

74LVT16374 • 74LVTH16374

Low Voltage 16-Bit D-Type Flip-Flop with 3-STATE Outputs

General Description

The LVT16374 and LVTH16374 contain sixteen non-inverting D-type flip-flops with 3-STATE outputs and is intended for bus oriented applications. The device is byte controlled. A buffered clock (CP) and Output Enable (\overline{OE}) are common to each byte and can be shorted together for full 16-bit operation.

The LVTH16374 data inputs include bushold, eliminating the need for external pull-up resistors to hold unused inputs.

These flip-flops are designed for low-voltage (3.3V) V_{CC} applications, but with the capability to provide a TTL interface to a 5V environment. The LVT16374 and LVTH16374 are fabricated with an advanced BiCMOS technology to achieve high speed operation similar to 5V ABT while maintaining a low power dissipation.

Features

- Input and output interface capability to systems at 5V V_{CC}
- Bushold data inputs eliminate the need for external pull-up resistors to hold unused inputs (74LVTH16374), also available without bushold feature (74LVT16374)
- Live insertion/extraction permitted
- Power Up/Power Down high impedance provides glitch-free bus load
- Outputs source/sink ≥ 2 mA to 54 mA
- Functional compatible with the 74 series 16374
- Latch-up performance exceeds 500 mA
- ESD performance:
 - Human body model $> 2000V$
 - Machine model $> 200V$
 - Charged-device model $> 1000V$
- Also packaged in plastic Fine-Pitch Ball Grid Array (FBGA)

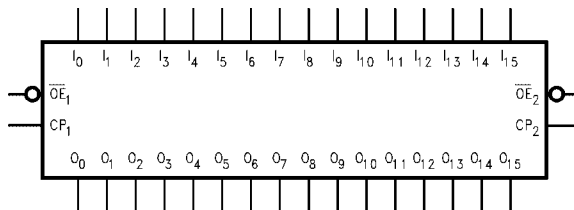
Ordering Code:

Order Number	Package Number	Package Description
74LVT16374G (Note 1)(Note 2)	BGA54A (Preliminary)	54-Ball Fine-Pitch Ball Grid Array (FBGA), JEDEC MO-205, 5.5mm Wide
74LVT16374MEA (Note 2)	MS48A	48-Lead Small Shrink Outline Package (SSOP), JEDEC MO-118, 0.300" Wide
74LVT16374MTD (Note 2)	MTD48	48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide
74LVTH16374G (Note 1)(Note 2)	BGA54A	54-Ball Fine-Pitch Ball Grid Array (FBGA), JEDEC MO-205, 5.5mm Wide
74LVTH16374MEA (Note 2)	MS48A	48-Lead Small Shrink Outline Package (SSOP), JEDEC MO-118, 0.300" Wide
74LVTH16374MTD (Note 2)	MTD48	48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide

Note 1: Ordering code "G" indicates Trays.

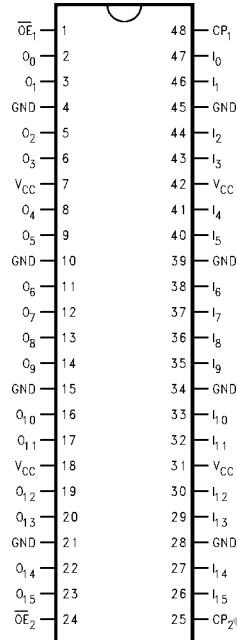
Note 2: Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

Logic Symbol

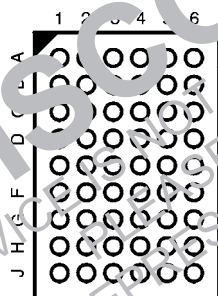


Connection Diagrams

Pin Assignment for SSOP and TSSOP



Pin Assignment for FBGA



(Top Thru View)

Pin Descriptions

Pin Names	Description
\overline{OE}_n	Output Enable Input (Active LOW)
CP_n	Clock Pulse Input
I_0-I_{15}	Inputs
O_0-O_{15}	3-STATE Outputs
NC	No Connect

FBGA Pin Assignments

	1	2	3	4	5	6
A	O_0	NC	\overline{OE}_1	CP_1	NC	I_0
B	O_2	O_1	NC	NC	I_1	I_2
C	O_4	O_3	V_{CC}	V_{CC}	I_3	I_4
D	O_6	O_5	GND	GND	I_5	I_6
E	O_8	O_7	GND	GND	I_7	I_8
F	O_{10}	O_9	GND	GND	I_9	I_{10}
G	O_{12}	O_{11}	V_{CC}	V_{CC}	I_{11}	I_{12}
H	O_{14}	O_{13}	NC	NC	I_{13}	I_{14}
J	O_{15}	NC	\overline{OE}_2	CP_2	NC	I_{15}

Truth Tables

Inputs			Outputs
CP_1	\overline{OE}_1	I_0-I_7	O_0-O_7
—	L	H	H
—	L	L	L
L	L	X	O_0
X	H	X	Z

Inputs			Outputs
CP_2	\overline{OE}_2	I_8-I_{15}	O_8-O_{15}
—	L	H	H
—	L	L	L
L	L	X	O_0
X	H	X	Z

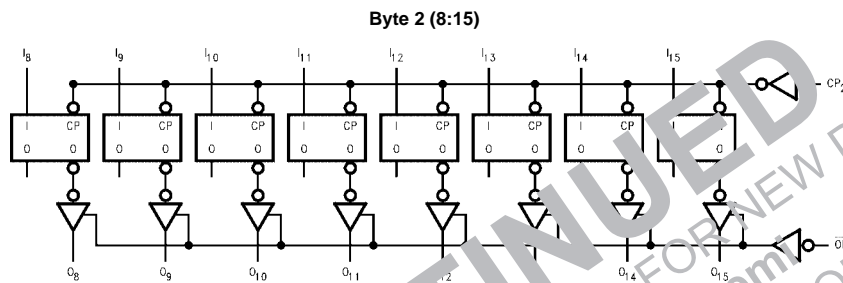
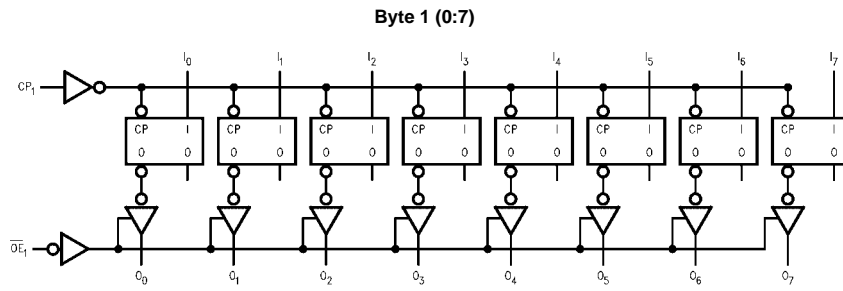
H = HIGH Voltage Level
 L = LOW Voltage Level
 X = Immaterial
 Z = HIGH Impedance
 O_0 = Previous O_0 before HIGH to LOW of CP

Functional Description

The LVT16374 and LVTH16374 consist of sixteen edge-triggered flip-flops with individual D-type inputs and 3-STATE true outputs. The device is byte controlled with each byte functioning identically, but independent of the other. The control pins can be shorted together to obtain full 16-bit operation. Each byte has a buffered clock and buffered Output Enable common to all flip-flops within that byte. The description which follows applies to each byte.

Each flip-flop will store the state of their individual D-type inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (CP_n) transition. With the Output Enable (\overline{OE}_n) LOW, the contents of the flip-flops are available at the outputs. When \overline{OE}_n is HIGH, the outputs go to the high impedance state. Operation of the \overline{OE}_n input does not affect the state of the flip-flops.

Logic Diagrams



Please note that these diagrams are provided for the understanding of logic operation and should not be used to estimate propagation delays.

DISCONTINUED

THIS DEVICE IS NOT RECOMMENDED FOR NEW DESIGN

PLEASE CONTACT YOUR FAIRCHILD SEMICONDUCTOR REPRESENTATIVE FOR INFORMATION

Absolute Maximum Ratings (Note 3)

Symbol	Parameter	Value	Conditions	Units
V_{CC}	Supply Voltage	-0.5 to +4.6		V
V_I	DC Input Voltage	-0.5 to +7.0		V
V_O	DC Output Voltage	-0.5 to +7.0	Output in 3-STATE	V
		-0.5 to +7.0	Output in High or Low State (Note 4)	
I_{IK}	DC Input Diode Current	-50	$V_I < \text{GND}$	mA
I_{OK}	DC Output Diode Current	-50	$V_O < \text{GND}$	mA
I_O	DC Output Current	64	$V_O > V_{CC}$ Output at High State	mA
		128	$V_O > V_{CC}$ Output at Low State	
I_{CC}	DC Supply Current per Supply Pin	± 64		mA
I_{GND}	DC Ground Current per Ground Pin	± 128		mA
T_{STG}	Storage Temperature	-65 to +150		$^{\circ}\text{C}$

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Units
V_{CC}	Supply Voltage	2.7	3.6	V
V_I	Input Voltage		5.5	V
I_{OH}	High-Level Output Current		-32	mA
I_{OL}	Low-Level Output Current		64	mA
T_A	Free-Air Operating Temperature	-40	85	$^{\circ}\text{C}$
$\Delta t/\Delta V$	Input Edge Rate, $V_{IN} = 0.8\text{V}-2.0\text{V}$, $V_{CC} = 3.0\text{V}$	0	10	ns/V

Note 3: Absolute Maximum continuous ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute maximum rated conditions is not implied.

Note 4: I_O Absolute Maximum Rating must be observed.

DC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	$T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$		Units	Conditions	
			Min	Max			
V_{IK}	Input LOW Voltage	2.7		-1.2	V	$I_I = -18 \text{ mA}$	
V_{IH}	Input HIGH Voltage	2.7-3.6	2.0		V	$V_O \leq 0.1\text{V}$ or $V_O \geq V_{CC} - 0.1\text{V}$	
V_{IL}	Input LOW Voltage	2.7-3.6		0.8			
V_{OH}	Output HIGH Voltage	2.7-3.6	$V_{CC} - 0.2$		V	$I_{OH} = -100 \mu\text{A}$	
		2.7	2.4			$I_{OH} = -8 \text{ mA}$	
		3.0	2.0			$I_{OH} = -32 \text{ mA}$	
V_{OL}	Output LOW Voltage	2.7		0.2	V	$I_{OL} = 100 \mu\text{A}$	
		2.7		0.5		$I_{OL} = 24 \text{ mA}$	
		3.0		0.4		$I_{OL} = 16 \text{ mA}$	
		3.0		0.5		$I_{OL} = 32 \text{ mA}$	
		3.0		0.55		$I_{OL} = 64 \text{ mA}$	
$I_{I(\text{HOLD})}$ (Note 5)	Bushold Input Minimum Drive	3.0	75	-75	μA	$V_I = 0.8\text{V}$ $V_I = 2.0\text{V}$	
$I_{I(\text{OD})}$ (Note 5)	Bushold Input Over-Drive Current to Change State	3.0	500	-500	μA	(Note 6) (Note 7)	
I_I	Input Current		3.6		μA	$V_I = 5.5\text{V}$	
		Control Pins	3.6			± 1	$V_I = 0\text{V}$ or V_{CC}
		Data Pins	3.6			-5	$V_I = 0\text{V}$
						$V_I = V_{CC}$	
I_{OFF}	Power Off Leakage Current	0		± 100	μA	$0\text{V} \leq V_I$ or $V_O \leq 5.5\text{V}$	
$I_{PU/PD}$	Power Up/Down 3-STATE Output Current	0-1.5V		± 100	μA	$V_O = 0.5\text{V}$ to 3.0V $V_I = \text{GND}$ or V_{CC}	
I_{OZL}	3-STATE Output Leakage Current	3.6		-5	μA	$V_O = 0.5\text{V}$	
I_{OZH}	3-STATE Output Leakage Current	3.6		5	μA	$V_O = 3.0\text{V}$	
I_{OZH+}	3-STATE Output Leakage Current	3.6		10	μA	$V_{CC} < V_O \leq 5.5\text{V}$	

DC Electrical Characteristics (Continued)

Symbol	Parameter	V _{CC} (V)	T _A = -40°C to +85°C		Units	Conditions
			Min	Max		
I _{OCH}	Power Supply Current	3.6		0.19	mA	Outputs HIGH
I _{OCL}	Power Supply Current	3.6		5	mA	Outputs LOW
I _{CCZ}	Power Supply Current	3.6		0.19	mA	Outputs Disabled
I _{CCZ+}	Power Supply Current	3.6		0.19	mA	V _{CC} ≤ V _O ≤ 5.5V, Outputs Disabled
ΔI _{CC}	Increase in Power Supply Current (Note 8)	3.6		0.2	mA	One Input at V _{CC} - 0.6V Other Inputs at V _{CC} or GND

Note 5: Applies to bushold versions only (74LVTH16374).

Note 6: An external driver must source at least the specified current to switch from LOW-to-HIGH.

Note 7: An external driver must sink at least the specified current to switch from HIGH-to-LOW.

Note 8: This is the increase in supply current for each input that is at the specified voltage level rather than V_{CC} or GND.

Dynamic Switching Characteristics (Note 9)

Symbol	Parameter	V _{CC} (V)	T _A = 25°C			Units	Conditions C _L = 50 pF, R _L = 500Ω
			Min	Typ	Max		
V _{OLP}	Quiet Output Maximum Dynamic V _{OL}	3.3		0.8		V	(Note 10)
V _{OLV}	Quiet Output Minimum Dynamic V _{OL}	3.3		-0.8		V	(Note 10)

Note 9: Characterized in SSOP package. Guaranteed parameter, but not tested.

Note 10: Max number of outputs defined as (n), n-1 data inputs are driven 0V to V_{CC}. Output under test held LOW.

AC Electrical Characteristics

Symbol	Parameter	T _A = -40°C to +85°C, C _L = 50 pF, R _L = 500Ω				Units
		V _{CC} = 3.3V ± 0.3V		V _{CC} = 2.7V		
		Min	Max	Min	Max	
f _{MAX}	Maximum Clock Frequency	160		160		MHz
t _{PHL}	Propagation Delay	1.3	4.3	1.9	4.6	ns
t _{PLH}	CP to O _n	1.6	4.5	1.6	5.2	ns
t _{PZL}	Output Enable	1.3	4.4	1.3	5.0	ns
t _{PZH}	Output Disable	1.0	4.5	1.0	5.4	ns
t _{PLZ}	Output Disable Time	1.5	4.6	1.5	4.8	ns
t _{PHZ}	Output Enable Time	2.0	5.0	2.0	5.4	ns
t _S	Setup Time	1.8		2.0		ns
t _H	Hold Time	0.8		0.1		ns
t _W	Pulse Width	3.0		3.0		ns
t _{OSSL}	Output to Output Skew (Note 11)		1.0		1.0	ns
t _{OSLH}			1.0		1.0	ns

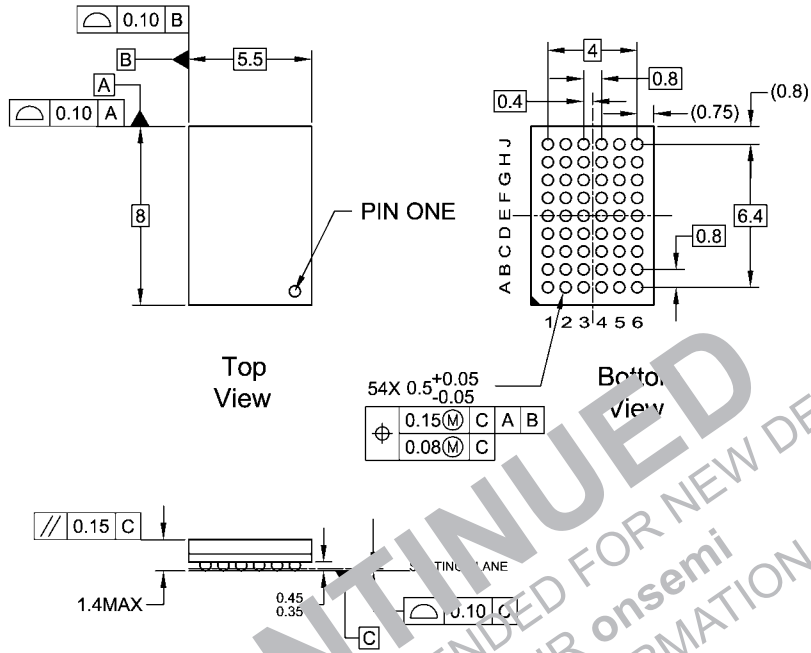
Note 11: Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t_{OSSL}) or LOW-to-HIGH (t_{OSLH}).

Capacitance (Note 12)

Symbol	Parameter	Conditions	Typical	Units
C _{IN}	Input Capacitance	V _{CC} = Open, V _I = 0V or V _{CC}	4	pF
C _{OUT}	Output Capacitance	V _{CC} = 3.0V, V _O = 0V or V _{CC}	8	pF

Note 12: Capacitance is measured at frequency f = 1 MHz, per MIL-STD-883, Method 3012.

Physical Dimensions inches (millimeters) unless otherwise noted



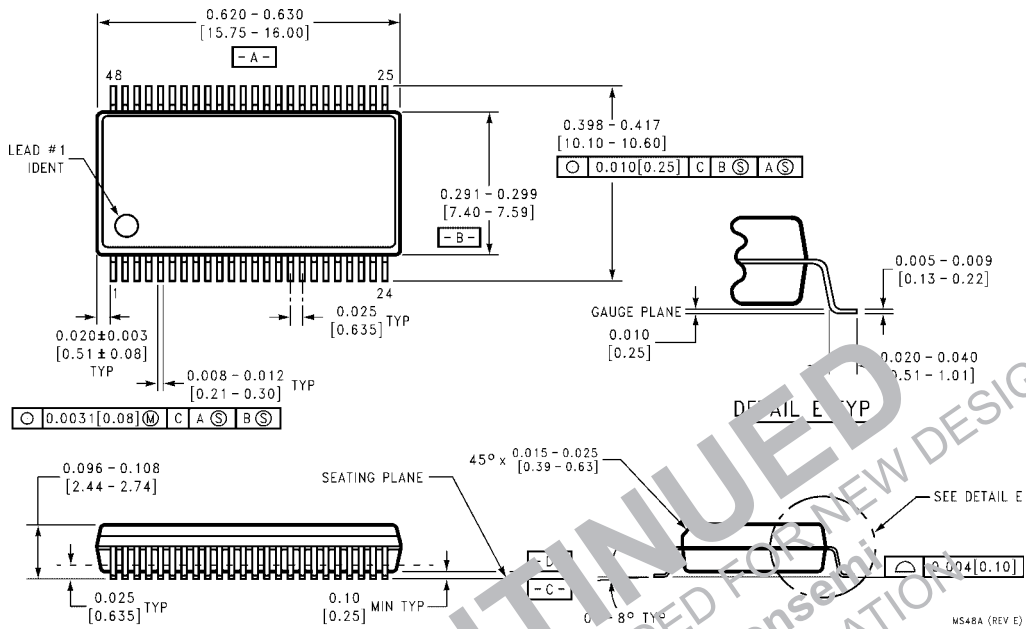
NOTES:

- A. THIS PACKAGE CONFORMS TO JEDEC MO-205
- B. ALL DIMENSIONS IN MILLIMETERS
- C. LAND PATTERN RECOMMENDATION: NSMD (Non Solder Mask Defined)
- D. LAND PADS WITH A SOLDERMASK OPENING OF .45MM CONCENTRIC TO PADS
- E. DRAWING CONFORMS TO ASME Y14.5M-1994

BGA54ArevD

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

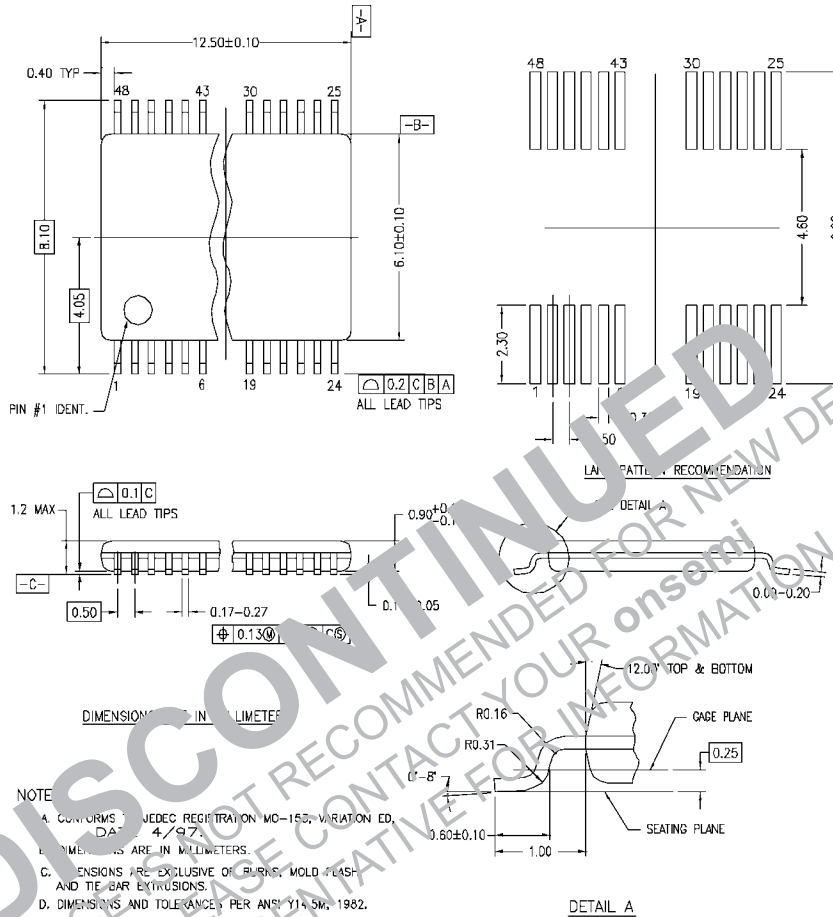
Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



48-Lead Small Shrink Outline Package (SSOP), JEDEC MC-148, 0.300" Wide
Package Number MS48A

DISCONTINUED
THIS DEVICE IS NOT RECOMMENDED FOR NEW DESIGN
PLEASE CONTACT YOUR FAIRCHILD REPRESENTATIVE FOR INFORMATION

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



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

Fairchild does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and Fairchild reserves the right at any time without notice to change said circuitry and specifications.


LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF FAIRCHILD SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

www.fairchildsemi.com

DISCONTINUED
THIS DEVICE IS NOT RECOMMENDED FOR NEW DESIGN
PLEASE CONTACT YOUR onsemi
REPRESENTATIVE FOR INFORMATION

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local
Sales Representative