

NCV8871 Automotive Grade High-Frequency SEPIC Controller Evaluation Board User's Manual



ON Semiconductor®

<http://onsemi.com>

EVAL BOARD USER'S MANUAL

Description

This NCV8871 evaluation board provides a convenient way to evaluate a high-frequency current-mode control SEPIC converter design. The topology uses two inductors. No additional components are required, other than dc supplies for the input and enable voltages. An external clock can be used to synchronize the switching frequency. The output is rated 12 V / 2 A with a 170 KHz switching frequency over the typical 6 V to 18 V automotive input voltage range.

Key Features

- 12 V / 2 A Output
- 170 KHz Switching Frequency (NCV887100)
- Input Undervoltage Lockout
- Internal Soft-Start
- Wide Input Voltage of 6 V to 40 V
- Regulates through 45 V Load Dump Conditions
- External Clock Synchronization up to 1.1 MHz
- Automotive Grade

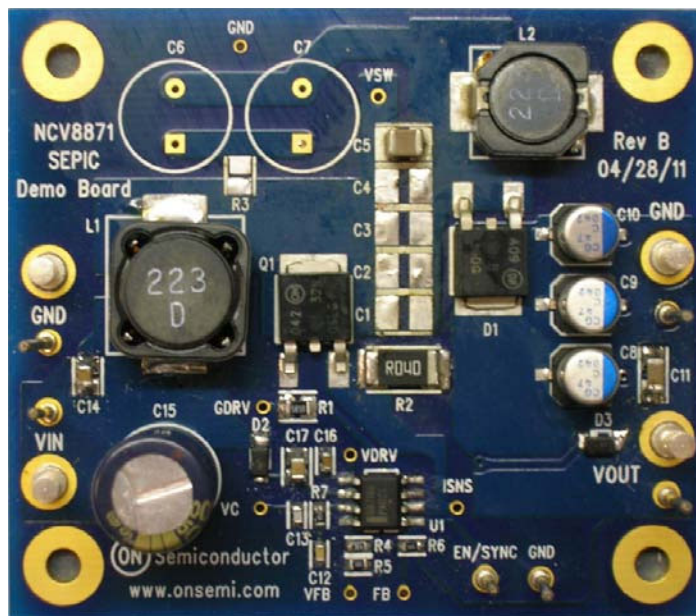


Figure 1. NCV887100 SEPIC Evaluation Board

Table 1. EVALUATION BOARD TERMINALS

Terminal	Function
VIN	Positive DC input voltage.
GND	Common DC return.
VOUT	Regulated DC output voltage.
EN/SYNC	Enable and synchronization input.

Table 2. ABSOLUTE MAXIMUM RATINGS (Voltages are with respect to GND)

Rating	Value	Unit
DC Supply Voltage (VIN)	-0.3 to 40	V
DC Supply Voltage (EN/SYNC)	-0.3 to 6	V
Peak Transient Voltage (Load Dump on VIN)	45	V
Junction Temperature	-40 to 150	°C
Ambient Temperature (evaluation board)	-40 to 105	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Table 3. ELECTRICAL CHARACTERISTICS

($T_A = 25^\circ\text{C}$, $4.5\text{ V} \leq V_{IN} \leq 40\text{ V}$, $V_{EN} = 2\text{ V}$, $V_{OUT} = 3.3\text{ V}$, $0 \leq I_{OUT} \leq 1.2\text{ A}$, unless otherwise specified)

Characteristic	Conditions	Typical Value	Unit
Switching			
Switching Frequency		170	KHz
Soft-start Time		7.4	ms
SYNC Frequency Range		170 – 1025	KHz
Current Limit			
Cycle-by-cycle Current Limit (FET)		10	A
Protections			
Input Undervoltage Lockout (UVLO)	V_{IN} decreasing	$< 6^*$	V
Input Undervoltage Lockout (UVLO)	V_{IN} increasing	6.7	V
Thermal Shutdown	T_A increasing	170	°C

*See Note 3 from Operational Guidelines (on next page)

