



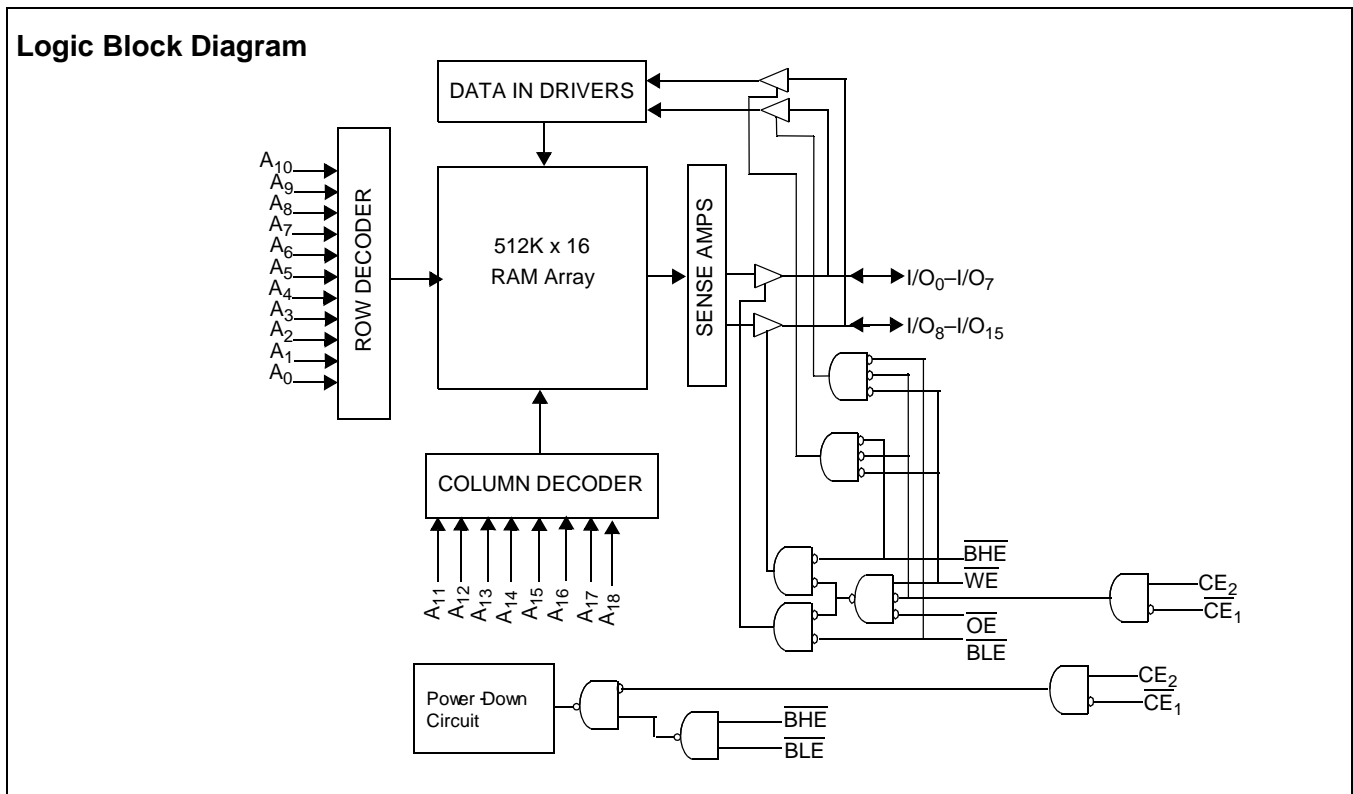
8-Mbit (512K x 16) Pseudo Static RAM

Features

- Advanced low-power MoBL<sup>®</sup> architecture
- High speed: 55 ns, 70 ns
- Wide voltage range: 2.7V to 3.3V
- Typical active current: 2 mA @ f = 1 MHz
- Typical active current: 11 mA @ f = f<sub>MAX</sub>
- Low standby power
- Automatic power-down when deselected

