

Features

- Thin small outline package (TSOP-I) configurable as 1 M × 16 or as 2 M × 8 SRAM
- Wide voltage range: 2.2 V–3.6 V
- Ultra-low active power: Typical active current: 2 mA at f = 1 MHz
- Ultra-low standby power
- Easy memory expansion with $\overline{CE}_1$, CE_2 and $\overline{OE}$ features
- Automatic power-down when deselected
- Complementary metal oxide semiconductor (CMOS) for optimum speed / power
- Available in Pb-free and non Pb-free 48-ball very fine-pitch ball grid array (VFBGA) and 48-pin TSOP I package

Functional Description

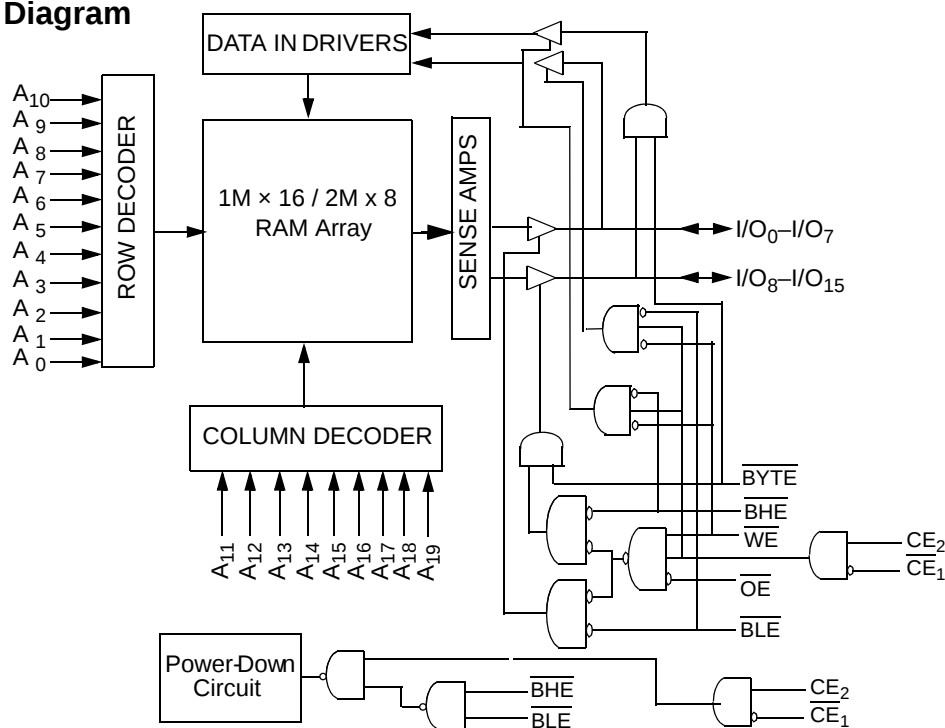
The CY62167DV30 is a high-performance CMOS static RAM organized as 1M words by 16-bits. This device features advanced circuit design to provide ultra-low active current. This is ideal for providing More Battery Life™ (MoBL®) in portable applications such as cellular telephones. The device also has an

automatic power-down feature that significantly reduces power consumption by 99% when addresses are not toggling. The device can also be put into standby mode when deselected ($\overline{CE}_1$ HIGH or CE_2 LOW or both $\overline{BHE}$ and $\overline{BLE}$ are HIGH). The input/output pins (I/O_0 through I/O_{15}) are placed in a high-impedance state when: deselected ($\overline{CE}_1$ HIGH or CE_2 LOW), outputs are disabled ($\overline{OE}$ HIGH), both Byte High Enable and Byte Low Enable are disabled ($\overline{BHE}$, $\overline{BLE}$ HIGH), or during a Write operation ($\overline{CE}_1$ LOW, CE_2 HIGH and $\overline{WE}$ LOW).

Writing to the device is accomplished by taking Chip Enables ($\overline{CE}_1$ LOW and CE_2 HIGH) and Write Enable ($\overline{WE}$) input LOW. If Byte Low Enable ($\overline{BLE}$) 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_{19}). If Byte High Enable ($\overline{BHE}$) 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_{19}).

Reading from the device is accomplished by taking Chip Enables ($\overline{CE}_1$ LOW and CE_2 HIGH) and Output Enable ($\overline{OE}$) LOW while forcing the Write Enable ($\overline{WE}$) HIGH. If Byte Low Enable ($\overline{BLE}$) is LOW, then data from the memory location specified by the address pins appear on I/O_0 to I/O_7 . If Byte High Enable ($\overline{BHE}$) is LOW, then data from memory appear on I/O_8 to I/O_{15} . See the truth table at the back of this data sheet for a complete description of Read and Write modes.

Logic Block Diagram



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Product Portfolio

Product	V _{CC} Range (V)			Speed (ns)	Power Dissipation					
					Operating I _{CC} (mA)				Standby I _{SB2} (μA)	
	f = 1 MHz		f = f _{Max}							
	Min	Typ ^[1]	Max		Typ ^[1]	Max	Typ ^[1]	Max	Typ ^[1]	Max
CY62167DV30LL	2.2	3.0	3.6	55	2	4	15	30	2.5	22
				70			12	25		

Pin Configurations

Figure 1. 48-ball VFBGA pinout (Top View) ^[2, 3]

