

T68 K/S/R 1M Family

Low Power 1M (128Kx8)-Bits Static RAM

■ DESCRIPTION

The T68K1M, T68S1M, and T68R1M device family is a low power and high performance CMOS SRAM organized as 131,072 words by 8 bits. It operates from 2.7V to 3.6V, 2.2V to 2.7V, and 1.65V to 2.2V. Easy memory expansion is provided by an active LOW chip enable 1 (/CE1), active HIGH chip enable 2 (CE2) and active LOW output enable (/OE) and three-state I/O drivers. Four control pins (/CE1, CE2, /OE, and /WE) fully control the operation mode of the T68 K/S/R 1M device family. An active LOW write enable signal (/WE active low) controls the write/read operation of the memory. When /CE1 and /WE inputs go LOW and CE2 input goes HIGH simultaneously, the device is in write mode and data on the 8 data pins (IO1~IO8) is written into the memory location specified by the address on address pins (A0~A16). When /CE1 and /OE inputs go LOW and CE2 and /WE input stay in HIGH state, the device is in read mode and data in the specified memory address is driven onto the 8 data pins. The 8 data pins will be in high-impedance state if both /OE and /WE pins are in HIGH (inactive) state. The T68 K/S/R 1M device family has an automatically power-down feature when the chip is deselected (/CE1 pin HIGH or CE2 pin LOW). The T68 K/S/R 1M device family is available in JEDEC standard 32-pin 450-mil SOP, 32-pin 8mmx20mm plastic TSOP, 32-pin 8mmx13.4mm plastic TSOP, and 36-ball 6mmx8mm BGA package, also for DICE.

■ FEATURES

- Operation voltage.....T68K1M.....2.7V ~ 3.6V
T68S1M..... 2.2V ~ 2.7V
T68R1M..... 1.65V ~ 2.2V
- Low active power and standby power
- High access times: 70ns/85ns/100ns
- TTL-compatible inputs and outputs
- Easy memory expansion with /CE1, CE2 and /OE
- Low data retention voltage.....2.0V (for K), 1.5V (for S), 1.0V (for R)
- Auto power down when deselected

