PRELIMINARY

CY62187G30 MoBL

64-Mbit (4M words × 16-bit) Static RAM with Error-Correcting Code (ECC)

Features

- Ultra-low standby current
  - Typical standby current: 6 µA
  - Maximum standby current: 38 µA
- High speed: 55 ns
- Embedded error-correcting code (ECC) for single-bit error correction[1]
- Operating voltage range: 2.2 V to 3.6 V
- 1.0-V data retention
- Transistor-transistor logic (TTL) compatible inputs and outputs
- Error indication (ERR) pin to indicate 1-bit error detection and correction
- Available in Pb-free 48-ball VFBGA package

Functional Description

CY62187G30 is a high-performance CMOS, low-power (MoBL®) SRAM device with embedded ECC[2]. This device is offered in Dual Chip Enable option.

To access a Dual Chip Enable device, assert both Chip Enable inputs – $\overline{CE}_1$ as LOW and CE_2 as HIGH.

To perform data writes, assert the Write Enable ($\overline{WE}$) input LOW, and provide the data and address on the device data pins (I/O_0 through I/O_{15}) and address pins (A_0 through A_{21}) respectively. The Byte High Enable ($\overline{BHE}$) and Byte Low Enable ($\overline{BLE}$) inputs control byte writes and write data on the corresponding I/O lines to the memory location specified. $\overline{BHE}$ controls I/O_8 through I/O_{15} and $\overline{BLE}$ controls I/O_0 through I/O_7.

To perform data reads, assert the Output Enable ($\overline{OE}$) input and provide the required address on the address lines. You can access the read data on the I/O lines (I/O_0 through I/O_{15}). To perform byte accesses, assert the required byte enable signal ($\overline{BHE}$ or $\overline{BLE}$) to read either the upper byte or the lower byte of the data from the specified address location.

All I/Os (I/O_0 through I/O_{15}) are placed in a High-Z state when the device is deselected ($\overline{CE}_1$ HIGH / CE_2 LOW for a Dual Chip Enable device), or the control signals are deasserted ($\overline{OE}$, $\overline{BLE}$, $\overline{BHE}$).

These devices have a unique byte power-down feature where, when both Byte Enables ($\overline{BHE}$ and $\overline{BLE}$) are disabled, the devices seamlessly switch to the standby mode irrespective of the state of the Chip Enables, thereby saving power.

CY62187G30 is available in a Pb-free 48-ball VFBGA package. See Logic Block Diagram – CY62187G30 on page 2.

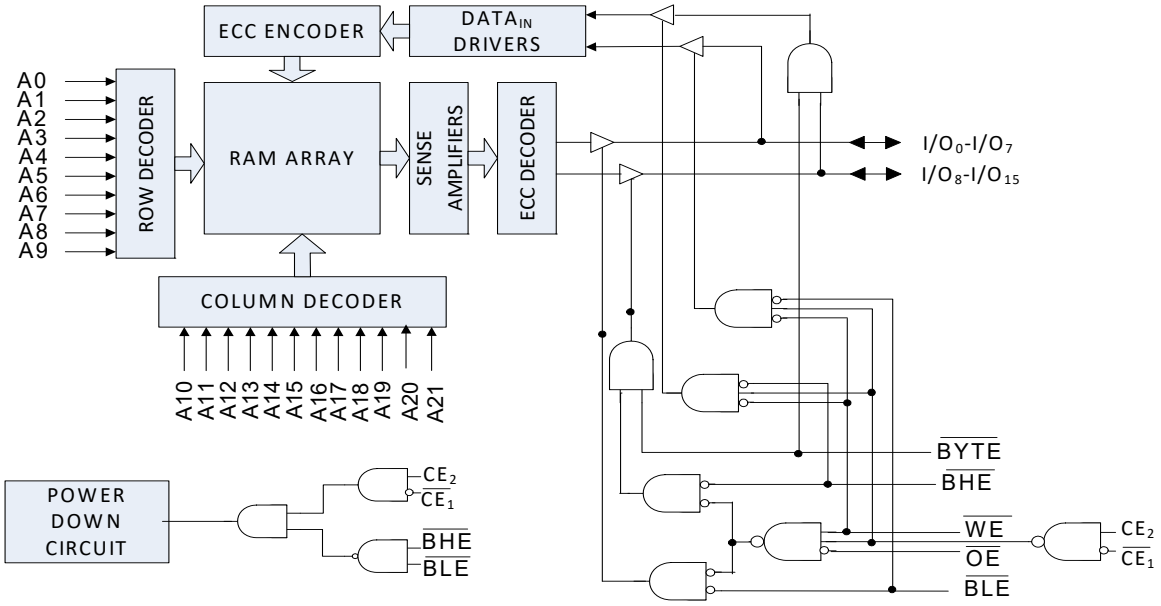
For a complete list of related documentation, click here.

Product Portfolio

Product	Features and Options (see Pin Configuration – CY62187G30)	Range	V_{CC} Range (V)	Speed (ns)	Current Consumption			
					Operating I_{CC}, (mA)		Standby, I_{SB2} (µA)	
					$f = f_{max}$			
					Typ[3]	Max	Typ[3]	Max
CY62187G30	Dual Chip Enable	Industrial	2.2 V–3.6 V	55	40	55	6	38

Notes
1. SER FIT rate <0.1 FIT/Mb. Refer to AN88889 for details.
2. This device does not support automatic write-back on error detection.
3. Typical values are included only for reference and are not guaranteed or tested. Typical values are measured at V_{CC} = 3 V (for V_{CC} range of 2.2 V–3.6 V), T_A = 25°C.