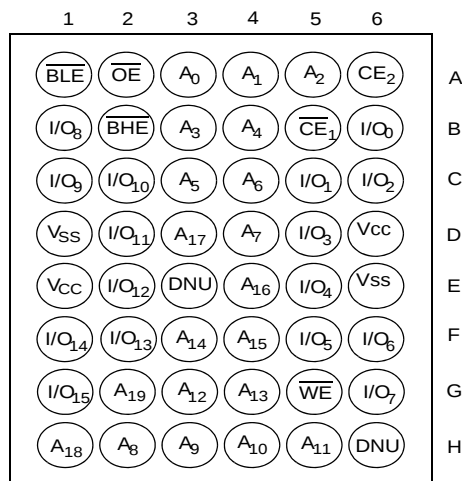
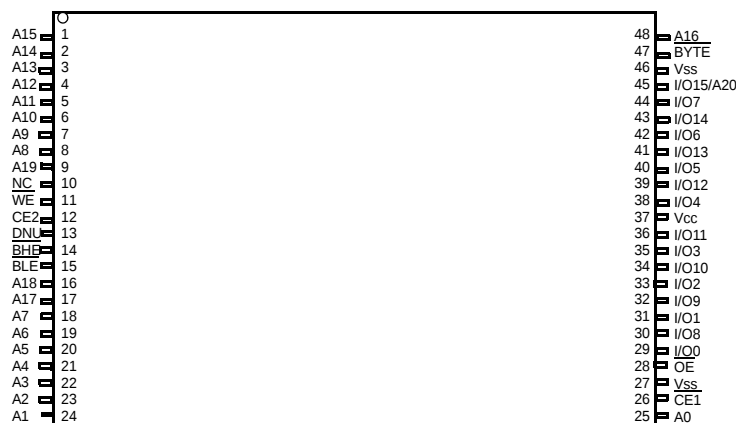


Figure 2. 48-pin TSOP I pinout (Top View) ^[4]



Notes

- 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.
- NC pins are not connected on the die.
- DNU pins have to be left floating.
- The BYTE pin in the 48-TSOP I package has to be tied to V_{CC} to use the device as a 1M X 16 SRAM. The 48-TSOP I package can also be used as a 2 M X 8 SRAM by tying the BYTE signal to V_{SS}. In the 2 M X 8 configuration, Pin 45 is A20, while BHE, BLE and I/O8 to I/O14 pins are not used (DNU).

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 -0.2 V to $V_{CC} + 0.3$ V

DC voltage applied to outputs in High-Z state ^[5, 6] -0.2 V to $V_{CC} + 0.3$ V

DC input voltage ^[5, 6] -0.2 V to $V_{CC} + 0.3$ V

Output current into outputs (LOW) 20 mA

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

Latch-up current > 200 mA

Operating Range

Device	Range	Ambient Temperature	V_{CC} ^[7]
CY62167DV30LL	Industrial	-40 °C to +85 °C	2.20 V to 3.60 V

Electrical Characteristics

Over the Operating Range

Parameter	Description	Test Conditions	CY62167DV30-55			CY62167DV30-70			Unit
			Min	Typ ^[8]	Max	Min	Typ ^[8]	Max	
V_{OH}	Output HIGH voltage	$I_{OH} = -0.1$ mA $V_{CC} = 2.20$ V	2.0	—	—	2.0	—	—	V
		$I_{OH} = -1.0$ mA $V_{CC} = 2.70$ V	2.4	—	—	2.4	—	—	
V_{OL}	Output LOW voltage	$I_{OL} = 0.1$ mA $V_{CC} = 2.20$ V	—	—	0.4	—	—	0.4	V
		$I_{OL} = 2.1$ mA $V_{CC} = 2.70$ V	—	—	—	—	—	—	
V_{IH}	Input HIGH voltage	$V_{CC} = 2.2$ V to 2.7 V	1.8	—	$V_{CC} + 0.3$	1.8	—	$V_{CC} + 0.3$	V
		$V_{CC} = 2.7$ V to 3.6 V	2.2	—	—	2.2	—	—	
V_{IL}	Input LOW voltage	$V_{CC} = 2.2$ V to 2.7 V	—0.3	—	0.6	—0.3	—	0.6	V
		$V_{CC} = 2.7$ V to 3.6 V	—	—	0.8	—	—	0.8	
I_{IX}	Input leakage current	$GND \leq V_I \leq V_{CC}$	—1	—	+1	—1	—	+1	μA
I_{OZ}	Output leakage current	$GND \leq V_O \leq V_{CC}$, output disabled	—1	—	+1	—1	—	+1	μA
I_{CC}	V_{CC} operating supply current	$V_{CC} = V_{CC(max)}$ $f = f_{Max} = 1/t_{RC}$	—	15	30	—	12	25	mA
		$I_{OUT} = 0$ mA CMOS levels $f = 1$ MHz	—	2	4	—	2	4	
I_{SB1}	Automatic power-down current — CMOS inputs	$\overline{CE}_1 \geq V_{CC} - 0.2$ V or $CE_2 \leq 0.2$ V, $V_{IN} \geq V_{CC} - 0.2$ V, $V_{IN} \leq 0.2$ V, $f = f_{Max}$ (address and data only), $f = 0$ ($\overline{OE}$, $\overline{WE}$), $V_{CC} = 3.60$ V	—	2.5	22	—	2.5	22	μA
I_{SB2}	Automatic power-down current — CMOS Inputs	$\overline{CE}_1 \geq V_{CC} - 0.2$ V or $CE_2 \leq 0.2$ V, $V_{IN} \geq V_{CC} - 0.2$ V or $V_{IN} \leq 0.2$ V, $f = 0$, $V_{CC} = 3.60$ V	—	2.5	22	—	2.5	22	μA

Notes

- $V_{IL(min)}$ = -2.0 V for pulse durations less than 20 ns.
- $V_{IH(max)}$ = $V_{CC} + 0.75$ V for pulse durations less than 20 ns.
- Full Device AC operation requires linear V_{CC} ramp from 0 to $V_{CC(min)}$ and V_{CC} must be stable at $V_{CC(min)}$ for 500 μs.
- 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.

