FAIRCHILD™

Is Now Part of

ON Semiconductor®

To learn more about ON Semiconductor, please visit our website at
www.onsemi.com

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

FAIRCHILD
SEMICONDUCTOR ™

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 loading
- Outputs source/sink -32 mA/$+64$ mA
- Functionally 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

www.fairchildsemi.com

74LVT16374 • 74LVTH16374
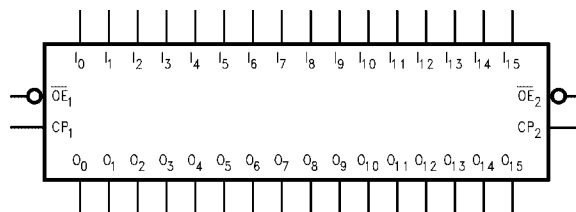
Connection Diagrams

Pin Assignment for SSOP and TSSOP

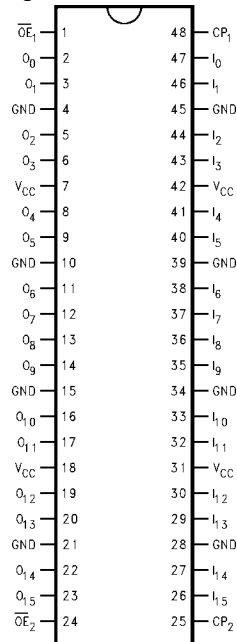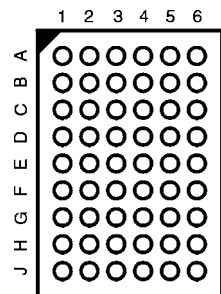|			
$\overline{OE}_1$	1	48	CP_1
O_0	2	47	I_0
O_1	3	46	I_1
GND	4	45	GND
O_2	5	44	I_2
O_3	6	43	I_3
V_{CC}	7	42	V_{CC}
O_4	8	41	I_4
O_5	9	40	I_5
GND	10	39	GND
O_6	11	38	I_6
O_7	12	37	I_7
O_8	13	36	I_8
O_9	14	35	I_9
GND	15	34	GND
O_{10}	16	33	I_{10}
O_{11}	17	32	I_{11}
V_{CC}	18	31	V_{CC}
O_{12}	19	30	I_{12}
O_{13}	20	29	I_{13}
GND	21	28	GND
O_{14}	22	27	I_{14}
O_{15}	23	26	I_{15}
$\overline{OE}_2$	24	25	CP_2

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_o
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_o
X	H	X	Z

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
Z = HIGH Impedance
O_o = Previous O_o 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

Byte 1 (0:7)

Byte 2 (8:15)
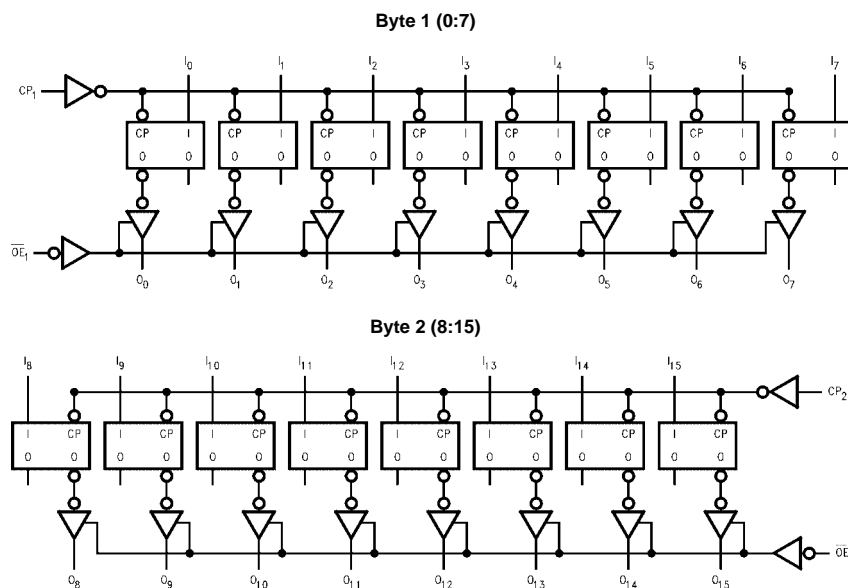
Please note that these diagrams are provided for the understanding of logic operation and should not be used to estimate propagation delays.