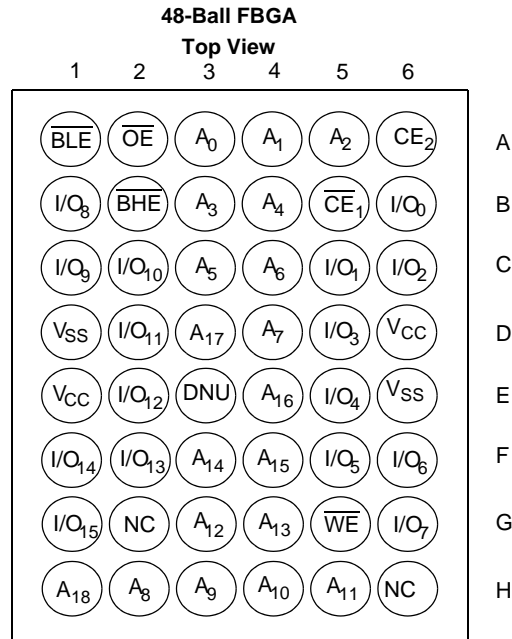
Functional Description<sup>[1]</sup>

The CYK512K16SCCA is a high-performance CMOS pseudo static RAM (PSRAM) organized as 512K words by 16 bits that supports an asynchronous memory interface. This device features advanced circuit design to provide ultra-low active current. This is ideal for providing More Battery Life™ (MoBL) in portable applications such as cellular telephones. The device can be put into standby mode reducing power consumption dramatically when deselected (CE<sub>1</sub> LOW, CE<sub>2</sub> HIGH or both BHE and BLE are HIGH). The input/output pins (I/O<sub>0</sub> through I/O<sub>15</sub>) are placed in a high-impedance state when: deselected (CE<sub>1</sub> HIGH, CE<sub>2</sub> LOW), OE is deasserted HIGH, or during a write operation (Chip Enabled and Write Enable WE LOW). Reading from the device is accomplished by asserting the Chip Enables (CE<sub>1</sub> LOW and CE<sub>2</sub> HIGH) and Output Enable (OE) LOW while forcing the Write Enable (WE) HIGH. If Byte Low Enable (BLE) is LOW, then data from the memory location specified by the address pins will appear on I/O<sub>0</sub> to I/O<sub>7</sub>. If Byte High Enable (BHE) is LOW, then data from memory will appear on I/O<sub>8</sub> to I/O<sub>15</sub>. See the Truth Table for a complete description of read and write modes.



Note:

1. For best-practice recommendations, please refer to the Cypress application note "System Design Guidelines" on <http://www.cypress.com>.

**Pin Configuration<sup>[2, 3, 4]</sup>**

**Product Portfolio<sup>[5]</sup>**

Product	V <sub>CC</sub> Range (V)			Speed (ns)	Power Dissipation					
					Operating, I <sub>CC</sub> (mA)				Standby, I <sub>SB2</sub> (μA)	
	Min.	Typ.	Max.		f = 1 MHz		f = f <sub>MAX</sub>			
					Typ. <sup>[5]</sup>	Max.	Typ. <sup>[5]</sup>	Max.		
CYK512K16SCCA	2.7	3.0	3.3	55	2	5	11	22	55	100
				70				17		

**Notes:**

2. DNU pins are to be left floating or tied to V<sub>SS</sub>.
3. Ball G2, H6 are the address expansion pins for the 16-Mbit and 32-Mbit densities respectively.
4. NC "no connect"—not connected internally to the die.
5. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at V<sub>CC</sub> = V<sub>CC</sub> (typ) and T<sub>A</sub> = 25°C.



**Maximum Ratings**

(Above which the useful life may be impaired. For user guidelines, not tested.)

Storage Temperature ..... -65°C to +150°C  
 Ambient Temperature with Power Applied ..... -40°C to +85°C  
 Supply Voltage to Ground Potential ..... -0.4V to 4.6V  
 DC Voltage Applied to Outputs in High-Z State<sup>[6, 7, 8]</sup> ..... -0.4V to 3.7V

DC Input Voltage<sup>[6, 7, 8]</sup> ..... -0.4V to 3.7V  
 Output Current into Outputs (LOW) ..... 20 mA  
 Static Discharge Voltage ..... > 2001V (per MIL-STD-883, Method 3015)  
 Latch-up Current ..... > 200 mA

**Operating Range**

Range	Ambient Temperature (T <sub>A</sub> )	V <sub>CC</sub>
Industrial	-25°C to +85°C	2.7V to 3.3V

**DC Electrical Characteristics** (Over the Operating Range)<sup>[5, 6, 7, 8]</sup>

Parameter	Description	Test Conditions	CYK512K16SCCA-55			CYK512K16SCCA-70			Unit
			Min.	Typ. <sup>[5]</sup>	Max.	Min.	Typ. <sup>[5]</sup>	Max.	
V <sub>CC</sub>	Supply Voltage		2.7	3.0	3.3	2.7		3.3	V
V <sub>OH</sub>	Output HIGH Voltage	I <sub>OH</sub> = -0.1 mA	V <sub>CC</sub> - 0.4			V <sub>CC</sub> - 0.4			V
V <sub>OL</sub>	Output LOW Voltage	I <sub>OL</sub> = 0.1 mA			0.4			0.4	V
V <sub>IH</sub>	Input HIGH Voltage		0.8 * V <sub>CC</sub>		V <sub>CC</sub> + 0.4	0.8 * V <sub>CC</sub>		V <sub>CC</sub> + 0.4	V
V <sub>IL</sub>	Input LOW Voltage	F = 0	-0.4		0.4	-0.4		0.4	V
I <sub>IX</sub>	Input Leakage Current	GND ≤ V <sub>IN</sub> ≤ V <sub>CC</sub>	-1		+1	-1		+1	μA
I <sub>OZ</sub>	Output Leakage Current	GND ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub> , Output Disabled	-1		+1	-1		+1	μA
I <sub>CC</sub>	V <sub>CC</sub> Operating Supply Current	f = f <sub>MAX</sub> = 1/t <sub>RC</sub>		11	22		11	17	mA
		f = 1 MHz		2	5		2	5	
I <sub>SB1</sub>	Automatic $\overline{CE}_1$ Power-down Current —CMOS Inputs	$\overline{CE} \geq V_{CC} - 0.2V$ , CE <sub>2</sub> ≤ 0.2V V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V, V <sub>IN</sub> ≤ 0.2V, f = f <sub>MAX</sub> (Address and Data Only), f = 0 (OE, WE, BHE and BLE)		100	400		100	400	μA
I <sub>SB2</sub>	Automatic $\overline{CE}_1$ Power-down Current —CMOS Inputs	$\overline{CE} \geq V_{CC} - 0.2V$ , CE <sub>2</sub> ≤ 0.2V V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V or V <sub>IN</sub> ≤ 0.2V, f = 0, V <sub>CC</sub> = 3.3V		55	100		55	100	μA