Capacitance

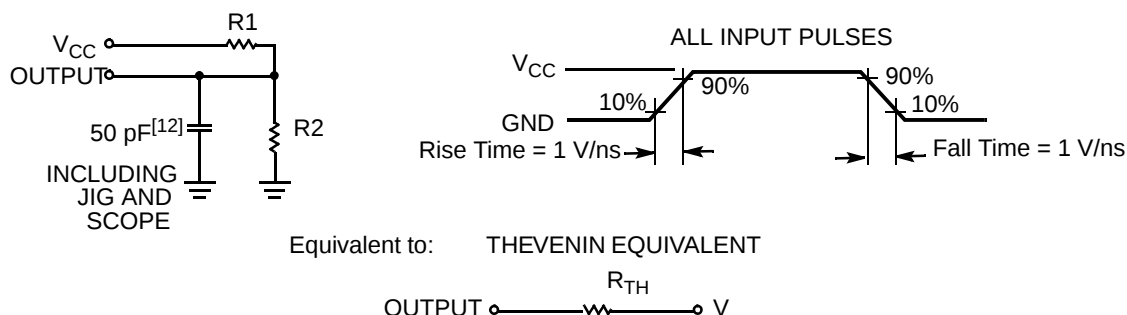
Parameter ^[10]	Description	Test Conditions	Max	Unit
C_{IN}	Input capacitance	$T_A = 25\text{ }^{\circ}\text{C}$, $f = 1\text{ MHz}$, $V_{CC} = V_{CC(\text{typ})}$	8	pF
C_{OUT}	Output capacitance		10	pF

Thermal Resistance

Parameter ^[10]	Description	Test Conditions	VFBGA	TSOP I	Unit
θ_{JA}	Thermal resistance (junction to ambient)	Still air, soldered on a 3×4.5 inch, 2-layer printed circuit board	55	60	$^{\circ}\text{C/W}$
θ_{JC}	Thermal resistance (junction to case)		16	4.3	$^{\circ}\text{C/W}$

AC Test Loads and Waveforms

Figure 3. 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

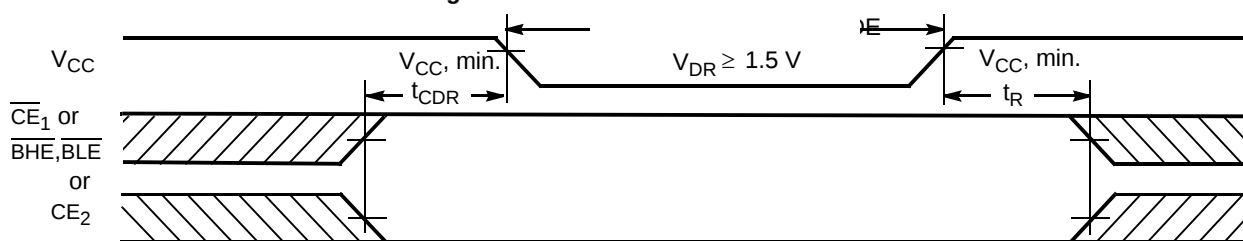
Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions	Min	Typ ^[9]	Max	Unit
V_{DR}	V_{CC} for data retention		1.5	–	–	V
I_{CCDR}	Data retention current	$V_{CC} = 1.5\text{ V}$, $\overline{CE}_1 \geq V_{CC} - 0.2\text{ V}$ or $CE_2 \leq 0.2\text{ V}$, $V_{IN} \geq V_{CC} - 0.2\text{ V}$ or $V_{IN} \leq 0.2\text{ V}$	–	–	10	μA
$t_{CDR}^{[10]}$	Chip deselect to data retention time		0	–	–	ns
$t_R^{[11]}$	Operation recovery time	CY62167DV30LL-55	55	–	–	ns
		CY62167DV30LL-70	70			

Data Retention Waveform

Figure 4. Data Retention Waveform^[12]



Notes

9. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at $V_{CC} = V_{CC(typ)}$, $T_A = 25\text{ }^\circ\text{C}$.
10. Tested initially and after any design or process changes that may affect these parameters.
11. Full device operation requires linear V_{CC} ramp from V_{DR} to $V_{CC(min.)} \geq 100\text{ }\mu\text{s}$ or stable at $V_{CC(min.)} \geq 100\text{ }\mu\text{s}$.
12. $\overline{BHE}.\overline{BLE}$ is the AND of both $\overline{BHE}$ and $\overline{BLE}$. Chip can be deselected by either disabling the chip enable signals or by disabling both $\overline{BHE}$ and $\overline{BLE}$.

Switching Characteristics

Over the Operating Range

Parameter ^[13]	Description	55 ns		70 ns		Unit
		Min	Max	Min	Max	
Read Cycle						
t _{RC}	Read cycle time	55	–	70	–	ns
t _{AA}	Address to data valid	–	55	–	70	ns
t _{OHA}	Data hold from address change	10	–	10	–	ns
t _{ACE}	CE ₁ LOW and CE ₂ HIGH to data valid	–	55	–	70	ns
t _{DOE}	OE LOW to data valid	–	25	–	35	ns
t _{LZOE}	OE LOW to low Z ^[14]	5	–	5	–	ns
t _{HZOE}	OE HIGH to high Z ^[14, 15]	–	20	–	25	ns
t _{LZCE}	CE ₁ LOW and CE ₂ HIGH to low Z ^[14]	10	–	10	–	ns
t _{HZCE}	CE ₁ HIGH and CE ₂ LOW to high Z ^[14, 15]	–	20	–	25	ns
t _{PU}	CE ₁ LOW and CE ₂ HIGH to power-up	0	–	0	–	ns
t _{PD}	CE ₁ HIGH and CE ₂ LOW to power-down	–	55	–	70	ns
t _{DBE}	BLE/BHE LOW to data valid	–	55	–	70	ns
t _{LZBE}	BLE/BHE LOW to low Z ^[14]	10	–	10	–	ns
t _{HZBE}	BLE/BHE HIGH to high Z ^[14, 15]	–	20	–	25	ns
Write Cycle ^[16]						
t _{WC}	Write cycle time	55	–	70	–	ns
t _{SCE}	CE ₁ LOW and CE ₂ HIGH to write end	40	–	60	–	ns
t _{AW}	Address setup to write end	40	–	60	–	ns
t _{HA}	Address hold from write end	0	–	0	–	ns
t _{SA}	Address setup to write start	0	–	0	–	ns
t _{PWE}	WE pulse width	40	–	45	–	ns
t _{BW}	BLE/BHE LOW to write end	40	–	60	–	ns
t _{SD}	Data setup to write end	25	–	30	–	ns
t _{HD}	Data hold from write end	0	–	0	–	ns
t _{HZWE}	WE LOW to high-Z ^[14, 15]	–	20	–	25	ns
t _{LZWE}	WE HIGH to low-Z ^[14]	10	–	10	–	ns

Notes

13. 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 0 to $V_{CC(typ)}$, and output loading of the specified I_{OL}/I_{OH} as shown in the "AC Test Loads and Waveforms" section.

