CY62167DV30 MoBL®

16-Mbit (1M x 16) Static RAM

Features

- **TSOP I Configurable as 1M x 16 or as 2M x 8 SRAM**
- **Very high speed: 45 ns**
- **Wide voltage range: 2.2V – 3.6V**
- **Ultra-low active power**
  - **Typical active current: 2 mA @ f = 1 MHz**
  - **Typical active current: 18.5 mA @ f = f_{Max} (45 ns speed)**
- **Ultra-low standby power**
- **Easy memory expansion with $\overline{CE}_1$, CE_2 and $\overline{OE}$ features**
- **Automatic power-down when deselected**
- **CMOS for optimum speed/power**
- **Available in Pb-free and non Pb-free 48-ball VFBGA and 48-pin TSOP I package**

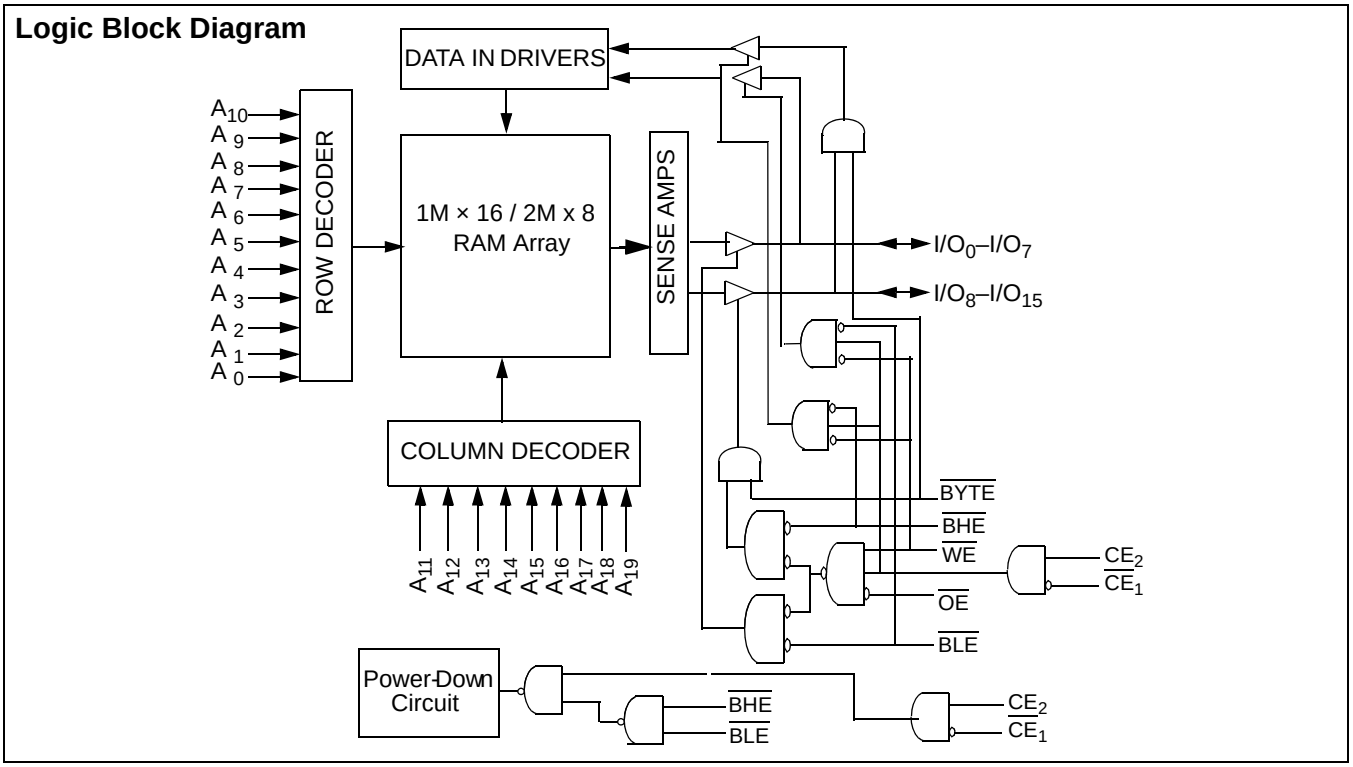
Functional Description[1]

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 will appear on I/O_0 to I/O_7. If Byte High Enable ($\overline{BHE}$) is LOW, then data from memory will 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



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

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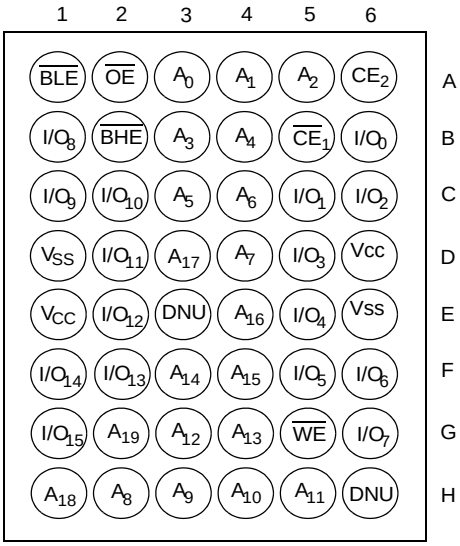
Product Portfolio