Logic Block Diagram – CY62187G30

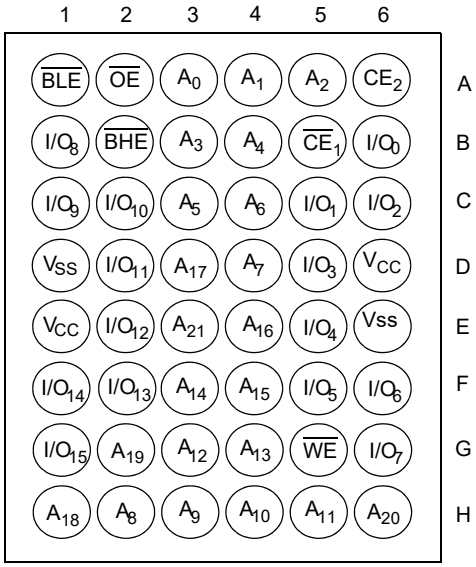


Contents

Pin Configuration – CY62187G30 ..... **4**
Maximum Ratings **5**
Operating Range **5**
DC Electrical Characteristics **5**
Capacitance **6**
Thermal Resistance **6**
AC Test Loads and Waveforms **6**
Data Retention Characteristics **7**
Data Retention Waveform **7**
Switching Characteristics **8**
Switching Waveforms **9**
Truth Table – CY62187G30 ..... **13**
Ordering Information **14**
Ordering Code Definitions 14
Package Diagram **15**
Acronyms **16**
Document Conventions **16**
Units of Measure 16
Document History Page **17**
Sales, Solutions, and Legal Information **18**
Worldwide Sales and Design Support 18
Products 18
PSoC® Solutions 18
Cypress Developer Community 18
Technical Support 18

Pin Configuration – CY62187G30

Figure 1. 48-ball VFBGA Pinout (Dual Chip Enable) – CY62187G30 [4]



Notes

4. NC pins are not connected internally to the die and are typically used for address expansion to a higher-density device. Refer to the respective datasheets for pin configuration.
5. Tie the $\overline{BYTE}$ pin in the 48-pin TSOP I package to V_{CC} to use the device as a 2M × 16 SRAM. The 48-pin TSOP I package can also be used as a 4M × 8 SRAM by tying the $\overline{BYTE}$ signal to V_{SS}. In the 4M × 8 configuration, pin 45 is the extra address line A21, while $\overline{BHE}$, $\overline{BLE}$, and I/O_8 to I/O_{14} pins are not used and can be left floating.

Maximum Ratings

Exceeding maximum ratings may shorten the useful life of the device. 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 V_{CC} + 0.5 V

DC voltage applied to outputs in High Z state[6] ..... –0.5 V to V_{CC} + 0.5 V

DC input voltage[6] ..... –0.5 V to V_{CC} + 0.5 V

Output current into outputs (LOW) ..... 20 mA

Static discharge voltage (MIL-STD-883, Method 3015) ..... >2001 V

Latch-up current ..... >140 mA

Operating Range

Grade	Ambient Temperature	V_{CC}[7]
Industrial	–40 °C to +85 °C	2.2 V to 3.6 V

DC Electrical Characteristics

Over the operating range of –40°C to 85°C

Parameter	Description		Test Conditions		55 ns			Unit
					Min	Typ [8]	Max	
V_{OH}	Output HIGH voltage	2.2 V to 2.7 V	V_{CC} = Min, I_{OH} = –0.1 mA		2.0	–	–	V
		2.7 V to 3.6 V	V_{CC} = Min, I_{OH} = –1.0 mA		2.4	–	–	
V_{OL}	Output LOW voltage	2.2 V to 2.7 V	V_{CC} = Min, I_{OL} = 0.1 mA		–	–	0.4	
		2.7 V to 3.6 V	V_{CC} = Min, I_{OL} = 2.1 mA		–	–	0.4	
V_{IH}	Input HIGH voltage[6]	2.2 V to 2.7 V	–		1.8	–	V_{CC} + 0.3	
		2.7 V to 3.6 V	–		2.0	–	V_{CC} + 0.3	
V_{IL}	Input LOW voltage[6]	2.2 V to 2.7 V	–		–0.3	–	0.6	
		2.7 V to 3.6 V	–		–0.3	–	0.8	
I_{IX}	Input leakage current		GND ≤ V_{IN} ≤ V_{CC}		–1.0	–	+1.0	µA
I_{OZ}	Output leakage current		GND ≤ V_{OUT} ≤ V_{CC}, Output disabled		–1.0	–	+1.0	
I_{CC}	V_{CC} operating supply current		V_{CC} = Max, I_{OUT} = 0 mA, CMOS levels	f = 22.22 MHz (45 ns)	–	40	55.0	mA
				f = 1 MHz	–	15	38.0	
I_{SB1}[11]	Automatic Power-down Current – CMOS Inputs; V_{CC} = 2.2 V to 3.6 V		$\overline{CE_1}$ ≥ V_{CC} – 0.2 V or CE_2 ≤ 0.2 V or ($\overline{BHE}$ and $\overline{BLE}$) ≥ V_{CC} – 0.2 V, V_{IN} ≥ V_{CC} – 0.2 V, V_{IN} ≤ 0.2 V, f = f_{max} (address and data only), f = 0 ($\overline{OE}$, and $\overline{WE}$), V_{CC} = $V_{CC(max)}$		–	12.0	38.0	µA
I_{SB2}[11]	Automatic Power-down Current – CMOS Inputs V_{CC} = 2.2 V to 3.6 V		$\overline{CE_1}$ ≥ V_{CC} – 0.2V or CE_2 ≤ 0.2 V or ($\overline{BHE}$ and $\overline{BLE}$) ≥ V_{CC} – 0.2 V, V_{IN} ≥ V_{CC} – 0.2 V or V_{IN} ≤ 0.2 V, f = 0, V_{CC} = $V_{CC(max)}$	–	–	–	–	µA
				–	–	–	–	
				–	–	–	–	
				–	–	6.0	38.0	

Notes

6. $V_{IL(min)}$ = –2.0 V and $V_{IH(max)}$ = V_{CC} + 2 V for pulse durations of less than 20 ns.
7. Full device AC operation assumes a 100-µs ramp time from 0 to V_{CC} (min) and 400-µs wait time after V_{CC} stabilizes to its operational value.
8. Indicates the value for the center of distribution at 3.0 V, 25°C and not 100% tested.
9. Chip enables ($\overline{CE_1}$ and CE_2) and $\overline{BYTE}$ must be tied to CMOS levels to meet the I_{SB1} / I_{SB2} / I_{CCDR} spec. Other inputs can be left floating.
10. The I_{SB2} maximum limits at 25 °C, 40 °C, and 70 °C are guaranteed by design and not 100% tested.

Capacitance

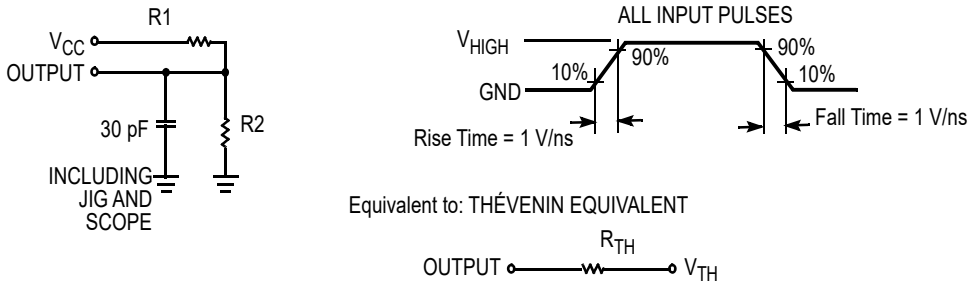
Parameter [11]	Description	Test Conditions	Max	Unit
C_{IN}	Input capacitance	T_A = 25 °C, f = 1 MHz, V_{CC} = $V_{CC(typ)}$	15.0	pF
C_{OUT}	Output capacitance		15.0	pF

Thermal Resistance

Parameter [11]	Description	Test Conditions	48-ball VFBGA	Unit
Θ_{JA}	Thermal resistance (junction to ambient)	Still air, soldered on a 3 × 4.5 inch, four-layer printed circuit board	82.6	°C/W
Θ_{JC}	Thermal resistance (junction to case)		10.8	°C/W

AC Test Loads and Waveforms

Figure 2. AC Test Loads and Waveforms



Parameters	2.5 V	3.0 V	Unit
R1	16667	1103	Ω
R2	15385	1554	Ω
R_{TH}	8000	645	Ω
V_{TH}	1.20	1.75	V
V_{HIGH}	2.5	3.0	V

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

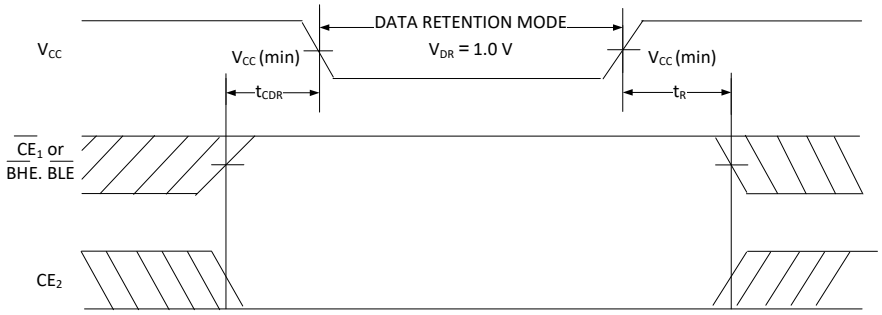
Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions	Min	Typ [12]	Max	Unit
V_{DR}	V_{CC} for data retention	–	1.5	–	–	V
I_{CCDR}[13, 14]	Data retention current	2.2 V < $V_{CC} \le$ 3.6 V $\overline{CE}_1 \ge V_{CC} - 0.2$ V or $CE_2 \le 0.2$ V or ($\overline{BHE}$ and $\overline{BLE}$) $\ge V_{CC} - 0.2$ V, $V_{IN} \ge V_{CC} - 0.2$ V or $V_{IN} \le 0.2$ V	–	6.0	38.0	µA
		1.5 V $\le V_{CC} \le$ 2.2 V, $\overline{CE}_1 \ge V_{CC} - 0.2$ V or $CE_2 \le 0.2$ V or ($\overline{BHE}$ and $\overline{BLE}$) $\ge V_{CC} - 0.2$ V, $V_{IN} \ge V_{CC} - 0.2$ V or $V_{IN} \le 0.2$ V	–	–	48.0	
t_{CDR}[15]	Chip deselect to data retention time	–	0.0	–	–	–
t_R[15, 16]	Operation recovery time	–	55.0	–	–	ns

Data Retention Waveform

Figure 3. Data Retention Waveform [17]



Notes

12. Indicates the value for the center of distribution at 3.0 V, 25°C and not 100% tested.
13. Chip Enables ($\overline{CE}_1$ and CE_2) and $\overline{BYTE}$ must be tied to CMOS levels to meet the I_{SB1} / I_{SB2} / I_{CCDR} spec. Other inputs can be left floating.
14. I_{CCDR} is guaranteed only after the device is first powered up to $V_{CC(min)}$ and then brought down to V_{DR}.
15. These parameters are guaranteed by design and are not tested.
16. Full-device operation requires linear V_{CC} ramp from V_{DR} to $V_{CC(min)} \ge 400$ µs or stable at $V_{CC(min)} \ge 400$ µs.
17. $\overline{BHE}$.$\overline{BLE}$ is the AND of both $\overline{BHE}$ and $\overline{BLE}$. Deselect the chip by either disabling the chip enable signals or by disabling both $\overline{BHE}$ and $\overline{BLE}$.

Switching Characteristics

Parameter [18]	Description	55 ns		Unit
		Min	Max	
Read Cycle				
t_{RC}	Read cycle time	55.0	–	ns
t_{AA}	Address to data valid / Address to ERR valid	–	55.0	ns
t_{OHA}	Data hold from address change / ERR hold from address change	10.0	–	ns
t_{ACE}	$\overline{CE}_1$ LOW and CE_2 HIGH to data valid / $\overline{CE}$ LOW to ERR valid	–	55.0	ns
t_{DOE}	$\overline{OE}$ LOW to data valid / $\overline{OE}$ LOW to ERR valid	–	25.0	ns
t_{LZOE}	$\overline{OE}$ LOW to low Z[19, 20]	5.0	–	ns
t_{HZOE}	$\overline{OE}$ HIGH to High-Z[19, 20, 21]	–	18.0	ns
t_{LZCE}	$\overline{CE}_1$ LOW and CE_2 HIGH to low Z[19, 20]	10.0	–	ns
t_{HZCE}	$\overline{CE}_1$ HIGH and CE_2 LOW to High-Z[19, 20, 21]	–	18.0	ns
t_{PU}	$\overline{CE}_1$ LOW and CE_2 HIGH to power-up[22]	0.0	–	ns
t_{PD}	$\overline{CE}_1$ HIGH and CE_2 LOW to power-down[22]	–	55.0	ns
t_{DBE}	BLE / BHE LOW to data valid	–	55.0	ns
t_{LZBE}	$\overline{BLE}$ / $\overline{BHE}$ LOW to low Z[19]	5.0	–	ns
t_{HZBE}	$\overline{BLE}$ / $\overline{BHE}$ HIGH to High-Z[19, 21]	–	18.0	ns
Write Cycle [23, 24]				
t_{WC}	Write cycle time	55.0	–	ns
t_{SCE}	$\overline{CE}_1$ LOW and CE_2 HIGH to write end	40.0	–	ns
t_{AW}	Address setup to write end	40.0	–	ns
t_{HA}	Address hold from write end	0	–	ns
t_{SA}	Address setup to write start	0	–	ns
t_{PWE}	$\overline{WE}$ pulse width	40.0	–	ns
t_{BW}	$\overline{BLE}$ / $\overline{BHE}$ LOW to write end	40.0	–	ns
t_{SD}	Data setup to write end	25.0	–	ns
t_{HD}	Data hold from write end	0.0	–	ns
t_{HZWE}	$\overline{WE}$ LOW to High-Z[19, 20, 21]	–	18.0	ns
t_{LZWE}	$\overline{WE}$ HIGH to low Z[19, 20]	10.0	–	ns