**Capacitance<sup>[9]</sup>**

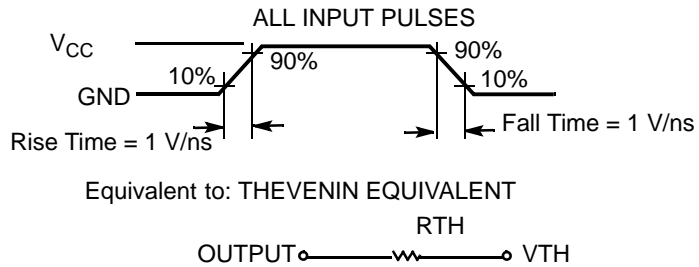
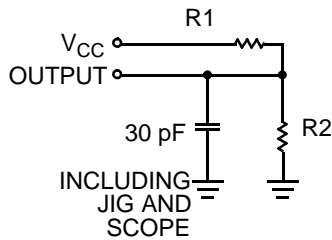
Parameter	Description	Test Conditions	Max.	Unit
C <sub>IN</sub>	Input Capacitance	T <sub>A</sub> = 25°C, f = 1 MHz	8	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>CC</sub> = V <sub>CC</sub> (typ)	8	pF

**Thermal Resistance<sup>[9]</sup>**

Parameter	Description	Test Conditions	FBGA	Unit
θ <sub>JA</sub>	Thermal Resistance (Junction to Ambient)	Test conditions follow standard test methods and procedures for measuring thermal impedance, per EIA / JESD51.	55	°C/W
θ <sub>JC</sub>	Thermal Resistance (Junction to Case)		17	°C/W

**Notes:**

- V<sub>IH</sub>(MAX) = V<sub>CC</sub> + 0.5V for pulse durations less than 20 ns.
- V<sub>IL</sub>(MIN) = -0.5V for pulse durations less than 20 ns.
- Overshoot and undershoot specifications are characterized and are not 100% tested.
- Tested initially and after design or process changes that may affect these parameters.

**AC Test Loads and Waveforms**


Parameters	3.0V V <sub>CC</sub>	Unit
R1	22000	Ω
R2	22000	Ω
R <sub>TH</sub>	11000	Ω
V <sub>TH</sub>	1.50	V