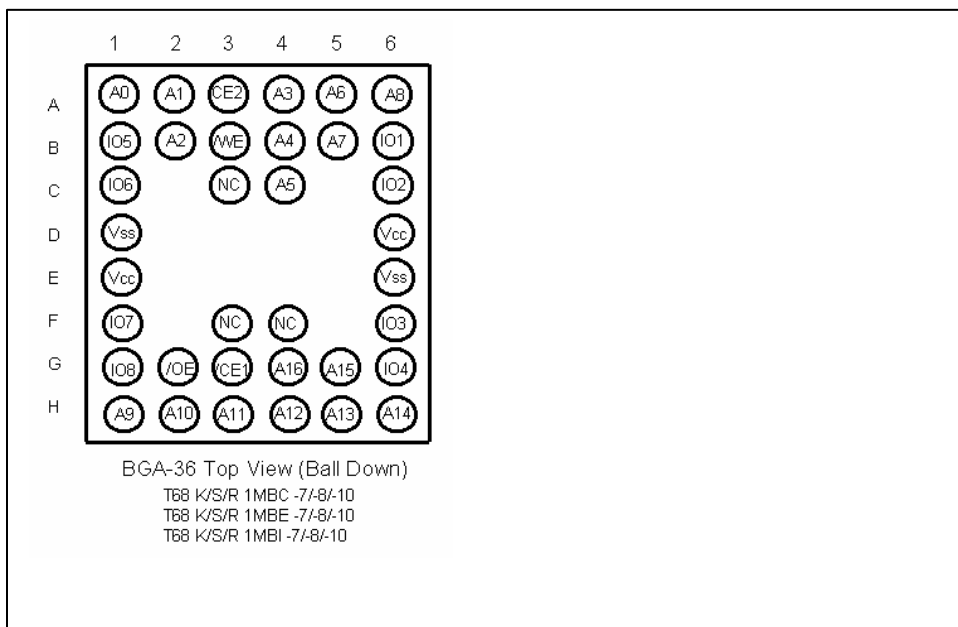
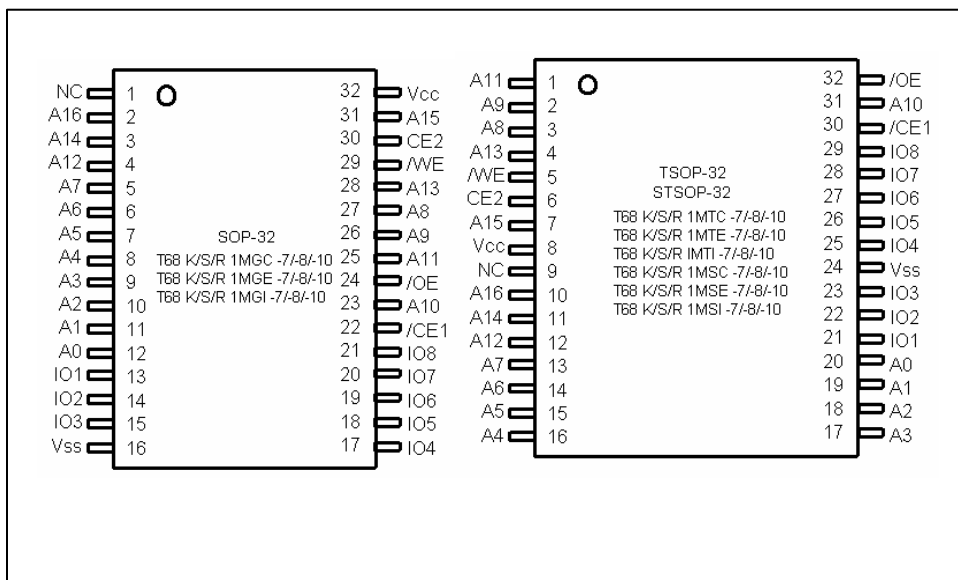
■ PRODUCT FAMILY

Part Number	V _{CC} Range	Speed	Operating Temperature	Power Dissipation		Package Type
				Operating (I _{CC2} , Max.)	Standby (I _{SB1} , Max.)	
T68K1MGC -7/-8	2.7V~3.6V	70ns/ 85ns	Commercial (+0°C~+70°C)	20mA	3uA	SOP-32
T68K1MTC -7/-8						TSOP-32
T68K1MSC -7/-8						STSOP-32
T68K1MBC -7/-8						BGA-36
T68K1MDC -7/-8						Dice
T68S1MGC -7/-8	2.2V~2.7V			20mA	3uA	SOP-32
T68S1MTC -7/-8						TSOP-32
T68S1MSC -7/-8						STSOP-32
T68S1MBC -7/-8						BGA-36
T68S1MDC -7/-8						Dice
T68R1MGC -8/-10	1.65V~2.2V	85ns/ 100ns		15mA	2uA	SOP-32
T68R1MTC -8/-10						TSOP-32
T68R1MSC -8/-10						STSOP-32
T68R1MBC -8/-10						BGA-36
T68R1MDC -8/-10						Dice