www.fairchildsemi.com

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	$V_I < GND$	mA
I_{OK}	DC Output Diode Current	−50	$V_O < GND$	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		°C

Recommended Operating Conditions

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

DC Electrical Characteristics (Continued)

Symbol	Parameter	V_{CC} (V)	T_A = −40°C to +85°C Min	Max	Units	Conditions
I_{CCH}	Power Supply Current	3.6		0.19	mA	Outputs HIGH
I_{CCL}	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	$V_{CC} \le V_O \le 5.5V$, 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 Min	Typ	Max	Units	Conditions C_L = 50 pF, R_L = 500Ω
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 3V. Output under test held LOW.

AC Electrical Characteristics

|		T_A = −40°C to +85°C, C_L = 50 pF, R_L = 500Ω					
Symbol	Parameter	V_{CC} = 3.3V ± 0.3V		V_{CC} = 2.7V		Units	
		Min	Max	Min	Max		
f_{MAX}	Maximum Clock Frequency	160		160		MHz	
t_{PHL}	Propagation Delay	1.9	4.3	1.9	4.6	ns	
t_{PLH}	CP to O$_n$	1.6	4.5	1.6	5.2		
t_{PZL}	Output Enable Time	1.3	4.4	1.3	5.0	ns	
t_{PZH}		1.0	4.5	1.0	5.4		
t_{PLZ}	Output Disable Time	1.5	4.6	1.5	4.8	ns	
t_{PHZ}		2.0	5.0	2.0	5.4		
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_{OSHL}	Output to Output Skew (Note 11)		1.0		1.0	ns	
t_{OSLH}			1.0		1.0		

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_{OSHL}) 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

Top View

Bottom View

PIN ONE

$54X\ 0.5^{+0.05}_{-0.05}$

SEATING PLANE

1.4MAX
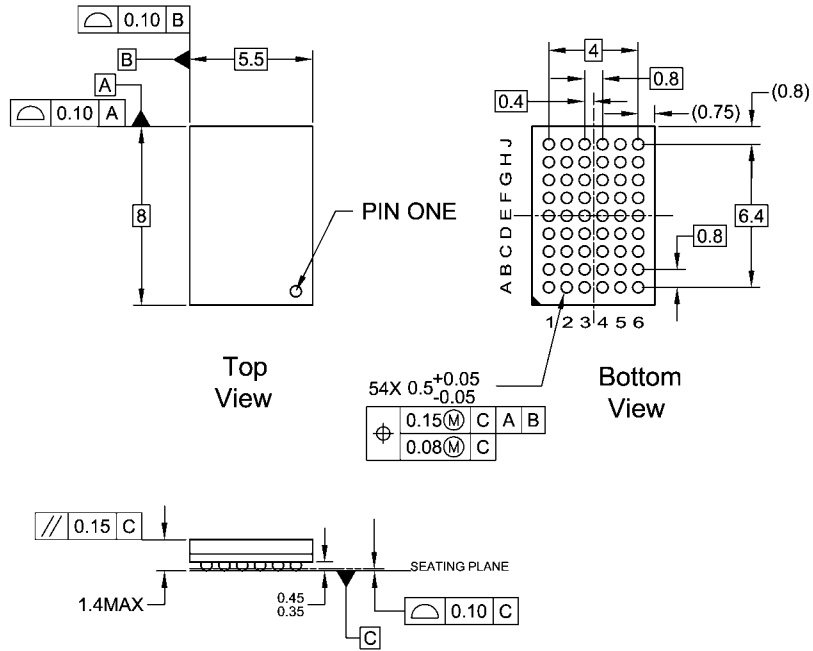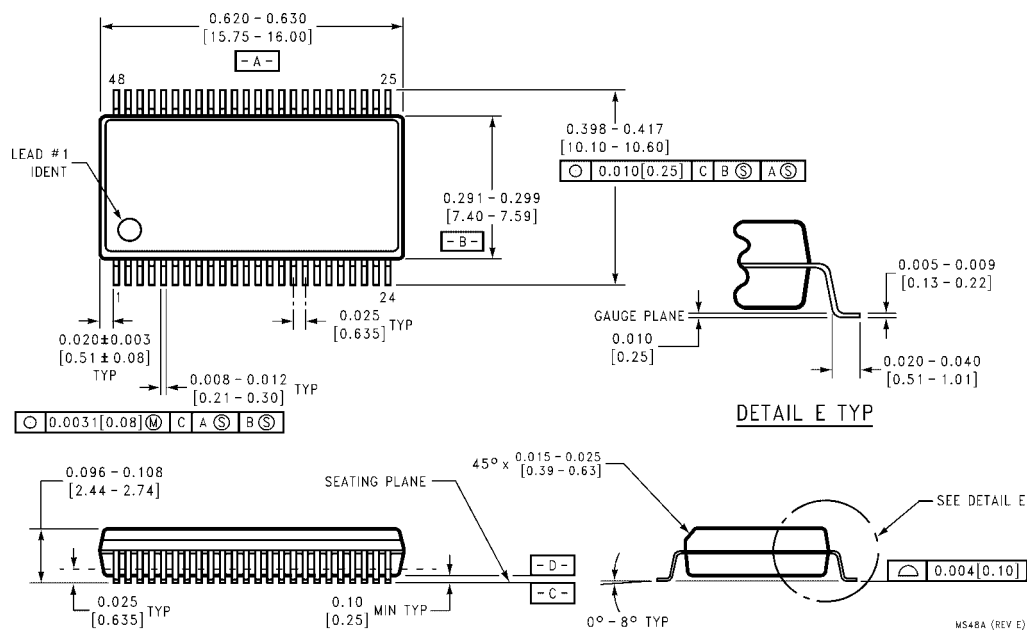
NOTES:
A. THIS PACKAGE CONFORMS TO JEDEC M0-205
B. ALL DIMENSIONS IN MILLIMETERS
C. LAND PATTERN RECOMMENDATION: NSMD (Non Solder Mask Defined)
   .35MM DIA PADS WITH A SOLDERMASK OPENING OF .45MM CONCENTRIC TO PADS
D. DRAWING CONFORMS TO ASME Y14.5M-1994

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)

0.620 – 0.630
[15.75 – 16.00]
– A –

48   25

LEAD #1
IDENT

0.291 – 0.299
[7.40 – 7.59]
– B –

1   24

0.020±0.003
[0.51 ± 0.08]
TYP

0.025
[0.635] TYP

0.008 – 0.012
[0.21 – 0.30] TYP

○ 0.0031[0.08] Ⓜ C A Ⓢ B Ⓢ

0.398 – 0.417
[10.10 – 10.60]
○ 0.010[0.25] C B Ⓢ A Ⓢ

0.005 – 0.009
[0.13 – 0.22]

GAUGE PLANE
0.010
[0.25]

0.020 – 0.040
[0.51 – 1.01]

DETAIL E TYP

0.096 – 0.108
[2.44 – 2.74]

SEATING PLANE

45° x 0.015 – 0.025
[0.39 – 0.63]

0.025
[0.635] TYP

0.10
[0.25] MIN TYP

– D –
– C –

0° – 8° TYP

SEE DETAIL E

△ 0.004[0.10]

MS48A (REV E)

48-Lead Small Shrink Outline Package (SSOP), JEDEC MO-118, 0.300" Wide
Package Number MS48A

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

12.50±0.10
0.40 TYP
8.10
4.05
6.10±0.10
PIN #1 IDENT.
0.2 C B A
ALL LEAD TIPS

0.1 C
ALL LEAD TIPS
1.2 MAX
-C-
0.50
0.17-0.27
0.13 M A B⑤ C⑤
0.90+0.15 -0.10
0.10±0.05

48 43 30 25
4.60 9.20
2.30
0.30
0.50
LAND PATTERN RECOMMENDATION

SEE DETAIL A
0.09-0.20

DIMENSIONS ARE IN MILLIMETERS

12.00° TOP & BOTTOM
R0.16
R0.31
0°-8°
GAGE PLANE
0.25
SEATING PLANE
0.60±0.10
1.00
DETAIL A

NOTES:
A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION ED, DATE 4/97.
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.

MTD48REVC

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.

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

© Semiconductor Components Industries, LLC

www.onsemi.com