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74VCX16245

Low Voltage 16-Bit Bidirectional Transceiver with 3.6V Tolerant Inputs and Outputs

General Description

The VCX16245 contains sixteen non-inverting bidirectional buffers with 3-STATE outputs and is intended for bus oriented applications. The device is byte controlled. Each byte has separate 3-STATE control inputs which can be shorted together for full 16-bit operation. The T/R inputs determine the direction of data flow through the device. The OE inputs disable both the A and B ports by placing them in a high impedance state.

The 74VCX16245 is designed for low voltage (1.2V to 3.6V) V_{CC} applications with I/O compatibility up to 3.6V.

The 74VCX16245 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining low CMOS power dissipation.

Features

- 1.2V to 3.6V V_{CC} supply operation
- 3.6V tolerant inputs and outputs
- t_{PD}
 - 2.5 ns max for 3.0V to 3.6V V_{CC}
- Power-off high impedance inputs and outputs
- Supply current inhibition/standby current (Note 1)
- Static Data I/O
 - 10 mA @ 3.0V V_{CC}
- Uses proprietary noise/EMI reduction circuitry
- Latchup performance exceeds 300 mA
- ESD performance
 - Human body model > 2000V
 - Machine model > 200V
- Also packaged in plastic Fine-Pitch Ball Grid Array (FBGA)

Note 1: To ensure the high-impedance state during power up or power down, OE should be tied to V_{CC} through a pull-up resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

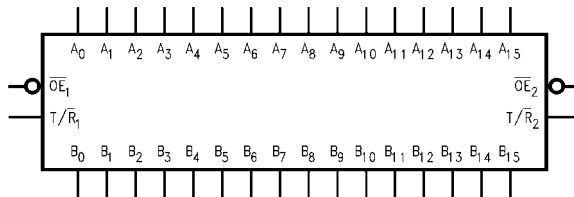
Ordering Code:

Order Number	Package Number	Package Description
74VCX16245G (Note 2)(Note 3)	BGA54A	54-Ball Fine-Pitch Ball Grid Array (FBGA), JEDEC MO-205, 5.5mm Wide
74VCX16245MTD (Note 3)	MTD48	48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide

Note 2: Ordering code "G" indicates Trays

Note 3: Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

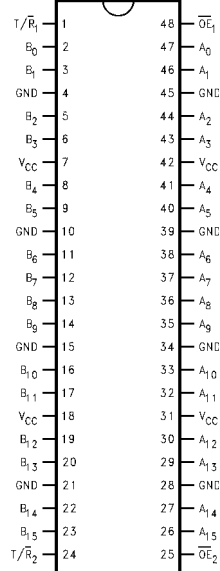
Logic Symbol



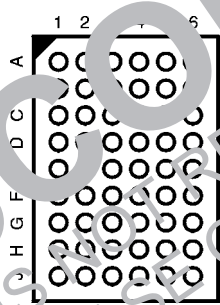
74VCX16245 Low Voltage 16-Bit Bidirectional Transceiver with 3.6V Tolerant Inputs and Outputs

Connection Diagrams

Pin Assignment of TSSOP

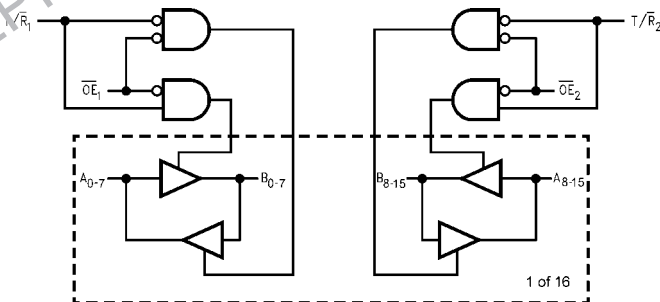


Pin Assignment for FBGA



(Top Thru View)

Logic Diagram



Pin Descriptions

Pin Names	Description
\overline{OE}_n	Output Enable Input (Active LOW)
T/\overline{R}_n	Transmit/Receive Input
A_0-A_{15}	Side A Inputs or 3-STATE Outputs
B_0-B_{15}	Side B Inputs or 3-STATE Outputs
NC	No Connect