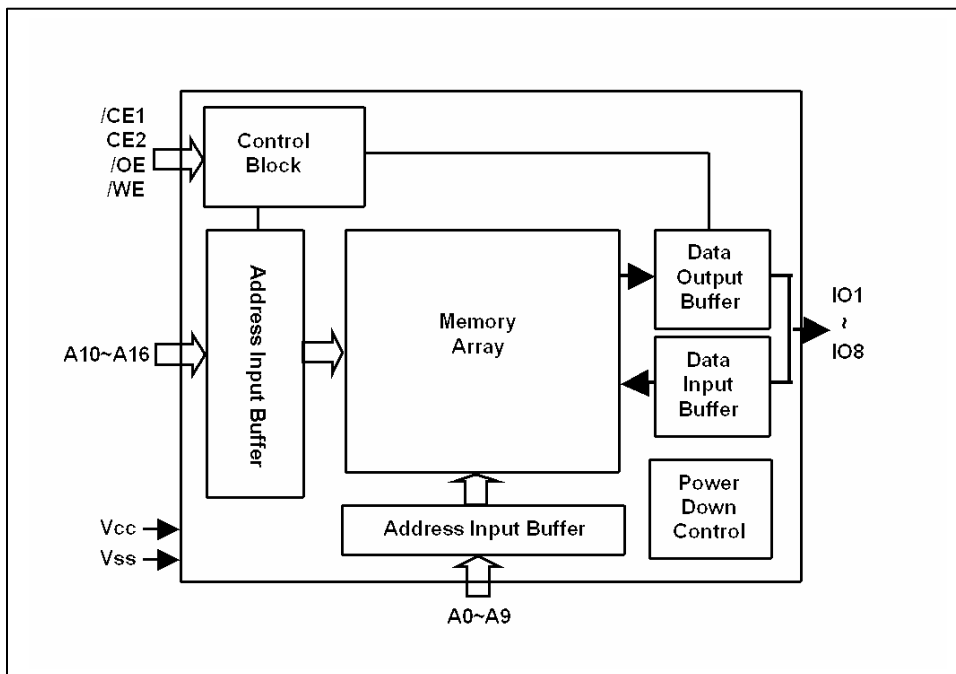
Part Number	V _{CC} Range	Speed	Operating Temperature	Power Dissipation		Package Type
				Operating (I _{CC2} , Max.)	Standby (I _{SB1} , Max.)	
T68K1MGE -7/-8	2.7V~3.6V	70ns/ 85ns	Extended (-25°C~+85°C)	20mA	3uA	SOP-32
T68K1MTE -7/-8						TSOP-32
T68K1MSE -7/-8						STSOP-32
T68K1MBE -7/-8						BGA-36
T68K1MDE -7/-8						Dice
T68S1MGE -7/-8	2.2V~2.7V			20mA	3uA	SOP-32
T68S1MTE -7/-8						TSOP-32
T68S1MSE -7/-8						STSOP-32
T68S1MBE -7/-8						BGA-36
T68S1MDE -7/-8						Dice
T68R1MGE -8/-10	1.65V~2.2V	85ns/ 100ns		15mA	2uA	SOP-32
T68R1MTE -8/-10						TSOP-32
T68R1MSE -8/-10						STSOP-32
T68R1MBE -8/-10						BGA-36
T68R1MDE -8/-10						Dice

Part Number	V _{CC} Range	Speed	Operating Temperature	Power Dissipation		Package Type
				Operating (I _{CC2} , Max.)	Standby (I _{SB1} , Max.)	
T68K1MGI -7/-8	2.7V~3.6V	70ns/ 85ns	Industrial (-40°C~+85°C)	20mA	3uA	SOP-32
T68K1MTI -7/-8						TSOP-32
68K1MSI -7/-8						STSOP-32
T68K1MBI -7/-8						BGA-36
T68K1MDI -7/-8						Dice
T68S1MGI -7/-8	2.2V~2.7V			20mA	3uA	SOP-32
T68S1MTI -7/-8						TSOP-32
T68S1MSI -7/-8						STSOP-32
T68S1MBI -7/-8						BGA-36
T68S1MDI -7/-8						Dice
T68R1MGI -8/-10	1.65V~2.2V	85ns/ 100ns		15mA	2uA	SOP-32
T68R1MTI -8/-10						TSOP-32
T68R1MSI -8/-10						STSOP-32
T68R1MBI -8/-10						BGA-36
T68R1MDI -8/-10						Dice

PIN CONFIGURATION



■ LOGIC BLOCK



■ (PIN DESCRIPTION)

Pin Name	Function
A0 ~ A16	Address Input Pins
IO1 ~ IO8	Data Input/Output Pins
/CE1	Chip Enable 1 Input Pin
CE2	Chip Enable 2 Input Pin
/OE	Output Enable Input Pin
/WE	Write Enable Input Pin
V _{CC}	Power Supply Pin
V _{SS}	Ground Pin

■ TRUTH TABLE

Mode	/CE1	CE2	/WE	/OE	I/O1~8	Power
Deselected	H	X ⁽¹⁾	X	X	High-Z	Standby
Deselected	X	L	X	X	High-Z	Standby
Write	L	H	L	X	Input	Active
Read	L	H	H	L	Output	Active
Output Disabled	L	H	H	H	High-Z	Active

1. 'X' means don't care. Must be in high or low state.