14. 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.

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

16. The internal Write time of the memory is defined by the overlap of WE, $CE_1 = V_{IL}$, BHE and/or BLE = 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 should be referenced to the edge of the signal that terminates the Write.

Switching Waveforms

Figure 5. Read Cycle 1 (Address Transition Controlled) [17, 18]

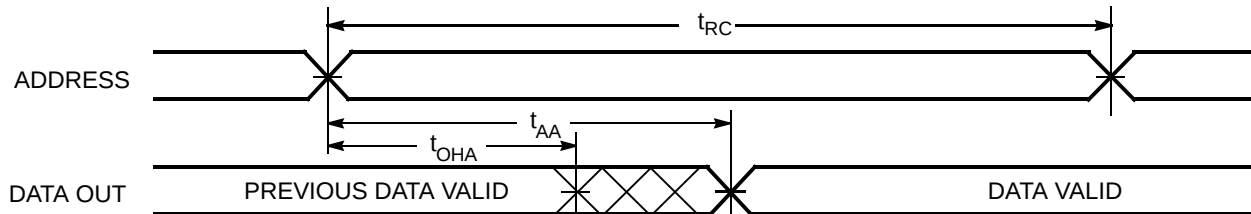
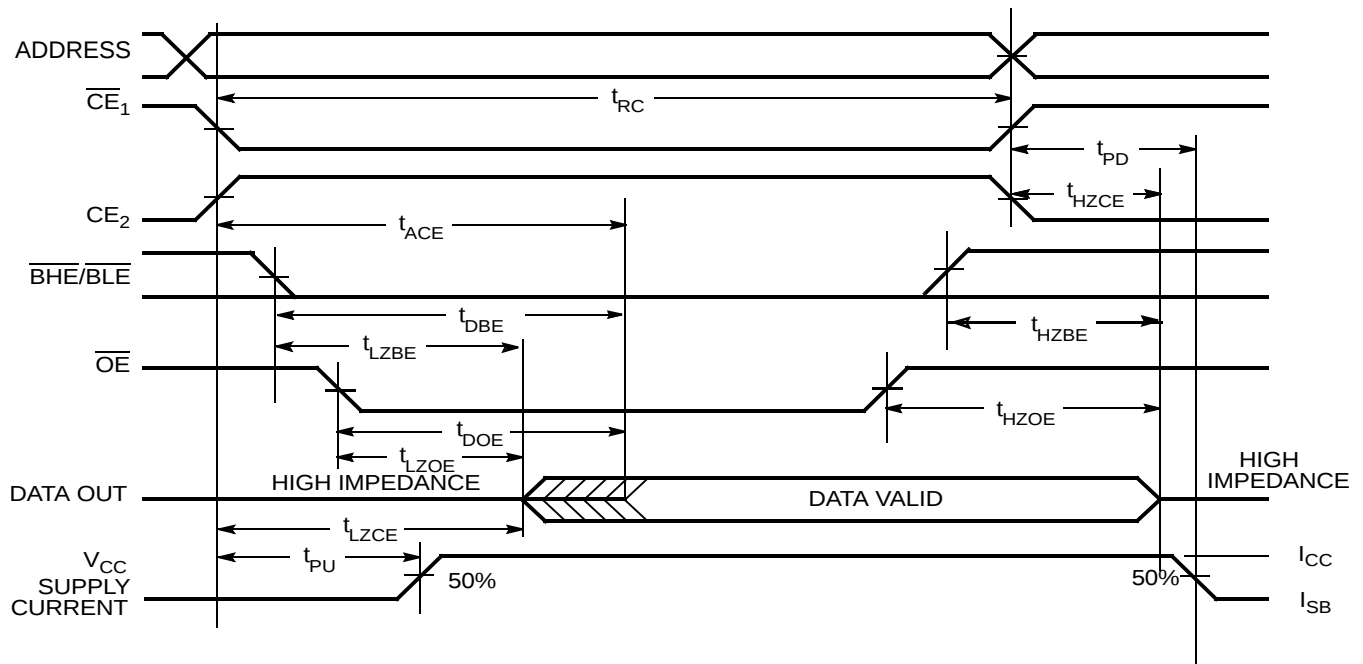


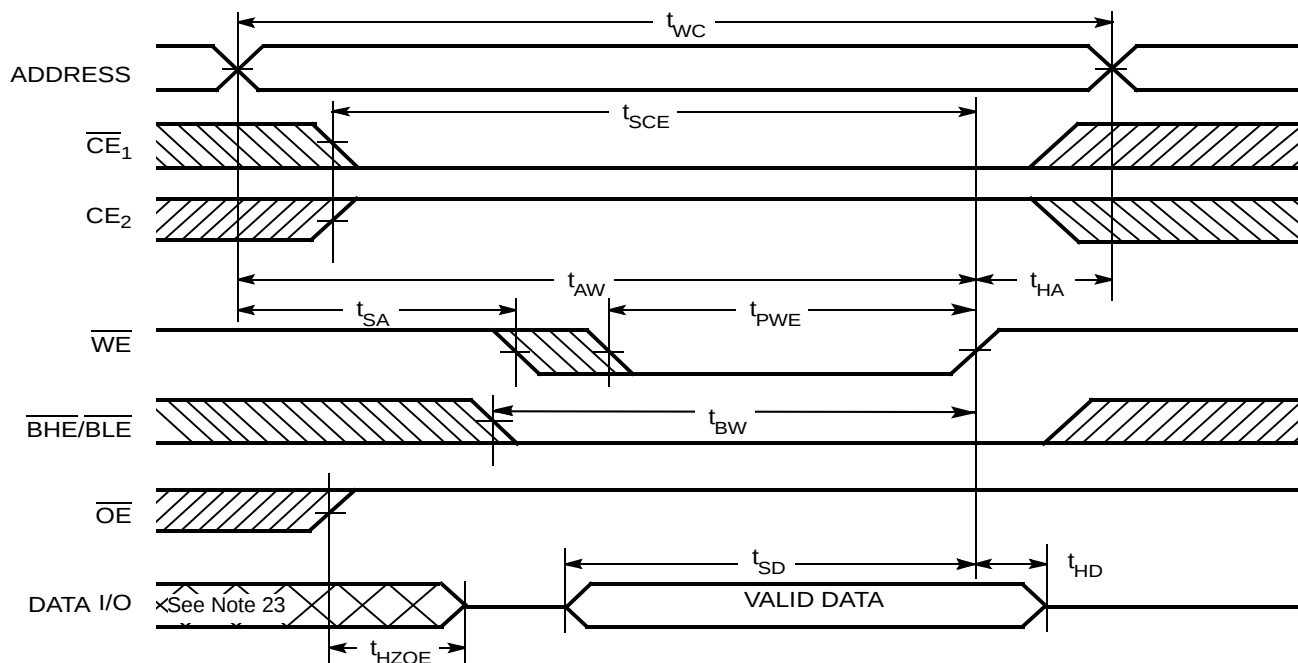
Figure 6. Read Cycle 2 ($\overline{\text{OE}}$ Controlled) [18, 19]