FBGA Pin Assignments

	1	2	3	4	5	
A	B_0	NC	\overline{OE}_1	T/\overline{R}_1	A_0	A_7
B	B_2	B_1	NC	NC	A_1	A_2
C	B_4	B_3	V_{CC}	V_{CC}	A_3	A_4
D	B_6	B_5	ID	ND	A_5	A_6
E	B_7	B_8	GND	GND	A_7	A_8
F	B_9	B_{10}	GND	GND	A_9	A_{10}
G	B_{11}	V_{CC}	V_{CC}	A_{11}	A_{12}	A_{13}
H	B_{14}	B_{13}	NC	NC	A_{14}	A_{15}
	B_{15}	NC	T/\overline{R}_2	\overline{OE}_2	NC	A_{15}

Truth Tables

Inputs		Outputs
\overline{OE}_1	T/\overline{R}_1	
L	L	Bus B_0-B_7 Data to Bus A_0-A_7
L	H	Bus A_0-A_7 Data to Bus B_0-B_7
H	X	HIGH Z State on A_0-A_7, B_0-B_7

Inputs		Outputs
\overline{OE}_2	T/\overline{R}_2	
L	L	Bus B_8-B_{15} Data to Bus A_8-A_{15}
L	H	Bus A_8-A_{15} Data to Bus B_8-B_{15}
H	X	HIGH Z State on A_8-A_{15}, B_8-B_{15}

H = HIGH Voltage Level
 L = LOW Voltage Level
 X = Immaterial (HIGH or LOW, inputs and I/O's may not float)
 Z = High Impedance

Absolute Maximum Ratings(Note 4)

Supply Voltage (V_{CC})	-0.5V to +4.6V
DC Input Voltage (V_I)	-0.5V to +4.6V
Output Voltage (V_O)	
Outputs 3-STATE	-0.5V to +4.6V
Outputs Active (Note 5)	-0.5 to $V_{CC} + 0.5V$
DC Input Diode Current (I_{IK}) $V_I < 0V$	-50 mA
DC Output Diode Current (I_{OK})	
$V_O < 0V$	-50 mA
$V_O > V_{CC}$	+50 mA
DC Output Source/Sink Current (I_{OH}/I_{OL})	± 50 mA
DC V_{CC} or Ground Current per Supply Pin (I_{CC} or Ground)	± 100 mA
Storage Temperature Range (T_{STG})	-65°C to +150°C

Recommended Operating Conditions (Note 6)

Power Supply	
Operating	1.2V to 3.6V
Input Voltage	-0.3V to 3.6V
Output Voltage (V_O)	
Output in Active States	0V to V_{CC}
Output in 3-STATE	0.0V to 3.6V
Output Current in I_{OH}/I_{OL}	
$V_{CC} = 3.0V$ to 3.6V	± 20 mA
$V_{CC} = 2.3V$ to 2.7V	± 18 mA
$V_{CC} = 1.65V$ to 2.3V	± 6 mA
$V_{CC} = 1.4V$ to 1.6V	± 5 mA
$V_{CC} = 1.2V$	± 100 μA
Free Air Operating Temperature (T_A)	-50°C to +85°C
Minimum Input Edge Rate ($\Delta t/\Delta V$)	≥ 10 ns/V
$V_{IN} = 0.8V$ to 1.2V, $V_{CC} = 3.0V$	

Note 4: The Absolute Maximum Ratings are those values beyond which the ability of the device to perform as intended is not guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the Absolute Maximum Ratings. The Recommended Operating Conditions tables will define the conditions for actual device operation.

Note 5: I_O Absolute Maximum Rating must be observed.

Note 6: Floating of unused pin (inputs or I/O) must be held HIGH or LOW.

DC Electrical Characteristics

Symbol	Parameter	Conditions	V_{CC} (V)	Min	Max	Units
V_{IH}	HIGH Level Input Voltage		2.7 - 3.6	2.0		V
			2.3 - 2.7	1.6		
			1.65 - 2.3	$0.65 \times V_{CC}$		
			1.4 - 1.6	$0.65 \times V_{CC}$		
			1.2	$0.65 \times V_{CC}$		
V_{IL}	LOW Level Input Voltage		2.7 - 3.6		0.8	V
			2.3 - 2.7		0.7	
			1.65 - 2.3		$0.35 \times V_{CC}$	
			1.4 - 1.6		$0.35 \times V_{CC}$	
			1.2		$0.05 \times V_{CC}$	
V_{OH}	HIGH Level Output Voltage	$I_{OH} = -100 \mu A$	2.7 - 3.6	$V_{CC} - 0.2$		V
		$I_{OH} = -12$ mA	2.7	2.2		
		$I_{OH} = -18$ mA	3.0	2.4		
		$I_{OH} = -24$ mA	3.0	2.2		
		$I_{OH} = -100 \mu A$	2.3 - 2.7	$V_{CC} - 0.2$		
		$I_{OH} = -6$ mA	2.3	2.0		
		$I_{OH} = -12$ mA	2.3	1.8		
		$I_{OH} = -18$ mA	2.3	1.7		
		$I_{OH} = -100 \mu A$	1.65 - 2.3	$V_{CC} - 0.2$		
		$I_{OH} = -6$ mA	1.65	1.25		
		$I_{OH} = -100 \mu A$	1.4 - 1.6	$V_{CC} - 0.2$		
		$I_{OH} = -2$ mA	1.4	1.05		
		$I_{OH} = -100 \mu A$	1.2	$V_{CC} - 0.2$		

DC Electrical Characteristics (Continued)							
Symbol	Parameter	Conditions	V _{CC} (V)	Min	Max	Units	
V _{OL}	LOW Level Output Voltage	I _{OL} = 100 μA	2.7 - 3.6		0.2	V	
		I _{OL} = 12 mA	2.7		0.4		
		I _{OL} = 18 mA	3.0		0.4		
		I _{OL} = 24 mA	3.0		0.55		
		I _{OL} = 100 μA	2.3 - 2.7		0.2		
		I _{OL} = 12 mA	2.3		0.4		
		I _{OL} = 18 mA	2.3		0.4		
		I _{OL} = 100 μA	1.65 - 2.3		0.2		
		I _{OL} = 6 mA	1.65		0.3		
		I _{OL} = 100 μA	1.4 - 1.6		0.1		
I _{OL} = 2 mA	1.4		0.35				
I _{OL} = 100 μA	1.2		0.1				
I _I	Input Leakage Current	0V ≤ V _I ≤ 3.6V	1.2 - 3.6		±5.0	μA	
I _{OZ}	3-STATE Output Leakage	0V ≤ V _O ≤ 3.6V V _I = V _{IH} or V _{IL}	3.6		±1.0	μA	
I _{OFF}	Power Off Leakage Current	0V ≤ (V _I , V _O) ≤ 3.6V	0		10	μA	
I _{CC}	Quiescent Supply Current	V _I = V _{CC} or GND	2 - 3.6		20	μA	
		V _{CC} ≤ (V _I , V _O) ≤ 3.6V (Note 7)	1.2 - 3.6		±1.0	μA	
ΔI _{CC}	Increase in I _{CC} per Input	V _{IH} = V _{CC} - 1V	2.7 - 3.6		750	μA	
Note 7: Outputs disabled or 3-STATE only.							
AC Electrical Characteristics (Note 8)							
Symbol	Parameter	Conditions	V _{CC} (V)	T _A = -40°C to +25°C		Units	Figure Number
t _{PHL} t _{PLH}	Propagation Delay	C _L = 30 pF, R _L = 500Ω	3.3 ± 0.3	0.8	2.5	ns	Figures 1, 2
			2.5 ± 0.2	1.0	3.0		
			1.8 ± 0.15	1.0	6.0		
		C _L = 15 pF, R _L = 2kΩ	1.5 ± 0.1	1.0	12.0		Figures 5, 6
			1.2	1.5	30		
t _{pZL} t _{pZH}	Output Enable Time	C _L = 30 pF, R _L = 500Ω	3.3 ± 0.3	0.8	3.8	ns	Figures 1, 3, 4
			2.5 ± 0.2	1.0	4.9		
			1.8 ± 0.15	1.5	9.3		
		C _L = 15 pF, R _L = 2kΩ	1.5 ± 0.1	1.0	18.6		Figures 5, 7, 8
			1.2	1.5	46.5		
t _{PLZ} t _{PHZ}	Output Disable Time	C _L = 30 pF, R _L = 500Ω	3.3 ± 0.3	0.8	3.7	ns	Figures 1, 3, 4
			2.5 ± 0.2	1.0	4.2		
			1.8 ± 0.15	1.5	7.6		
		C _L = 15 pF, R _L = 2kΩ	1.5 ± 0.1	1.0	15.2		Figures 5, 7, 8
			1.2	1.5	38		
t _{OSSL} t _{OSSLH}	Output to Output Skew (Note 9)	C _L = 30 pF, R _L = 500Ω	3.3 ± 0.3		0.5	ns	
			2.5 ± 0.2		0.5		
			1.8 ± 0.15		0.75		
		C _L = 15 pF, R _L = 2kΩ	1.5 ± 0.1		1.5		
			1.2		1.5		
Note 8: For C _L = 50pF, add approximately 300ps to the AC maximum specification.							
Note 9: Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t _{OSSL}) or LOW-to-HIGH (t _{OSSLH}).							

Dynamic Switching Characteristics					
Symbol	Parameter	Conditions	V _{CC} (V)	T _A = +25°C	Units
				Typical	
V _{OLP}	Quiet Output Dynamic Peak V _{OL}	C _L = 30 pF, V _{IH} = V _{CC} , V _{IL} = 0V	1.8	0.25	V
			2.5	0.6	
			3.3	0.8	
V _{OLV}	Quiet Output Dynamic Valley V _{OL}	C _L = 30 pF, V _{IH} = V _{CC} , V _{IL} = 0V	1.8	-0.25	V
			2.5	-0.6	
			3.3	-0.8	
V _{OHV}	Quiet Output Dynamic Valley V _{OH}	C _L = 30 pF, V _{IH} = V _{CC} , V _{IL} = 0V	1.8	1.5	V
			2.5	1	
			3.3	2	
Capacitance					
Symbol	Parameter	Conditions	V _{CC} (V)	T _A = +25°C	Units
				Typical	
C _{IN}	Input Capacitance	V _{CC} = 1.8V, 2.5V, or 3.3V, V _I = 0V or V _{CC}		6	pF
C _{IO}	Output Capacitance	V _I = 0V, or V _{CC} ; V _{CC} = 1.8V, 2.5V, or 3.3V		7	pF
C _{PD}	Power Dissipation Capacitance	V _I = 0V or V _{CC} ; F = 100 kHz; V _{CC} = 1.8V, 2.5V, or 3.3V		20	pF

AC Loading and Waveforms (V_{CC} 3.3V ± 0.3V to 1.8V ± 0.15V)

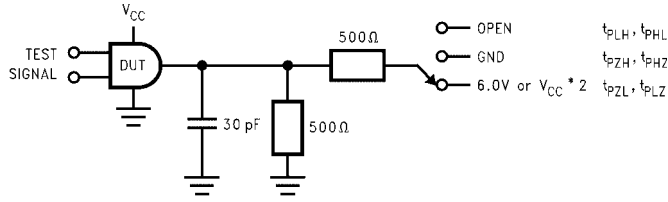


FIGURE 1. AC Test Circuit

TEST	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6V at $V_{CC} = 3.3 \pm 0.3V$; $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V, 1.8V \pm 0.15V$
t_{PZH}, t_{PHZ}	GND

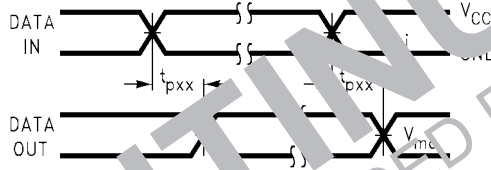


FIGURE 2. Waveforms for Inverting and Non-inverting Function

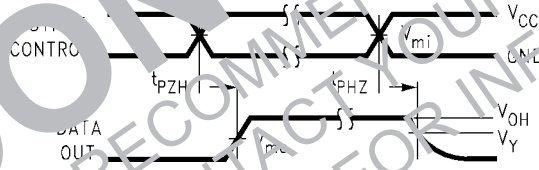


FIGURE 3. 3-STATE Output High Enable and Disable Times for Low Voltage Logic

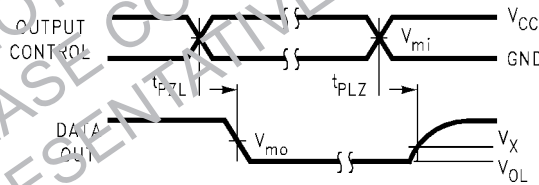
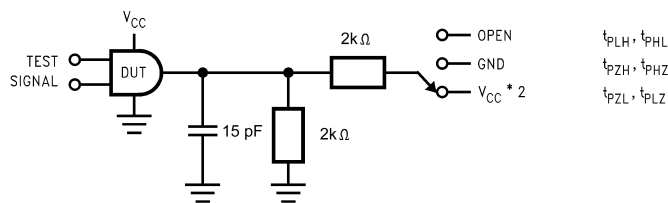


FIGURE 4. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic

Symbol	V_{CC}		
	3.3V ± 0.3V	2.5V ± 0.2V	1.8V ± 0.15V
V_{mi}	1.5V	$V_{CC}/2$	$V_{CC}/2$
V_{mo}	1.5V	$V_{CC}/2$	$V_{CC}/2$
V_X	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$	$V_{OL} + 0.15V$
V_Y	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$	$V_{OH} - 0.15V$

AC Loading and Waveforms ($V_{CC} 1.5V \pm 0.1V$ to $1.2V$)



TEST	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	$V_{CC} \times 2$ at $V_{CC} = 1.5 \pm 0.1V$

FIGURE 5. AC Test Circuit

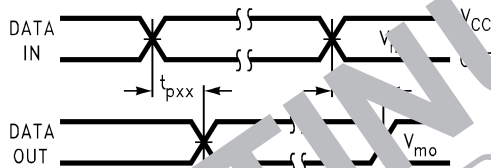


FIGURE 6. Waveform for Inverting and Non-inverting Functions

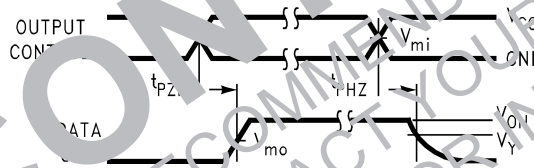


FIGURE 7. 3-STATE Output High Enable and Disable Times for Low Voltage Logic

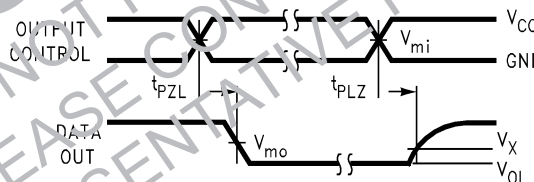
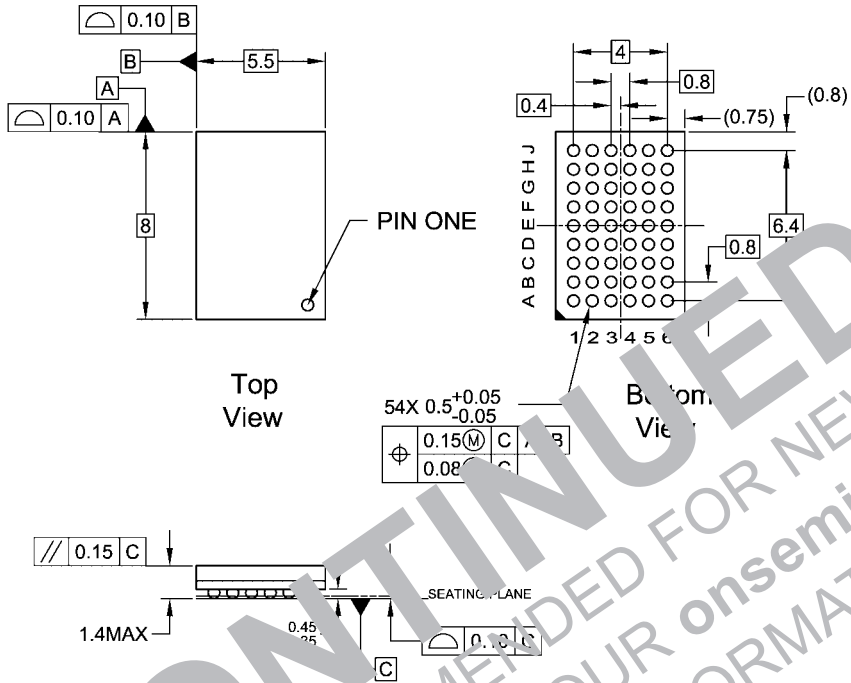


FIGURE 8. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic

Symbol	V_{CC}
	$1.5V \pm 0.1V$
V_{mi}	$V_{CC}/2$
V_{mo}	$V_{CC}/2$
V_x	$V_{OL} + 0.1V$
V_y	$V_{OH} - 0.1V$

Physical Dimensions inches (millimeters) unless otherwise noted



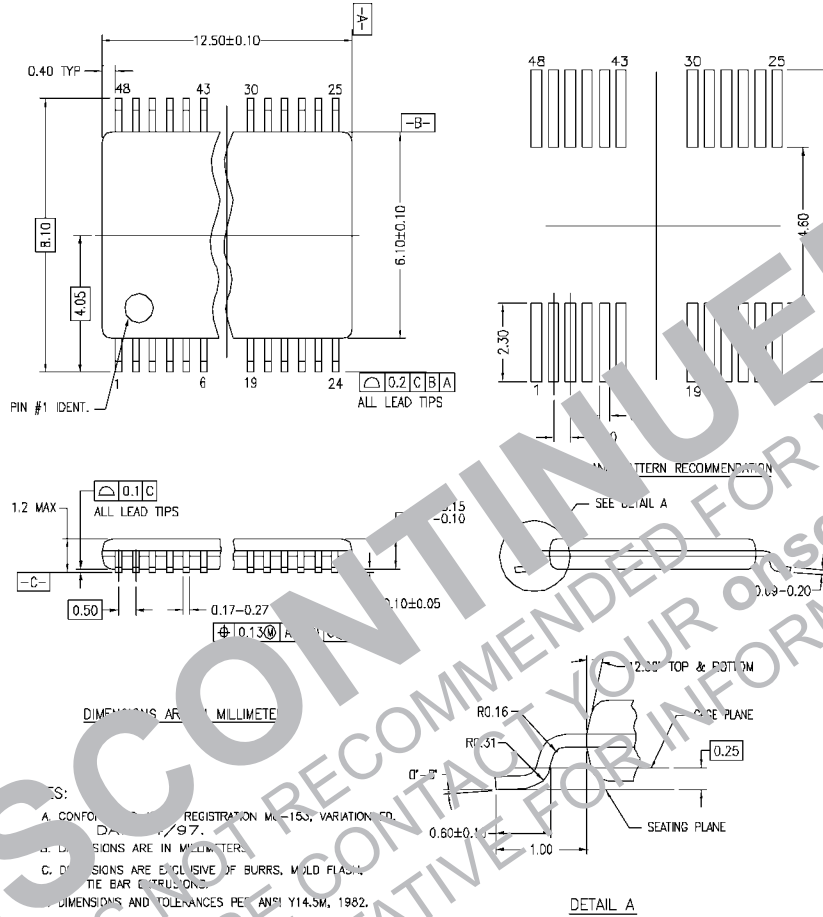
NOTES:

- A. THIS PACKAGE CONFORMS TO JEDEC MO-205
- B. ALL DIMENSIONS IN MILLIMETERS
- C. LUMINA CORPORATION RECOMMENDATION, NSMD (Non Solder Mask Defined)
- D. 0.35mm DIA PADS WITH A SOLDER MASK OPENING OF .45mm CONCENTRIC TO PADS
- E. DRAWING CONFORMS TO ASME Y14.5M-1994

BGA54A revD

54-Ball Fine-Pitch Ball Grid Array (FBGA), JEDEC MO-205, 5.5mm Wide
Package Number BGA54A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



MTD48REVC

48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide Package Number MTD48

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74V/CX16245 Low Voltage 16-5V Bidirectional Transceiver with 3.6V Tolerant Inputs and Outputs

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