■ ABSOLUTE MAXIMUM RATINGS ⁽¹⁾

Symbol	Parameter	Rating	Unit
V _{CC}	Power Supply Voltage (to V _{SS})	-0.5 ~ V _{CC} .max+1V ⁽²⁾	V
		-0.5 ~ V _{CC} .max+0.3V ⁽³⁾	V
V _{IN} /V _{OUT}	Input / Output Voltage	-0.5 ~ V _{CC} +0.5V ⁽²⁾	V
		-0.5 ~ V _{CC} +0.3V ⁽³⁾	V
I _{OUT}	Output Current into Outputs (LOW)	20	mA
P _D	Power Dissipation	1.0	W
T _{STG}	Storage Temperature	-65 ~ +150	°C
T _{SOLDER}	Soldering Temperature and Time	260 °C , 10sec (Lead Only)	
T _A	Operating Temperature	C-Grade	0 ~ 70
		E-Grade	-25 ~ 85
		I-Grade	-40 ~ 85

1. Stresses greater than those listed in the **Absolute Maximum Ratings** table may cause permanent damage to the device. Functional operation should be restricted to recommended operating condition. Exposure to absolute maximum ratings conditions for extended periods may affect reliability.

2. For K and S family.

3. For R family.

■ RECOMMENDED DC OPERATING RANGE

Symbol		Parameter	Rating	Unit
V _{CC}	T68K1M	Supply Voltage	2.7 ~ 3.6	V
	T68S1M		2.2 ~ 2.7	V
	T68R1M		1.65 ~ 2.2	V
V _{SS}		Ground	0	V
V _{IH}	T68K1M	Input High Voltage	2.2 ~ V _{CC} +0.5	V
	T68S1M		2.0 ~ V _{CC} +0.5	V
	T68R1M		1.4 ~ V _{CC} +0.5	V
V _{IL}	T68K1M	Input Low Voltage	-0.5 ~ 0.6	V
	T68S1M		-0.5 ~ 0.6	V
	T68R1M		-0.5 ~ 0.4	V

■ CAPACITANCES ⁽¹⁾

Symbol	Parameter	Min.	Max.	Condition
C _{IN}	Input Capacitance	-	8pF	Unmeasured pins set to 0V
C _{IO}	Input/Output Capacitance	-	10pF	

1. The Capacitances listed in the above table are sampled, not 100% tested.

■ DATA RETENTION CHARACTERISTICS

Symbol	Parameter		Test Condition		Min.	Typ.	Max.	Unit
V _{DR}	V _{CC} for Data Retention	T68K1M	Standby Mode		2.0	-	3.6	V
		T68S1M			1.5	-	2.7	
		T68R1M			1.0	-	2.2	
I _{DR}	Data Retention Current	T68K1M	V _{CC} =2.0V and CMOS Standby mode ⁽¹⁾	C-Grade	-	-	2	uA
				E-Grade	-	-	3	
				I-Grade	-	-	3	
		T68S1M	V _{CC} =1.5V and CMOS Standby mode ⁽¹⁾	C-Grade	-	-	1	
				E-Grade	-	-	2	
				I-Grade	-	-	2	
		T68R1M	V _{CC} =1.0V and CMOS Standby mode ⁽¹⁾	C-Grade	-	-	1	
				E-Grade	-	-	2	
				I-Grade	-	-	2	
T _{SDR}	Data Retention Setup Time		See data retention waveform		0	-	-	ns
T _{RDR}	Data Retention Recovery Time				T _{REC}	-	-	ns