Notes

17. The device is continuously selected. $\overline{\text{OE}}$, $\overline{\text{CE}}_1 = V_{IL}$, $\overline{\text{BHE}}$ and/or $\overline{\text{BLE}} = V_{IL}$, and $\text{CE}_2 = V_{IH}$.
18. WE is HIGH for read cycle.
19. Address valid prior to or coincident with $\overline{\text{CE}}_1$, $\overline{\text{BHE}}$, $\overline{\text{BLE}}$ transition LOW and CE_2 transition HIGH.

Switching Waveforms (continued)

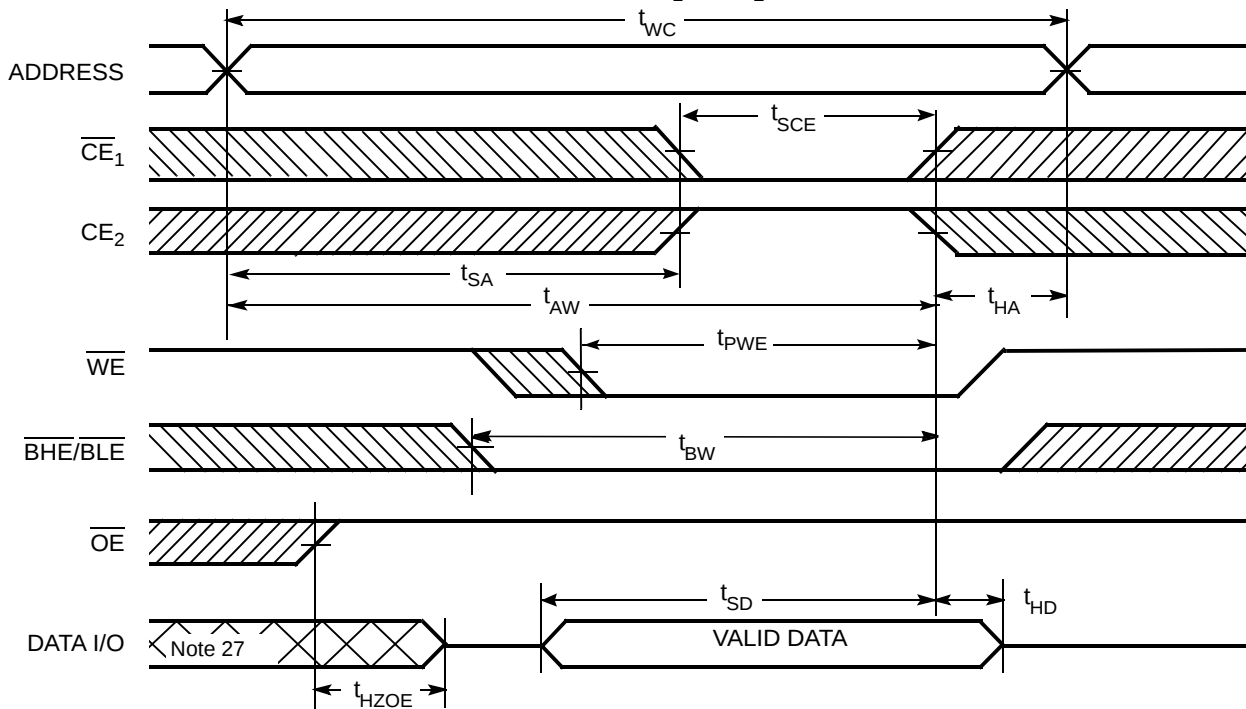
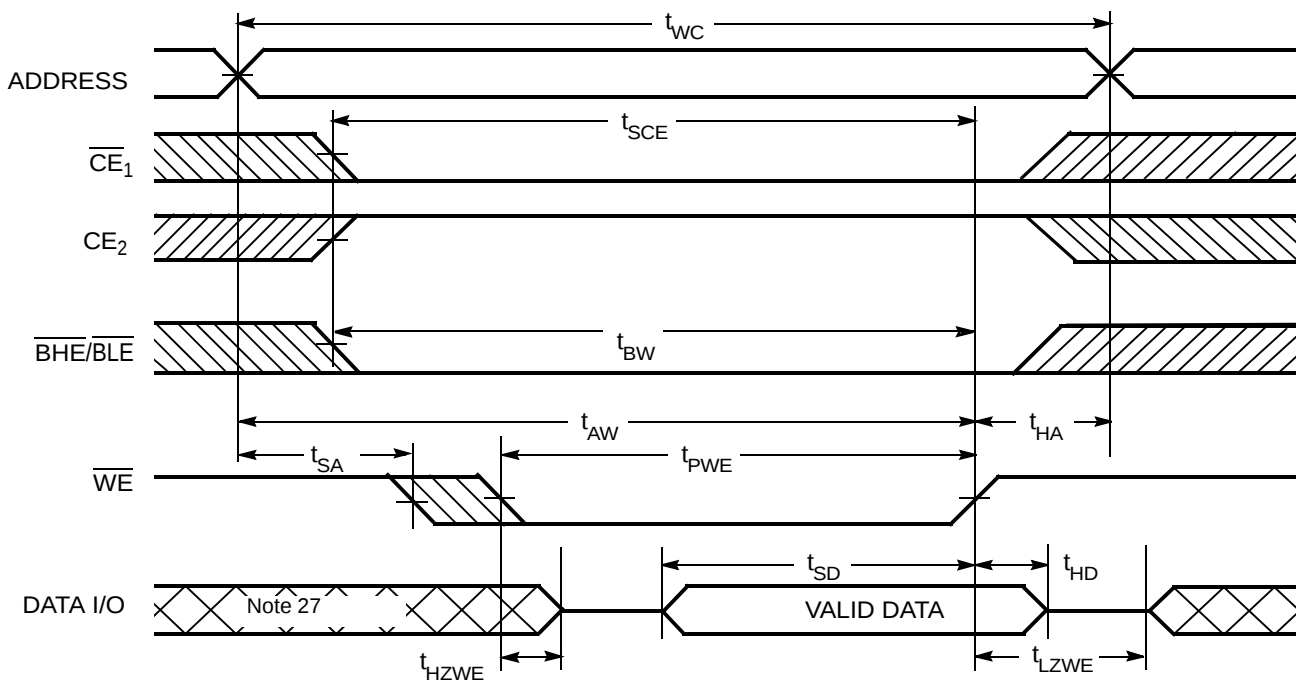
Figure 7. Write Cycle 1 ($\overline{WE}$ Controlled) [20, 21, 22]

Notes

20. The internal Write time of the memory is defined by the overlap of $\overline{WE}$, $\overline{CE}_1 = V_{IL}$, $\overline{BHE}$ and/or $\overline{BLE} = V_{IL}$, 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 should be referenced to the edge of the signal that terminates the Write.

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

22. If $\overline{CE}_1$ goes HIGH and CE_2 goes LOW simultaneously with $\overline{WE} = V_{IH}$, the output remains in a high-impedance state.

23. During this period, the I/Os are in output state and input signals should not be applied.

Switching Waveforms (continued)
Figure 8. Write Cycle 2 ($\overline{CE_1}$ or CE_2 Controlled) [24, 25, 26]

Figure 9. Write Cycle 3 ($\overline{WE}$ Controlled, $\overline{OE}$ LOW) [26]

Notes

24. The internal Write time of the memory is defined by the overlap of $\overline{WE}$, $\overline{CE_1} = V_{IL}$, $\overline{BHE}$ and/or $\overline{BLE} = V_{IL}$, 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 should be referenced to the edge of the signal that terminates the Write.

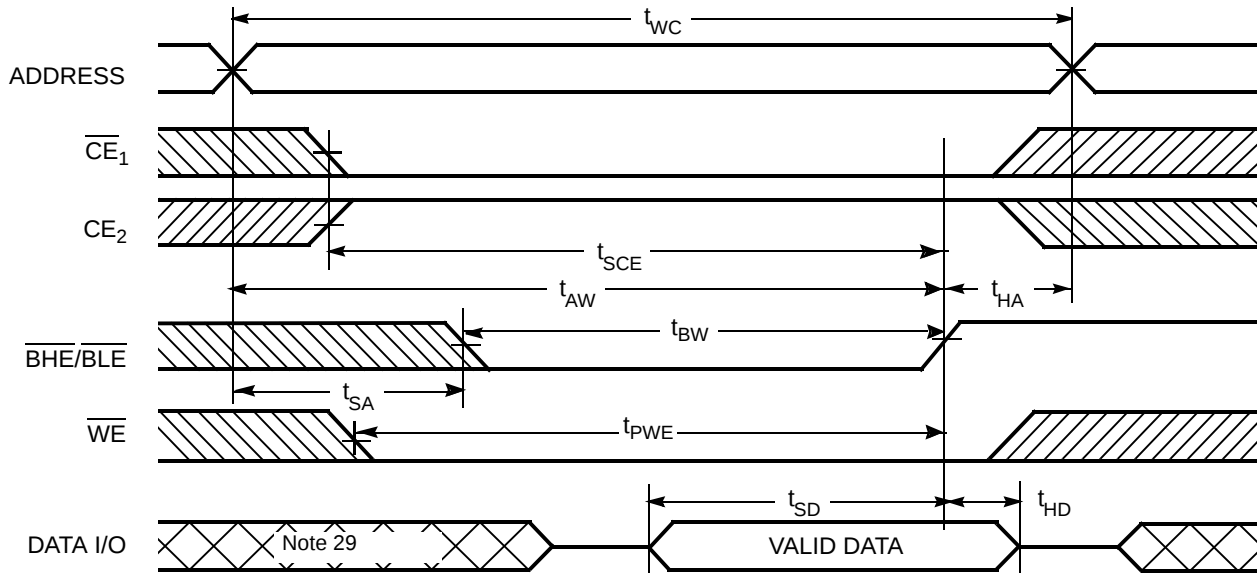
25. Data I/O is high-impedance if $\overline{OE} = V_{IH}$.

26. If $\overline{CE_1}$ goes HIGH and CE_2 goes LOW simultaneously with $\overline{WE} = V_{IH}$, the output remains in a high-impedance state.

27. During this period, the I/Os are in output state and input signals should not be applied.

Switching Waveforms (continued)

Figure 10. Write Cycle 4 ($\overline{\text{BHE/BLE}}$ Controlled, $\overline{\text{OE}}$ LOW) ^[28]



Notes

28. If $\overline{\text{CE}}_1$ goes HIGH and CE_2 goes LOW simultaneously with $\overline{\text{WE}} = V_{IH}$, the output remains in a high-impedance state.
 29. During this period, the I/Os are in output state and input signals should not be applied.

