

4-Mbit (256K x 16) Pseudo Static RAM

Features

- **Wide voltage range: 2.70V–3.30V**
- **Access time: 55 ns, 60 ns and 70 ns**
- **Ultra-low active power**
 - Typical active current: 1 mA @ f = 1 MHz
 - Typical active current: 8 mA @ f = f_{max} (70-ns speed)
- **Ultra low standby power**
- **Automatic power-down when deselected**
- **CMOS for optimum speed/power**
- **Offered in a 48-ball BGA package**

Functional Description^[1]

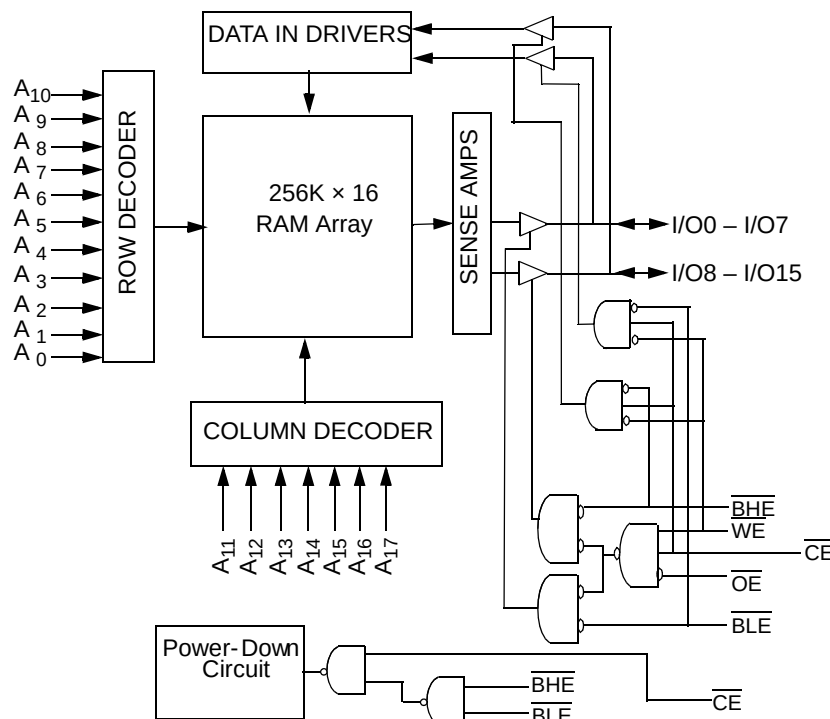
The CYK256K16MCCB is a high-performance CMOS Pseudo static RAM organized as 256K words by 16 bits that supports an asynchronous memory interface. This device features advanced circuit design to provide ultra-low active current. This is ideal for providing More Battery Life™ (MoBL®) in portable applications such as cellular telephones. The device

can be put into standby mode when deselected ($\overline{\text{CE}}$ HIGH or both $\overline{\text{BHE}}$ and $\overline{\text{BLE}}$ are HIGH). The input/output pins (I/O_0 through I/O_{15}) are placed in a high-impedance state when: deselected (CE HIGH), outputs are disabled (OE HIGH), both $\overline{\text{Byte High Enable}}$ and $\overline{\text{Byte Low Enable}}$ are disabled ($\overline{\text{BHE}}$, $\overline{\text{BLE}}$ HIGH), or during a write operation (CE LOW and WE LOW).

Writing to the device is accomplished by taking Chip Enable (CE LOW) and Write Enable (WE) input LOW. If $\overline{\text{Byte Low Enable}}$ ($\overline{\text{BLE}}$) is LOW, then data from I/O pins (I/O_0 through I/O_7) is written into the location specified on the address pins (A_0 through A_{17}). If $\overline{\text{Byte High Enable}}$ ($\overline{\text{BHE}}$) is LOW, then data from I/O pins (I/O_8 through I/O_{15}) is written into the location specified on the address pins (A_0 through A_{17}).

Reading from the device is accomplished by taking Chip Enable (CE LOW) and Output Enable (OE) LOW while forcing the Write Enable (WE) HIGH. If $\overline{\text{Byte Low Enable}}$ ($\overline{\text{BLE}}$) is LOW, then data from the memory location specified by the address pins will appear on I/O_0 to I/O_7 . If $\overline{\text{Byte High Enable}}$ ($\overline{\text{BHE}}$) is LOW, then data from memory will appear on I/O_8 to I/O_{15} . Refer to the truth table for a complete description of read and write modes.