**Switching Characteristics** (Over the Operating Range) <sup>[10, 11, 12, 13, 14]</sup>

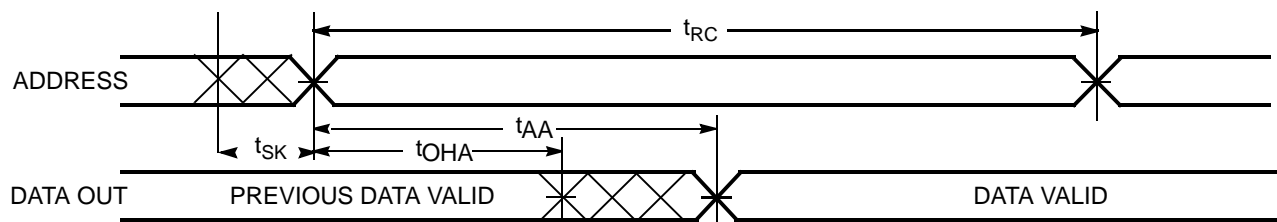
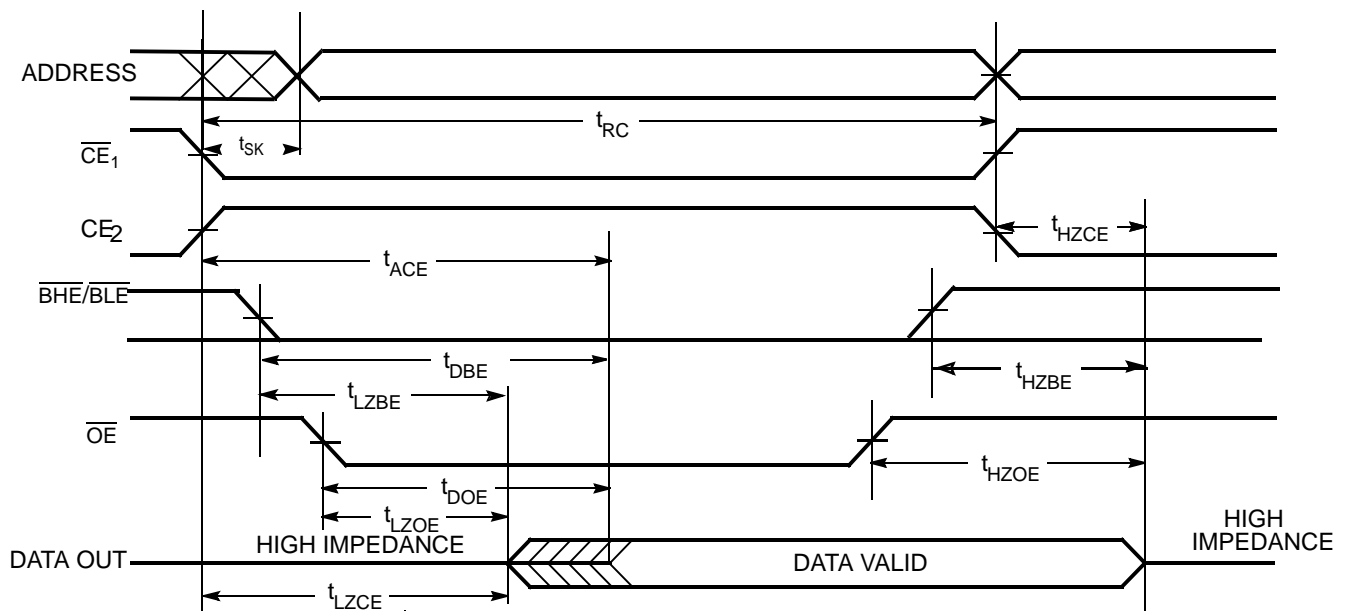
Parameter	Description	CYK512K16SCCA-55		CYK512K16SCCA-70		Unit
		Min.	Max.	Min.	Max.	
<b>Read Cycle</b>						
t <sub>RC</sub>	Read Cycle Time	55 <sup>[14]</sup>		70		ns
t <sub>AA</sub>	Address to Data Valid		55		70	ns
t <sub>OHA</sub>	Data Hold from Address Change	5		5		ns
t <sub>ACE</sub>	$\overline{CE}_1$ LOW and CE <sub>2</sub> HIGH to Data Valid		55		70	ns
t <sub>DOE</sub>	$\overline{OE}$ LOW to Data Valid		25		35	ns
t <sub>LZOE</sub>	$\overline{OE}$ LOW to Low Z <sup>[11, 12]</sup>	5		5		ns
t <sub>HZOE</sub>	$\overline{OE}$ HIGH to High Z <sup>[11, 12]</sup>		25		25	ns
t <sub>LZCE</sub>	$\overline{CE}_1$ LOW and CE <sub>2</sub> HIGH to Low Z <sup>[11, 12]</sup>	5		5		ns
t <sub>HZCE</sub>	$\overline{CE}_1$ HIGH and CE <sub>2</sub> LOW to High Z <sup>[11, 12]</sup>		25		25	ns
t <sub>DBE</sub>	$\overline{BLE}/\overline{BHE}$ LOW to Data Valid		55		70	ns
t <sub>LZBE</sub>	$\overline{BLE}/\overline{BHE}$ LOW to Low Z <sup>[11, 12]</sup>	5		5		ns
t <sub>HZBE</sub>	$\overline{BLE}/\overline{BHE}$ HIGH to High-Z <sup>[11, 12]</sup>		10		25	ns
t <sub>SK</sub> <sup>[14]</sup>	Address Skew		0		10	ns

**Notes:**

- Test conditions assume signal transition time of 1V/ns or higher, timing reference levels of V<sub>CC(typ)</sub>/2, input pulse levels of 0V to V<sub>CC(typ)</sub>, and output loading of the specified I<sub>OL</sub>/I<sub>OH</sub> and 30-pF load capacitance
- t<sub>HZOE</sub>, t<sub>HZCE</sub>, t<sub>HZBE</sub> and t<sub>HZWE</sub> transitions are measured when the outputs enter a high-impedance state.
- High-Z and Low-Z parameters are characterized and are not 100% tested.
- The internal write time of the memory is defined by the overlap of  $\overline{WE}$ ,  $\overline{CE}_1 = V_{IL}$ , CE<sub>2</sub> = V<sub>IH</sub>,  $\overline{BHE}$  and/or  $\overline{BLE} = V_{IL}$ . All signals must be ACTIVE to initiate a write and any of these signals can terminate a write by going INACTIVE. The data input set-up and hold timing should be referenced to the edge of the signal that terminates write.
- To achieve 55-ns performance, the read access should be  $\overline{CE}$  controlled. In this case t<sub>ACE</sub> is the critical parameter and t<sub>SK</sub> is satisfied when the addresses are stable prior to chip enable going active. For the 70-ns cycle, the addresses must be stable within 10 ns after the start of the read cycle.