Note: 1. Standby mode: /CE1≥V_{CC}-0.2V or CE2≤V_{SS}+0.2V

■ DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter		Test Condition	Min	Typ	Max	Unit
I _{LI}	Input Leakage Current		V _{IN} = V _{SS} to V _{CC}	-1	-	1	μA
I _{LO}	Output Leakage Current		/CE1=V _{IH} CE2=V _{IL} or /OE=V _{IH} or /WE=V _{IL} , V _{IO} =V _{SS} to V _{CC}	-1	-	1	μA
I _{CC1}	Average Operating Current	T68K1M	/CE1≤0.2V, CE2≥V _{CC} -0.2V, V _{IN} ≤0.2V or V _{IN} ≥V _{CC} -0.2V	-	3 ⁽¹⁾	6	mA
		T68S1M	Cycle time = 1μs, 100% duty,	-	3 ⁽¹⁾	6	
		T68R1M	I _{IO} =0mA	-	2 ⁽¹⁾	4	
I _{CC2}		T68K1M	/CE1=V _{IL} , CE2=V _{IH} , V _{IN} =V _{IH} or V _{IN} =V _{IL}	-	15 ⁽¹⁾	20	mA
		T68S1M	Cycle time = min, 100% duty,	-	15 ⁽¹⁾	20	
		T68R1M	I _{IO} =0mA	-	10 ⁽¹⁾	15	
V _{OL}	Output Low Voltage	T68K1M	IOL = 2.0mA	-	-	0.4	V
		T68S1M	IOL = 0.5mA	-	-	0.4	
		T68R1M	IOL = 0.2mA	-	-	0.4	
V _{OH}	Output High Voltage	T68K1M	IOH = -1.0mA	2.2	-	-	V
		T68S1M	IOH = -0.5mA	2.0	-	-	
		T68R1M	IOH = -0.1mA	1.4	-	-	
I _{SB}	TTL Standby Current	T68K1M	/CE1=V _{IH} or CE2= V _{IL} ,	-	-	0.2	mA
		T68S1M	other inputs = V _{IH} or V _{IL}	-	-	0.2	
		T68R1M		-	-	0.2	
I _{SB1}	CMOS Standby Current	T68K1M	/CE1≥V _{CC} -0.2V or	-	1.0 ⁽¹⁾	3	μA
		T68S1M	CE2≤V _{SS} +0.2V ,	-	1.0 ⁽¹⁾	3	
		T68R1M	other inputs = 0 to V _{CC}	-	0.8 ⁽¹⁾	2	

Note: 1. Ta=25°C, V_{CC}=3.0V (K), V_{CC}=2.5V (S), and V_{CC}=1.8V (R), not 100% tested.

■ AC ELECTRICAL CHARACTERISTICS

● TEST CONDITIONS

Input Pulse Level: $0.2V_{CC}$ (V_L), $0.8V_{CC}$ (V_H)

Input Rising and Falling Time: 5ns

Input and Output Reference Voltage: 0.9V(R), 1.1V(S), 1.5V (K)

Output Load: $C_L = 30pF$ + one TTL gate

● READ CYCLE

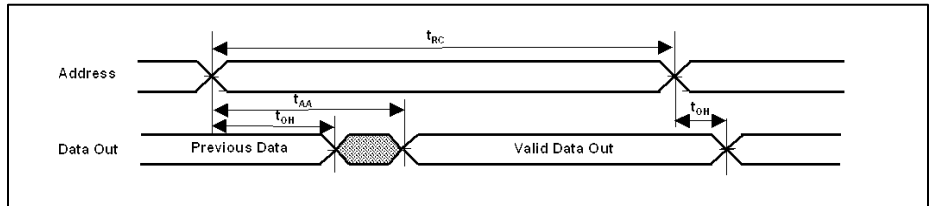
Symbol	Parameter List	Speed Bin						Units
		-7 (70ns)		-8(85ns)		-10(100ns)		
		Min	Max	Min	Max	Min	Max	
t _{RC}	Read Cycle Time	70	-	85	-	100	-	ns
t _{AA}	Address Access Time	-	70	-	85	-	100	ns
t _{CO}	Chip Select to Output	-	70	-	85	-	100	ns
t _{OE}	Output Enable to Valid Output	-	35	-	40	-	50	ns
t _{LZ}	Chip Select to Low-Z Output	10	-	10	-	10	-	ns
t _{OLZ}	Output Enable to Low-Z Output	5	-	5	-	5	-	ns
t _{HZ}	Chip Disable to High-Z Output	0	25	0	25	0	30	ns
t _{OHZ}	Output Disable to High-Z Output	0	25		25		30	ns
t _{OH}	Output Hold From Address	10	-	10	-	15	-	ns