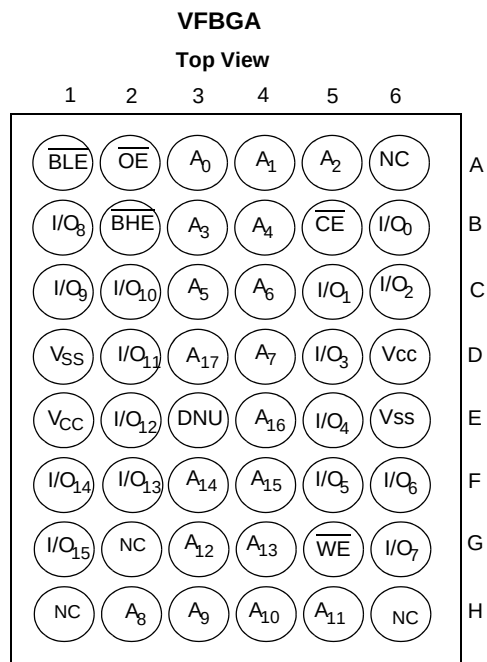
Logic Block Diagram



Note:

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

Pin Configuration^[2, 3, 4]



Product Portfolio

Product	V _{CC} Range (V)			Speed (ns)	Power Dissipation					
					Operating I _{CC} (mA)				Standby I _{SB} (μA)	
					f = 1MHz		f = f _{max}			
	Min.	Typ. ^[5]	Max.		Typ. ^[5]	Max.	Typ. ^[5]	Max.	Typ. ^[5]	Max.
	CYK256K16MCCB	2.70	3.0		3.30	55	1	5	14	22
60										
70				8		15				

Notes:

- Ball H1, G2 and ball H6 for the VFBGA package can be used to upgrade to an 8-Mbit, 16-Mbit and 32-Mbit density, respectively.
- NC "no connect" – not connected internally to the die.
- DNU (Do Not Use) pins have to be left floating or tied to V_{SS} to ensure proper application.
- Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at V_{CC} = V_{CC(typ.)}, T_A = 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 -55°C to + 125°C

Supply Voltage to Ground Potential -0.4V to 4.6V

DC Voltage Applied to Outputs

in High-Z State^[6, 7, 8] -0.4V to 3.7V

DC Input Voltage^[6, 7, 8] -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	V _{CC}
Industrial	-25°C to +85°C	2.70V to 3.30V

Electrical Characteristics Over the Operating Range

Parameter	Description	Test Conditions	CYK256K16MCCB -55, 60, 70			Unit
			Min.	Typ. ^[5]	Max.	
V _{CC}	Supply Voltage		2.7	3.0	3.3	V
V _{OH}	Output HIGH Voltage	I _{OH} = -0.1 mA V _{CC} = 2.70V	V _{CC} - 0.4			V
V _{OL}	Output LOW Voltage	I _{OL} = 0.1 mA V _{CC} = 2.70V			0.4	V
V _{IH}	Input HIGH Voltage		0.8 * V _{CC}		V _{CC} + 0.4V	V
V _{IL}	Input LOW Voltage		-0.4		0.6	V
I _{IX}	Input Leakage Current	GND ≤ V _{IN} ≤ V _{CC}	-1		+1	μA
I _{OZ}	Output Leakage Current	GND ≤ V _{OUT} ≤ V _{CC} , Output Disabled	-1		+1	μA
I _{CC}	V _{CC} Operating Supply Current	f = f _{MAX} = 1/t _{RC} V _{CC} = V _{CCmax} I _{OUT} = 0 mA CMOS levels		14 for -55 14 for -60 8 for -70	22 for -55 22 for -60 15 for -70	mA
		f = 1 MHz		1 for all speeds	5 for all speeds	mA
I _{SB1}	Automatic CE Power-Down Current—CMOS Inputs	CE ≥ V _{CC} - 0.2V V _{IN} ≥ V _{CC} - 0.2V, V _{IN} ≤ 0.2V f = f _{MAX} (Address and Data Only), f = 0 (OE, WE, BHE and BLE), V _{CC} = 3.30V	V _{CC} = 3.3V	150	250	μA
I _{SB2}	Automatic CE Power-Down Current—CMOS Inputs	CE ≥ V _{CC} - 0.2V V _{IN} ≥ V _{CC} - 0.2V or V _{IN} ≤ 0.2V, f = 0, V _{CC} = 3.30V	V _{CC} = 3.3V	17	40	μA

Thermal Resistance^[9]

Parameter	Description	Test Conditions	BGA	Unit
Θ _{JA}	Thermal Resistance (Junction to Ambient)	Test conditions follow standard test methods and procedures for measuring thermal impedance, per EIA/JESD51.	55	°C/W
Θ _{JC}	Thermal Resistance (Junction to Case)		17	°C/W

Capacitance^[9]

Parameter	Description	Test Conditions	Max.	Unit
C _{IN}	Input Capacitance	T _A = 25°C, f = 1 MHz, V _{CC} = V _{CC(typ)}	8	pF
C _{OUT}	Output Capacitance		8	pF

Notes:

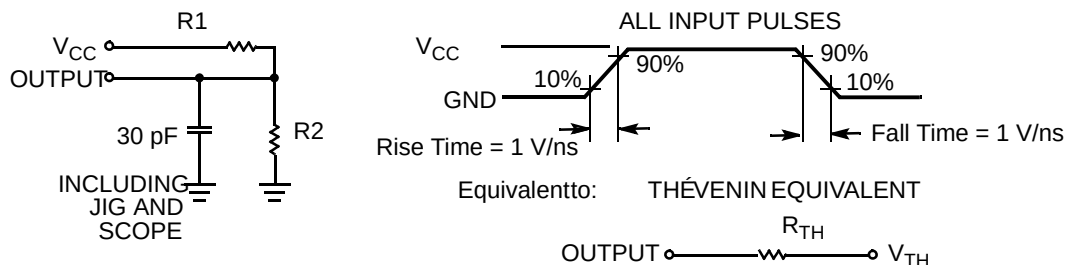
6. V_{IL(MIN)} = -0.5V for pulse durations less than 20 ns.

7. V_{IH(Max)} = V_{CC} + 0.5V for pulse durations less than 20 ns.

8. Overshoot and undershoot specifications are characterized and are not 100% tested.

9. Tested initially and after any design or process changes that may affect these parameters.

AC Test Loads and Waveforms



Parameters	3.0V V _{CC}	Unit
R1	22000	Ω
R2	22000	Ω
R _{TH}	11000	Ω
V _{TH}	1.50	V

Switching Characteristics Over the Operating Range^[10]

Parameter	Description	55 ns ^[14]		60 ns		70 ns		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
Read Cycle								
t _{RC}	Read Cycle Time	55		60		70		ns
t _{AA}	Address to Data Valid		55		60		70	ns
t _{OHA}	Data Hold from Address Change	5		8		10		ns
t _{ACE}	$\overline{\text{CE}}$ LOW to Data Valid		55		60		70	ns
t _{DOE}	$\overline{\text{OE}}$ LOW to Data Valid		25		25		35	ns
t _{LZOE}	$\overline{\text{OE}}$ LOW to LOW Z ^[11, 13]	5		5		5		ns
t _{HZOE}	$\overline{\text{OE}}$ HIGH to High Z ^[11, 13]		25		25		25	ns
t _{LZCE}	$\overline{\text{CE}}$ LOW to Low Z ^[11, 13]	2		2		5		ns
t _{HZCE}	$\overline{\text{CE}}$ HIGH to High Z ^[11, 13]		25		25		25	ns
t _{DBE}	BLE/BHE LOW to Data Valid		55		60		70	ns
t _{LZBE}	BLE/BHE LOW to Low Z ^[11, 13]	5		5		5		ns
t _{HZBE}	BLE/BHE HIGH to HIGH Z ^[11, 13]		10		10		25	ns
t _{SK} ^[14]	Address Skew		0		5		10	ns
Write Cycle ^[12]								
t _{WC}	Write Cycle Time	55		60		70		ns
t _{SCE}	$\overline{\text{CE}}$ LOW to Write End	45		45		60		ns
t _{AW}	Address Set-Up to Write End	45		45		55		ns
t _{HA}	Address Hold from Write End	0		0		0		ns
t _{SA}	Address Set-Up to Write Start	0		0		0		ns
t _{PWE}	$\overline{\text{WE}}$ Pulse Width	40		40		45		ns

Notes:

10. Test conditions for all parameters other than tri-state parameters assume signal transition time of 1 ns/V, timing reference levels of V_{CC(typ)}/2, input pulse levels of 0V to V_{CC(typ)}, and output loading of the specified I_{OL}/I_{OH} as shown in the "AC Test Loads and Waveforms" section.

11. t_{HZOE}, t_{HZCE}, t_{HZBE}, and t_{HZWE} transitions are measured when the outputs enter a high impedance state.

12. The internal Write time of the memory is defined by the overlap of $\overline{WE}$, $\overline{CE} = V_{IL}$, BHE and/or 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 the write.

13. High-Z and Low-Z parameters are characterized and are not 100% tested.

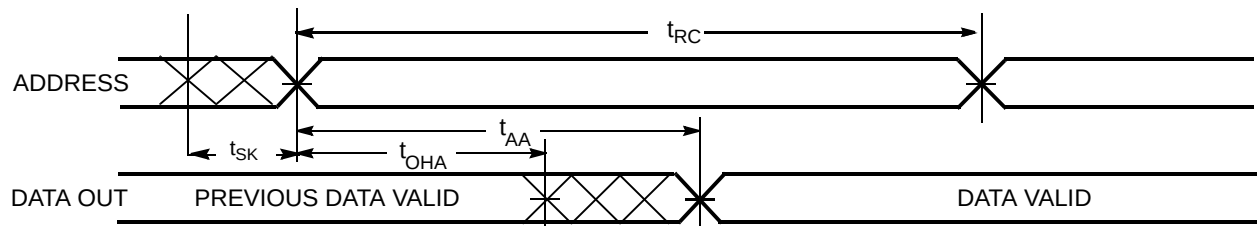
14. To achieve 55-ns performance, the read access should be $\overline{CE}$ controlled. In this case t_{ACE} is the critical parameter and t_{SK} is satisfied when the addresses are stable prior to chip enable going active. For the 70-ns cycle, the addresses must be stable within 10 ns after the start of the read cycle.

Switching Characteristics Over the Operating Range^[10] (continued)

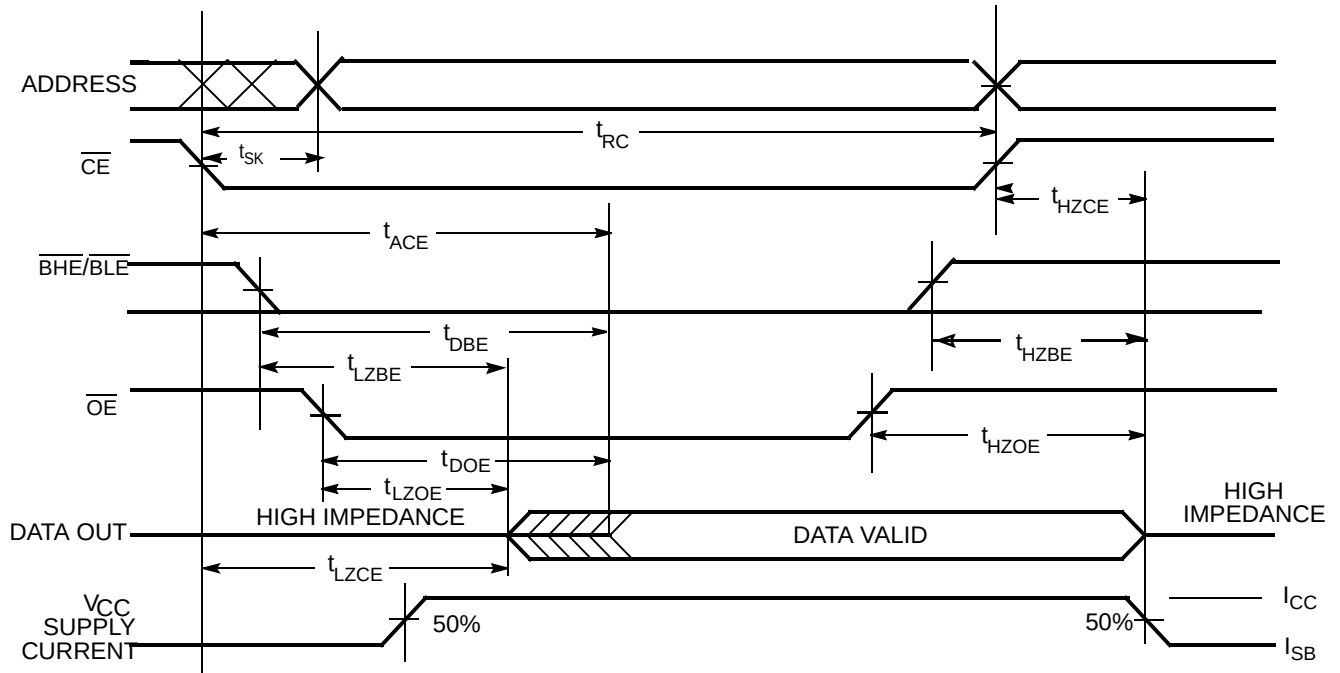
Parameter	Description	55 ns ^[14]		60 ns		70 ns		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
t_{BW}	BLE/BHE LOW to Write End	50		50		55		ns
t_{SD}	Data Set-Up to Write End	25		25		25		ns
t_{HD}	Data Hold from Write End	0		0		0		ns
t_{HZWE}	WE LOW to High-Z ^[11, 13]		25		25		25	ns
t_{LZWE}	WE HIGH to Low-Z ^[11, 13]	5		5		5		ns

Switching Waveforms

Read Cycle 1 (Address Transition Controlled)^[14, 15, 16]



Read Cycle 2 (OE Controlled)^[14, 16]

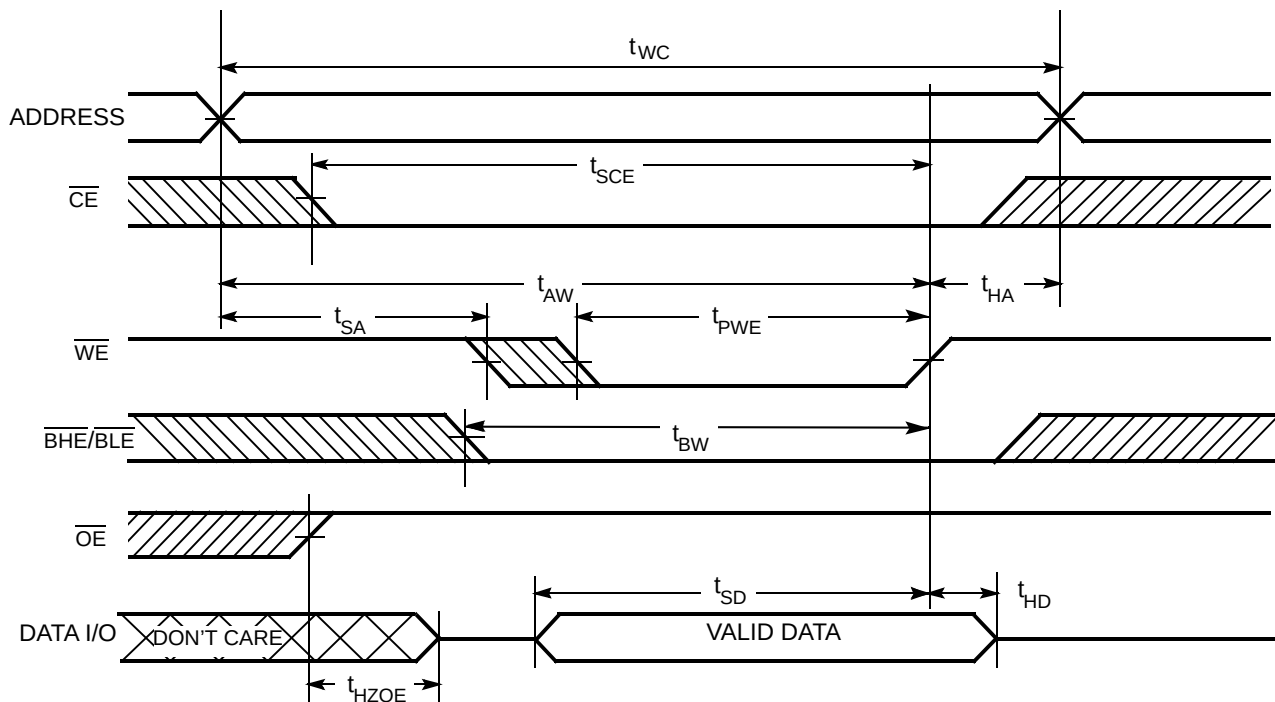


Notes:

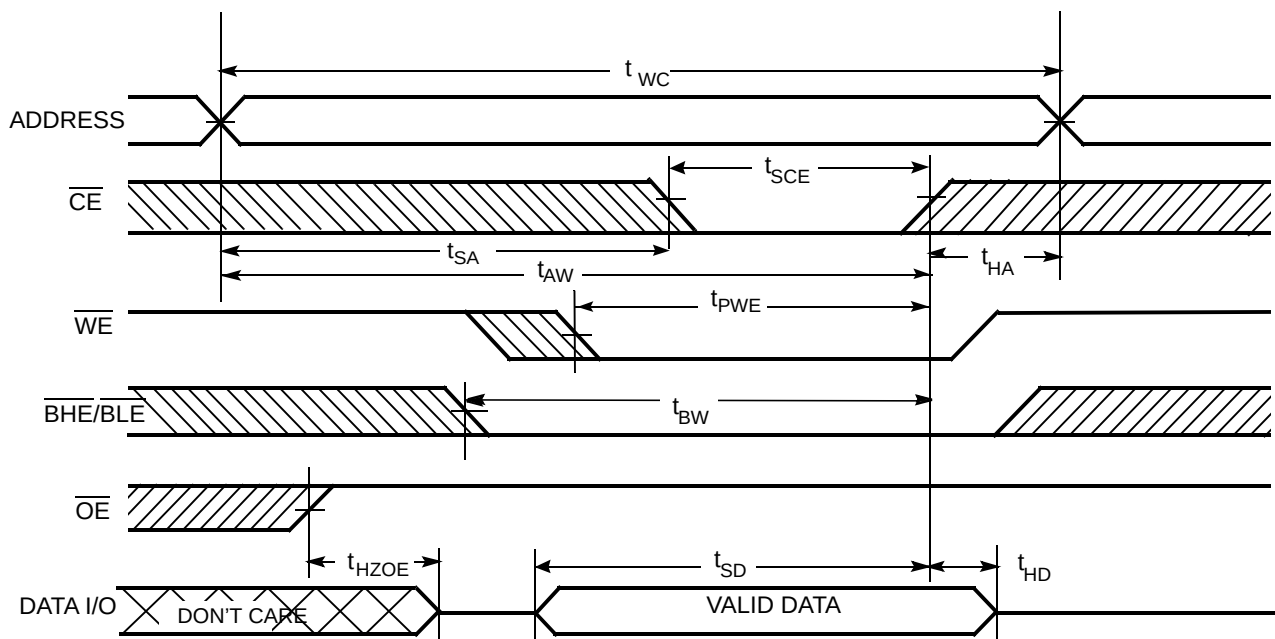
15. Device is continuously selected. $\overline{OE}$, $\overline{CE} = V_{IL}$.
16. WE is HIGH for Read Cycle.

Switching Waveforms (continued)

Write Cycle 1 ($\overline{\text{WE}}$ Controlled) [12, 13, 17, 18, 19]



Write Cycle 2 ($\overline{\text{CE}}$ Controlled) [12, 13, 17, 18, 19]

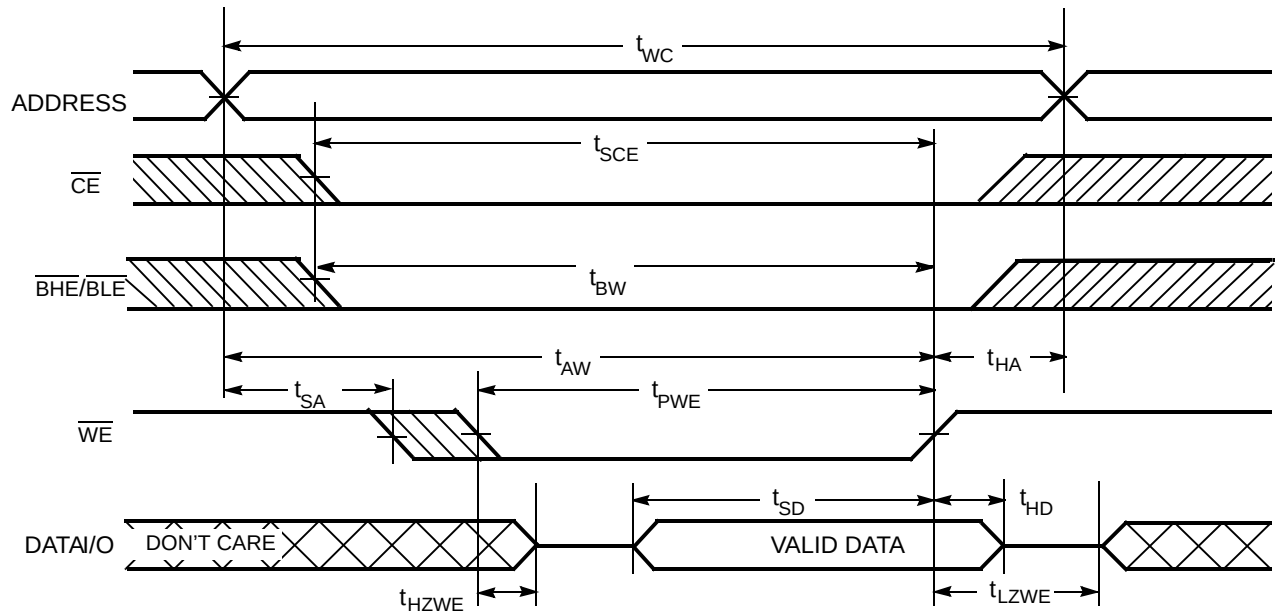


Notes:

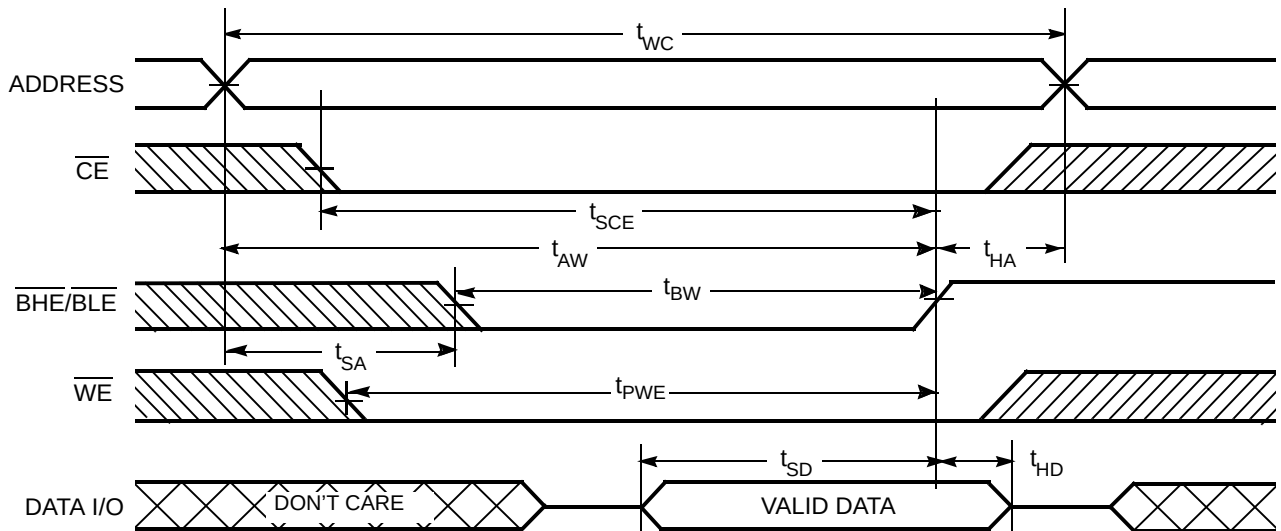
17. Data I/O is high-impedance if $\overline{\text{OE}} \geq V_{\text{IH}}$.
18. If Chip Enable goes INACTIVE with $\overline{\text{WE}} = V_{\text{IH}}$, the output remains in a high-impedance state.
19. During this period in the DATA I/O waveform, the I/Os could be in the output state and input signals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

Switching Waveforms (continued)

Write Cycle 3 ($\overline{\text{WE}}$ Controlled, $\overline{\text{OE}}$ LOW)^[18, 19]



Write Cycle 4 ($\overline{\text{BHE/BLE}}$ Controlled, $\overline{\text{OE}}$ LOW)^[18, 19]



Truth Table ^[20]

CE	WE	OE	BHE	BLE	Inputs/Outputs	Mode	Power
H	X	X	X	X	High Z	Deselect/Power-Down	Standby (I _{SB})
X	X	X	H	H	High Z	Deselect/Power-Down	Standby (I _{SB})
L	H	L	L	L	Data Out (I/O0 – I/O15)	Read	Active (I _{CC})
L	H	L	H	L	Data Out (I/O0 – I/O7); High Z (I/O8 – I/O15)	Read	Active (I _{CC})
L	H	L	L	H	High Z (I/O0 – I/O7); Data Out (I/O8 – I/O15)	Read	Active (I _{CC})
L	H	H	L	H	High Z	Output Disabled	Active (I _{CC})
L	H	H	H	L	High Z	Output Disabled	Active (I _{CC})
L	H	H	L	L	High Z	Output Disabled	Active (I _{CC})
L	L	X	L	L	Data In (I/O0 – I/O15)	Write	Active (I _{CC})
L	L	X	H	L	Data In (I/O0 – I/O7); High Z (I/O8 – I/O15)	Write	Active (I _{CC})
L	L	X	L	H	High Z (I/O0 – I/O7); Data In (I/O8 – I/O15)	Write	Active (I _{CC})

Ordering Information

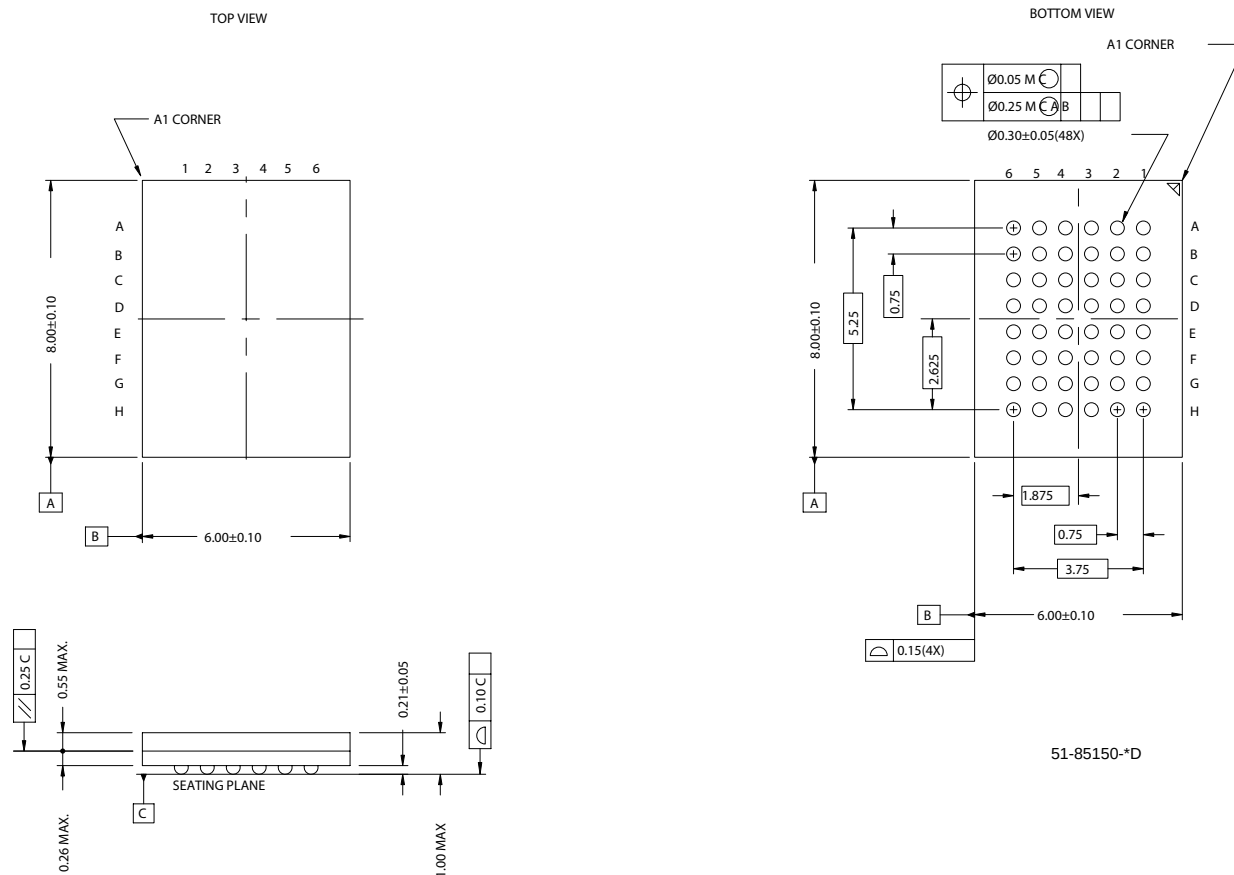
Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
55	CYK256K16MCCBU-55BVI	51-85150	48-ball Fine Pitch BGA (6 mm × 8mm × 1.0 mm)	Industrial
	CYK256K16MCBU-55BVXI		48-ball Fine Pitch BGA (6 mm × 8mm × 1.0 mm) (Pb-Free)	
60	CYK256K16MCCBU-60BVI	51-85150	48-ball Fine Pitch BGA (6 mm × 8mm × 1.0 mm)	Industrial
70	CYK256K16MCCBU-70BVI	51-85150	48-ball Fine Pitch BGA (6 mm × 8mm × 1.0 mm)	Industrial
	CYK256K16MCBU-70BVXI		48-ball Fine Pitch BGA (6 mm × 8mm × 1.0 mm) (Pb-Free)	

Note:

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

Package Diagram

48-ball VFBGA (6 x 8 x 1 mm) (51-85150)



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Document History Page

Document Title: CYK256K16MCCB MoBL3™ 4-Mbit (256K x 16) Pseudo Static RAM Document Number: 38-05585				
REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	223482	See ECN	REF	New data sheet
*A	234474	See ECN	SYT	Changed ball E3 on package pinout from NC to DNU
*B	260330	See ECN	PCI	Changed from preliminary to final
*C	298651	See ECN	PCI	Added 60-ns speed bin
*D	314013	See ECN	RKF	Added Pb-Free parts to the Ordering information
*E	397852	See ECN	SYT	Changed address of Cypress Semiconductor Corporation on Page# 1 from "3901 North First Street" to "198 Champion Court" Changed typo in ordering code from CYK256K16MCCB to CYK256K16MCCBU in the "Ordering Information" on Page#8 Updated the revision of package diagram of Spec 51-85150 from *B to *D
*F	522566	See ECN	NXR	Changed V _{IL} Max spec from 0.4 V to 0.6 V in DC Electrical Characteristics table