

# 3.3/5 V ECL Differential Phase-Frequency Detector

## MC100LVEL40

### Description

The MC100LVEL40 is a three state phase frequency–detector intended for phase–locked loop applications which require a minimum amount of phase and frequency difference at lock. Advanced design significantly reduces the dead zone of the detector. For proper operation, the input edge rate of the R and V inputs should be less than 5 ns. The device is designed to work with a 3.3 V power supply.

When the reference (R) and the feedback (FB) inputs are unequal in frequency and/or phase the differential up (U) and down (D) outputs will provide pulse streams which when subtracted and integrated provide an error voltage for control of a VCO.

The  $V_{BB}$  pin, an internally generated voltage supply, is available to this device only. For single-ended input conditions, the unused differential input is connected to  $V_{BB}$  as a switching reference voltage.  $V_{BB}$  may also rebias AC coupled inputs. When used, decouple  $V_{BB}$  and  $V_{CC}$  via a 0.01  $\mu$ F capacitor and limit current sourcing or sinking to 0.5 mA. When not used,  $V_{BB}$  should be left open.

For application information, refer to AND8040/D, “Phase Lock Loop Operation.”

The 100 Series Contains Temperature Compensation.

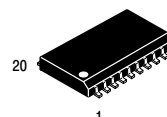
### Features

- 250 MHz Typical Bandwidth
- PECL Mode Operating Range:  
 $V_{CC} = 3.0 \text{ V to } 5.5 \text{ V}$  with  $V_{EE} = 0 \text{ V}$
- NECL Mode Operating Range:  
 $V_{CC} = 0 \text{ V}$  with  $V_{EE} = -3.0 \text{ V to } -5.5 \text{ V}$
- Internal Input Pulldown Resistor
- This Devices are Pb–Free, Halogen Free and are RoHS Compliant



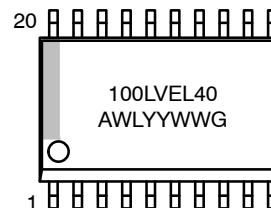
ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)



SO-20  
DW SUFFIX  
CASE 751D

### MARKING DIAGRAM



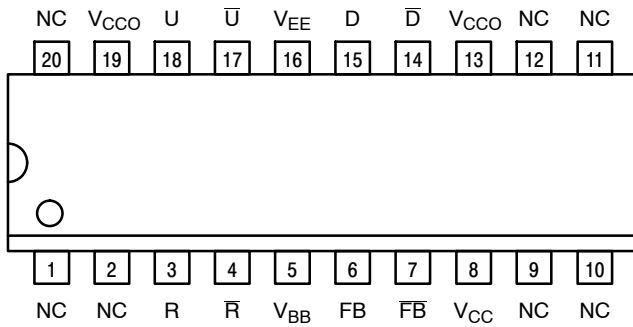
A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week  
G = Pb–Free Package

\*For additional marking information, refer to Application Note [AND8002/D](#).

### ORDERING INFORMATION

| Device         | Package              | Shipping        |
|----------------|----------------------|-----------------|
| MC100LVEL40DWG | SOIC–20<br>(Pb–Free) | 38 Units / Tube |

# MC100LVEL40

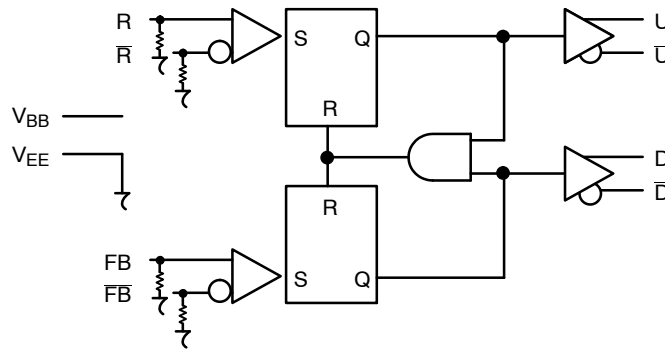


Warning: All V<sub>CC</sub>, V<sub>CCO</sub>, and V<sub>EE</sub> pins must be externally connected to Power Supply to guarantee proper operation.