OPERATIONAL GUIDELINES

1. Connect a DC input voltage, within the 6 V to 40 V range, between VIN and GND.
2. Connect a DC enable voltage, within the 2.0 V to 5.0 V range, between EN/SYNC and GND.
3. The evaluation board feedback components were selected to for continuous operation at rated 12 V / 2 A output power at a minimum input voltage of 6 V. The NCV887100 V_{IN} has its operational voltage diode-ored between the converter output (12 V) and input voltages. The converter turns-on typically at 6.7 V. Once energized, the output voltage supplies power to the IC when the battery voltage is below (approximately) 11.5 V. The decreasing V_{IN} UVLO voltage depends on load current as well as

V_{IN} , and will be less than 6 V when operating below rated output current.

4. Optionally for external clock synchronization, connect a pulse source between EN/SYNC and GND. The high state level should be within the 2 to 5 V range, and the low state level within the -0.3 V to 0.8 V range, with a minimum pulse width of 40 ns and a frequency within the 170 and 1100 KHz range.

NOTE: The converter was designed for 170 KHz 12 V / 2 A continuous mode operation. Operation beyond 170 KHz and/or at a different output voltage may require modifications of feedback loop component and inductor values.

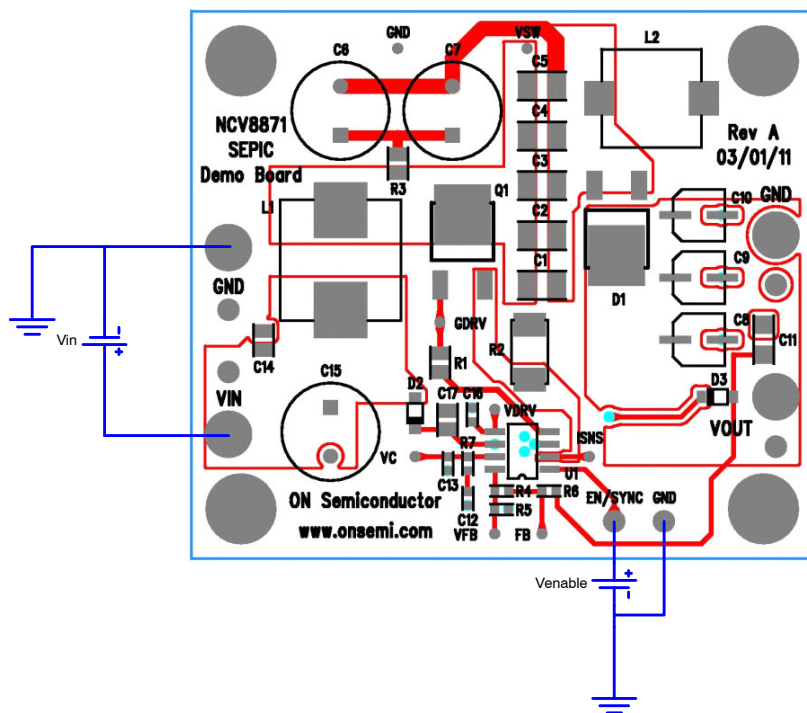


Figure 2. Evaluation Board Connections

NCV8871SEPGEVB

TYPICAL PERFORMANCE

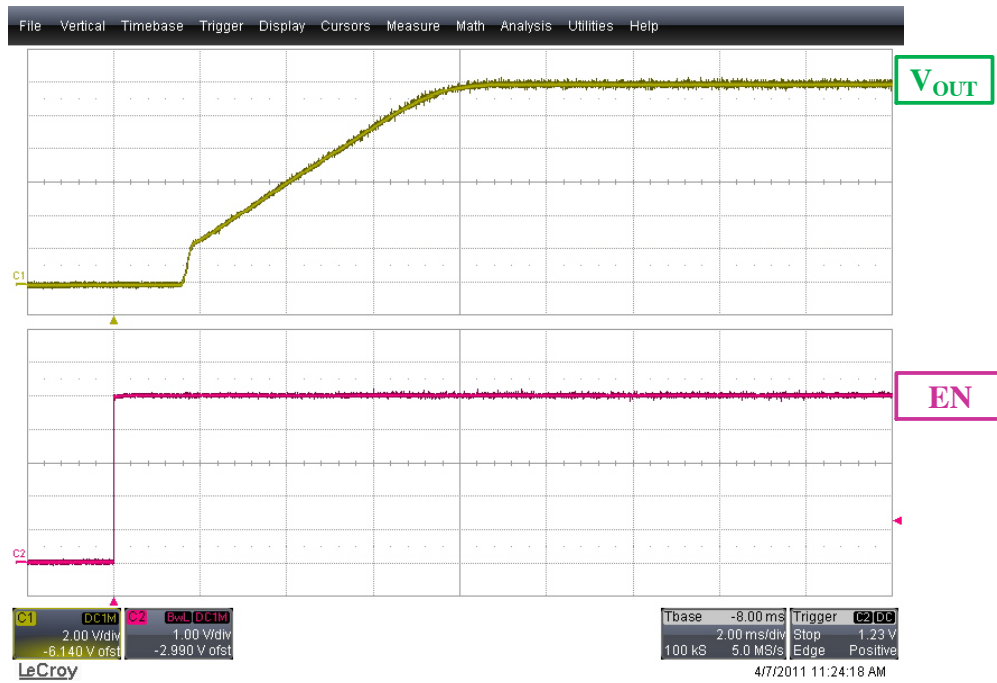


Figure 3. Typical Start-up with $V_{IN} = 12\text{ V}$, $R_{OUT} = 6\ \Omega$



Figure 4. Operational Waveforms, $V_{IN} = 12\text{ V}$, $R_{OUT} = 6\ \Omega$

SCHEMATIC

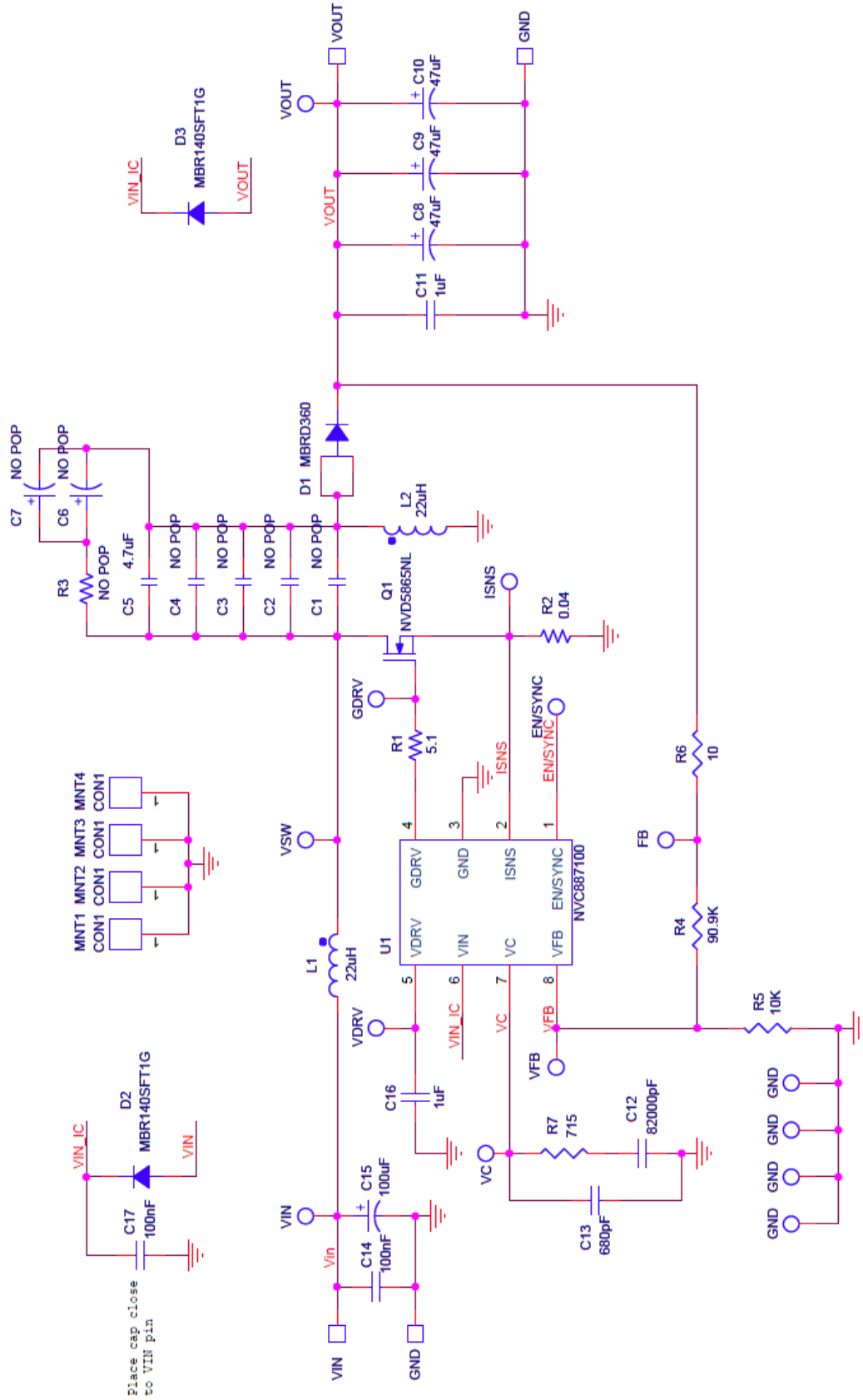


Figure 5. NCV887100 SEPIC Evaluation Board Schematic

NCV8871SEPGEVB

Table 4. BILL OF MATERIALS

Component	Description	Manufacturer P/N	Vendor P/N
C1	DO NOT POPULATE		
C2	DO NOT POPULATE		
C3	DO NOT POPULATE		
C4	DO NOT POPULATE		
C5	CAP CER 4.7UF 50V 10% X7R 1210	GRM32ER71H475KA88L	490-1864-1-ND
C6	DO NOT POPULATE		
C7	DO NOT POPULATE		
C8	CAP POLY ALUM 47UF 16V SMD	PCG1C470MCL1GS	493-3095-1-ND
C9	CAP POLY ALUM 47UF 16V SMD	PCG1C470MCL1GS	493-3095-1-ND
C10	CAP POLY ALUM 47UF 16V SMD	PCG1C470MCL1GS	493-3095-1-ND
C11	CAP CER 1UF 50V X7R 1206	GCM31MR71H105KA55L	490-4795-1-ND
C12	CAP CER .082UF 10% 16V X7R 0603	0603YC823KAT2A	478-1238-1-ND
