



# LP62S2048-T Series

## 256K X 8 BIT LOW VOLTAGE CMOS SRAM

### Features

- Power supply range: 2.7V to 3.3V
- Access times: 70/100 ns (max.)
- Current:
  - Low power version:      Operating: 30mA (max.)  
                                  Standby: 50µA (max.)
  - Very low power version: Operating: 30mA (max.)  
                                  Standby: 10µA (max.)
- Full static operation, no clock or refreshing required
- All inputs and outputs are directly TTL-compatible
- Common I/O using three-state output
- Output enable and two chip enable inputs for easy application
- Data retention voltage: 2V (min.)
- Available in 32-pin SOP, TSOP, TSSOP (8 X 13.4mm) and 36-pin CSP packages

### General Description

The LP62S2048-T is a low operating current 2,097,152-bit static random access memory organized as 262,144 words by 8 bits and operates on a low power supply range: 2.7V to 3.3V. It is built using AMIC's high performance CMOS process.

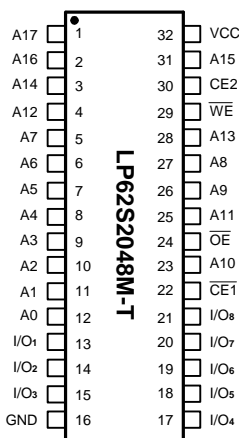
Inputs and three-state outputs are TTL compatible and allow for direct interfacing with common system bus structures.

Two chip enable inputs are provided for POWER-DOWN and device enable and an output enable input is included for easy interfacing.

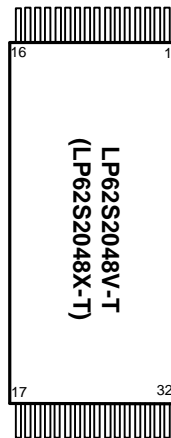
Data retention is guaranteed at a power supply voltage as low as 2V.

### Pin Configurations

#### ■ SOP

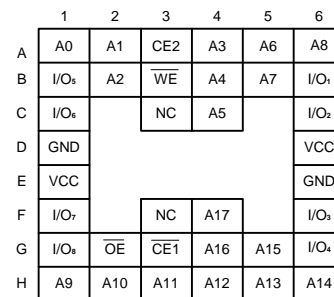


#### ■ TSOP/(TSSOP)

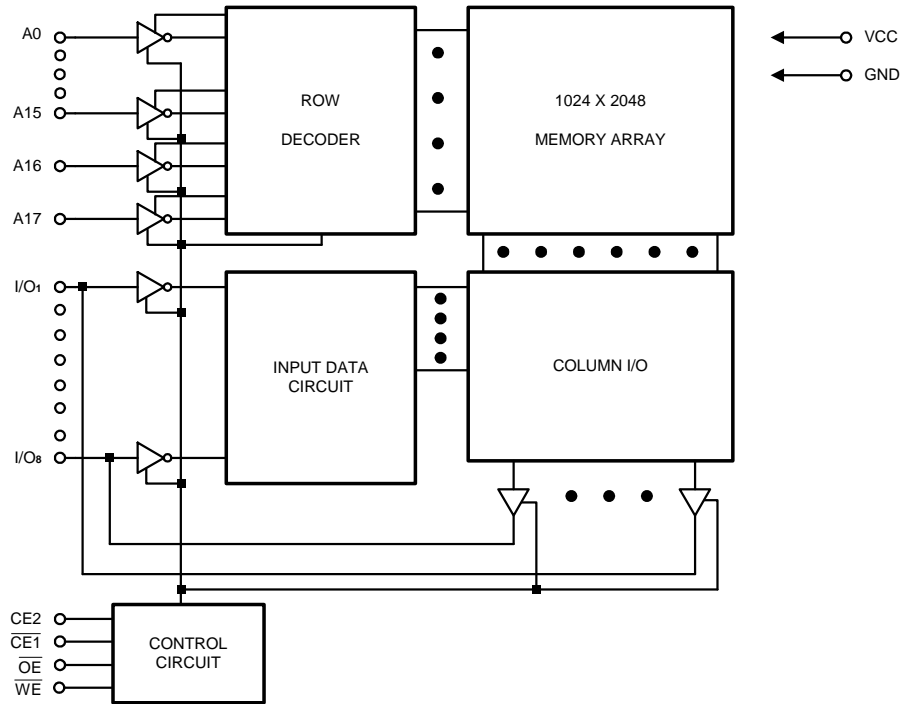


#### ■ CSP (Chip Size Package)

##### 36-pin Top View



Pin No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Pin Name	A11	A9	A8	A13	WE	CE2	A15	VCC	A17	A16	A14	A12	A7	A6	A5	A4
Pin No.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Pin Name	A3	A2	A1	A0	I/O8	I/O7	I/O6	GND	I/O4	I/O5	I/O3	I/O2	I/O1	CE1	A10	OE

**Block Diagram**

**Pin Description - SOP**

Pin No.	Symbol	Description
1 - 12, 23, 25 - 28, 31	A0 - A17	Address Inputs
13 - 15, 17 - 21	I/O <sub>1</sub> - I/O <sub>8</sub>	Data Input/Outputs
16	GND	Ground
22	$\overline{CE1}$	Chip Enable
24	$\overline{OE}$	Output Enable
29	$\overline{WE}$	Write Enable
30	CE2	Chip Enable
32	VCC	Power Supply

**Pin Descriptions - TSOP/TSSOP**

Pin No.	Symbol	Description
1 - 4, 7, 9 - 20, 31	A0 - A17	Address Inputs
5	$\overline{WE}$	Write Enable
6	CE2	Chip Enable
8	VCC	Power Supply
9	NC	No Connection
21 - 23, 25 - 29	I/O <sub>1</sub> - I/O <sub>8</sub>	Data Input/Outputs
24	GND	Ground
30	$\overline{CE1}$	Chip Enable
32	$\overline{OE}$	Output Enable