**Figure 1. 20-Lead Pinout (Top View)**

**Table 1. PIN DESCRIPTION**

| PIN                                | FUNCTION                          |
|------------------------------------|-----------------------------------|
| U, $\bar{U}$                       | ECL Up Differential Outputs       |
| D, $\bar{D}$                       | ECL Down Differential Outputs     |
| FB, $\bar{FB}$                     | ECL Feedback Differential Inputs  |
| R, $\bar{R}$                       | ECL Reference Differential Inputs |
| V <sub>BB</sub>                    | Reference Voltage Output          |
| V <sub>CC</sub> , V <sub>CCO</sub> | Positive Supply                   |
| V <sub>EE</sub>                    | Negative Supply                   |
| NC                                 | No Connect                        |



**Figure 2. Logic Diagram**

**Table 2. ATTRIBUTES**

| Characteristics                                        | Value                |
|--------------------------------------------------------|----------------------|
| ESD Protection Human Body Model                        | > 2 kV               |
| Moisture Sensitivity (Note 1)                          | Pb-Free Pkg          |
| SOIC-20                                                | Level 3              |
| Flammability Rating<br>Oxygen Index: 28 to 34          | UL 94 V-0 @ 0.125 in |
| Transistor Count                                       | 356 Devices          |
| Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test |                      |

1. For additional information, see Application Note [AND8003/D](#).

# MC100LVEL40

**Table 3. MAXIMUM RATINGS**

| Symbol           | Parameter                                          | Condition 1                                    | Condition 2                                                          | Rating            | Unit         |
|------------------|----------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------|-------------------|--------------|
| V <sub>CC</sub>  | PECL Mode Power Supply                             | V <sub>EE</sub> = 0 V                          |                                                                      | 8 to 0            | V            |
| V <sub>EE</sub>  | NECL Mode Power Supply                             | V <sub>CC</sub> = 0 V                          |                                                                      | –8 to 0           | V            |
| V <sub>I</sub>   | PECL Mode Input Voltage<br>NECL Mode Input Voltage | V <sub>EE</sub> = 0 V<br>V <sub>CC</sub> = 0 V | V <sub>I</sub> ≤ V <sub>CC</sub><br>V <sub>I</sub> ≥ V <sub>EE</sub> | 6 to 0<br>–6 to 0 | V<br>V       |
| I <sub>out</sub> | Output Current                                     | Continuous<br>Surge                            |                                                                      | 50<br>100         | mA<br>mA     |
| I <sub>BB</sub>  | V <sub>BB</sub> Sink/Source                        |                                                |                                                                      | ±0.5              | mA           |
| T <sub>A</sub>   | Operating Temperature Range                        |                                                |                                                                      | –40 to +85        | °C           |
| T <sub>stg</sub> | Storage Temperature Range                          |                                                |                                                                      | –65 to +150       | °C           |
| θ <sub>JA</sub>  | Thermal Resistance (Junction–to–Ambient)           | 0 lfpm<br>500 lfpm                             | SOIC–20<br>SOIC–20                                                   | 90<br>306         | °C/W<br>°C/W |
| θ <sub>JC</sub>  | Thermal Resistance (Junction–to–Case)              | Standard Board                                 | SOIC–20                                                              | 30 to 35          | °C/W         |
| T <sub>sol</sub> | Wave Solder (Pb–Free)                              |                                                |                                                                      | 265               | °C           |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