C13	CAP CER 680PF 50V 5% C0G 0603	GRM1885C1H681JA01D	490-1447-1-ND
C14	CAP CER .1UF 50V X7R 0603	GCM188R71H104KA57D	490-4779-1-ND
C15	CAP 100UF 50V ELECT FC RADIAL	EEU-FC1H101	P10323-ND
C16	CAP CER 1UF 16V X7R 10% 0603	GCM188R71C105KA64D	490-5241-1-ND
C17	CAP CER .1UF 50V X7R 0603	GCM188R71H104KA57D	490-4779-1-ND
D1	60 V, 3.0 A Schottky Rectifier DPAK	MBRD360G	MBRD360G
D2	DIODE SCHOTTKY 40V 1A SOD123FL	MBR140SFT1G	MBR140SFT1G
D3	DIODE SCHOTTKY 40V 1A SOD123FL	MBR140SFT1G	MBR140SFT1G
L1	High Temp SMT Power Inductor 2.3A	MSS1260T-223ML	MSS1260T-223ML
L2	High Temp SMT Power Inductor 1.9A	MSS1038T-223ML	MSS1038T-223ML
Q1	N-CHANNEL MOSFET, LOGIC LEVEL, 60V 16mOHMS	NVD5865NL	NVD5865NL
R1	RES 5.10 OHM 1/8W 1% 0805 SMD	CRCW08055R10FKEA	541-5.10CCCT-ND
R2	RES .04 OHM 3W 1% 2512 SMD	CRA2512-FZ-R040ELF	CRA2512-FZ-R040ELFCT-ND
R3	DO NOT POPULATE		
R4	RES 90.9K OHM 1/10W 1% 0603 SMD	RC0603FR-0790K9L	311-90.9KHRCT-ND
R5	RES 10.0K OHM 1/10W 1% 0603 SMD	MCR03EZPFX1002	RHM10.0KHCT-ND
R6	RES 10.0 OHM 1/10W 1% 0603 SMD	RC0603FR-0710RL	311-10.0HRCT-ND
R7	RES 715 OHM 1/10W 1% 0603 SMD	CRCW0603715RFKEA	541-715HCT-ND
U1	ON SEMI Non-Sync Boost Controller	NCV887100	NCV887100D1R2G