● WRITE CYCLE

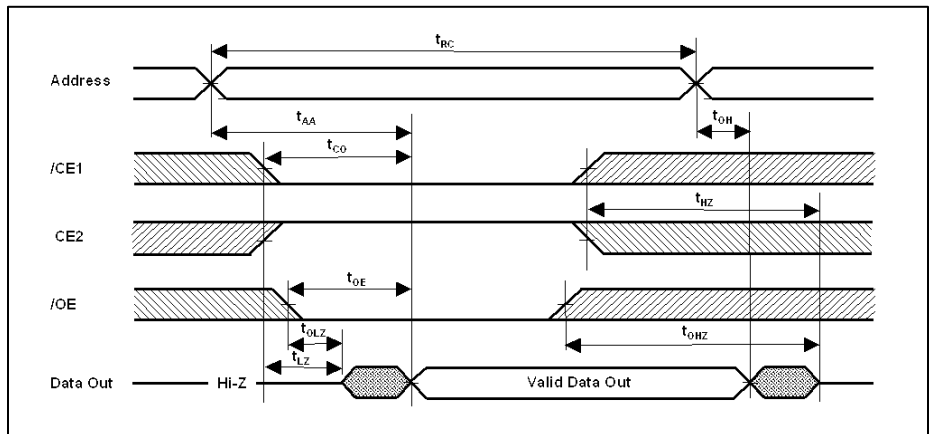
Symbol	Parameter List	Speed Bin						Units
		-7 (70ns)		-8(85ns)		-10 (100ns)		
		Min	Max	Min	Max	Min	Max	
t _{WC}	Write Cycle Time	70	-	85	-	100	-	ns
t _{CW}	Chip Select to End of Write	60	-	70	-	80	-	ns
t _{AS}	Address Setup Time	0	-	0	-	0	-	ns
t _{AW}	Address Valid to End of Write	60	-	70	-	80	-	ns
t _{WP}	Write Pulse Width	55	-	60	-	70	-	ns
t _{WR}	Write Recovery Time	0	-	0	-	0	-	ns
t _{WHZ}	Write to Output High-Z	0	25	0	25	0	30	ns
t _{DW}	Data to Write Time Overlap	30	-	35	-	40	-	ns
t _{DH}	Data Hold from Write Time	0	-	0	-	0	-	ns
t _{OW}	End Write to Output Low-Z	5	-	5	-	5	-	ns