**Pin Description - CSP**

Symbol	Description	Symbol	Description
A0 - A17	Address Inputs	NC	No Connection
$\overline{WE}$	Write Enable	I/O <sub>1</sub> - I/O <sub>8</sub>	Data Input/Output
$\overline{OE}$	Output Enable	VCC	Power Supply
$\overline{CE1}$	Chip Enable	GND	Ground
CE2	Chip Enable	--	--

**Recommended DC Operating Conditions**

(T<sub>A</sub> = -25°C to + 85°C)

Symbol	Parameter	Min.	Typ.	Max.	Unit
VCC	Supply Voltage	2.7	3.0	3.3	V
GND	Ground	0	0	0	V
V <sub>IH</sub>	Input High Voltage	2.0	-	VCC + 0.3	V
V <sub>IL</sub>	Input Low Voltage	-0.3	-	+0.6	V
C <sub>L</sub>	Output Load	-	-	30	pF
TTL	Output Load	-	-	1	-

**Absolute Maximum Ratings\***

VCC to GND . . . . . -0.5V to + 4.6V  
 IN, IN/OUT Volt to GND . . . . . -0.5V to VCC + 0.5V  
 Operating Temperature, Topr . . . . . -25°C to + 85°C  
 Storage Temperature, Tstg . . . . . -55°C to + 125°C  
 Temperature Under Bias, Tbias . . . . . -10°C to + 85°C  
 Power Dissipation, P<sub>T</sub> . . . . . 0.7W  
 Soldering Temp. & Time . . . . . 260°C, 10 sec

**\*Comments**

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to this device. These are stress ratings only. Functional operation of this device at these or any other conditions above those indicated in the operational sections of this specification is not implied or intended. Exposure to the absolute maximum rating conditions for extended periods may affect device reliability.

**DC Electrical Characteristics** (T<sub>A</sub> = -25°C to + 85°C, VCC = 2.7V to 3.3V, GND = 0V)

Symbol	Parameter	LP62S2048-70LT/10LT		LP62S2048-70LLT/10LLT		Unit	Conditions
		Min.	Max.	Min.	Max.		
I <sub>LI</sub>	Input Leakage Current	-	1	-	1	μA	V <sub>IN</sub> = GND to VCC
I <sub>LO</sub>	Output Leakage Current	-	1	-	1	μA	$\overline{CE1} = V_{IH}$ or $CE2 = V_{IL}$ or $\overline{OE} = V_{IH}$ or $\overline{WE} = V_{IL}$ V <sub>I/O</sub> = GND to VCC
I <sub>CC</sub>	Active Power Supply Current	-	3	-	3	mA	$\overline{CE1} = V_{IL}$ , CE2 = V <sub>IH</sub> I <sub>I/O</sub> = 0mA
I <sub>CC1</sub>	Dynamic Operating Current	-	30	-	30	mA	Min. Cycle, Duty = 100% $\overline{CE1} = V_{IL}$ , CE2 = V <sub>IH</sub> I <sub>I/O</sub> = 0mA
I <sub>CC2</sub>		-	5	-	5	mA	$\overline{CE1} = V_{IL}$ , CE2 = V <sub>IH</sub> V <sub>IH</sub> = VCC, V <sub>IL</sub> = 0V f = 1 MHz, I <sub>I/O</sub> = 0mA

**DC Electrical Characteristics (continued)**

Symbol	Parameter	LP62S2048-70LT/10LT		LP62S2048-70LLT/10LLT		Unit	Conditions
		Min.	Max.	Min.	Max.		
I <sub>SB</sub>	Standby Power Supply Current	-	0.5	-	0.5	mA	$\overline{CE1} = V_{IH}$ or $CE2 = V_{IL}$
I <sub>SB1</sub>		-	50	-	10	μA	$\overline{CE1} \geq V_{CC} - 0.2V$ $V_{IN} \geq 0V$
I <sub>SB2</sub>		-	50	-	10	μA	$CE2 \leq 0.2V$ $V_{IN} \geq 0V$
V <sub>oL</sub>	Output Low Voltage	-	0.4	-	0.4	V	I <sub>oL</sub> = 2.1mA
V <sub>oH</sub>	Output High Voltage	2.2	-	2.2	-	V	I <sub>oH</sub> = -1.0mA

**Truth Table**

Mode	$\overline{CE1}$	CE2	$\overline{OE}$	$\overline{WE}$	I/O Operation	Supply Current
Standby	H	X	X	X	High Z	I <sub>SB</sub> , I <sub>SB1</sub>
	X	L	X	X	High Z	I <sub>SB</sub> , I <sub>SB2</sub>
Output Disable	L	H	H	H	High Z	I <sub>CC</sub> , I <sub>CC1</sub> , I <sub>CC2</sub>
Read	L	H	L	H	D <sub>OUT</sub>	I <sub>CC</sub> , I <sub>CC1</sub> , I <sub>CC2</sub>
Write	L	H	X	L	D <sub>IN</sub>	I <sub>CC</sub> , I <sub>CC1</sub> , I <sub>CC2</sub>