NCV8871SEPGVB

PCB LAYOUT

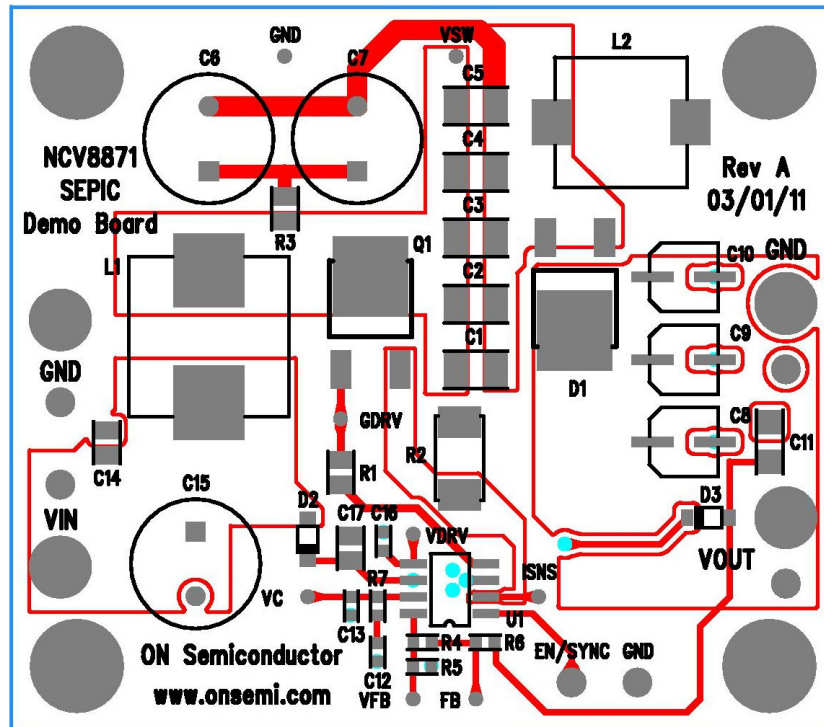


Figure 6. Top View

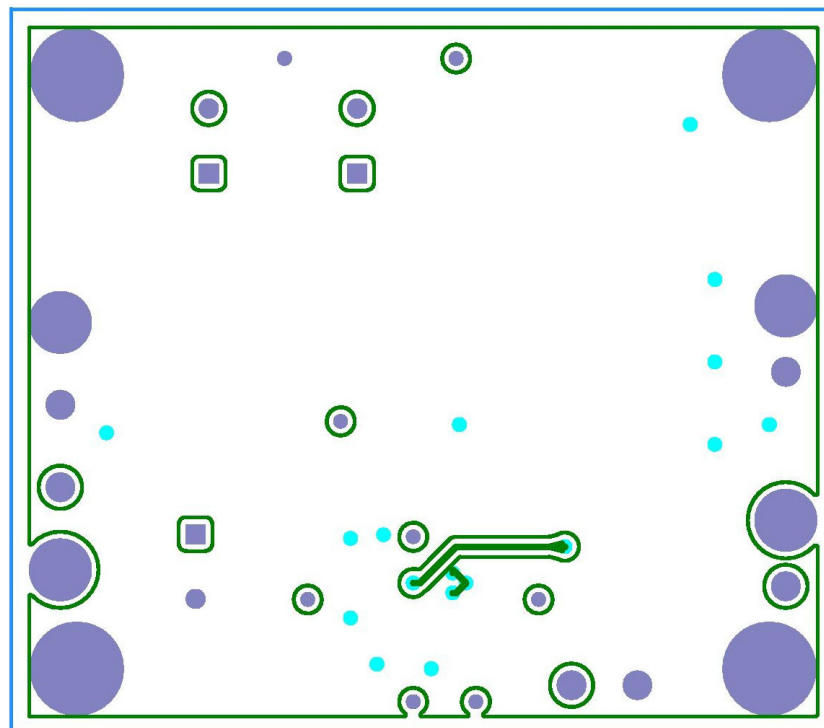


Figure 7. Bottom View

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. **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.

The evaluation board/kit (research and development board/kit) (hereinafter the "board") is not a finished product and is not available for sale to consumers. The board is only intended for research, development, demonstration and evaluation purposes and will only be used in laboratory/development areas by persons with an engineering/technical training and familiar with the risks associated with handling electrical/mechanical components, systems and subsystems. This person assumes full responsibility/liability for proper and safe handling. Any other use, resale or redistribution for any other purpose is strictly prohibited.

THE BOARD IS PROVIDED BY ONSEMI TO YOU "AS IS" AND WITHOUT ANY REPRESENTATIONS OR WARRANTIES WHATSOEVER. WITHOUT LIMITING THE FOREGOING, ONSEMI (AND ITS LICENSORS/SUPPLIERS) HEREBY DISCLAIMS ANY AND ALL REPRESENTATIONS AND WARRANTIES IN RELATION TO THE BOARD, ANY MODIFICATIONS, OR THIS AGREEMENT, WHETHER EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY AND ALL REPRESENTATIONS AND WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, NON-INFRINGEMENT, AND THOSE ARISING FROM A COURSE OF DEALING, TRADE USAGE, TRADE CUSTOM OR TRADE PRACTICE.

onsemi reserves the right to make changes without further notice to any board.

You are responsible for determining whether the board will be suitable for your intended use or application or will achieve your intended results. Prior to using or distributing any systems that have been evaluated, designed or tested using the board, you agree to test and validate your design to confirm the functionality for your application. Any technical, applications or design information or advice, quality characterization, reliability data or other services provided by **onsemi** shall not constitute any representation or warranty by **onsemi**, and no additional obligations or liabilities shall arise from **onsemi** having provided such information or services.