**Table 4. LVPECL DC CHARACTERISTICS** V<sub>CC</sub> = 3.3 V, V<sub>EE</sub> = 0 V (Note 2)

| Symbol             | Characteristic                                                                                        | –40°C       |      |            | 25°C        |      |            | 85°C        |      |            | Unit     |
|--------------------|-------------------------------------------------------------------------------------------------------|-------------|------|------------|-------------|------|------------|-------------|------|------------|----------|
|                    |                                                                                                       | Min         | Typ  | Max        | Min         | Typ  | Max        | Min         | Typ  | Max        |          |
| I <sub>EE</sub>    | Power Supply Current                                                                                  |             | 38   | 45         |             | 38   | 47         |             | 38   | 47         | mA       |
| V <sub>OH</sub>    | Output HIGH Voltage (Note 3)                                                                          | 2215        | 2295 | 2420       | 2275        | 2345 | 2420       | 2275        | 2345 | 2420       | mV       |
| V <sub>OL</sub>    | Output LOW Voltage (Note 3)                                                                           | 1470        | 1605 | 1745       | 1490        | 1595 | 1380       | 1490        | 1595 | 1680       | mV       |
| V <sub>IH</sub>    | Input HIGH Voltage (Single–Ended)                                                                     | 2135        |      | 2420       | 2135        |      | 2420       | 2135        |      | 2420       | mV       |
| V <sub>IL</sub>    | Input LOW Voltage (Single–Ended)                                                                      | 1490        |      | 1825       | 1490        |      | 1825       | 1490        |      | 1825       | mV       |
| V <sub>BB</sub>    | Output Voltage Reference                                                                              | 1.92        |      | 2.04       | 1.92        |      | 2.04       | 1.92        |      | 2.04       | V        |
| V <sub>IHCMR</sub> | Input HIGH Voltage Common Mode Range (Note 7)<br>V <sub>pp</sub> < 500 mV<br>V <sub>pp</sub> ≥ 500 mV | 1.3<br>1.5  |      | 3.3<br>3.3 | 1.2<br>1.4  |      | 3.3<br>3.3 | 1.2<br>1.4  |      | 3.3<br>3.3 | V<br>V   |
| I <sub>IH</sub>    | Input HIGH Current                                                                                    |             |      | 150        |             |      | 150        |             |      | 150        | μA       |
| I <sub>IL</sub>    | Input LOW Current<br>Others<br>R, FB                                                                  | 0.5<br>–300 |      |            | 0.5<br>–300 |      |            | 0.5<br>–300 |      |            | μA<br>μA |

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfpm.

- Input and output parameters vary 1:1 with V<sub>CC</sub>. V<sub>EE</sub> can vary ± 0.3 V.
- Outputs are terminated through a 50 Ω resistor to V<sub>CC</sub> – 2 V.
- V<sub>IHCMR</sub> min varies 1:1 with V<sub>EE</sub>, max varies 1:1 with V<sub>CC</sub>. The V<sub>IHCMR</sub> range is referenced to the most positive side of the differential input signal. Normal operation is obtained if the HIGH level falls within the specified range and the peak-to-peak voltage lies between V<sub>ppmin</sub> and 1 V.

# MC100LVEL40

**Table 5. LVNECL DC CHARACTERISTICS**  $V_{CC} = 0\text{ V}$ ;  $V_{EE} = -3.0\text{ V}$  (Note 5)

| Symbol      | Characteristic                                                                                           | -40°C |       |       | 25°C  |       |       | 85°C  |       |       | Unit          |
|-------------|----------------------------------------------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------------|
|             |                                                                                                          | Min   | Typ   | Max   | Min   | Typ   | Max   | Min   | Typ   | Max   |               |
| $I_{EE}$    | Power Supply Current                                                                                     |       | 38    | 45    |       | 38    | 47    |       | 38    | 47    | mA            |
| $V_{OH}$    | Output HIGH Voltage (Note 6)                                                                             | -1085 | -1005 | -880  | -1025 | -955  | -880  | -1025 | -955  | -880  | mV            |
| $V_{OL}$    | Output LOW Voltage (Note 6)                                                                              | -1830 | -1695 | -1555 | -1810 | -1705 | -1620 | -1810 | -1705 | -1620 | mV            |
| $V_{IH}$    | Input HIGH Voltage (Single-Ended)                                                                        | -1165 |       | -880  | -1165 |       | -880  | -1165 |       | -880  | mV            |
| $V_{IL}$    | Input LOW Voltage (Single-Ended)                                                                         | -1810 |       | -1475 | -1810 |       | -1475 | -1810 |       | -1475 | mV            |
| $V_{BB}$    | Output Voltage Reference                                                                                 | -1.38 |       | -1.26 | -1.38 |       | -1.26 | -1.38 |       | -1.26 | V             |
| $V_{IHCMR}$ | Input HIGH Voltage Common Mode Range (Note 7)<br>$V_{pp} < 500\text{ mV}$<br>$V_{pp} \geq 500\text{ mV}$ |       |       |       |       |       |       |       |       |       |               |
|             |                                                                                                          | -2.0  |       | -0.4  | -2.1  |       | -0.4  | -2.1  |       | -0.4  | V             |
|             |                                                                                                          | -1.8  |       | -0.4  | -1.9  |       | -0.4  | -1.9  |       | -0.4  | V             |
| $I_{IH}$    | Input HIGH Current                                                                                       |       |       | 150   |       |       | 150   |       |       | 150   | $\mu\text{A}$ |
| $I_{IL}$    | Input LOW Current<br>Others<br>$\overline{R}$ , $\overline{FB}$                                          | 0.5   |       |       | 0.5   |       |       | 0.5   |       |       | $\mu\text{A}$ |
|             |                                                                                                          | -300  |       |       | -300  |       |       | -300  |       |       | $\mu\text{A}$ |

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfm.

5. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary  $\pm 0.3\text{ V}$ .

6. All loading with  $50\ \Omega$  resistor to  $V_{CC} - 2\text{ V}$ .

7.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ , max varies 1:1 with  $V_{CC}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal. Normal operation is obtained if the HIGH level falls within the specified range and the peak-to-peak voltage lies between  $V_{ppmin}$  and  $1\text{ V}$ .

**Table 6. AC CHARACTERISTICS**  $V_{CC} = 3.3\text{ V}$ ;  $V_{EE} = 0.0\text{ V}$  or  $V_{CC} = 0\text{ V}$ ;  $V_{EE} = -3.3\text{ V}$  (Note 8)

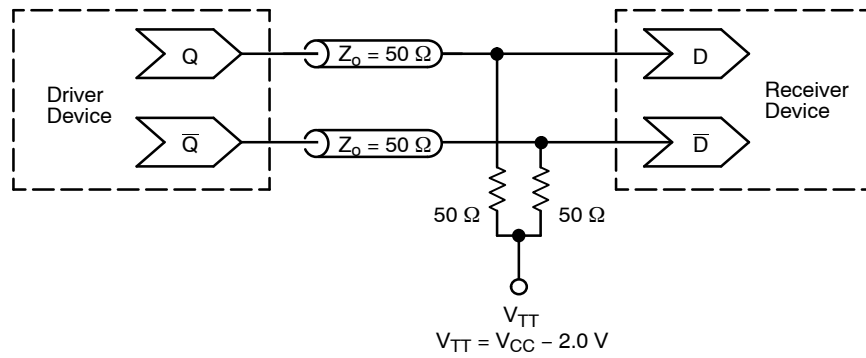
| Symbol                 | Characteristic                                       | -40°C       |     |             | 25°C        |     |             | 85°C        |     |             | Unit |
|------------------------|------------------------------------------------------|-------------|-----|-------------|-------------|-----|-------------|-------------|-----|-------------|------|
|                        |                                                      | Min         | Typ | Max         | Min         | Typ | Max         | Min         | Typ | Max         |      |
| $F_{max}$              | Maximum Toggle Frequency                             |             | TBD |             |             | TBD |             |             | TBD |             | GHz  |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>R to U, FB to D                 | 430<br>1200 |     | 630<br>1400 | 450<br>1250 |     | 650<br>1450 | 480<br>1370 |     | 680<br>1590 | ps   |
| $V_{PP}$               | Input Swing (Differential Configuration)<br>(Note 9) | 150         |     | 1000        | 150         |     | 1000        | 150         |     | 1000        | mV   |
| $t_{JITTER}$           | Cycle-to-Cycle Jitter                                |             | TBD |             |             | TBD |             |             | TBD |             | ps   |
| $t_r$ , $t_f$          | Output Rise/Fall Times                               | 175         |     | 475         | 175         |     | 475         | 175         |     | 475         | ps   |

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfm.

8.  $V_{EE}$  can vary  $\pm 0.3\text{ V}$ .

9.  $V_{PP(min)}$  is minimum input swing for which AC parameters guaranteed. The device has a DC gain of  $\approx 40$ .

## MC100LVEL40

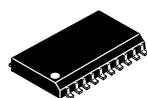


**Figure 3. Typical Termination for Output Driver and Device Evaluation**  
(See Application Note [AND8020/D](#) – Termination of ECL Logic Devices.)