Notes

18. Test conditions assume signal transition time (rise/fall) of 3 ns or less, timing reference levels of 1.5 V (for $V_{CC} \geq 3$ V) and $V_{CC}/2$ (for $V_{CC} < 3$ V), and input pulse levels of 0 to 3 V (for $V_{CC} \geq 3$ V) and 0 to V_{CC} (for $V_{CC} < 3$V). Test conditions for the read cycle use the output loading shown in Figure 2 on page 6, unless specified otherwise.
19. At any temperature and voltage condition, t_{HZCE} is less than t_{LZCE}, t_{HZBE} is less than t_{LZBE}, t_{HZOE} is less than t_{LZOE}, and t_{HZWE} is less than t_{LZWE} for any device.
20. Tested initially and after any design or process changes that may affect these parameters.
21. t_{HZOE}, t_{HZCE}, t_{HZBE}, and t_{HZWE} transitions are measured when the outputs enter a high-impedance state.
22. These parameters are guaranteed by design and are not tested.
23. The internal write time of the memory is defined by the overlap of $\overline{WE}$ = V_{IL}, $\overline{CE}_1$ = V_{IL}, $\overline{BHE}$ or $\overline{BLE}$ or both = V_{IL}, and CE_2 = V_{IH}. 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 refer to the edge of the signal that terminates the write.
24. The minimum write cycle pulse width for Write Cycle No. 1 ($\overline{WE}$ Controlled, $\overline{OE}$ LOW) should be equal to the sum of t_{HZWE} and t_{SD}.

Switching Waveforms

Figure 4. Read Cycle No. 1 of CY62187G30 (Address Transition Controlled) [25, 26]

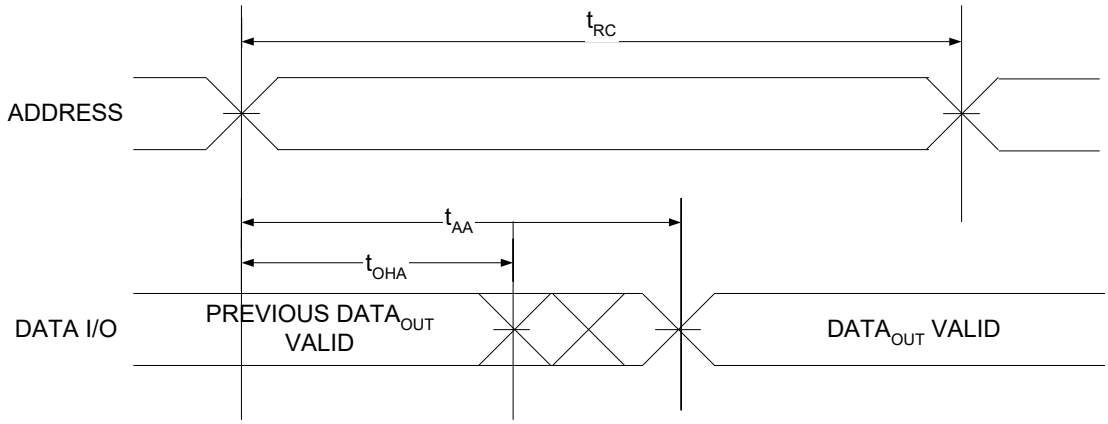
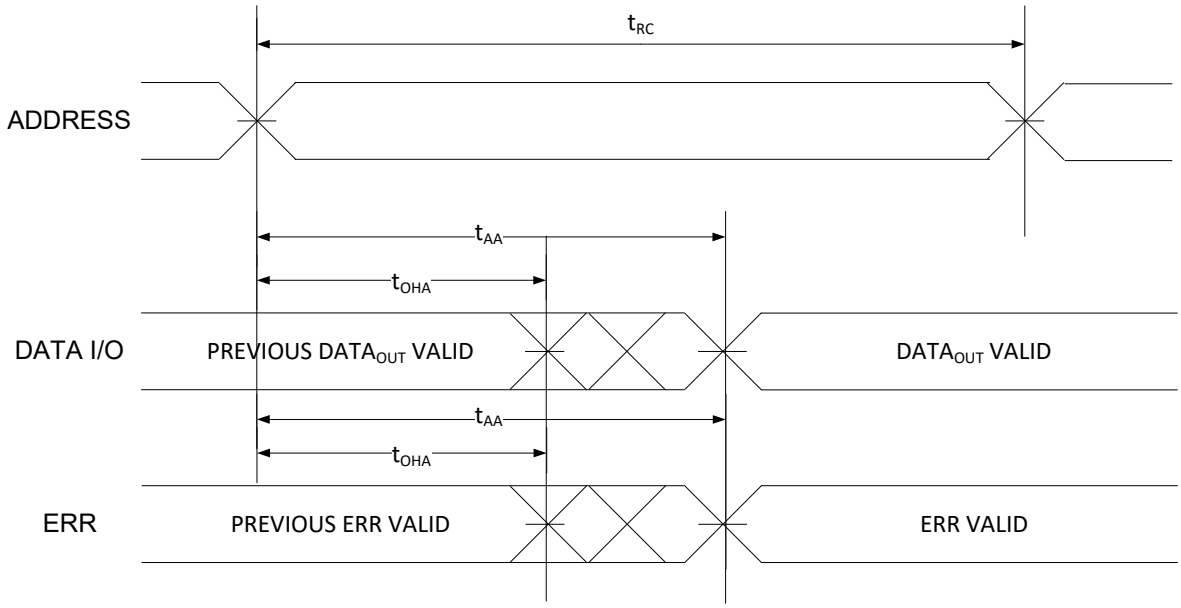


Figure 5. Read Cycle No. 1 of CY62177GE30 (Address Transition Controlled) [25, 26]



Notes
25. The device is continuously selected. $\overline{OE}$ = V_{IL}, $\overline{CE}$ = V_{IL}, $\overline{BHE}$ or $\overline{BLE}$, or both = V_{IL}.
26. $\overline{WE}$ is HIGH for read cycle.

Switching Waveforms (continued)

Figure 6. Read Cycle No. 2 ($\overline{OE}$ Controlled) [27, 28, 29, 31]

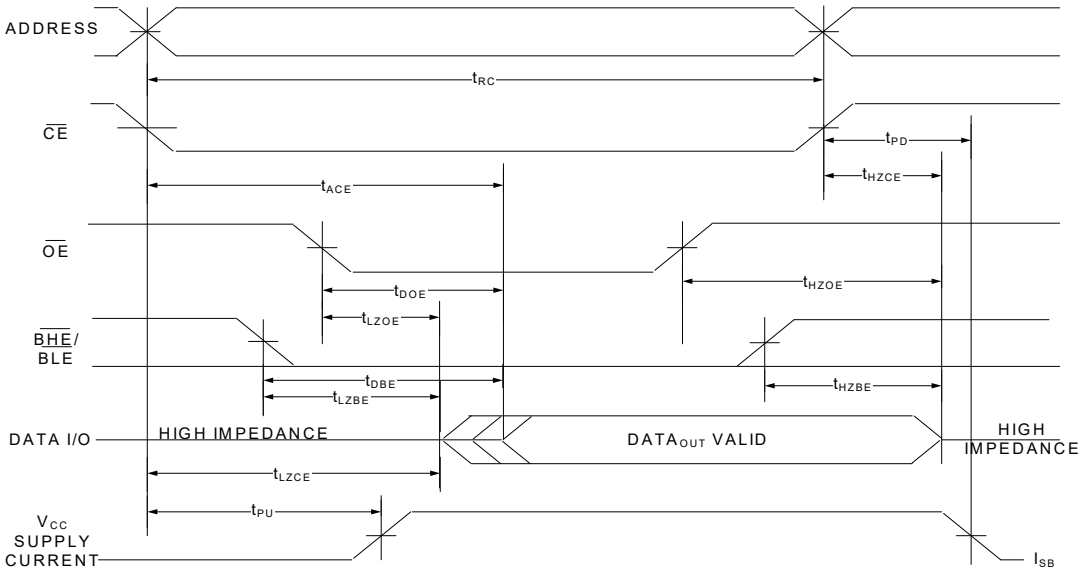
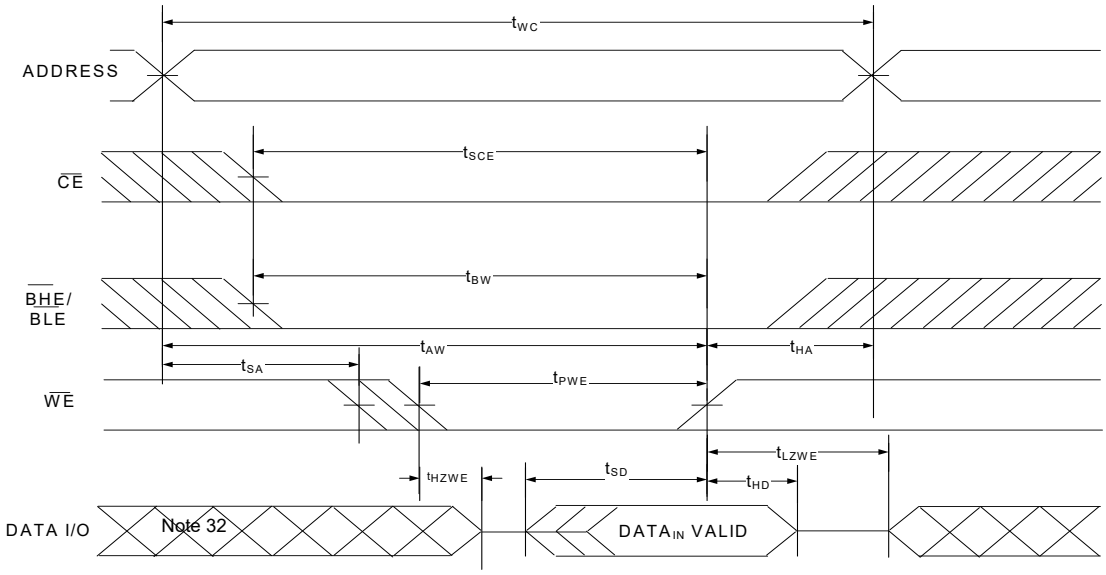


Figure 7. Write Cycle No. 1 ($\overline{WE}$ Controlled, $\overline{OE}$ LOW) [28, 30, 31, 32]

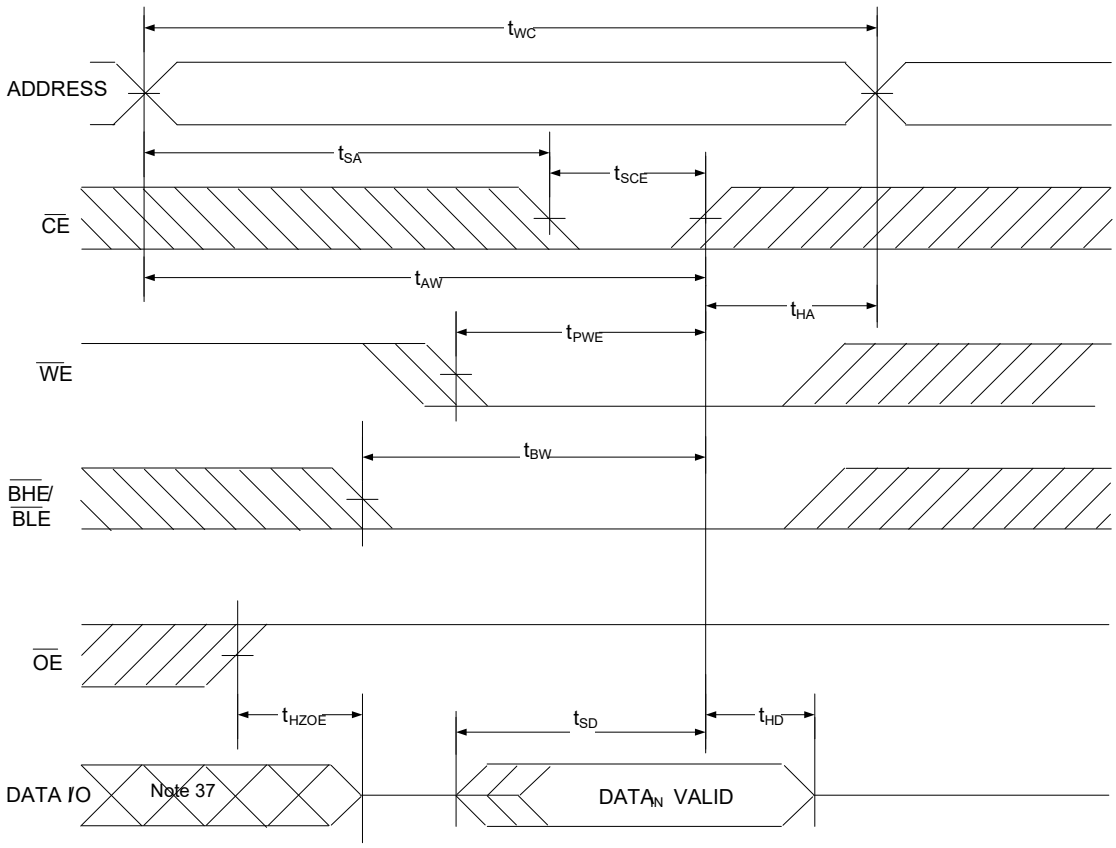


Notes

27. WE is HIGH for read cycle.
28. For all Dual Chip Enable devices, CE is the logical combination of $\overline{CE}_1$ and CE_2. When $\overline{CE}_1$ is LOW and CE_2 is HIGH, CE is LOW; when $\overline{CE}_1$ is HIGH or CE_2 is LOW, CE is HIGH.
29. Address valid prior to or coincident with CE LOW transition.
30. The internal write time of the memory is defined by the overlap of $\overline{WE}$ = V_{IL}, $\overline{CE}_1$ = V_{IL}, $\overline{BHE}$ or $\overline{BLE}$, or both = V_{IL}, and CE_2 = V_{IH}. 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 refer to the edge of the signal that terminates the write.
31. Data I/O is in the High-Z state if $\overline{CE}$ = V_{IH}, or $\overline{OE}$ = V_{IH}, or $\overline{BHE}$, and/or $\overline{BLE}$ = V_{IH}.
32. During this period, the I/Os are in the output state. Do not apply input signals.
33. The minimum write cycle pulse width should be equal to the sum of t_{HZWE} and t_{SD}.

Switching Waveforms (continued)

Figure 8. Write Cycle No. 2 ($\overline{CE}$ Controlled) [34, 35, 36]



Notes

34. For all Dual Chip Enable devices, $\overline{CE}$ is the logical combination of $\overline{CE}_1$ and CE_2. When $\overline{CE}_1$ is LOW and CE_2 is HIGH, $\overline{CE}$ is LOW; when $\overline{CE}_1$ is HIGH or CE_2 is LOW, $\overline{CE}$ is HIGH.
35. The internal write time of the memory is defined by the overlap of $\overline{WE}$ = V_{IL}, $\overline{CE}_1$ = V_{IL}, $\overline{BHE}$ or $\overline{BLE}$ or both = V_{IL}, and CE_2 = V_{IH}. All signals must be ACTIVE to initiate a write.Any of these signals can terminate a write by going INACTIVE. The data input setup and hold timing must refer to the edge of the signal that terminates the write.
36. Data I/O is in the High-Z state if $\overline{CE}$ = V_{IH}, or $\overline{OE}$ = V_{IH}, or $\overline{BHE}$, and/or $\overline{BLE}$ = V_{IH}.
37. During this period, the I/Os are in output state. Do not apply input signals.

Switching Waveforms (continued)

Figure 9. Write Cycle No. 4 ($\overline{BHE}$/$\overline{BLE}$ Controlled, $\overline{OE}$ LOW) [38, 39, 40]

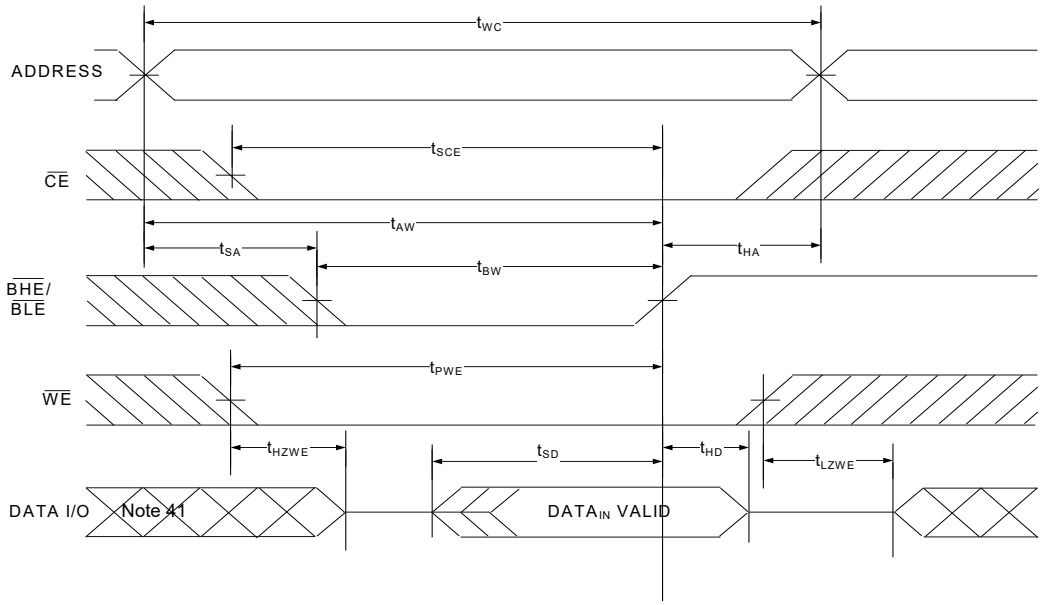
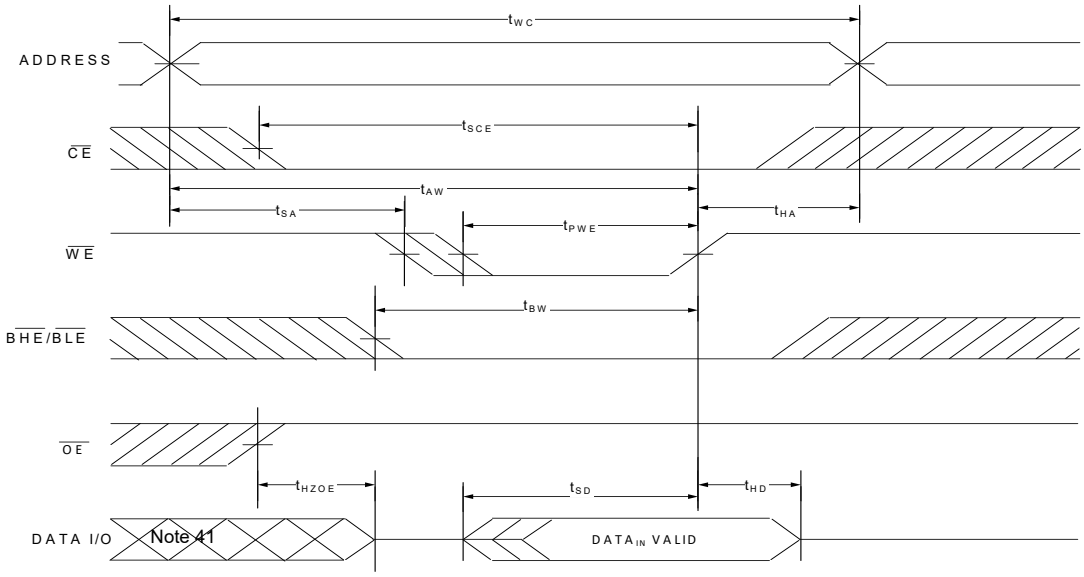


Figure 10. Write Cycle No. 5 ($\overline{WE}$ Controlled) [38, 39, 40]



Notes

38. For all Dual Chip Enable devices, $\overline{CE}$ is the logical combination of $\overline{CE}_1$ and CE_2. When $\overline{CE}_1$ is LOW and CE_2 is HIGH, $\overline{CE}$ is LOW; when $\overline{CE}_1$ is HIGH or CE_2 is LOW, $\overline{CE}$ is HIGH.
39. The internal write time of the memory is defined by the overlap of $\overline{WE}$ = V_{IL}, $\overline{CE}_1$ = V_{IL}, $\overline{BHE}$ or $\overline{BLE}$ or both = V_{IL}, and CE_2 = V_{IH}. All signals must be ACTIVE to initiate a write. Any of these signals can terminate a write by going INACTIVE. The data input setup and hold timing must refer to the edge of the signal that terminates the write.
40. Data I/O is in the High-Z state if $\overline{CE}$ = V_{IH}, or $\overline{OE}$ = V_{IH}, or $\overline{BHE}$, and/or $\overline{BLE}$ = V_{IH}.
41. During this period, the I/Os are in output state. Do not apply input signals.

Truth Table – CY62187G30

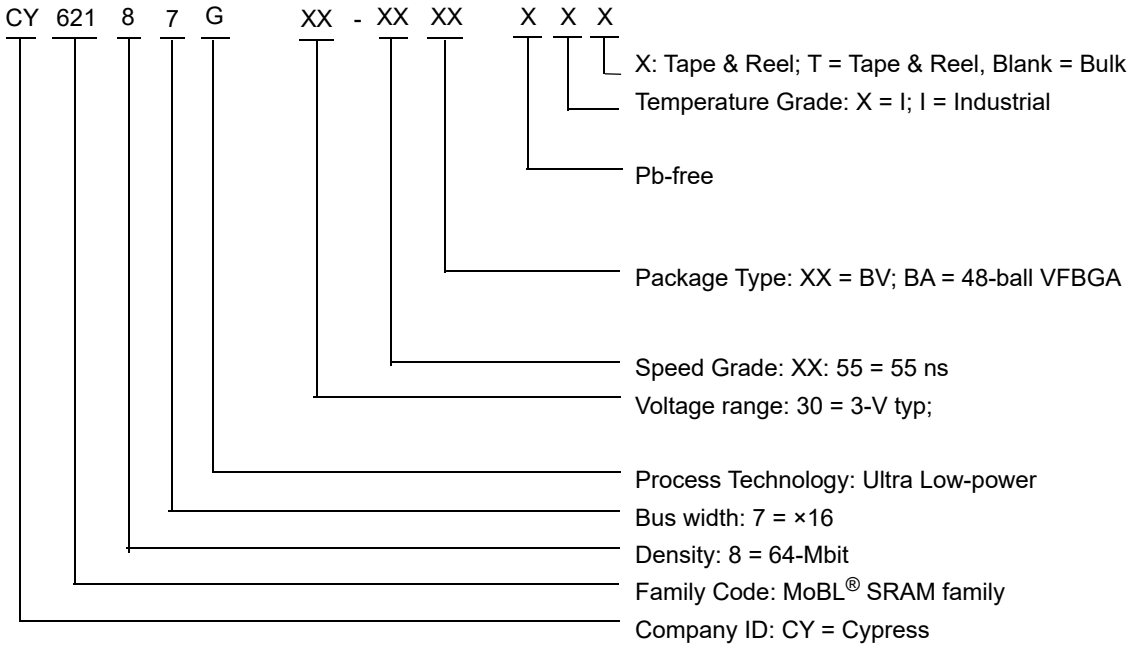
$\overline{CE_1}$	CE_2	$\overline{WE}$	$\overline{OE}$	$\overline{BHE}$	$\overline{BLE}$	Inputs/Outputs	Mode	Power
H	X[42]	X	X	X	X	High-Z	Deselect/Power-down	Standby (I_{SB})
X[42]	L	X	X	X	X	High-Z	Deselect/Power-down	Standby (I_{SB})
X[42]	X[42]	X	X	H	H	High-Z	Deselect/Power-down	Standby (I_{SB})
L	H	H	L	L	L	Data Out (I/O_0–I/O_{15})	Read	Active (I_{CC})
L	H	H	L	H	L	Data Out (I/O_0–I/O_7); High-Z (I/O_8–I/O_{15})	Read	Active (I_{CC})
L	H	H	L	L	H	High-Z (I/O_0–I/O_7); Data Out (I/O_8–I/O_{15})	Read	Active (I_{CC})
L	H	H	H	L	H	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	L	High-Z	Output disabled	Active (I_{CC})
L	H	L	X	L	L	Data In (I/O_0–I/O_{15})	Write	Active (I_{CC})
L	H	L	X	H	L	Data In (I/O_0–I/O_7); High-Z (I/O_8–I/O_{15})	Write	Active (I_{CC})
L	H	L	X	L	H	High-Z (I/O_0–I/O_7); Data In (I/O_8–I/O_{15})	Write	Active (I_{CC})