Truth Table

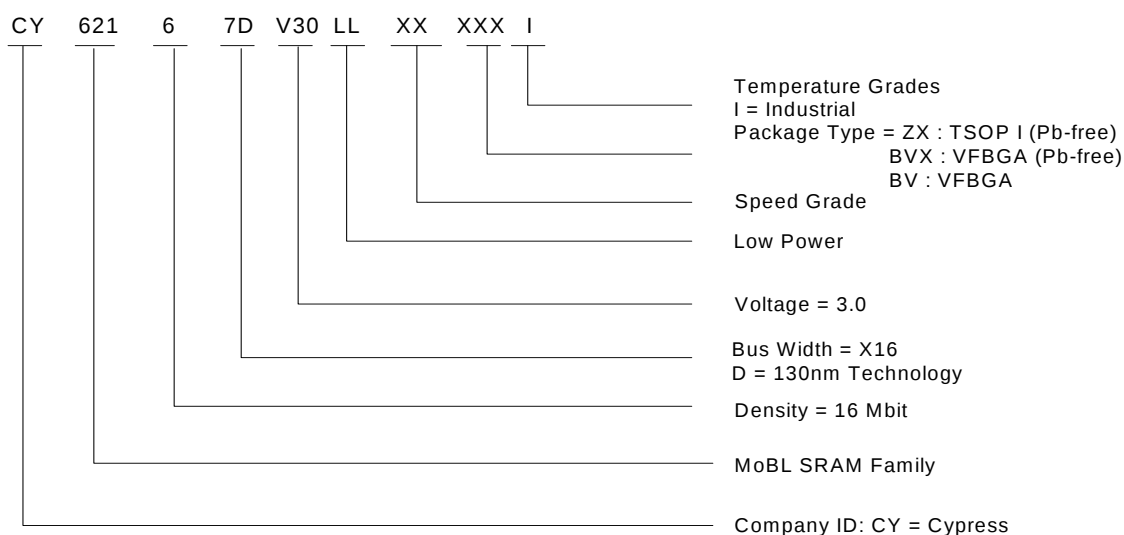
$\overline{CE}_1$	CE_2	$\overline{WE}$	$\overline{OE}$	$\overline{BHE}$	$\overline{BLE}$	Inputs/Outputs	Mode	Power
H	X	X	X	X	X	High Z	Deselect/Power-down	Standby (I_{SB})
X	L	X	X	X	X	High Z	Deselect/Power-down	Standby (I_{SB})
X	X	X	X	H	H	High Z	Deselect/Power-down	Standby (I_{SB})
L	H	H	L	L	L	Data out (I/O_0 – I/O_{15})	Read	Active (I_{CC})
L	H	H	L	H	L	High Z (I/O_8 – I/O_{15}); Data out (I/O_0 – I/O_7)	Read	Active (I_{CC})
L	H	H	L	L	H	Data out (I/O_8 – I/O_{15}); High Z (I/O_0 – I/O_7)	Read	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	High Z (I/O_8 – I/O_{15}); Data in (I/O_0 – I/O_7)	Write	Active (I_{CC})
L	H	L	X	L	H	Data in (I/O_8 – I/O_{15}); High Z (I/O_0 – I/O_7)	Write	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})

Ordering Information

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
55	CY62167DV30LL-55BVI	51-85178	48-ball FBGA (8 × 9.5 × 1 mm)	Industrial
	CY62167DV30LL-55BVXI		48-ball FBGA (8 × 9.5 × 1 mm) Pb-free	
	CY62167DV30LL-55ZXI	51-85183	48-pin TSOP I (12 × 18.4 × 1 mm) Pb-free	
70	CY62167DV30LL-70BVI	51-85178	48-ball FBGA (8 × 9.5 × 1 mm)	

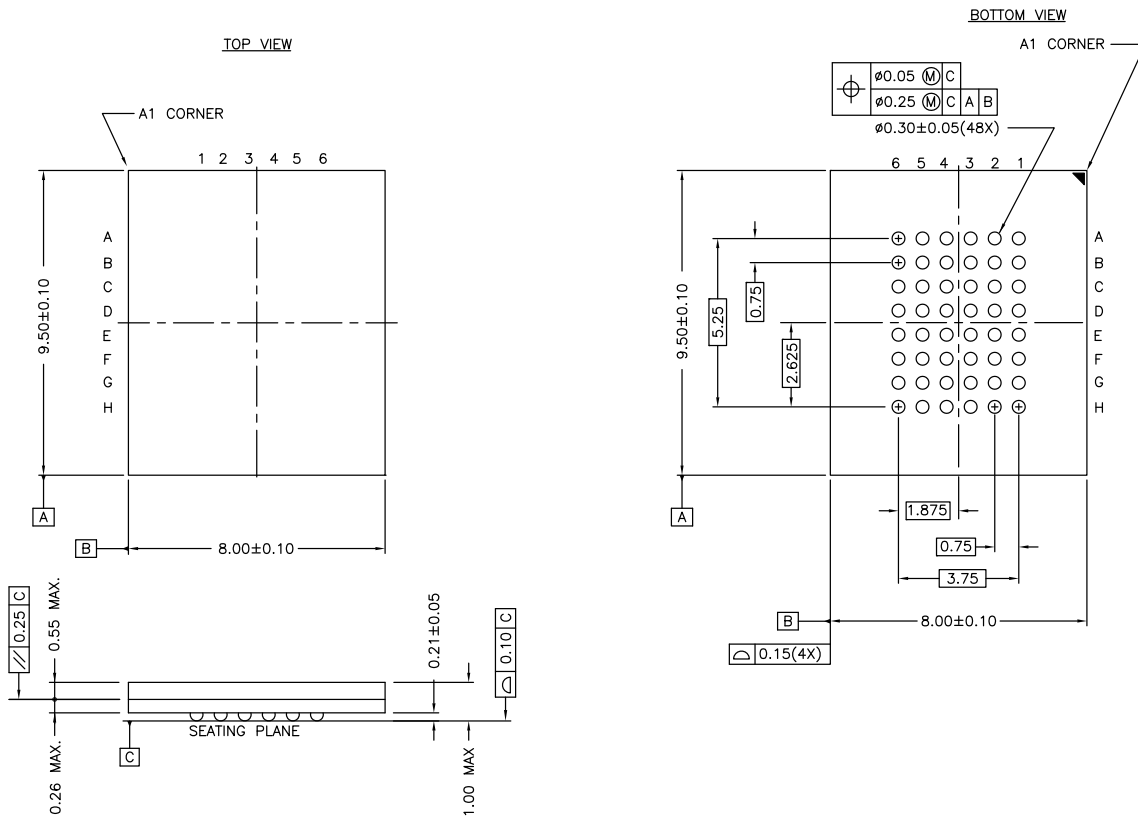
Please contact your local Cypress sales representative for availability of these parts