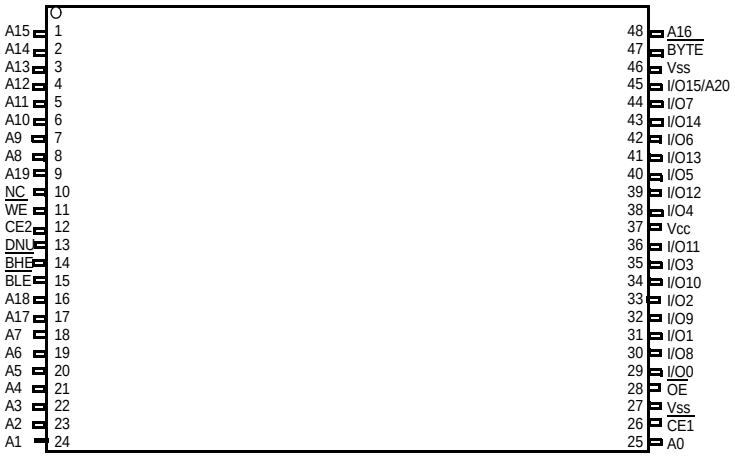
Product	V_{CC} Range (V)			Speed (ns)	Power Dissipation					
					Operating I_{CC}(mA)				Standby I_{SB2}(µA)	
					f = 1MHz		f = f_{Max}			
	Min.	Typ.[2]	Max.		Typ.[2]	Max.	Typ.[2]	Max.	Typ.[2]	Max.
CY62167DV30LL	2.2	3.0	3.6	45	2	4	18.5	37	2.5	22
				55			15	30		
				70			12	25		

Pin Configuration[3, 4, 5]

48-ball VFBGA
Top View



48-Pin TSOP I (Forward) (1M x 16/ 2M x 8)[6]
Top View



Notes:
2. 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.
3. NC pins are not connected on the die.
4. DNU pins have to be left floating.
5. Ball H6 for the FBGA package can be used to upgrade to a 32M density.
6. 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-TSOPI package can also be used as a 2M X 8 SRAM by tying the BYTE signal to V_{SS}. In the 2M x 8 configuration, Pin 45 is A20, while BHE, BLE and I/O8 to I/O14 pins are not used (DNU).

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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 ..... –0.2V to V_{CC} + 0.3V

DC Voltage Applied to Outputs in High-Z State[7, 8] ..... –0.2V to V_{CC} + 0.3V

DC Input Voltage[7, 8] ..... –0.2V to V_{CC} + 0.3V

Output Current into Outputs (LOW) .....20 mA

Static Discharge Voltage ..... > 2001V (per MIL-STD-883, Method 3015)

Latch-up Current .....> 200 mA

Operating Range

Device	Range	Ambient Temperature	V_{CC}[9]
CY62167DV30LL	Industrial	–40°C to +85°C	2.20V to 3.60V

Electrical Characteristics Over the Operating Range

Parameter	Description	Test Conditions		CY62167DV30-45			CY62167DV30-55			CY62167DV30-70			Unit
				Min.	Typ.[2]	Max.	Min.	Typ.[2]	Max.	Min.	Typ.[2]	Max.	
V_{OH}	Output HIGH Voltage	I_{OH} = –0.1 mA	V_{CC} = 2.20V	2.0			2.0			2.0			V
		I_{OH} = –1.0 mA	V_{CC} = 2.70V	2.4			2.4			2.4			
V_{OL}	Output LOW Voltage	I_{OL} = 0.1 mA	V_{CC} = 2.20V			0.4			0.4			0.4	V
		I_{OL} = 2.1mA	V_{CC} = 2.70V										
V_{IH}	Input HIGH Voltage	V_{CC} = 2.2V to 2.7V		1.8		V_{CC} +0.3V	1.8		V_{CC} +0.3V	1.8		V_{CC} +0.3V	V
		V_{CC}= 2.7V to 3.6V		2.2			2.2			2.2			
V_{IL}	Input LOW Voltage	V_{CC} = 2.2V to 2.7V		–0.3		0.6	–0.3		0.6	–0.3		0.6	V
		V_{CC}= 2.7V to 3.6V				0.8			0.8			0.8	
I_{IX}	Input Leakage Current	GND ≤ V_I ≤ V_{CC}		–1		+1	–1		+1	–1		+1	µA
I_{OZ}	Output Leakage Current	GND ≤ V_O ≤ V_{CC}, Output Disabled		–1		+1	–1		+1	–1		+1	µA
I_{CC}	V_{CC} Operating Supply Current	V_{CC} = $V_{CC(max)}$ I_{OUT} = 0 mA CMOS levels	f = f_{Max} = $1/t_{RC}$		18.5	37		15	30		12	25	mA
			f = 1 MHz		2	4		2	4		2	4	
I_{SB1}	Automatic CE Power-down Current — CMOS Inputs	$\overline{CE_1}$ ≥ V_{CC} – 0.2V or CE_2 ≤ 0.2V V_{IN} ≥ V_{CC} – 0.2V, V_{IN} ≤ 0.2V, f = f_{Max} (Address and Data Only), f = 0 ($\overline{OE}$, $\overline{WE}$, $\overline{BHE}$, $\overline{BLE}$), V_{CC} = 3.60V			2.5	22		2.5	22		2.5	22	µA
I_{SB2}	Automatic CE Power-down Current — CMOS Inputs	$\overline{CE_1}$ ≥ V_{CC} – 0.2V or CE_2 ≤ 0.2V, V_{IN} ≥ V_{CC} – 0.2V or V_{IN} ≤ 0.2V, f = 0, V_{CC} = 3.60V			2.5	22		2.5	22		2.5	22	µA

Notes:
7. $V_{IL(min.)}$ = –2.0V for pulse durations less than 20 ns.
8. $V_{IH(max)}$ = V_{CC} + 0.75V for pulse durations less than 20 ns.
9. 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.