onsemi products including the boards are not designed, intended, or authorized for use in life support systems, or any FDA Class 3 medical devices or medical devices with a similar or equivalent classification in a foreign jurisdiction, or any devices intended for implantation in the human body. You agree to indemnify, defend and hold harmless **onsemi**, its directors, officers, employees, representatives, agents, subsidiaries, affiliates, distributors, and assigns, against any and all liabilities, losses, costs, damages, judgments, and expenses, arising out of any claim, demand, investigation, lawsuit, regulatory action or cause of action arising out of or associated with any unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of any products and/or the board.

This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and may not meet the technical requirements of these or other related directives.

FCC WARNING – This evaluation board/kit is intended for use for engineering development, demonstration, or evaluation purposes only and is not considered by **onsemi** to be a finished end product fit for general consumer use. It may generate, use, or radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment may cause interference with radio communications, in which case the user shall be responsible, at its expense, to take whatever measures may be required to correct this interference.

onsemi does not convey any license under its patent rights nor the rights of others.

LIMITATIONS OF LIABILITY: **onsemi** shall not be liable for any special, consequential, incidental, indirect or punitive damages, including, but not limited to the costs of requalification, delay, loss of profits or goodwill, arising out of or in connection with the board, even if **onsemi** is advised of the possibility of such damages. In no event shall **onsemi**'s aggregate liability from any obligation arising out of or in connection with the board, under any theory of liability, exceed the purchase price paid for the board, if any.

The board is provided to you subject to the license and other terms per **onsemi**'s standard terms and conditions of sale. For more information and documentation, please visit www.onsemi.com.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales