

CY62146E MoBL[®]

4-Mbit (256 K × 16) Static RAM

Features

- Very high speed: 45 ns
- Wide voltage range: 4.5 V to 5.5 V
- Ultra low standby power
 Typical standby current: 1 μA
 Maximum standby current: 7 μA
- Ultra low active power
 Typical active current: 2 mA at f = 1 MHz
- Easy memory expansion with CE and OE features
- Automatic power down when deselected
- Complementary metal oxide semiconductor (CMOS) for optimum speed and power
- Available in Pb-free 44-pin thin small outline package (TSOP) Type II package

Functional Description

The CY62146E is a high performance CMOS static RAM organized as 256K words by 16 bits. This device features advanced circuit design to provide ultra low active current. It is ideal for providing More Battery Life™ (MoBL[®]) in portable applications. The device also has an automatic power down

Logic Block Diagram

feature that reduces power consumption when addresses are not toggling. Placing the device into standby mode reduces power consumption by more than 99% when deselected (\overline{CE} HIGH). The input and output pins (I/O₀ through I/O₁₅) are placed in a high impedance state when the device is deselected (\overline{CE} HIGH), the outputs are disabled (\overline{OE} HIGH), both Byte High Enable and Byte Low Enable are disabled (BHE, BLE HIGH) or during a write operation (\overline{CE} LOW and WE LOW).

<u>To write</u> to the device, take Chip Enable $\overline{(CE)}$ and Write Enable $\overline{(WE)}$ inputs LOW. If Byte Low Enable (BLE) is LOW, then data from I/O pins (I/O₀ through I/O₇) is written into the location specified on the address pins (A₀ through A₁₇). If Byte High Enable (BHE) is LOW, then data from I/O pins (I/O₈ through I/O₁₅) is written into the location specified on the address pins (A₀ through A₁₇).

To read <u>from</u> the device, take Chip Enable ($\overline{\text{CE}}$) and Output Enable ($\overline{\text{OE}}$) LOW <u>while</u> forcing the Write Enable (WE) HIGH. If Byte Low Enable (BLE) is LOW, then data from the memory location specified by <u>the a</u>ddress pins appears on I/O₀ to I/O₇. If Byte High Enable (BHE) is LOW, then data from memory appears on I/O₈ to I/O₁₅. See Truth Table on page 11 for a complete description of read and write modes.

The CY62146E device is suitable for interfacing with processors that have TTL I/P levels. It is not suitable for processors that require CMOS I/P levels. Please Electrical Characteristics on page 4 for more details and suggested alternatives.



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CY62146E MoBL[®]

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Pin Configurations

Figure 1. 44-pin TSOP II pinout (Top View) ^[1]

A₄ 🗖 1	44 🗖 A ₅
A ₃ <u>□</u> 2	43 🗖 A ₆
A ₂ <u> </u>	42 🗖 A7
A ₁ <u>□</u> 4	41 🗖 OE
A ₀ <u>□</u> 5	40 🗆 BHE
CE C 6	39 🗆 BLE
I/O ₀ <u>□</u> 7	38 🗖 I/O ₁₅
I/O ₁ □ 8	37 🗖 I/O ₁₄
I/O ₂ ☐ 9	36 🗍 I/O ₁₃
I/O ₃ ☐ 10	35 🗍 I/O ₁₂
V _{CC} □11	34 □ V _{SS}
V _{SS} □ 12	33 🗆 V _{CC}
I/O ₄ ∐ 13	32 🔲 I/O ₁₁
I/O ₅ ☐ 14	31 🗖 I/O ₁₀
I/O ₆ 15	30 🗖 I/O ₉
<u>I/O₇</u> 16	29 🗋 I/O ₈
WE 🗆 17	28 🗆 NC
A ₁₇ □ 18	27 🗖 A ₈
A ₁₆ 19	26 🗌 A ₉
A ₁₅ 20	25 🗌 A ₁₀
	24 🗋 A ₁₁
A ₁₃ <u></u> 22	23 🗋 A ₁₂

Product Portfolio

							F	ower Di	ssipatio	n	
Product	Range	V	_{CC} Range (V)	Speed	0	perating	l I _{CC} , (m/	4)	Standb	oy, I _{SB2}
Froduct	Nange				(ns)	f = 1 MHz f = f _{max}		(μÅ)			
		Min	Тур [2]	Max		Typ ^[2]	Max	Typ ^[2]	Мах	Typ ^[2]	Max
CY62146ELL	Industrial / Automotive-A	4.5	5.0	5.5	45	2	2.5	15	20	1	7

Notes

NC pins are not connected on the die.
NC pins are not connected on the die.
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

Exceeding maximum ratings may impair the useful life of the device. These user guidelines are not tested.

Storage temperature	–65 °C to +150 °C
Ambient temperature with power applied	–55 °C to +125 °C
Supply voltage to ground potential	–0.5 V to 6.0 V
DC voltage applied to outputs in high Z state ^[3, 4]	–0.5 V to 6.0 V
DC input voltage ^[3, 4]	–0.5 V to 6.0 V

Output current into outputs (LOW)	20 mA
Static discharge voltage	
(MIL-STD-883, Method 3015)>2	2001 V
Latch-up current>2	200 mA

Operating Range

Device	Range	Ambient Temperature	V_{CC} ^[5]
CY62146ELL	Industrial / Automotive-A	–40 °C to +85 °C	4.5 V–5.5 V

Electrical Characteristics

Over the Operating Range

Parameter	Description	Tost Co	Test Conditions		45 ns (Industrial/Automotive-A)			
Farameter	Description	lest col	lations	Min	Тур ^[6]	Max	Unit	
V _{OH}	Output high voltage	$V_{CC} = 4.5 V$	I _{OH} = -1.0 mA	2.4	-	-	V	
		$V_{CC} = 5.5 V$	I _{OH} = -0.1 mA	_	_	3.4 ^[7]		
V _{OL}	Output low voltage	I _{OL} = 2.1 mA	·	_	-	0.4	V	
V _{IH}	Input high voltage	4.5 <u>≤</u> V _{CC} <u>≤</u> 5.5		2.2	-	V _{CC} + 0.5	V	
V _{IL}	Input low voltage	$4.5 \le V_{CC} \le 5.5$	$4.5 \le V_{CC} \le 5.5$		-	0.8	V	
I _{IX}	Input leakage current	$GND \leq V_I \leq V_{CC}$		-1	-	+1	μA	
I _{OZ}	Output leakage current	$GND \leq V_O \leq V_{CC}$	output disabled	-1	-	+1	μA	
I _{CC}	V _{CC} operating supply current	$f = f_{max} = 1/t_{RC}$	$V_{CC} = V_{CCmax}$	_	15	20	mA	
		f = 1 MHz	I _{OUT} = 0 mA, CMOS levels	-	2	2.5		
I _{SB2} ^[8]	Automatic CE power down current – CMOS inputs	$\label{eq:constraint} \begin{array}{ c c } \hline \overline{CE} \geq V_{CC} - 0.2 \\ V_{IN} \geq V_{CC} - 0.2 \\ f = 0, \ V_{CC} = V_{CC} \end{array}$	√, V or V _{IN} <u><</u> 0.2 V, _(max)	-	1	7	μA	

Notes

- 3. $V_{IL}(min) = -2.0$ V for pulse durations less than 20 ns for I < 30 mA.
- 4. $V_{IH}(max) = V_{CC} + 0.75$ V for pulse durations less than 20 ns.

V_{IH}(max) = V_{CC} + 0.75 V for pulse durations less than 20 hs.
 Full Device AC operation assumes a minimum of 100 μs ramp time from 0 to V_{CC} (min) and 200 μs wait time after V_{CC} stabilization.
 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.
 Please note that the maximum V_{OH} limit does not exceed minimum CMOS V_{IH} of 3.5 V. If you are interfacing this SRAM with 5 V legacy processors that require a minimum V_{IH} <u>of 3.5 V</u>, please refer to <u>Application Note AN6081</u> for technical details and options you may consider.
 Chip enable (CE) and byte enables (BHE and BLE) need to be tied to CMOS levels to meet the I_{SB2} / I_{CCDR} spec. Other inputs are left floating.



Capacitance

Parameter ^[9]	Description	Test Conditions	Max	Unit
C _{IN}	Input capacitance	$T_A = 25 \text{ °C}, f = 1 \text{ MHz}, V_{CC} = V_{CC(typ)}$	10	pF
C _{OUT}	Output capacitance		10	pF

Thermal Resistance

Parameter ^[9]	Description	Test Conditions	44-pin TSOP II	Unit
Θ_{JA}		Still Air, soldered on a 3×4.5 inch, two layer printed circuit board	77	°C/W
Θ _{JC}	Thermal resistance (junction to case)		13	°C/W

AC Test Loads and Waveforms

Figure 2. AC Test Loads and Waveforms



Parameters	5.0 V	Unit
R1	1800	Ω
R2	990	Ω
R _{TH}	639	Ω
V _{TH}	1.77	V



Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions	Min	Typ ^[10]	Max	Unit
V _{DR}	V _{CC} for data retention		2	-	-	V
I _{CCDR} ^[11]	Data retention current	$V_{CC} = 2 \text{ V}, \overline{CE} \ge V_{CC} - 0.2 \text{ V},$ $V_{IN} \ge V_{CC} - 0.2 \text{ V or } V_{IN} \le 0.2 \text{ V}$	-	1	7	μA
t _{CDR} ^[12]	Chip deselect to data retention time		0	_	_	ns
t _R ^[13]	Operation recovery time		45	_	_	ns

Data Retention Waveform

Figure 3. Data Retention Waveform



Notes

10. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at $V_{CC} = V_{CC(typ)}$, $T_A = 25 \text{ °C}$. 11. Chip enable (CE) and byte enables (BHE and BLE) need to be tied to CMOS levels to meet the I_{SB2} / I_{CCDR} spec. Other inputs are left floating. 12. Tested initially and after any design or process changes that may affect these parameters. 13. Full device operation requires linear V_{CC} ramp from V_{DR} to $V_{CC(min)} \ge 100 \,\mu s$ or stable at $V_{CC(min)} \ge 100 \,\mu s$.



Switching Characteristics

Over the Operating Range

Parameter ^[14, 15]	Description	45 ns (Industria	45 ns (Industrial / Automotive-A)		
Parameter	Description	Min	Max	Unit	
Read Cycle					
t _{RC}	Read cycle time	45	-	ns	
t _{AA}	Address to data valid	-	45	ns	
t _{OHA}	Data hold from address change	10	-	ns	
t _{ACE}	CE LOW to data valid	-	45	ns	
t _{DOE}	OE LOW to data valid	_	22	ns	
t _{LZOE}	OE LOW to Low Z ^[16]	5	-	ns	
t _{HZOE}	OE HIGH to High Z ^[16, 17]	-	18	ns	
t _{LZCE}	CE LOW to Low Z ^[16]	10	-	ns	
t _{HZCE}	CE HIGH to High Z ^[16, 17]	-	18	ns	
t _{PU}	CE LOW to power-up	0	-	ns	
t _{PD}	CE HIGH to power-down	-	45	ns	
t _{DBE}	BLE/BHE LOW to data valid	-	22	ns	
t _{LZBE}	BLE/BHE LOW to Low Z ^[16]	5	-	ns	
t _{HZBE}	BLE/BHE HIGH to High Z [16, 17]	-	18	ns	
Write Cycle [18]					
t _{WC}	Write cycle time	45	-	ns	
t _{SCE}	CE LOW to write end	35	-	ns	
t _{AW}	Address setup to write end	35	-	ns	
t _{HA}	Address hold from write end	0	-	ns	
t _{SA}	Address setup to write start	0	-	ns	
t _{PWE}	WE pulse width	35	-	ns	
t _{BW}	BLE/BHE LOW to write end	35	-	ns	
t _{SD}	Data setup to write end	25	-	ns	
t _{HD}	Data hold from write end	0	-	ns	
t _{HZWE}	WE LOW to High Z ^[16, 17]	-	18	ns	
t _{LZWE}	WE HIGH to Low Z ^[16]	10	-	ns	

Notes

- 14. Test conditions for all parameters other than tri-state parameters assume signal transition time of 3 ns (1 V/ns) or less, timing reference levels of 1.5 V, input pulse levels of 0 to 3 V, and output loading of the specified I_{OL}/I_{OH} as shown in Figure 2 on page 5.
- 15. AC timing parameters are subject to byte enable signals (\overline{BHE} or \overline{BLE}) not switching when chip is disabled. See application note AN13842 for further clarification. 16. At any temperature and voltage condition, t_{HZCE} is less than t_{LZCE} , t_{HZBE} is less than t_{LZBE} , t_{HZOE} , and t_{HZWE} is less than t_{LZWE} for any device. 17. t_{HZOE} , t_{HZCE} , t_{HZBE} , and t_{HZWE} transitions are measured when the outputs enter a high-impedance state.
- 18. The internal write time of the memory is defined by the overlap of \overline{WE} , $\overline{CE} = V_{IL}$, \overline{BHE} , \overline{BLE} or both = 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 setup and hold timing must be referenced to the edge of the signal that terminates the write.



Switching Waveforms

Figure 4. Read Cycle No.1: Address Transition Controlled ^[19, 20]







Notes

19. The device is continuously selected. \overline{OE} , $\overline{CE} = V_{IL}$, \overline{BHE} , \overline{BLE} , or both = V_{IL} . 20. WE is HIGH for read cycle. 21. Address valid before or similar to \overline{CE} , \overline{BHE} , \overline{BLE} transition LOW.



Switching Waveforms (continued)



Figure 6. Write Cycle 1: WE Controlled ^[22, 23, 24]





Notes

22. Data I/O is high impedance if $\overline{OE} = V_{IH}$.

23. If \overline{CE} goes HIGH simultaneously with $\overline{WE} = V_{IH}$, the output remains in a high impedance state.

24. The internal write time of the memory is defined by the overlap of WE, CE = V_{IL}, BHE, BLE or both = V_{IL}. All signals must be active to initiate a write and any of these signals can terminate the write by going inactive. The input setup and hold timing must be referenced to the dge of the signal that terminate the write.
25. During this period, the I/Os are in output state. Do not apply input signals.



Switching Waveforms (continued)



Figure 8. Write Cycle 3: WE controlled, OE LOW ^[26, 27]





Notes

26. If CE goes HIGH simultaneously with $\overline{WE} = V_{IH}$, the output remains in a high impedance state. 27. The internal write time of the memory is defined by the overlap of WE, $\overline{CE} = V_{IL}$, \overline{BHE} , \overline{BLE} or both = V_{IL} . All signals must be active to initiate a write and any of these signals can terminate the write by going inactive. The input setup and hold timing must be referenced to the dge of the signal that terminate the write. 28. During this period, the I/Os are in output state. Do not apply input signals.



Truth Table

CE [29]	WE	OE	BHE	BLE	Inputs/Outputs	Mode	Power
Н	Х	Х	X ^[29]	X ^[29]	High Z	Deselect/power down	Standby (I _{SB})
L	Х	Х	Н	Н	High Z	Output disabled	Active (I _{CC})
L	Н	L	L	L	Data out (I/O ₀ –I/O ₁₅)	Read	Active (I _{CC})
L	Η	L	Н	L	Data out (I/O ₀ –I/O ₇); I/O ₈ –I/O ₁₅ in High-Z	Read	Active (I _{CC})
L	Н	L	L	Н	Data out (I/O ₈ –I/O ₁₅); I/O ₀ –I/O ₇ in High-Z	Read	Active (I _{CC})
L	Н	Н	L	L	High Z	Output disabled	Active (I _{CC})
L	Н	Н	Н	L	High Z	Output disabled	Active (I _{CC})
L	Н	Н	L	Н	High Z	Output disabled	Active (I _{CC})
L	L	Х	L	L	Data in (I/O ₀ –I/O ₁₅)	Write	Active (I _{CC})
L	L	Х	Н	L	Data in (I/O ₀ –I/O ₇); I/O ₈ –I/O ₁₅ in High Z	Write	Active (I _{CC})
L	L	Х	L	Η	Data in (I/O ₈ –I/O ₁₅); I/O ₀ –I/O ₇ in High Z	Write	Active (I _{CC})

Note 29. Chip enable (CE) and byte enables (BHE and BLE) must be at CMOS levels (not floating) to meet the I_{SB2} / I_{CCDR} spec. Intermediate voltage levels on these pins is not permitted.



Ordering Information

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
45	CY62146ELL-45ZSXI	51-85087	44-pin TSOP II (Pb-free)	Industrial
	CY62146ELL-45ZSXA	51-85087	44-pin TSOP II (Pb-free)	Automotive-A

Contact your local Cypress sales representative for availability of these parts.

Ordering Code Definitions





Package Diagram

Figure 10. 44-pin TSOP Z44-II Package Outline, 51-85087



51-85087 *E





Acronyms

Acronym	Description		
BHE	Byte High Enable		
BLE	Byte Low Enable		
CE	Chip Enable		
CMOS	Complementary Metal Oxide Semiconductor		
I/O	Input/Output		
OE	Output Enable		
SRAM	Static Random Access Memory		
TSOP	Thin Small Outline Package		
VFBGA	Very Fine-Pitch Ball Gird Array		
WE	Write Enable		

Document Conventions

Units of Measure

Symbol	Unit of Measure		
°C	degree Celsius		
MHz	megahertz		
μΑ	microampere		
mA	milliampere		
ns	nanosecond		
Ω	ohm		
pF	picofarad		
V	volt		
W	watt		





Document History Page

Rev.	ECN No.	Issue Date	Orig. of Change	Description of Change
**	463213	See ECN	NXR	New data sheet.
*A	684343	See ECN	VKN	Added Preliminary Automotive-A Information Updated Ordering Information Table
*В	925501	See ECN	VKN	Added footnote #8 related to I _{SB2} and I _{CCDR} Added footnote #13 related AC timing parameters
*C	1045260	See ECN	VKN	Converted Automotive-A specs from preliminary to final
*D	2073548	See ECN	VKN / AESA	Corrected typo in the Data Retention Waveform and removed its irrelevant footnote
*E	2943752	06/03/2010	VKN	Added Contents Added footnote related to chip enable in Truth Table Updated Package Diagram Added Sales, Solutions, and Legal Information
*F	3109050	12/13/2010	PRAS	Changed Table Footnotes to Footnotes. Added Ordering Code Definitions.
*G	3149059	01/20/2011	RAME	Updated as per latest template Corrected Errors in Ordering Code Definitions Added Acronyms and Units of Measure.
*H	3296704	06/29/11	RAME	Removed reference to AN1064 SRAM system guidelines
*	3921993	03/05/2013	MEMJ	Updated Switching Waveforms: Added Note 24 and refered the same note in Figure 6, Figure 7. Removed Note "WE is HIGH for read cycle." and its references in Figure 6, Figure 7. Added Note 27 and refered the same note in Figure 8, Figure 9. Updated Package Diagram: spec 51-85087 – Changed revision from *C to *E.
*J	4013949	06/04/2013	MEMJ	Updated Functional Description.
U	1010010	50,07,2010		Updated Electrical Characteristics: Added one more Test Condition " $V_{CC} = 5.5 \text{ V}$, $I_{OH} = -0.1 \text{ mA}$ " for V_{OH} parameter and added maximum value corresponding to that Test Condition. Added Note 7 and referred the same note in maximum value for V_{OH} parameter corresponding to Test Condition " $V_{CC} = 5.5 \text{ V}$, $I_{OH} = -0.1 \text{ mA}$ ".



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