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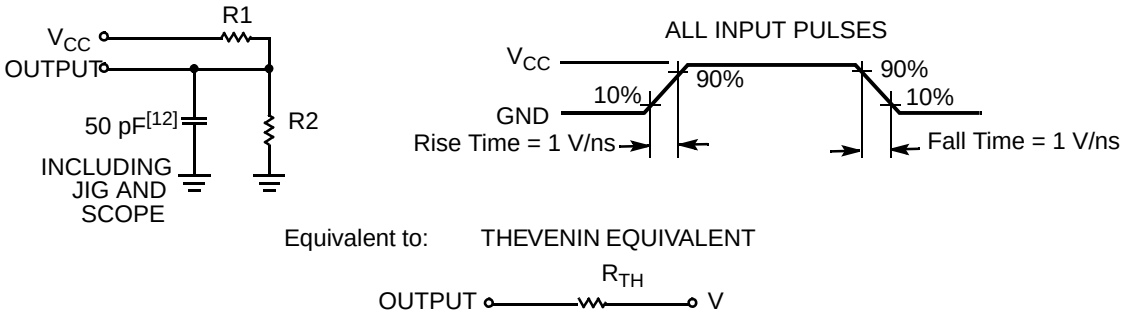
Capacitance[10, 11]

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		10	pF

Thermal Resistance[10]

Parameter	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	°C/W
Θ_{JC}	Thermal Resistance (Junction to Case)		16	4.3	°C/W

AC Test Loads and Waveforms[12]



Parameters	2.5V	3.0V	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.[2]	Max.	Unit
V_{DR}	V_{CC} for Data Retention		1.5			V
I_{CCDR}	Data Retention Current	V_{CC}= 1.5V $\overline{CE}_1 \geq V_{CC} - 0.2V$, $CE_2 \leq 0.2V$, $V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$			10	µA
t_{CDR}[10]	Chip Deselect to Data Retention Time		0			ns
t_R[13]	Operation Recovery Time		t_{RC}			ns

Notes:
10. Tested initially and after any design or process changes that may affect these parameters.
11. This applies for all packages.
12. Test condition for the 45 ns part is with a load capacitance of 30 pF.
13. Full device operation requires linear V_{CC} ramp from V_{DR} to $V_{CC(min.)} \geq 100$ µs or stable at $V_{CC(min.)} \geq 100$ µs.

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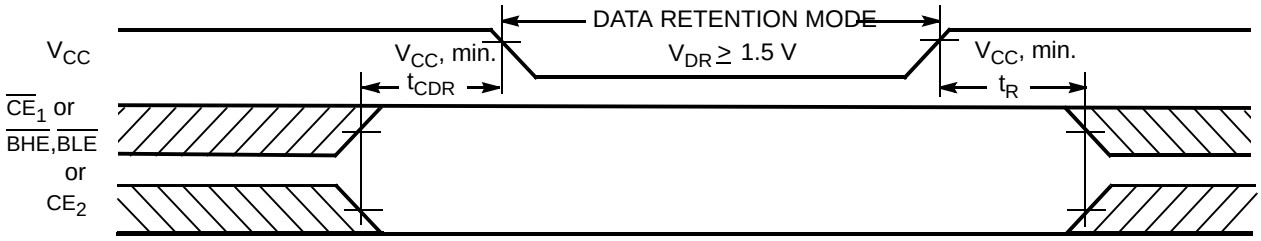
Data Retention Waveform[14]



Switching Characteristics Over the Operating Range[15]

Parameter	Description	45 ns [12]		55 ns		70 ns		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
Read Cycle								
t_{RC}	Read Cycle Time	45		55		70		ns
t_{AA}	Address to Data Valid		45		55		70	ns
t_{OHA}	Data Hold from Address Change	10		10		10		ns
t_{ACE}	$\overline{CE}_1$ LOW and CE_2 HIGH to Data Valid		45		55		70	ns
t_{DOE}	$\overline{OE}$ LOW to Data Valid		25		25		35	ns
t_{LZOE}	$\overline{OE}$ LOW to LOW Z[16]	5		5		5		ns
t_{HZOE}	$\overline{OE}$ HIGH to High Z[16, 17]		15		20		25	ns
t_{LZCE}	$\overline{CE}_1$ LOW and CE_2 HIGH to Low Z[16]	10		10		10		ns
t_{HZCE}	$\overline{CE}_1$ HIGH and CE_2 LOW to High Z[16, 17]		20		20		25	ns
t_{PU}	$\overline{CE}_1$ LOW and CE_2 HIGH to Power-up	0		0		0		ns
t_{PD}	$\overline{CE}_1$ HIGH and CE_2 LOW to Power-down		45		55		70	ns
t_{DBE}	BLE/BHE LOW to Data Valid		45		55		70	ns
t_{LZBE}	$\overline{BLE}$/$\overline{BHE}$ LOW to Low Z[16]	10		10		10		ns
t_{HZBE}	$\overline{BLE}$/$\overline{BHE}$ HIGH to HIGH Z[16, 17]		15		20		25	ns
Write Cycle[18]								
t_{WC}	Write Cycle Time	45		55		70		ns
t_{SCE}	$\overline{CE}_1$ LOW and CE_2 HIGH to Write End	40		40		60		ns
t_{AW}	Address Set-Up to Write End	40		40		60		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}	$\overline{WE}$ Pulse Width	35		40		45		ns
t_{BW}	$\overline{BLE}$/$\overline{BHE}$ LOW to Write End	40		40		60		ns
t_{SD}	Data Set-Up to Write End	25		25		30		ns
t_{HD}	Data Hold from Write End	0		0		0		ns
t_{HZWE}	$\overline{WE}$ LOW to High-Z[16, 17]		15		20		25	ns
t_{LZWE}	$\overline{WE}$ HIGH to Low-Z[16]	10		10		10		ns

Notes:
14. $\overline{BHE}$.$\overline{BLE}$ 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 $\overline{BLE}$.
15. 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.
16. At any given 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 given 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 $\overline{WE}$, $\overline{CE}_1 = V_{IL}$, $\overline{BHE}$ 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 set-up and hold timing should be referenced to the edge of the signal that terminates the Write.

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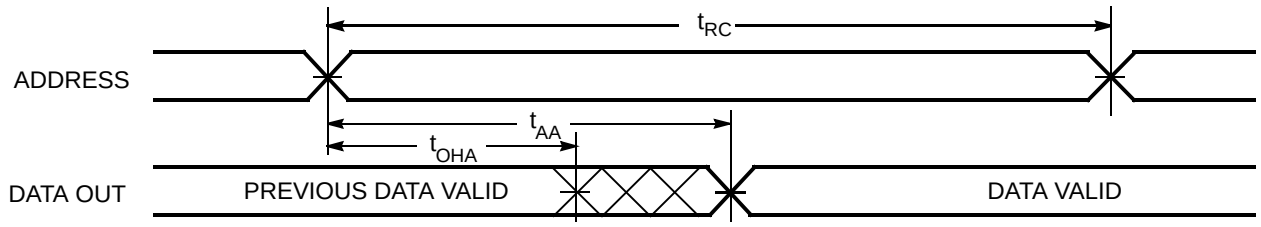
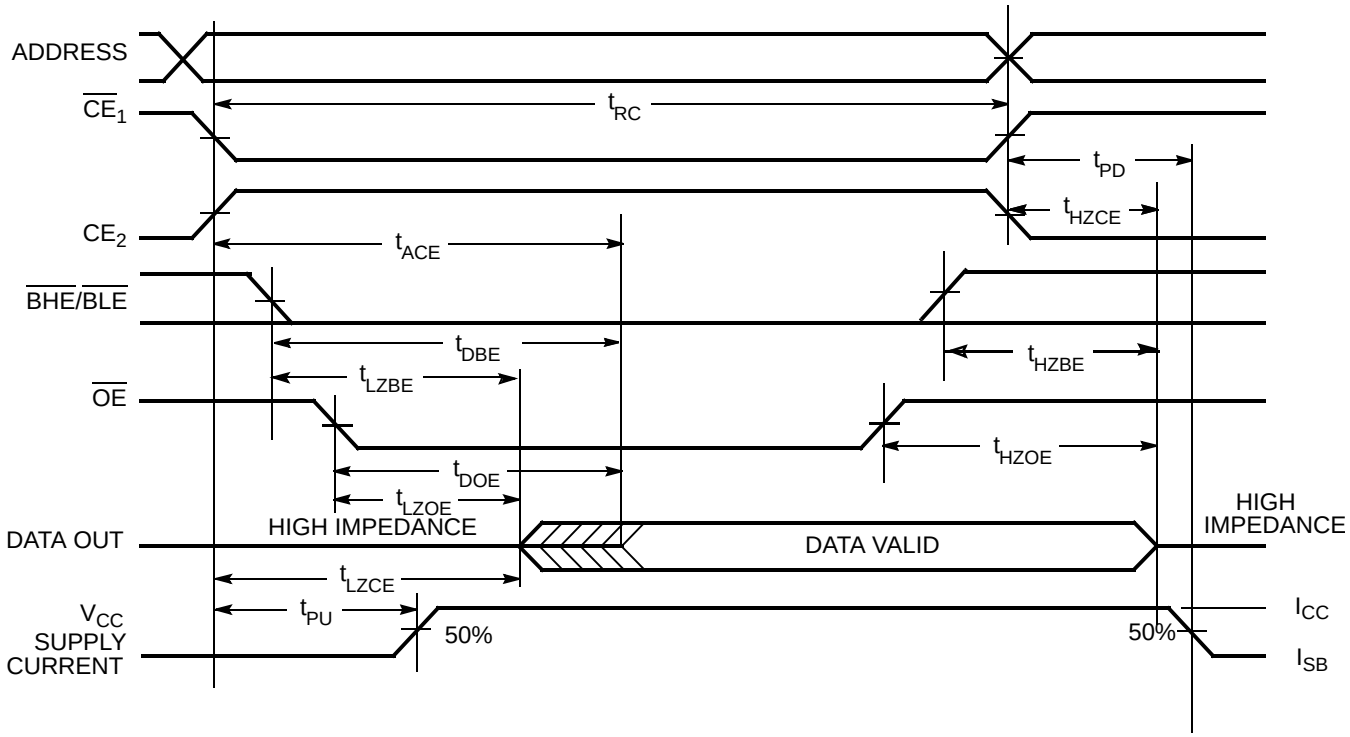
Switching Waveforms

Read Cycle 1 (Address Transition Controlled)[19, 20]



Read Cycle 2 ($\overline{OE}$ Controlled)[20, 21]



Notes:
19. The device is continuously selected. $\overline{OE}$, $\overline{CE_1} = V_{IL}$, $\overline{BHE}$ and/or $\overline{BLE} = V_{IL}$, and $CE_2 = V_{IH}$.
20. $\overline{WE}$ is HIGH for read cycle.
21. Address valid prior to or coincident with $\overline{CE_1}$, $\overline{BHE}$, $\overline{BLE}$ transition LOW and CE_2 transition HIGH.

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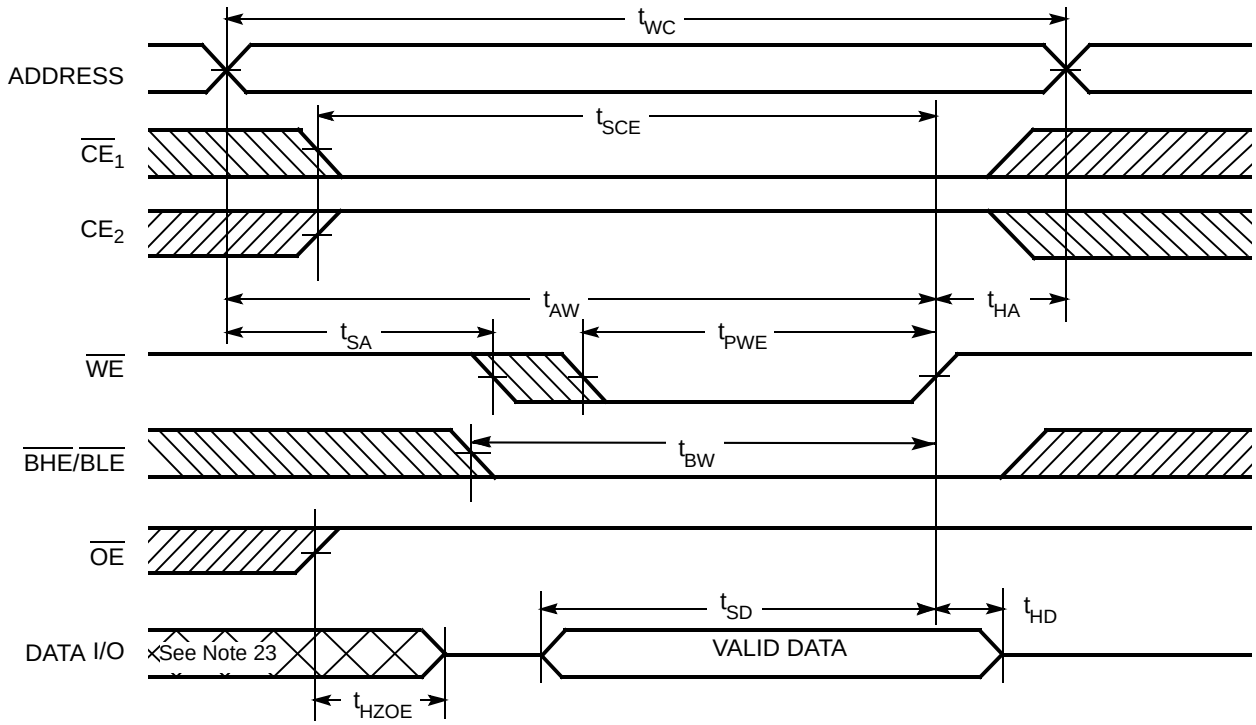
Switching Waveforms (continued)

Write Cycle 1 ($\overline{WE}$ Controlled)[18, 22, 23, 24]



Notes:
22. Data I/O is high-impedance if $\overline{OE}$ = V_{IH}.
23. 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.
24. During this period, the I/Os are in output state and input signals should not be applied.

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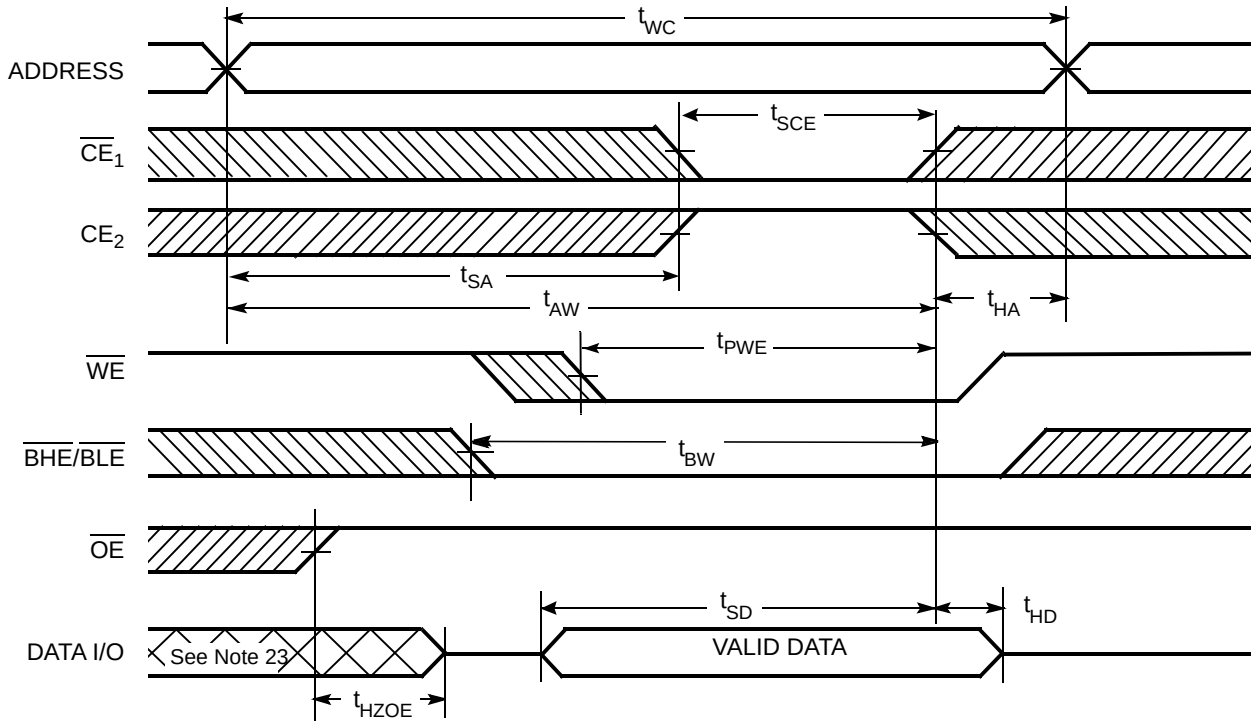
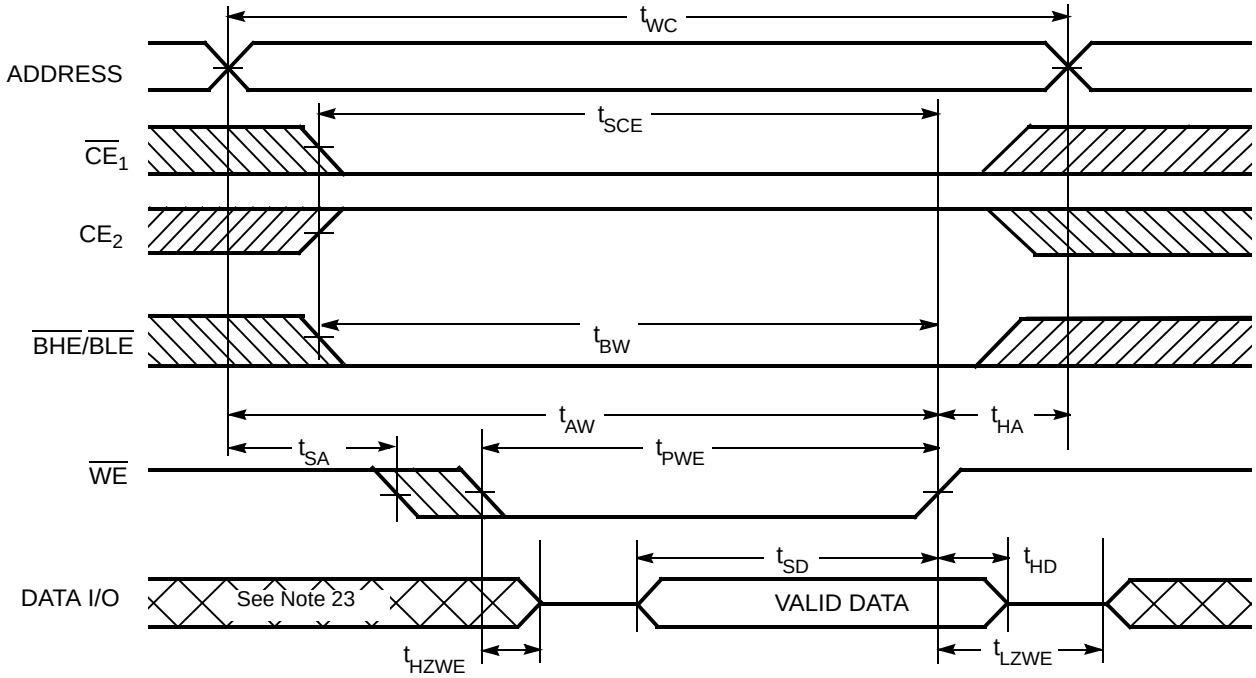
Switching Waveforms (continued)

Write Cycle 2 ($\overline{CE}_1$ or CE_2 Controlled)[18, 22, 23, 24]



Write Cycle 3 ($\overline{WE}$ Controlled, $\overline{OE}$ LOW)[23, 24]



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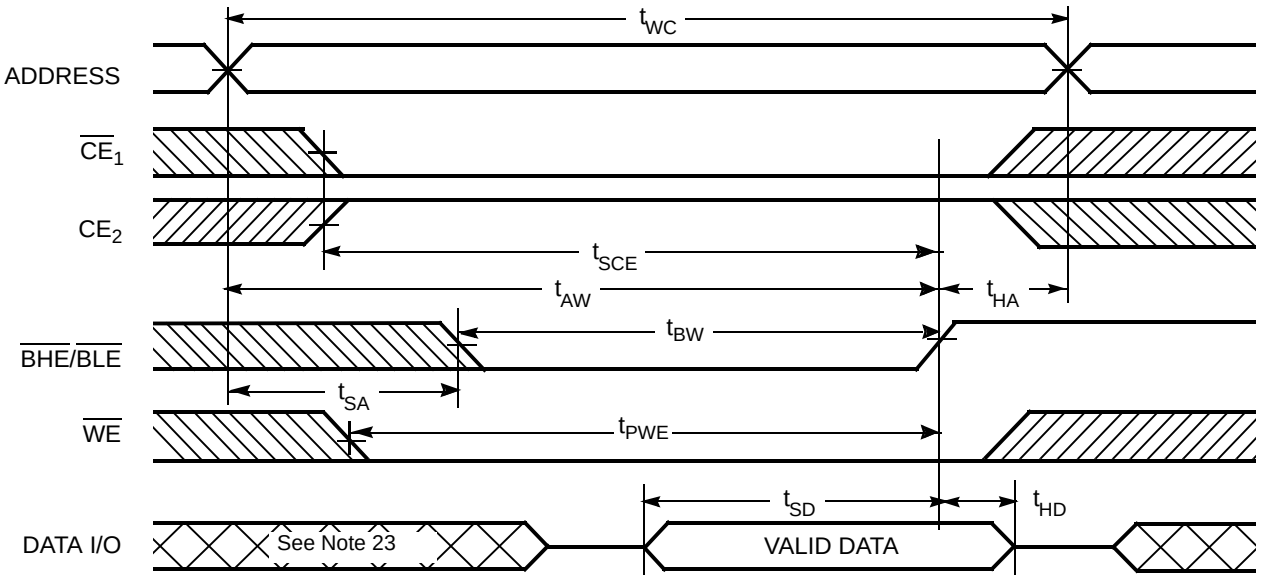
Switching Waveforms (continued)

Write Cycle 4 ($\overline{BHE}$/$\overline{BLE}$ Controlled, $\overline{OE}$ LOW)[23, 24]



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})

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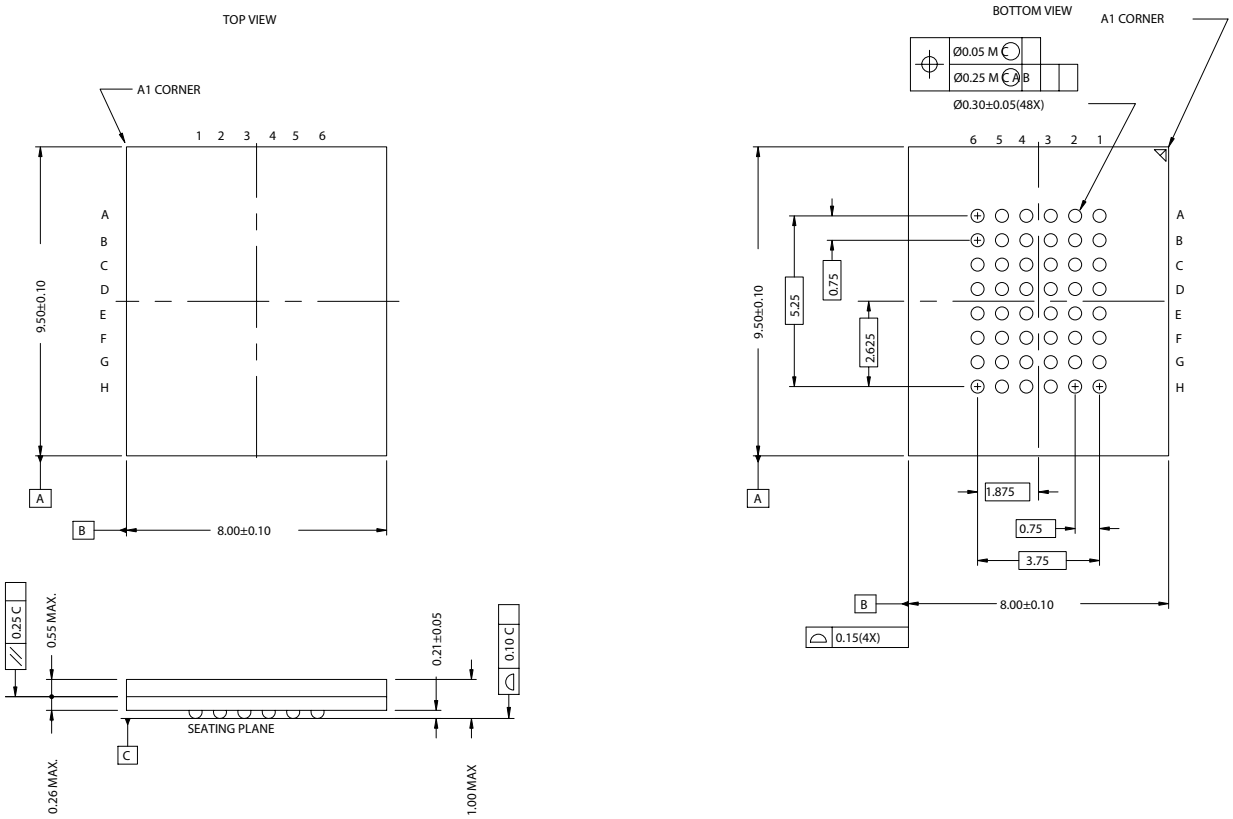
Ordering Information

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
45	CY62167DV30LL-45ZXI	51-85183	48-pin TSOP I (12 x 18.4 x 1 mm) (Pb-free)	Industrial
55	CY62167DV30LL-55BVI	51-85178	48-ball Fine Pitch BGA (8 x 9.5 x 1 mm)	
	CY62167DV30LL-55BVXI		48-ball Fine Pitch BGA (8 x 9.5 x 1 mm) (Pb-free)	
	CY62167DV30LL-55ZI	51-85183	48-pin TSOP I (12 x 18.4 x 1 mm)	
	CY62167DV30LL-55ZXI		48-pin TSOP I (12 x 18.4 x 1 mm) (Pb-free)	
70	CY62167DV30LL-70BVI	51-85178	48-ball Fine Pitch BGA (8 x 9.5 x 1 mm)	

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

Package Diagrams

48-ball VFBGA (8 x 9.5 x 1 mm) (51-85178)



51-85178-**

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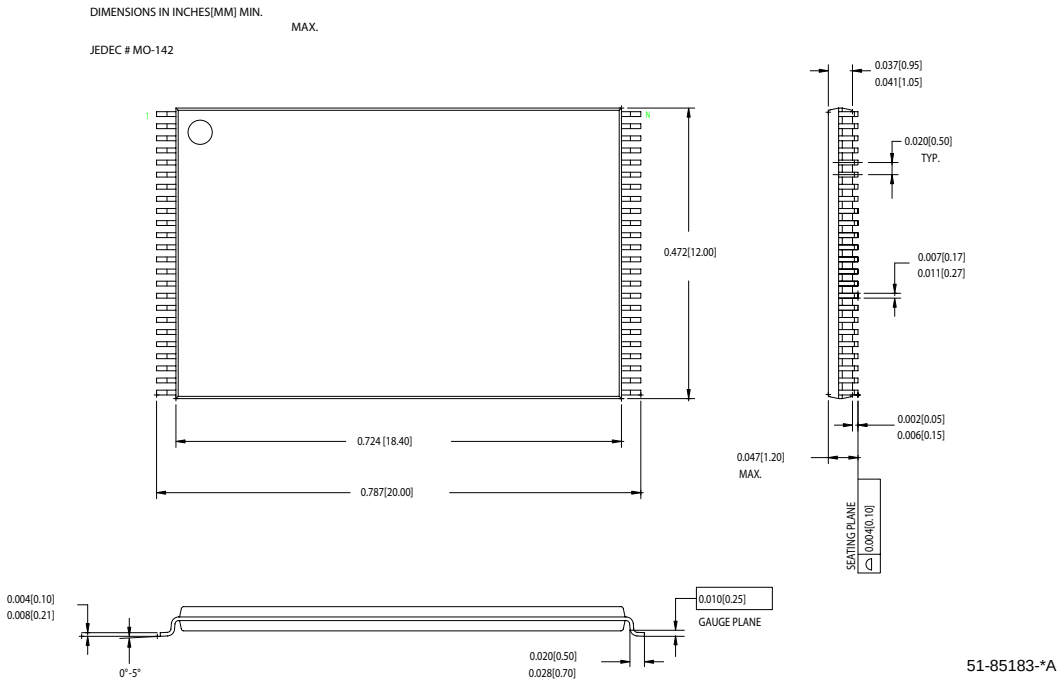
Package Diagrams (continued)

48-pin TSOP I (12 x 18.4 x 1mm) (51-85183)



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Document History Page

Document Title: CY62167DV30 MoBL®, 16-Mbit (1M x 16) Static RAM Document Number: 38-05328				
REV.	**ECN NO.**	**Issue Date**	**Orig. of Change**	**Description of Change**
**	118408	09/30/02	GUG	New Data Sheet
*A	123692	02/11/03	DPM	Changed Advanced to Preliminary Added package diagram
*B	126555	04/25/03	DPM	Minor change: Changed Sunset Owner from DPM to HRT
*C	127841	09/10/03	XRJ	Added 48 TSOP I package
*D	205701		AJU	Changed $\overline{\text{BYTE}}$ pin usage description for 48 TSOPI package
*E	238050	See ECN	KKV/AJU	Replaced 48-ball VFBGA package diagram; Modified Package Name in Ordering Information table from BV48A to BV48B
*F	304054	See ECN	PCI	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	See ECN	VKN	Modified datasheet to explain x8 configurability Removed L power bin from the product offering Updated Ordering Information Table

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