■ TIMING DIAGRAMS

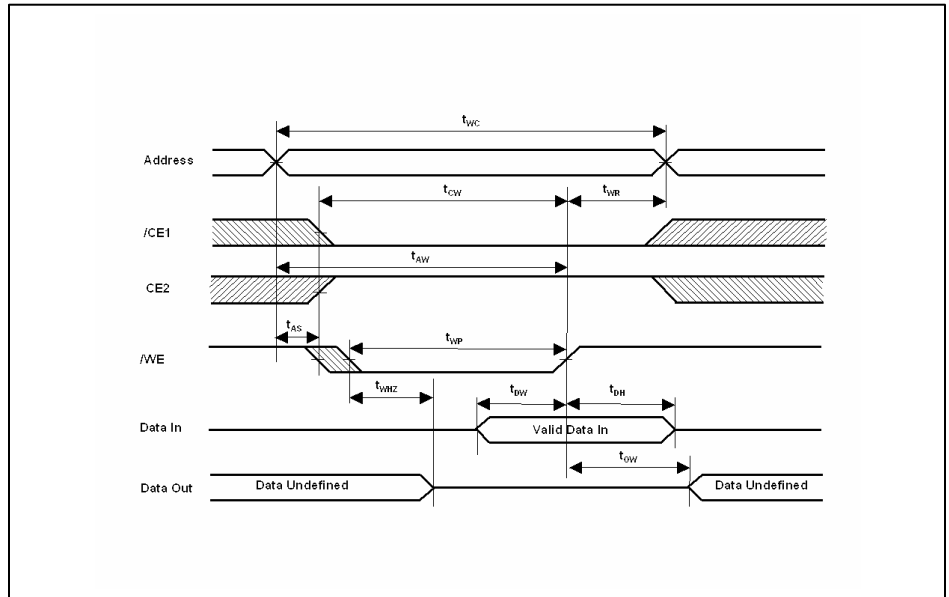
● TIMEING WAVEFORM OF READ CYCLE (1) (Address Controlled, /CE1= /OE=VIL, CE2= /WE=VIH)



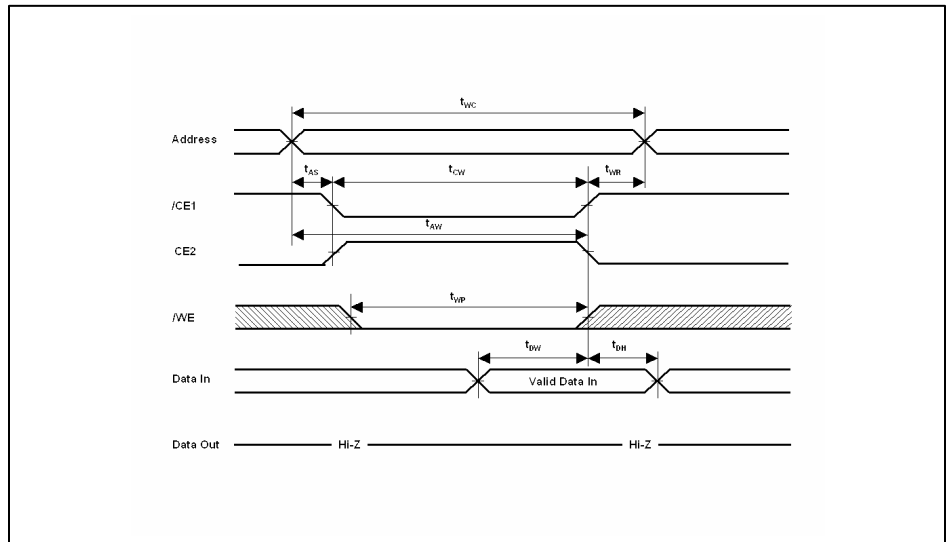
● TIMEING WAVEFORM OF READ CYCLE (2) (/WE=VIH)



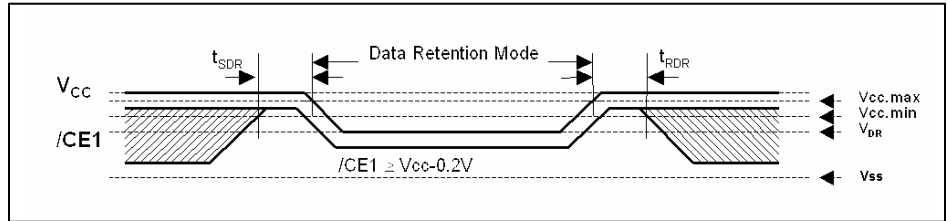
● TIMING WAVEFORM OF WRITE CYCLE (1) (/WE Controlled)