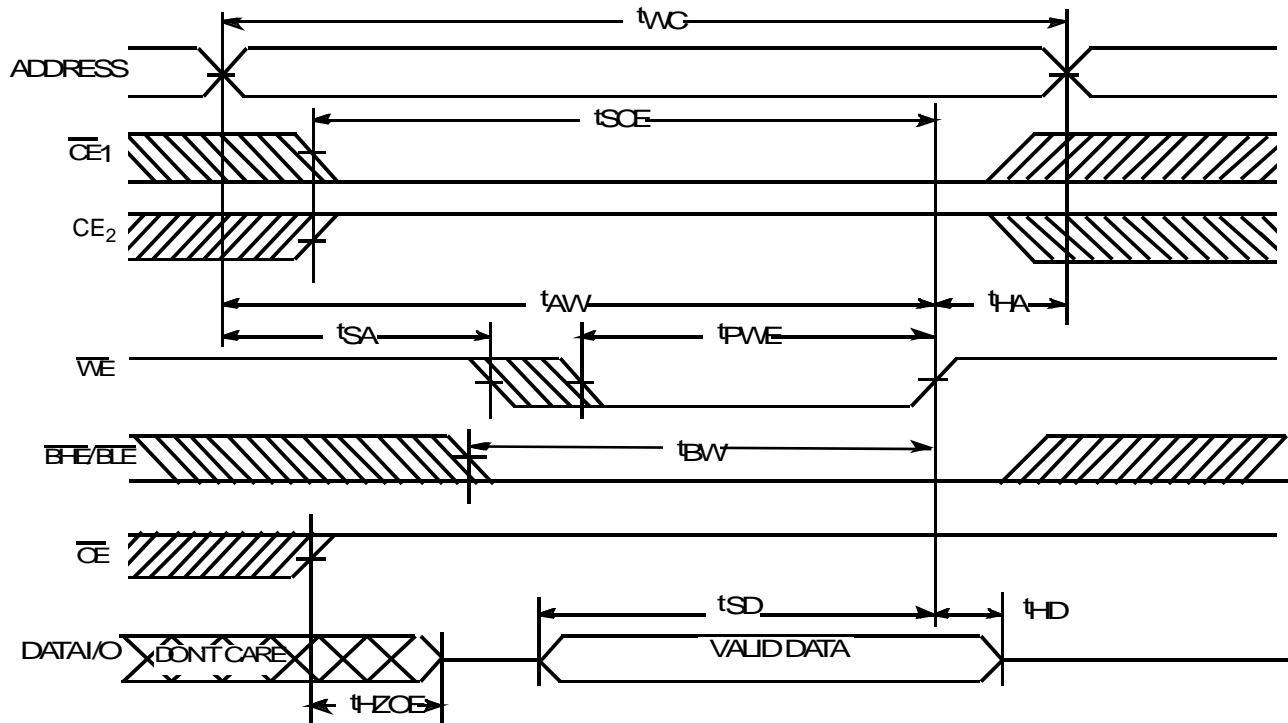
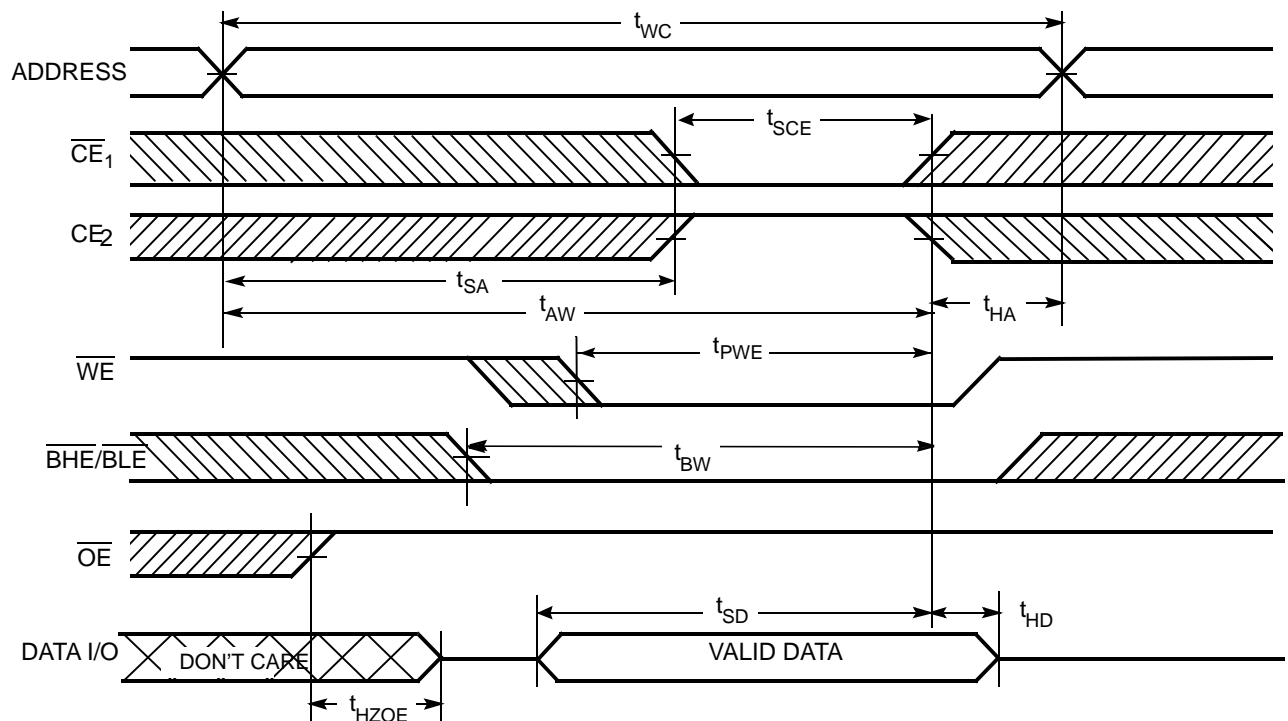
**Switching Characteristics** (Over the Operating Range) (continued)<sup>[10, 11, 12, 13, 14]</sup>

