, or $\overline{WE}$ is low.
6. $\overline{OE}$ must be held either at V_{IH} or V_{IL} during the write cycle.
7. The D_{OUT} pins have the same phase as the write cycle write data.

Data Retention Characteristics at Ta = –40 to +85°C

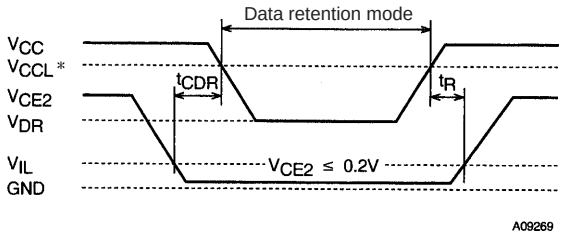
Parameter	Symbol	Conditions		Ratings min	Ratings typ	Ratings max	Unit
Data retention supply voltage	V_{DR}	$V_{CE2} \le 0.2$ V or $V_{\overline{CE1}} \ge V_{CC} - 0.2$ V, $V_{CE2} \ge V_{CC} - 0.2$ V		2.0		5.5	µA
Data retention supply current	I_{CCDR}	V_{CC} = 3V, $V_{CE2} \le 0.2$ V, or $V_{\overline{CE1}} \ge V_{CC} - 0.2$ V, $V_{CE2} \ge V_{CC} - 0.2$ V	Ta ≤ 70°C			0.8	µA
			Ta ≤ 85°C			2.5	
Chip enable setup time	t_{CDR}			0			ns
Chip enable hold time	t_R			t_{RC}*			ns

Note *: t_{RC} is the read cycle time.

Data Retention Waveforms (1): $\overline{CE1}$ Control



Data Retention Waveforms (2): CE2 Control



Note *: In 5-V operation: 4.5 V
In 3-V operation: 2.7 V

Notes on Circuit Design

When actually design a circuit using these devices, take the following points into consideration and design the circuit so that none of the maximum rating items are ever exceeded.

- Variations in the supply voltage
- Variations in the electrical characteristics of components such as semiconductor devices, resistors, and capacitors.
- Ambient temperature
- Variations in input and clock signals
- Possible application of abnormal pulses

Also, these devices must be operated within the ranges stipulated in the allowable operating ranges.
If CMOS IC input pins are left open, intermediate potential input voltages may occur leading to incorrect operation due to through currents or other phenomenon. Applications must handle unused input pins appropriately.