Note: X = H or L

**Capacitance** (T<sub>A</sub> = 25°C, f = 1.0MHz)

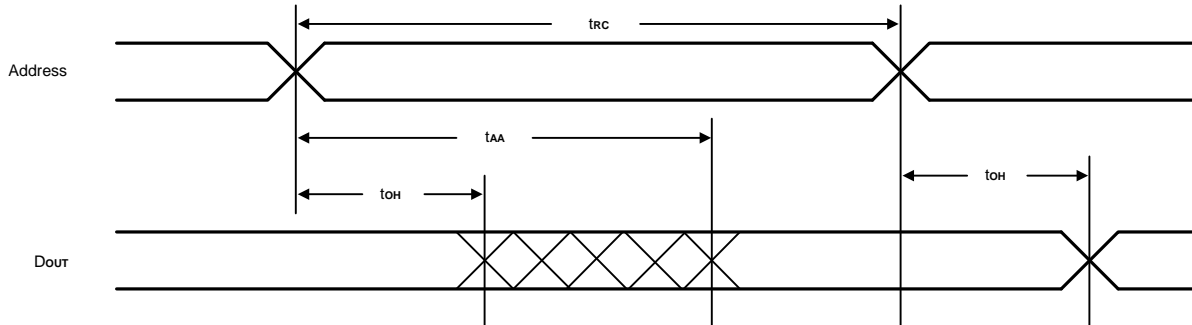
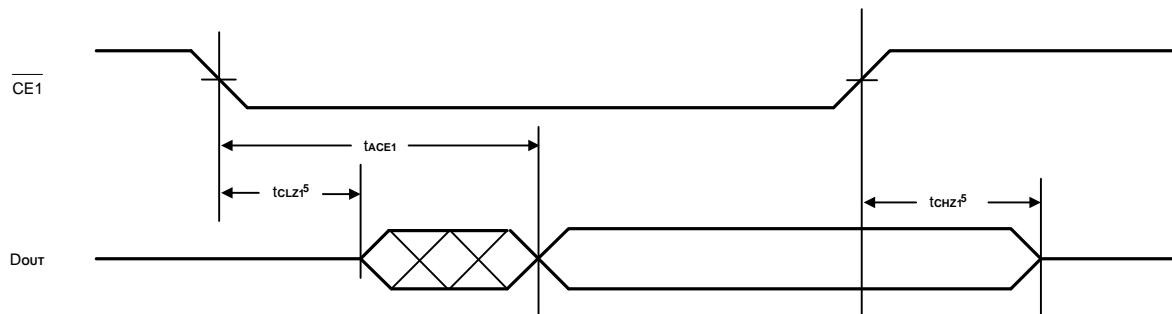
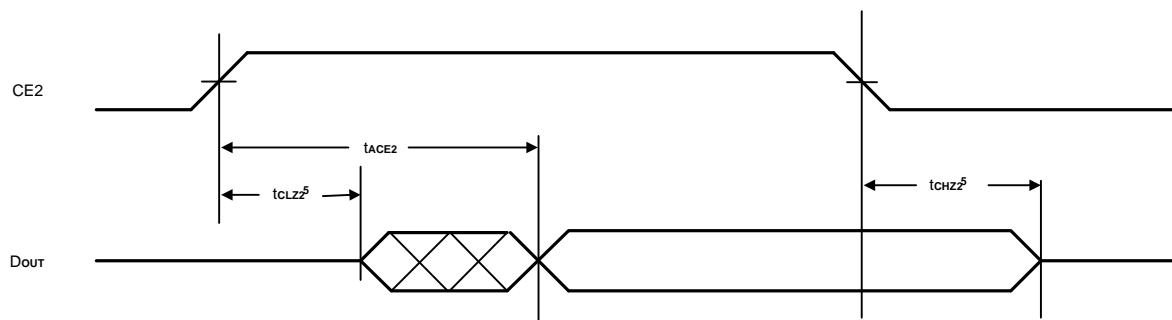
Symbol	Parameter	Min.	Max.	Unit	Conditions
C <sub>IN</sub> *	Input Capacitance		6	pF	V <sub>IN</sub> = 0V
C <sub>I/O</sub> *	Input/Output Capacitance		8	pF	V <sub>I/O</sub> = 0V

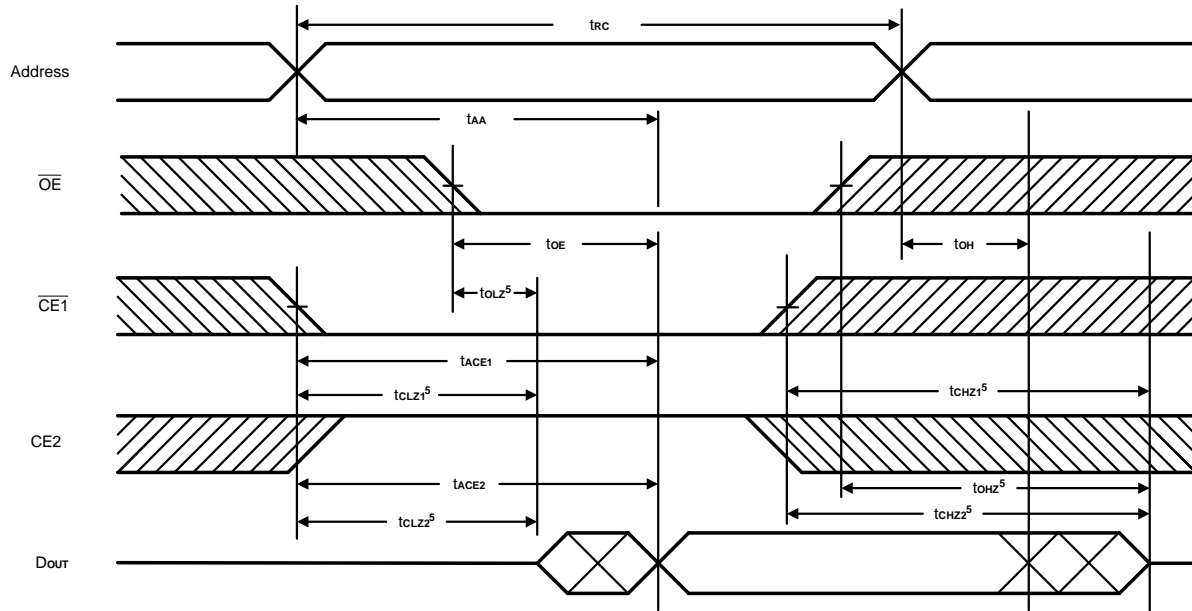
\* These parameters are sampled and not 100% tested.

**AC Characteristics** ( $T_A = -25^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{CC} = 2.7\text{V}$  to  $3.3\text{V}$ )

Symbol	Parameter	LP62S2048-70LT/LLT		LP62S2048-10LT/LLT		Unit	
		Min.	Max.	Min.	Max.		
Read Cycle							
$t_{RC}$	Read Cycle Time	70	-	100	-	ns	
$t_{AA}$	Address Access Time	-	70	-	100	ns	
$t_{ACE1}$	Chip Enable Access Time	$\overline{CE1}$	-	70	-	100	ns
$t_{ACE2}$		CE2	-	70	-	100	ns
$t_{OE}$	Output Enable to Output Valid	-	35	-	50	ns	
$t_{CLZ1}$	Chip Enable to Output in Low Z	$\overline{CE1}$	10	-	10	-	ns
$t_{CLZ2}$		CE2	10	-	10	-	ns
$t_{OLZ}$	Output Enable to Output in Low Z	5	-	5	-	ns	
$t_{CHZ1}$	Chip Disable to Output in High Z	$\overline{CE1}$	0	25	0	35	ns
$t_{CHZ2}$		CE2	0	25	0	35	ns
$t_{OHZ}$	Output Disable to Output in High Z	0	25	0	35	ns	
$t_{OH}$	Output Hold from Address Change	10	-	10	-	ns	
Write Cycle							
$t_{WC}$	Write Cycle Time	70	-	100	-	ns	
$t_{CW}$	Chip Enable to End of Write	60	-	80	-	ns	
$t_{AS}$	Address Setup Time	0	-	0	-	ns	
$t_{AW}$	Address Valid to End of Write	60	-	80	-	ns	
$t_{WP}$	Write Pulse Width	50	-	60	-	ns	
$t_{WR}$	Write Recovery Time	0	-	0	-	ns	
$t_{WHZ}$	Write to Output in High Z	0	25	0	35	ns	
$t_{DW}$	Data to Write Time Overlap	30	-	40	-	ns	
$t_{DH}$	Data Hold from Write Time	0	-	0	-	ns	
$t_{OW}$	Output Active from End of Write	5	-	5	-	ns	

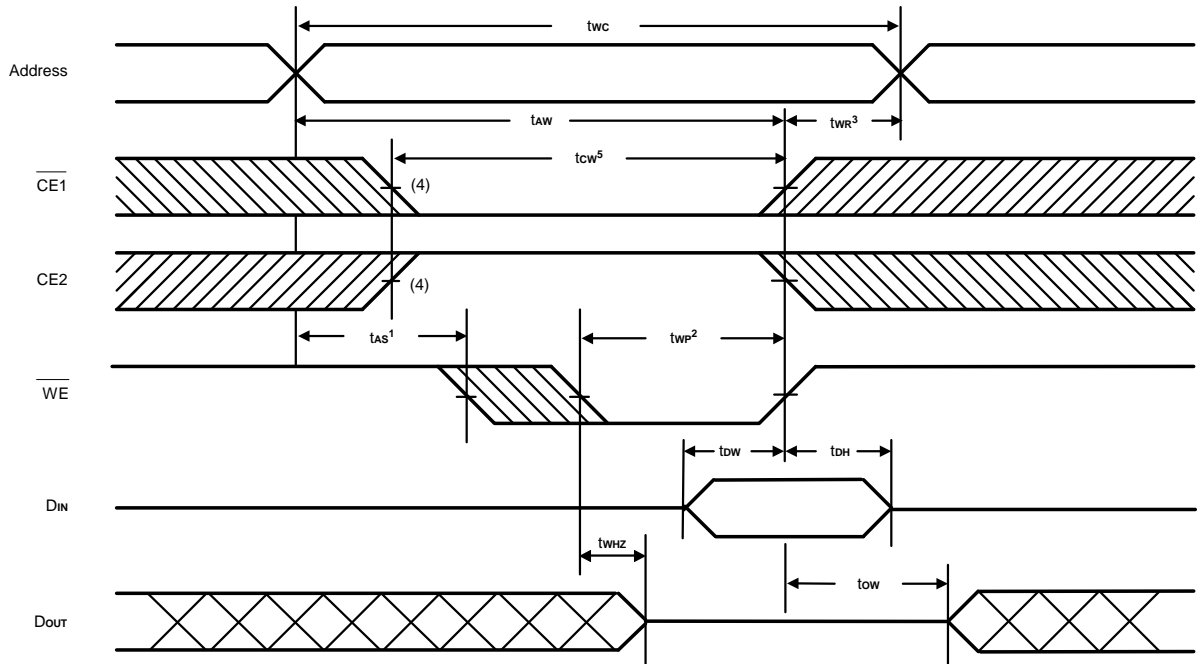
Notes:  $t_{CHZ1}$ ,  $t_{CHZ2}$ ,  $t_{OHZ}$ , and  $t_{WHZ}$  are defined as the time at which the outputs achieve the open circuit condition and are not referred to output voltage levels.