Note
42. The ‘X’ (Don’t care) state for the Chip Enables refers to the logic state (either HIGH or LOW). Intermediate voltage levels on these pins are not permitted.

Ordering Information

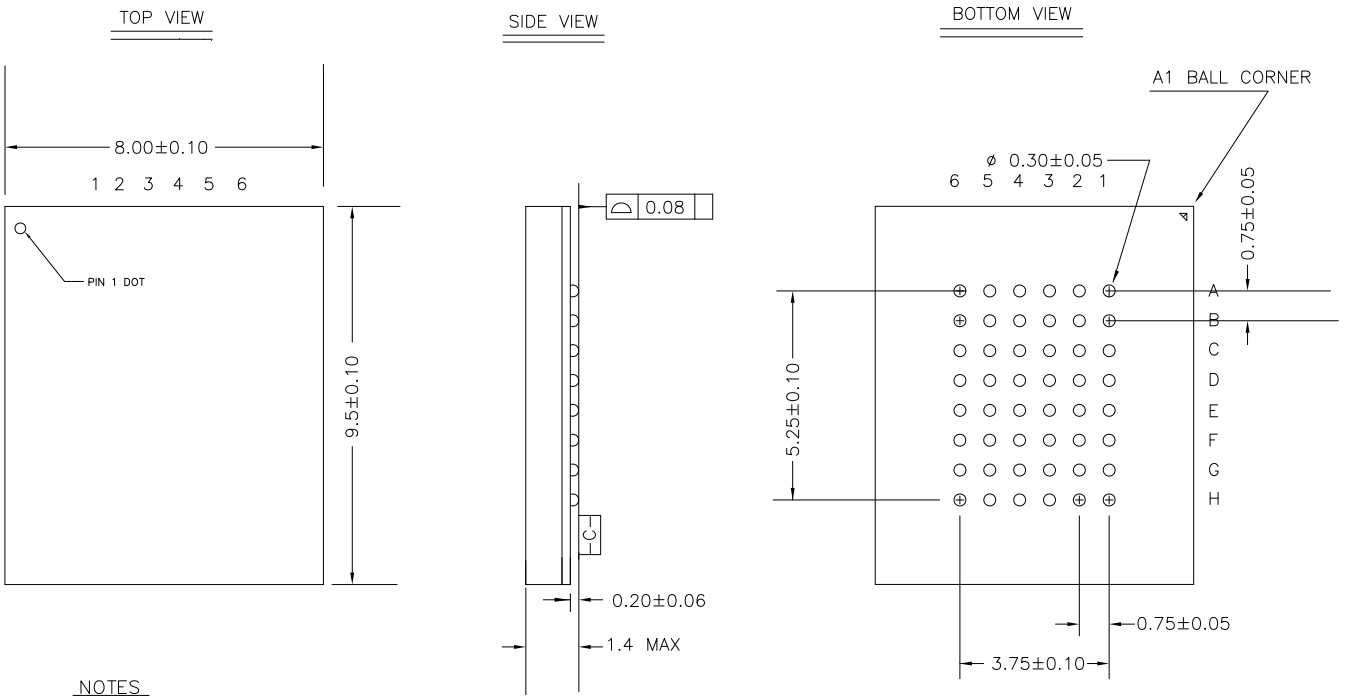
Speed (ns)	Voltage Range	Ordering Code	Package Diagram	Package Type (all Pb-free)	Key Features / Differentiators	Operating Range
55	2.2 V–3.6 V	CY62187G30-55BAXI	001-50044	48-ball VFBGA	Dual Chip Enable	Industrial
		CY62187G30-55BAXIT				

Ordering Code Definitions



Package Diagram

Figure 11. 48L FBGA 8 × 9.5 × 1.4 MM BK48L Package Outline, 001-50044



Acronyms

Table 1. Acronyms Used in this Document

Acronym	Description
$\overline{\text{BHE}}$	Byte High Enable
$\overline{\text{BLE}}$	Byte Low Enable
$\overline{\text{CE}}$	Chip Enable
CMOS	Complementary metal oxide semiconductor
I/O	Input/output
$\overline{\text{OE}}$	Output Enable
SRAM	Static random access memory
TSOP	Thin small outline package
VFBGA	Very fine-pitch ball grid array
$\overline{\text{WE}}$	Write Enable

Document Conventions

Units of Measure

Table 2. Units of Measure

Symbol	Unit of Measure
°C	degree Celsius
MHz	megahertz
µA	microampere
µs	microsecond
mA	milliampere
mm	millimeter
ns	nanosecond
Ω	ohm
%	percent
pF	picofarad
V	volt
W	watt

Document History Page

Document Title: CY62187G30 MoBL, 64-Mbit (4M words × 16-bit) Static RAM with Error-Correcting Code (ECC) Document Number: 002-24731			
Rev.	**ECN**	**Submission Date**	**Description of Change**
**	6270829	08/16/2018	New datasheet
*A	6714290	10/30/2019	Updated maximum standby current value in Features, Product Portfolio, and DC Electrical Characteristics. Updated Icc maximum value in Product Portfolio and DC Electrical Characteristics. Updated Icc @ 1MHz maximum value in DC Electrical Characteristics. Updated Data Retention Characteristics. Added Thermal Resistance values. Added Package Diagram spec 001-50044.

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