### Resource Reference of Application Notes

- AN1405/D** – ECL Clock Distribution Techniques
- AN1406/D** – Designing with PECL (ECL at +5.0 V)
- AN1503/D** – ECLinPS™ I/O SPiCE Modeling Kit
- AN1504/D** – Metastability and the ECLinPS Family
- AN1568/D** – Interfacing Between LVDS and ECL
- AN1672/D** – The ECL Translator Guide
- AND8001/D** – Odd Number Counters Design
- AND8002/D** – Marking and Date Codes
- AND8020/D** – Termination of ECL Logic Devices
- AND8066/D** – Interfacing with ECLinPS
- AND8090/D** – AC Characteristics of ECL Devices

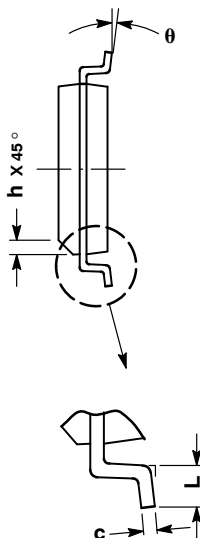
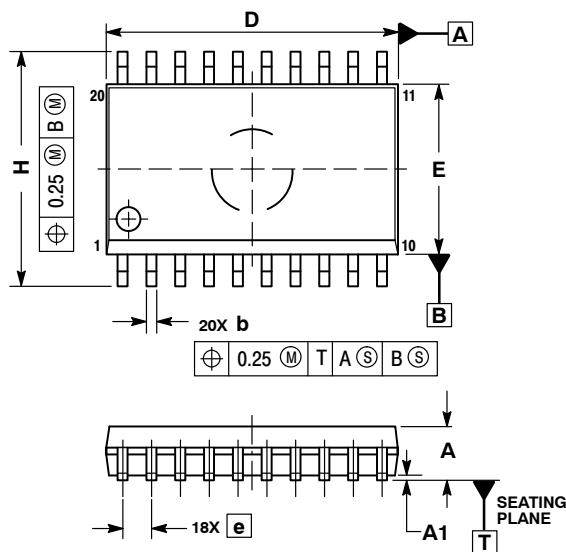
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 1:1

SOIC-20 WB  
CASE 751D-05  
ISSUE H

DATE 22 APR 2015

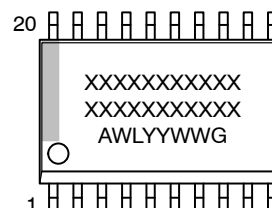


## NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

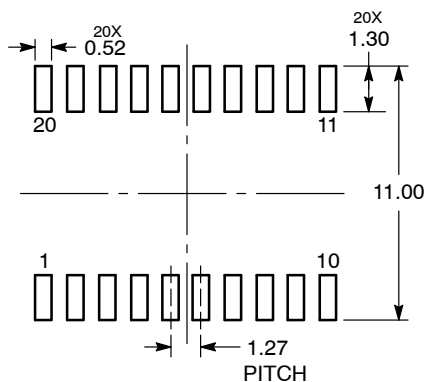
| DIM      | MILLIMETERS |       |
|----------|-------------|-------|
|          | MIN         | MAX   |
| A        | 2.35        | 2.65  |
| A1       | 0.10        | 0.25  |
| b        | 0.35        | 0.49  |
| c        | 0.23        | 0.32  |
| D        | 12.65       | 12.95 |
| E        | 7.40        | 7.60  |
| e        | 1.27 BSC    |       |
| H        | 10.05       | 10.55 |
| h        | 0.25        | 0.75  |
| L        | 0.50        | 0.90  |
| $\theta$ | 0°          | 7°    |

## GENERIC MARKING DIAGRAM\*



XXXXXX = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week  
G = Pb-Free Package

## RECOMMENDED SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

|                  |             |                                                                                                                                                                                     |
|------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DOCUMENT NUMBER: | 98ASB42343B | Electronic versions are uncontrolled except when accessed directly from the Document Repository.<br>Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| DESCRIPTION:     | SOIC-20 WB  | PAGE 1 OF 1                                                                                                                                                                         |

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi 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. onsemi does not convey any license under its patent rights nor the rights of others.

**onsemi**, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** 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 **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** 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. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** 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 **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** 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 **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## ADDITIONAL INFORMATION

### TECHNICAL PUBLICATIONS:

Technical Library: [www.onsemi.com/design/resources/technical-documentation](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

### ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)

For additional information, please contact your local Sales Representative at  
[www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)