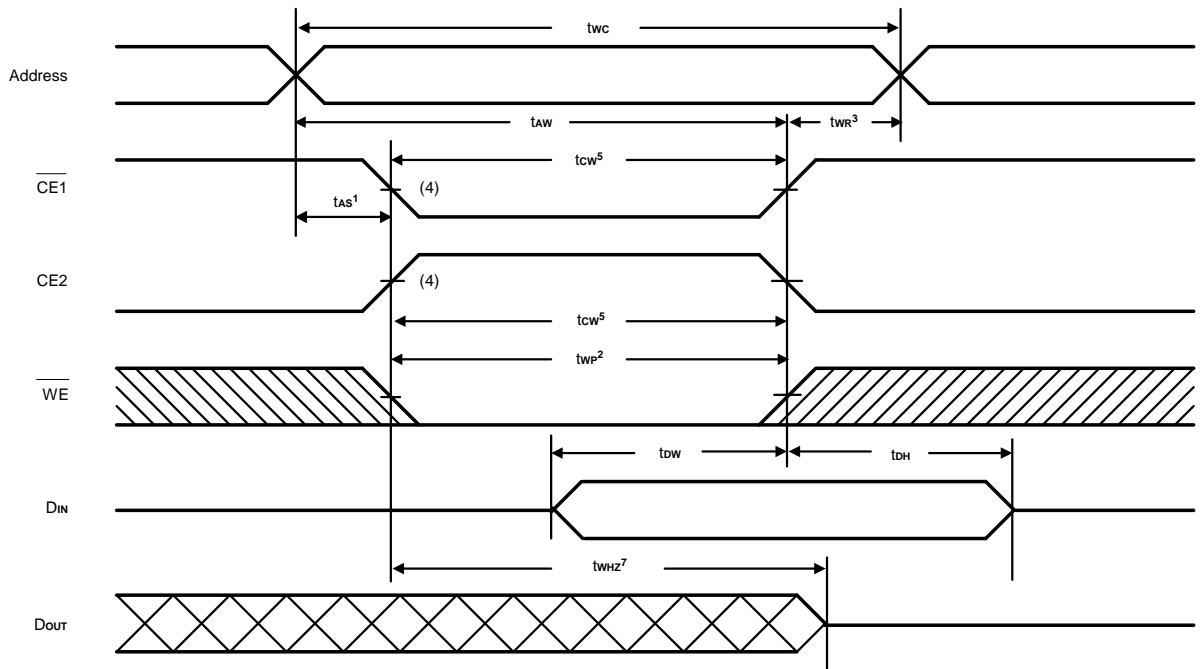
**Timing Waveforms**
**Read Cycle 1 (1, 2, 4)**

**Read Cycle 2 (1, 3, 4, 6)**

**Read Cycle 3 (1, 4, 7, 8)**


**Timing Waveforms (continued)**
**Read Cycle 4 <sup>(1)</sup>**


- Notes:
1.  $\overline{WE}$  is high for Read Cycle.
  2. Device is continuously enabled  $\overline{CE1} = V_{IL}$  and  $CE2 = V_{IH}$ .
  3. Address valid prior to or coincident with  $\overline{CE1}$  transition low.
  4.  $\overline{OE} = V_{IL}$ .
  5. Transition is measured  $\pm 500\text{mV}$  from steady state. This parameter is sampled and not 100% tested.
  6. CE2 is high.
  7.  $\overline{CE1}$  is low.
  8. Address valid prior to or coincident with CE2 transition high.



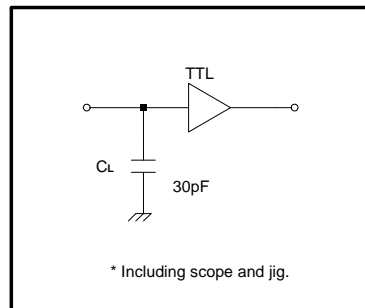
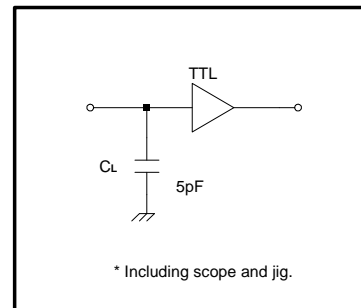
**Timing Waveforms (continued)**
**Write Cycle 1 <sup>(6)</sup>**  
**(Write Enable Controlled)**


**Timing Waveforms (continued)**
**Write Cycle 2  
(Chip Enable Controlled)**


- Notes:
1.  $t_{AS}$  is measured from the address valid to the beginning of Write.
  2. A Write occurs during the overlap ( $t_{WP}$ ) of a low  $\overline{CE1}$ , a high CE2 and a low  $\overline{WE}$ .
  3.  $t_{WR}$  is measured from the earliest of  $\overline{CE1}$  or  $\overline{WE}$  going high or CE2 going low to the end of the Write cycle.
  4. If the  $\overline{CE1}$  low transition or the CE2 high transition occurs simultaneously with the  $\overline{WE}$  low transition or after the  $\overline{WE}$  transition, outputs remain in a high impedance state.
  5.  $t_{CW}$  is measured from the later of  $\overline{CE1}$  going low or CE2 going high to the end of Write.
  6.  $\overline{OE}$  is continuously low. ( $\overline{OE} = V_{IL}$ )
  7. Transition is measured  $\pm 500\text{mV}$  from steady state. This parameter is sampled and not 100% tested.

**AC Test Conditions**

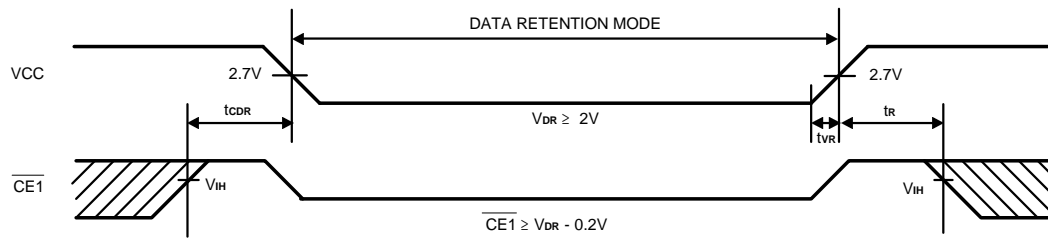
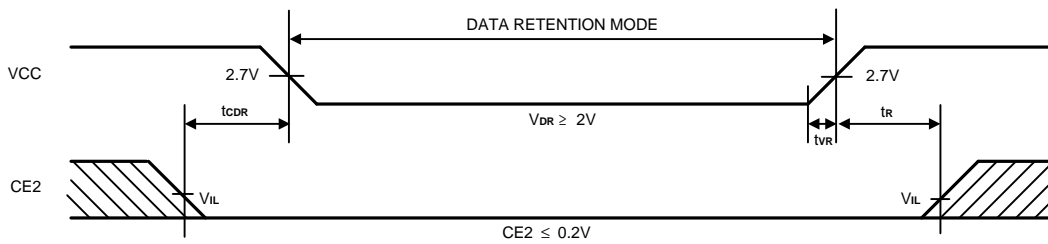
Input Pulse Levels	0.4V to 2.4V
Input Rise and Fall Time	5 ns
Input and Output Timing Reference Levels	1.5V
Output Load	See Figures 1 and 2


**Figure 1. Output Load**

**Figure 2. Output Load for  $t_{CLZ1}$ ,  $t_{CLZ2}$ ,  $t_{OHZ}$ ,  $t_{OLZ}$ ,  $t_{CHZ1}$ ,  $t_{CHZ2}$ ,  $t_{WHZ}$ , and  $t_{OW}$** 
**Data Retention Characteristics** ( $T_A = -25^\circ\text{C}$  to  $85^\circ\text{C}$ )

Symbol	Parameter	Min.	Max.	Unit	Conditions
$V_{DR1}$	VCC for Data Retention	2.0	3.3	V	$\overline{CE1} \geq V_{CC} - 0.2V$
$V_{DR2}$		2.0	3.3	V	$CE2 \leq 0.2V$ ,
$I_{CCDR1}$	Data Retention Current	L-Version	-	20*	$\mu A$ $V_{CC} = 2.0V$ , $\overline{CE1} \geq V_{CC} - 0.2V$ , $V_{IN} \geq 0V$
		LL-Version	-	5**	
$I_{CCDR2}$	Data Retention Current	L-Version	-	20*	$\mu A$ $V_{CC} = 2.0V$ , $CE2 \leq 0.2V$ , $V_{IN} \geq 0V$
		LL-Version	-	5**	
$t_{CDR}$	Chip Disable to Data Retention Time	0	-	ns	See Retention Waveform
$t_R$	Operation Recovery Time	$t_{RC}$	-	ns	
$t_{VR}$	VCC Rising Time from Data Retention Voltage to Operating Voltage	5	-	ms	

\*\* LP62S2048-70LLT/10LLT       $I_{CCDR}$ : max.  $1\mu A$  at  $T_A = 0^\circ\text{C}$  to  $+40^\circ\text{C}$

\* LP62S2048-70LT/10LT       $I_{CCDR}$ : max.  $5\mu A$  at  $T_A = 0^\circ\text{C}$  to  $+40^\circ\text{C}$

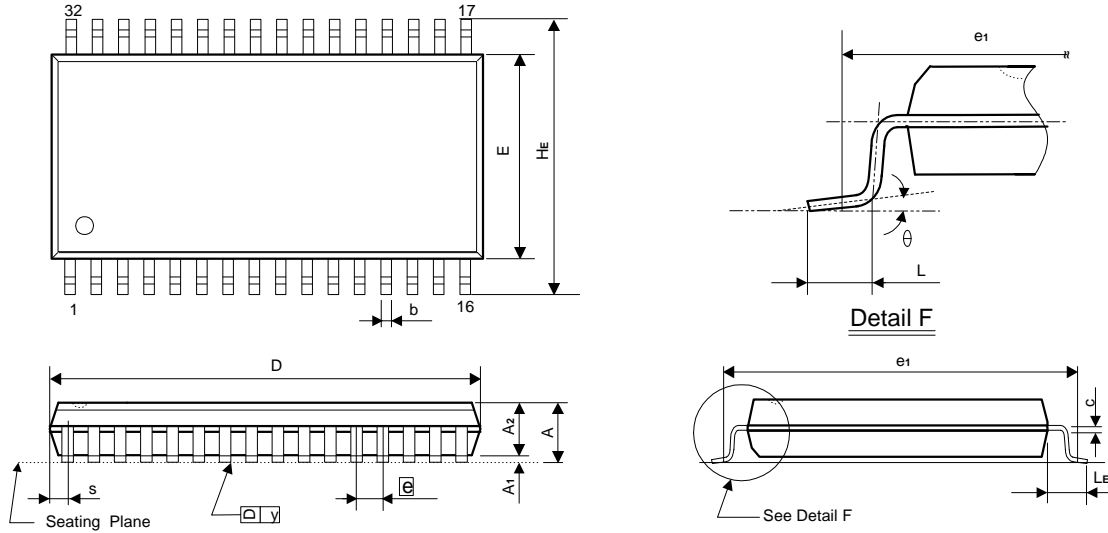
**Low VCC Data Retention Waveform (1) ( $\overline{CE1}$  Controlled)**