Ordering Code Definitions



Package Diagrams

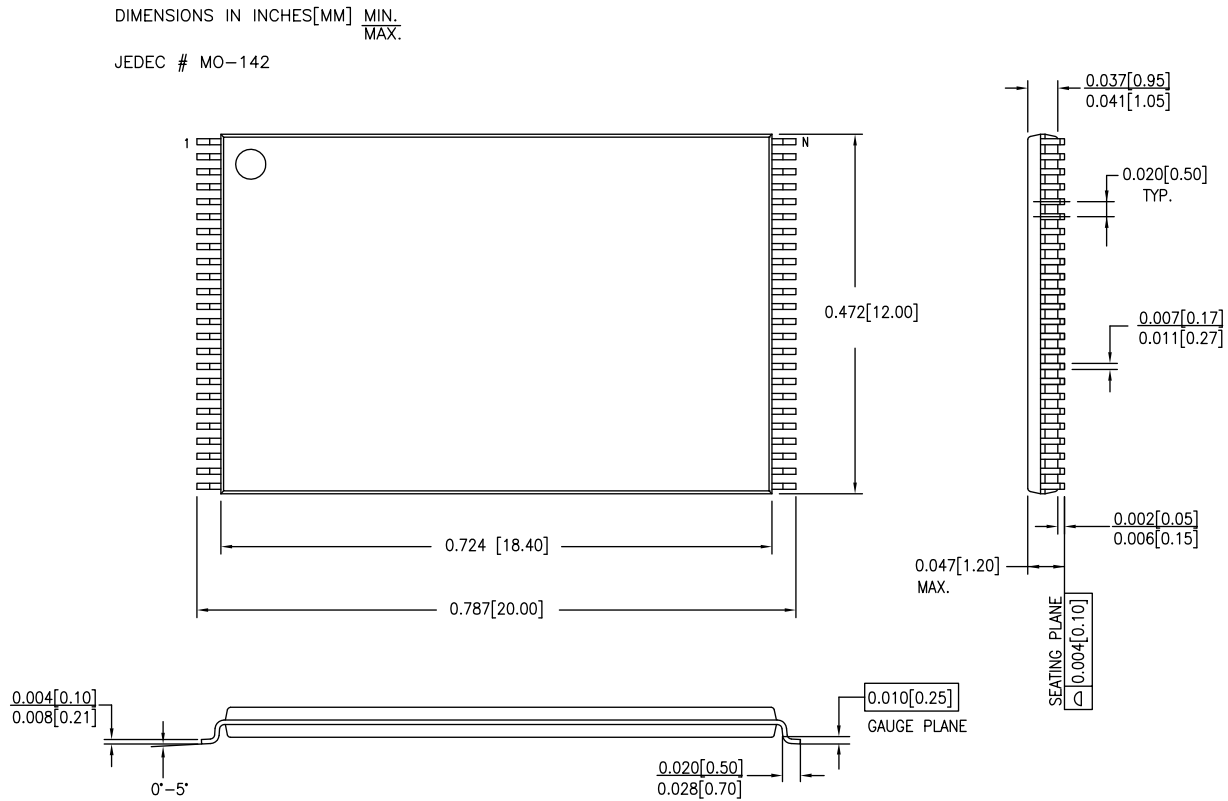
Figure 11. 48-ball VFBGA (8 × 9.5 × 1 mm) BV48B Package Outline, 51-85178



51-85178 *C

Package Diagrams (continued)

Figure 12. 48-pin TSOP I (12 × 18.4 × 1 mm) Z48A Package Outline, 51-85183



51-85183 *C

Acronyms

Acronym	Description
CMOS	Complementary Metal Oxide Semiconductor
I/O	Input/Output
SRAM	Static Random Access Memory
TSOP	Thin Small Outline Package
VFBGA	Very Fine-Pitch Ball Grid Array

Document Conventions

Units of Measure

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

Document History Page

Document Title: CY62167DV30 MoBL®, 16-Mbit (1 M × 16) Static RAM Document Number: 38-05328				
Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	118408	GUG	09/30/02	New data sheet.
*A	123692	DPM	02/11/03	Changed status from Advanced to Preliminary. Added package diagram
*B	126555	DPM	04/25/03	Minor change: Changed Sunset Owner from DPM to HRT
*C	127841	XRJ	09/10/03	Added 48 TSOP I package
*D	205701	AJU	See ECN	Changed BYTE pin usage description for 48 TSOP I package
*E	238050	KKV/AJU	See ECN	Replaced 48-ball VFBGA package diagram; Modified Package Name in Ordering Information table from BV48A to BV48B
*F	304054	PCI	See ECN	Added 45-ns Speed Bin in AC, DC and Ordering Information tables Added Footnote #12 on page #4 Added Pb-free packages on page # 10
*G	492895	VKN	See ECN	Modified datasheet to explain x8 configurability. Removed L power bin from the product offering Updated Ordering Information Table
*H	2896036	AJU	03/19/10	Removed 45-ns. Removed inactive parts from Ordering Information. Updated Packaging Information Updated links in Sales, Solutions, and Legal Information.
*I	3067267	RAME	11/08/10	Updated datasheet as per new template Added Ordering Code Definitions . Added Acronyms and Units of Measure . Updated all table notes to footnote. Package diagram updated 51-85178 from ** to *A
*J	3329789	RAME	07/27/11	Removed references to AN1064 SRAM system guidelines. Updated template according to current CY standards.
*K	4108382	AJU	08/29/2013	Updated Pin Configurations: Removed the note "Ball H6 for the FBGA package can be used to upgrade to a 32M density" and its reference in <i>Figure 1</i> . Updated Package Diagrams: spec 51-85178 – Changed revision from *A to *C. Updated in new template.

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