Parameter	Description	CYK512K16SCCA-55		CYK512K16SCCA-70		Unit
		Min.	Max.	Min.	Max.	
<b>Write Cycle<sup>[13]</sup></b>						
$t_{WC}$	Write Cycle Time	55		70		ns
$t_{SCE}$	$\overline{CE}_1$ LOW and $CE_2$ HIGH to Write End	45		55		ns
$t_{AW}$	Address Set-up to Write End	45		55		ns
$t_{HA}$	Address Hold from Write End	0		0		ns
$t_{SA}$	Address Set-up to Write Start	0		0		ns
$t_{PWE}$	$\overline{WE}$ Pulse Width	40		55		ns
$t_{BW}$	$\overline{BLE}/\overline{BHE}$ LOW to Write End	50		55		ns
$t_{SD}$	Data Set-up to Write End	42		42		ns
$t_{HD}$	Data Hold from Write End	0		0		ns
$t_{HZWE}$	$\overline{WE}$ LOW to High Z <sup>[11, 12]</sup>		25		25	ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low Z <sup>[11, 12]</sup>	5		5		ns

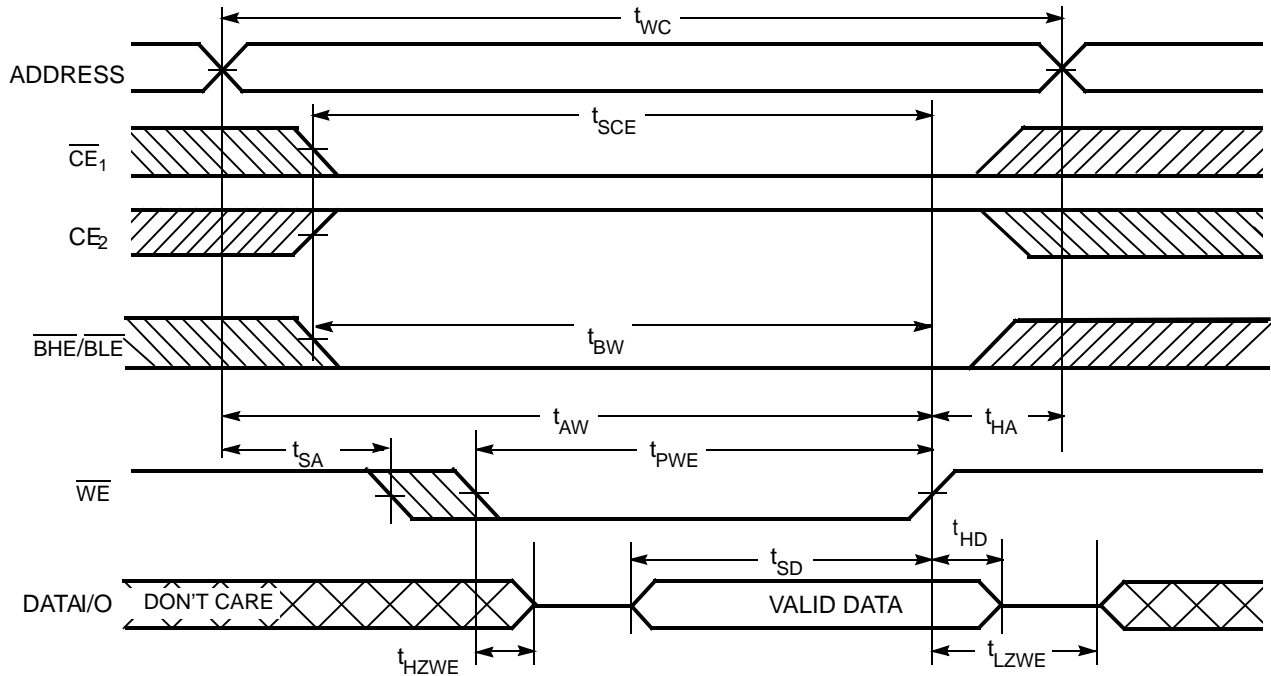
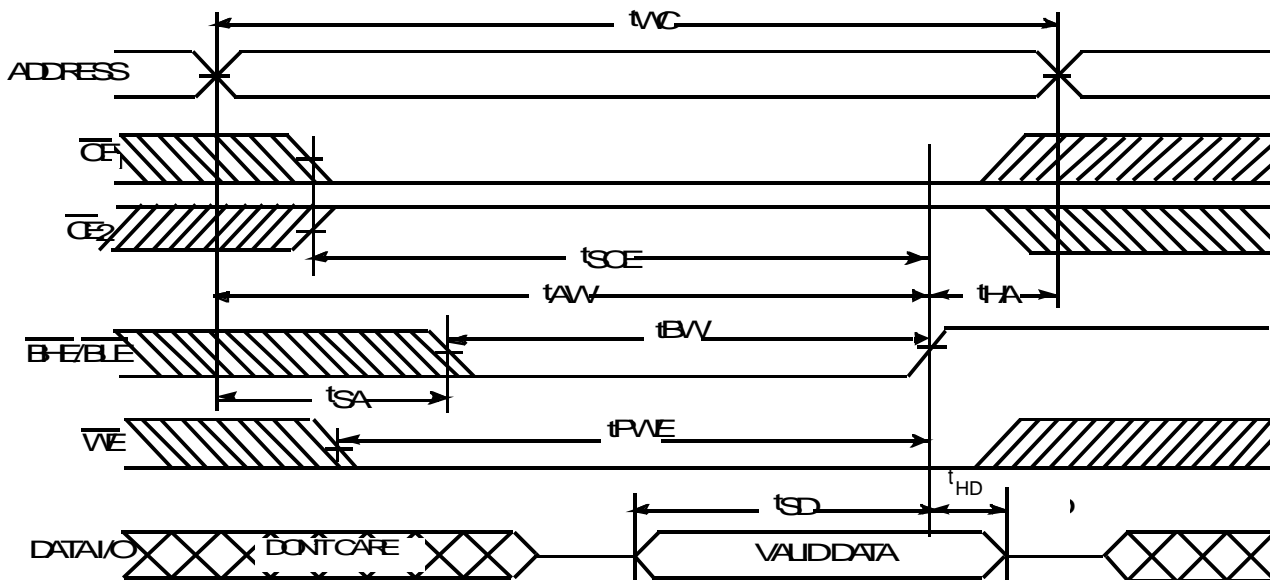
**Switching Waveforms**
**Read Cycle 1 (Address Transition Controlled)<sup>[14, 15, 16]</sup>**

**Read Cycle 2 (OE Controlled)<sup>[14, 15]</sup>**

**Notes:**

15.  $\overline{WE}$  is HIGH for Read Cycle.

16. Device is continuously selected.  $\overline{OE}$ ,  $\overline{CE} = V_{IL}$ .

**Switching Waveforms (continued)**
**Write Cycle No. 1 (WE Controlled)<sup>[12, 13, 17, 18, 19]</sup>**

**Write Cycle 2 (CE1 or CE2 Controlled)<sup>[12, 13, 17, 18, 19]</sup>**

**Notes:**

17. Data I/O is high impedance if  $\overline{OE} \geq V_{IH}$ .
18. If Chip Enable goes INACTIVE simultaneously with  $\overline{WE} = \text{HIGH}$ , the output remains in a high-impedance state.
19. During the DON'T CARE period in the DATA I/O waveform, the I/Os are in output state and input signals should not be applied.

**Switching Waveforms (continued)**
**Write Cycle 3 ( $\overline{\text{WE}}$  Controlled,  $\overline{\text{OE}}$  LOW)<sup>[18, 19]</sup>**

**Write Cycle No. 4 ( $\overline{\text{BHE}}/\overline{\text{BLE}}$  Controlled,  $\overline{\text{OE}}$  LOW)<sup>[18, 19]</sup>**


**Truth Table<sup>[20]</sup>**

$\overline{CE}_1$	$\overline{CE}_2$	$\overline{WE}$	$\overline{OE}$	$\overline{BHE}$	$\overline{BLE}$	Inputs/Outputs	Mode	Power
H	X	X	X	X	X	High Z	Deselect/Power-down	Standby ( $I_{SB}$ )
X	L	X	X	X	X	High Z	Deselect/Power-down	Standby ( $I_{SB}$ )
X	X	X	X	H	H	High Z	Deselect/Power-down	Standby ( $I_{SB}$ )
L	H	H	L	L	L	Data Out ( $I/O_0$ – $I/O_{15}$ )	Read (Upper Byte and Lower Byte)	Active ( $I_{CC}$ )
L	H	H	L	H	L	Data Out ( $I/O_0$ – $I/O_7$ ); $I/O_8$ – $I/O_{15}$ in High Z	Read (Lower Byte only)	Active ( $I_{CC}$ )
L	H	H	L	L	H	Data Out ( $I/O_8$ – $I/O_{15}$ ); $I/O_0$ – $I/O_7$ in High Z	Read (Upper Byte only)	Active ( $I_{CC}$ )
L	H	H	H	L	L	High Z	Output Disabled	Active ( $I_{CC}$ )
L	H	H	H	H	L	High Z	Output Disabled	Active ( $I_{CC}$ )
L	H	H	H	L	H	High Z	Output Disabled	Active ( $I_{CC}$ )
L	H	L	X	L	L	Data In ( $I/O_0$ – $I/O_{15}$ )	Write (Upper Byte and Lower Byte)	Active ( $I_{CC}$ )
L	H	L	X	H	L	Data In ( $I/O_0$ – $I/O_7$ ); $I/O_8$ – $I/O_{15}$ in High Z	Write (Lower Byte Only)	Active ( $I_{CC}$ )
L	H	L	X	L	H	Data In ( $I/O_8$ – $I/O_{15}$ ); $I/O_0$ – $I/O_7$ in High Z	Write (Upper Byte Only)	Active ( $I_{CC}$ )

**Ordering Information**

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
55	CYK512K16SCCAU-55BAI	BA48K	48-ball Fine Pitch BGA (6.0 x 8.0 x 1.2 mm)	Industrial
70	CYK512K16SCCAU-70BAI	BA48K	48-ball Fine Pitch BGA (6.0 x 8.0 x 1.2 mm)	Industrial
55	CYK512K16SCAU-55BAXI	BA48K	48-ball Fine Pitch BGA (6.0 x 8.0 x 1.2 mm) (Pb-Free)	Industrial
70	CYK512K16SCAU-70BAXI	BA48K	48-ball Fine Pitch BGA (6.0 x 8.0 x 1.2 mm) (Pb-Free)	Industrial

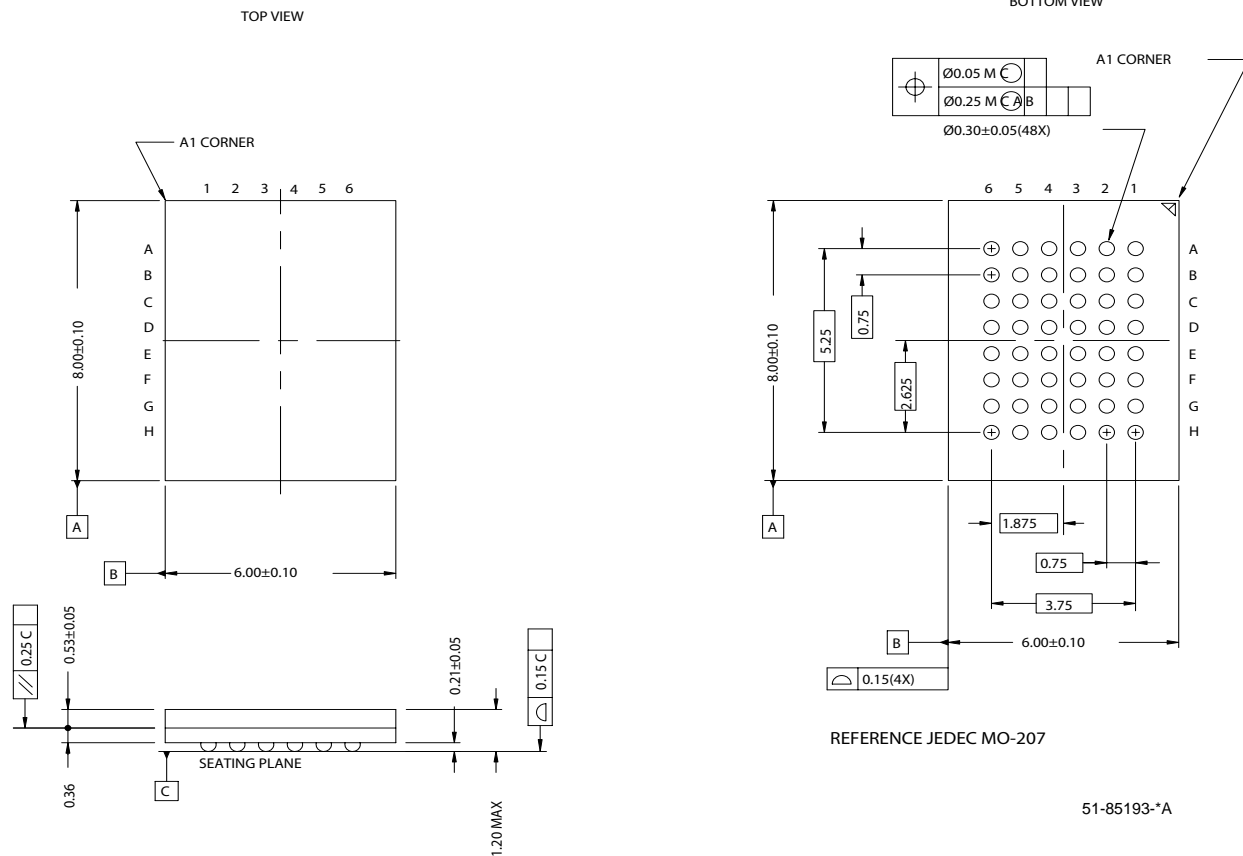
**Note:**

20. H = Logic HIGH, L = Logic LOW, X = Don't Care



**Package Diagrams**

**48-Ball (6 mm x 8 mm x 1.2 mm) FBGA BA48K**



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**Document History Page**

Document Title: CYK512K16SCCA 8-Mbit (512K x 16) Pseudo Static RAM Document #: 38-05425				
REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	130538	01/27/04	AWK	New Data Sheet
*A	216680	See ECN	REF	Added 55 ns Speed bin Updated from Advance Information to Final Data Sheet.
*B	220121	See ECN	REF	Changed the $t_{OHA}$ for 70 ns speed grade from 10 ns to 5 ns Changed the $I_{SB2}$ from 80 $\mu$ A to 100 $\mu$ A
*C	230851	See ECN	AJU	Changed Ordering code from CYK512K16SCCA to CYK512K16SCCAU in 'Ordering Information' table Modified MAX limit on DC Input voltage from 3.3V to 3.7V in 'Maximum Ratings' section
*D	283389	See ECN	REF	Changed the $t_{SD}$ write parameter from 25ns to 42ns for both the 55ns and 70ns speed grade.
*E	313999	See ECN	RKF	Added Pb-Free parts to the Ordering information