**Low VCC Data Retention Waveform (2) (CE2 Controlled)**


**Ordering Information**

Part No.	Access Time (ns)	Operating Current Max. (mA)	Standby Current Max. (mA)	Package
LP62S2048M-70LT	70	30	50	32L SOP
LP62S2048M-70LLT		30	10	32L SOP
LP62S2048V-70LT		30	50	32L TSOP
LP62S2048V-70LLT		30	10	32L TSOP
LP62S2048X-70LT		30	50	32L TSSOP
LP62S2048X-70LLT		30	10	32L TSSOP
LP62S2048U-70LT		30	50	36L CSP
LP62S2048U-70LLT		30	10	36L CSP
LP62S2048M-10LT	100	30	50	32L SOP
LP62S2048M-10LLT		30	10	32L SOP
LP62S2048V-10LT		30	50	32L TSOP
LP62S2048V-10LLT		30	10	32L TSOP
LP62S2048X-10LT		30	50	32L TSSOP
LP62S2048X-10LLT		30	10	32L TSSOP
LP62S2048U-10LT		30	50	36L CSP
LP62S2048U-10LLT		30	10	36L CSP

**Package Information**
**SOP (W.B.) 32L Outline Dimensions**

unit: inches/mm



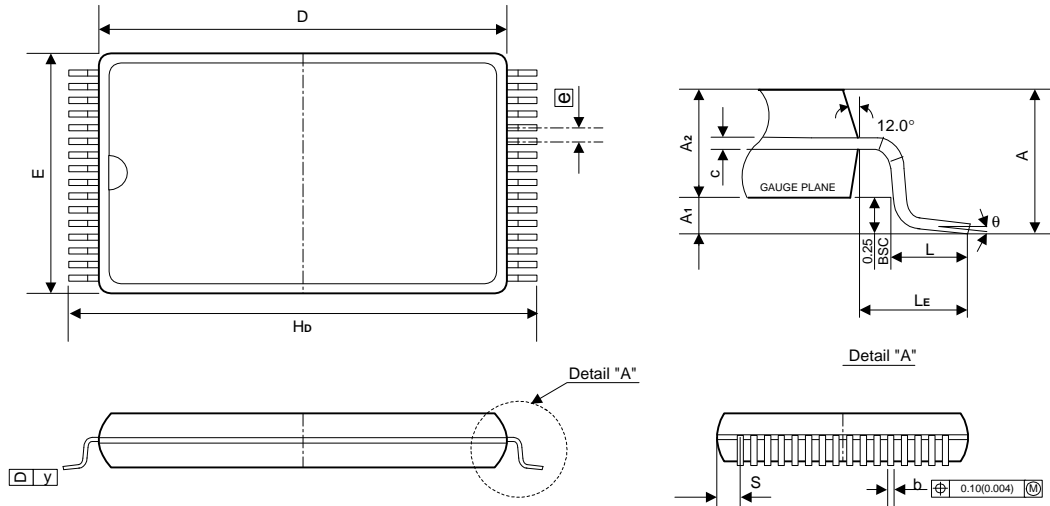
Symbol	Dimensions in inches	Dimensions in mm
A	0.118 Max.	3.00 Max.
A <sub>1</sub>	0.004 Min.	0.10 Min.
A <sub>2</sub>	0.106±0.005	2.69±0.13
b	0.016 +0.004 -0.002	0.41 +0.10 -0.05
c	0.008 +0.004 -0.002	0.20 +0.10 -0.05
D	0.805 Typ. (0.820 Max.)	20.45 Typ. (20.83 Max.)
E	0.445±0.010	11.30±0.25
e	0.050 ±0.006	1.27±0.15
e <sub>1</sub>	0.525 NOM.	13.34 NOM.
HE	0.556±0.010	14.12±0.25
L	0.031±0.008	0.79±0.20
LE	0.055±0.008	1.40±0.20
S	0.044 Max.	1.12 Max.
y	0.004 Max.	0.10 Max.
θ	0° ~ 10°	0° ~ 10°

**Notes:**

1. The maximum value of dimension D includes end flash.
2. Dimension E does not include resin fins.
3. Dimension e<sub>1</sub> is for PC Board surface mount pad pitch design reference only.
4. Dimension S includes end flash.

**Package Information**
**TSOP 32L TYPE I (8 X 20mm) Outline Dimensions**

unit: inches/mm



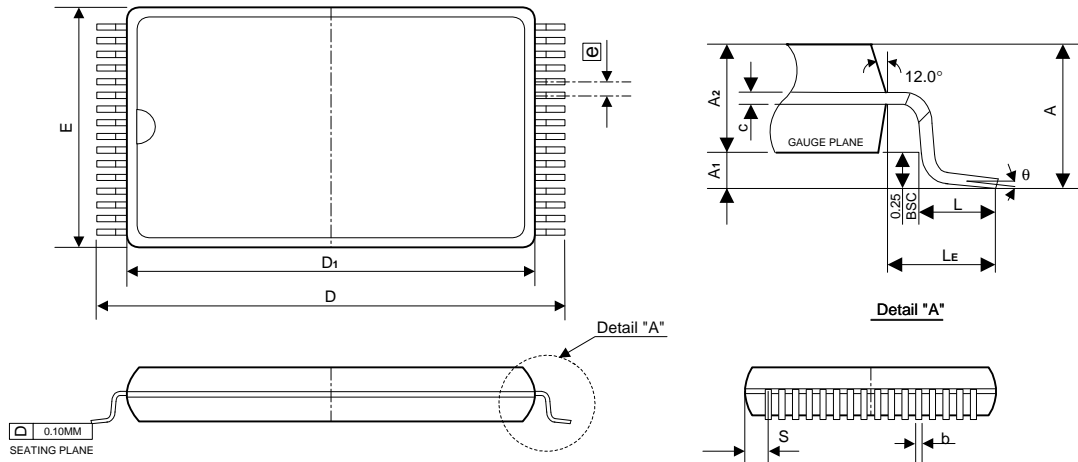
Symbol	Dimensions in inches	Dimensions in mm
A	0.047 Max.	1.20 Max.
A <sub>1</sub>	0.004±0.002	0.10±0.05
A <sub>2</sub>	0.039±0.002	1.00±0.05
b	0.008±0.001	0.20±0.03
c	0.006±0.001	0.15±0.02
D	0.724±0.004	18.40±0.10
E	0.315±0.004	8.00±0.10
e <sub>1</sub>	0.020 TYP.	0.50 TYP.
H <sub>b</sub>	0.787±0.007	20.00±0.20
L	0.020±0.004	0.50±0.10
LE	0.031 TYP.	0.80 TYP.
S	0.0167 TYP.	0.425 TYP.
Y	0.004 Max.	0.10 Max.
θ	0° ~ 6°	0° ~ 6°