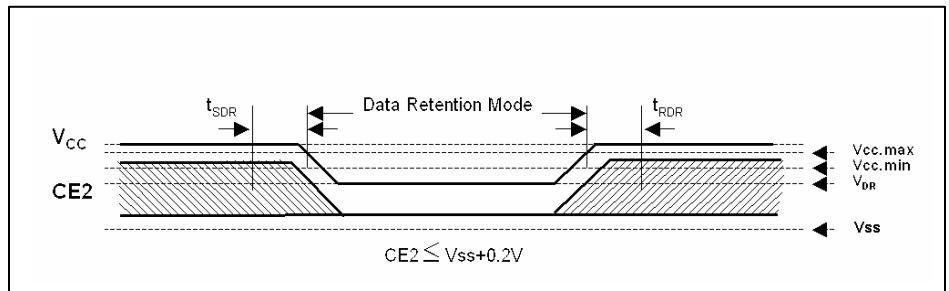
● TIMING WAVEFORM OF WRITE CYCLE (2) (/CE1 OR CE2 Controlled)



● DATA RETENTION WAVEFORM (1) (/CE1 Controlled)

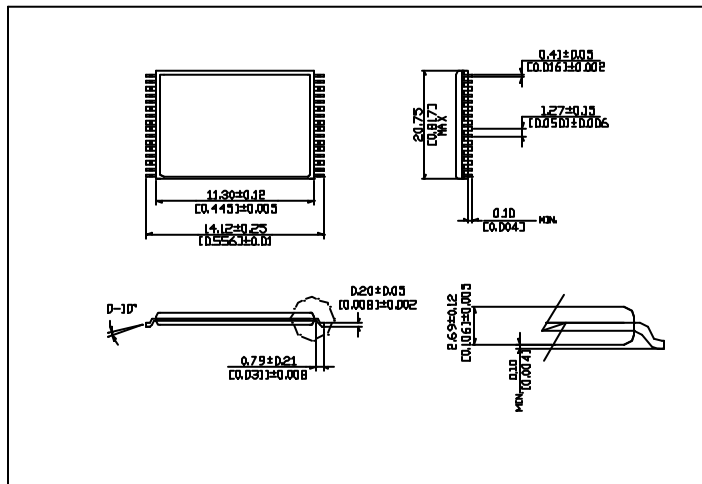


● DATA RETENTION WAVEFORM (2) (CE2 Controlled)

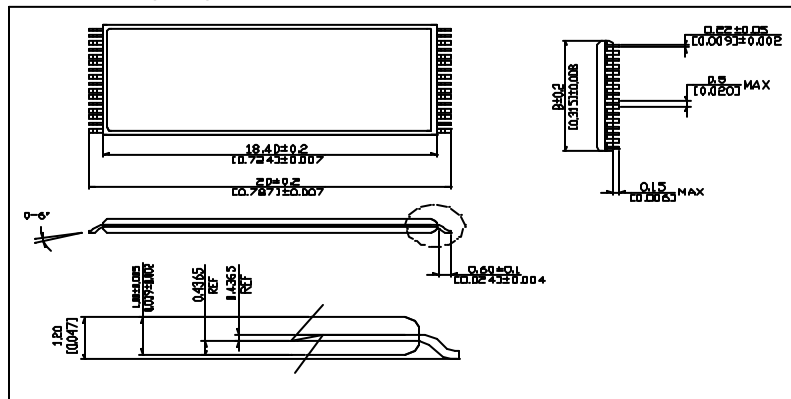


■ PACKAGE DIMENSION

32L PIN SOP (445 mil)



32L PIN TSOP (8x20)



[illegible]

Figure 1: Mechanical drawing of the PCB layout. The drawing includes three views: Top View, Bottom View, and Side View. The Top View shows a square PCB with dimensions 6.00±0.10 by 8.00±0.10. A circular feature is labeled A1. The Bottom View shows the same square with a grid of 16 solder balls arranged in 4 rows (A-D) and 4 columns (1-4). Dimensions include 6.00±0.10, 3.75(ref), 5.25(ref), and 8.00±0.10. A triangular feature is labeled A2. The Side View shows the profile of the PCB with dimensions 0.60(min.), 1.20(max.), 0.20(min.), 0.30±0.05, 0.75(ref), and 8.00±0.10. A label 'SOLDER BALL' points to one of the balls.