**Notes:**

1. The maximum value of dimension D includes end flash.
2. Dimension E does not include resin fins.
3. Dimension e<sub>1</sub> is for PC Board surface mount pad pitch design reference only.
4. Dimension S includes end flash.

**Package Information**
**TSSOP 32L TYPE I (8 X 13.4mm) Outline Dimensions**

unit: inches/mm



Symbol	Dimensions in inches	Dimensions in mm
A	0.049 Max.	1.25 Max.
A1	0.002 Min.	0.05 Min.
A2	0.039±0.002	1.00±0.05
b	0.008±0.001	0.20±0.03
c	0.006±0.0003	0.15±0.008
E	0.315±0.004	8.00±0.10
e	0.020 TYP.	0.50 TYP.
D	0.528±0.008	13.40±0.20
D1	0.465±0.004	11.80±0.10
L	0.02±0.008	0.50±0.20
LE	0.0266 Min.	0.675 Min.
S	0.0109 TYP.	0.278 TYP.
y	0.004 Max.	0.10 Max.
$\theta$	0° ~ 6°	0° ~ 6°

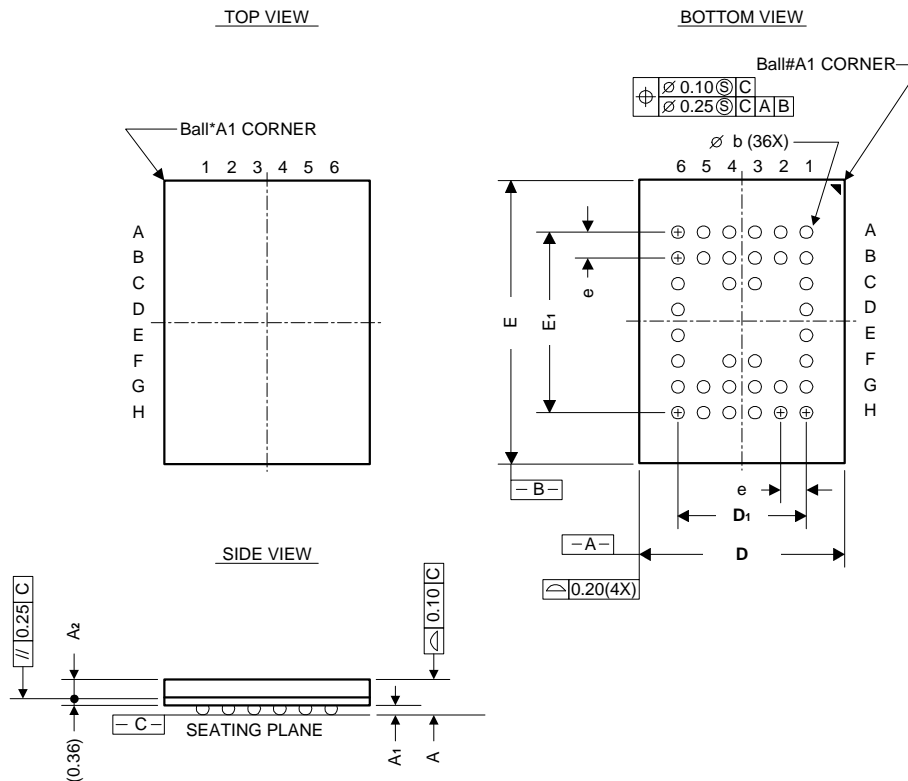
**Notes:**

1. The maximum value of dimension D includes end flash.
2. Dimension E does not include resin fins.
3. Dimension e<sub>1</sub> is for PC Board surface mount pad pitch design reference only.
4. Dimension S includes end flash.



**Package Information**
**36LD CSP (6 x 8 mm) Outline Dimensions**

unit: mm



Symbol	Dimensions in mm		
	MIN.	NOM.	MAX.
A	1.00	1.10	1.20
A <sub>1</sub>	0.16	0.21	0.26
A <sub>2</sub>	0.48	0.53	0.58
D	5.80	6.00	6.20
D <sub>1</sub>	---	3.75	---
E <sub>1</sub>	---	5.25	---
e	---	0.75	---
b	0.25	0.30	0.35

**Note:**

1. THE BALL DIAMETER, BALL PITCH, STAND-OFF & PACKAGE THICKNESS ARE DIFFERENT FROM JEDEC SPEC MO192 (LOW PROFILE BGA FAMILY).
2. PRIMARY DATUM C AND SEATING PLANE ARE DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.
3. DIMENSION b IS MEASURED AT THE MAXIMUM. THERE SHALL BE A MINIMUM CLEARANCE OF 0.25mm BETWEEN THE EDGE OF THE SOLDER BALL AND THE BODY EDGE.
4. BALL PAD OPENING OF SUBSTRATE IS  $\Phi$  0.25mm (SMD) SUGGEST TO DESIGN THE PCB LAND SIZE AS  $\Phi$  0.25mm (NSMD)