

NCV898031 SEPGEVB

NCV898031 Automotive Grade High-Frequency SEPIC Controller Evaluation Board User's Manual



ON Semiconductor®

<http://onsemi.com>

EVAL BOARD USER'S MANUAL

Description

This NCV898031 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. The output is rated 7 V/8.5 W with a 2 MHz switching frequency over the typical 6 V to 18 V automotive input voltage range.

Key Features

- 7 V/1.22 A Output
- 2 MHz Switching Frequency
- Input Undervoltage Lockout
- Internal Soft-Start
- Wide Input Voltage of 6 V to 40 V
- Regulates through Load Dump Conditions
- Automotive Grade



Figure 1. NCV898031 SEPIC Evaluation Board

Table 1. EVALUATION BOARD TERMINALS

Terminal	Function
V _{IN}	Positive DC Input Voltage
GND	Common DC Return
V _{OUT}	Regulated DC Output Voltage
EN	Enable Input

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

Rating	Value	Unit
DC Supply Voltage (V _{IN})	–0.3 to 40	V
DC Supply Voltage (EN)	–0.3 to 6	V
Junction Temperature	–40 to 150	°C
Ambient Temperature (Evaluation Board)	–40 to 105	°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 3. ELECTRICAL CHARACTERISTICS

(T_A = 25°C, 4.5 V ≤ V_{IN} ≤ 40 V, V_{EN} = 2 V, V_{OUT} = 3.3 V, 0 ≤ I_{OUT} ≤ 1.2 A, unless otherwise specified)

Characteristic	Condition	Typical Value	Unit
Switching			
Switching Frequency	–	2	MHz
Soft-Start Time	–	650	μs
Current Limit			
Cycle-by-Cycle Current Limit (FET)	–	4	A
Protections			
Input Undervoltage Lockout (UVLO)	V _{IN} Decreasing	< 6 (Note 1)	V
Input Undervoltage Lockout (UVLO)	V _{IN} Increasing	6.7	V
Thermal Shutdown	T _A Increasing	170	°C

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

1. NCV898031 IC UVLO is 3.05 V (V_{IN} falling). The demo board current limit resistor was selected to limit power when V_{IN} is reduced below 6 V. See Point 3 from Test Procedure.

PCB LAYERS

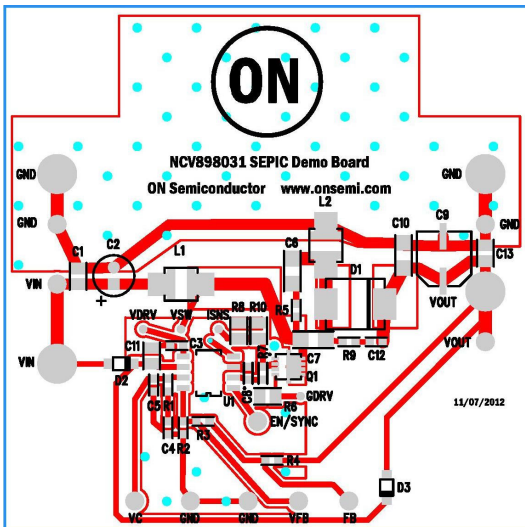


Figure 2. Top View

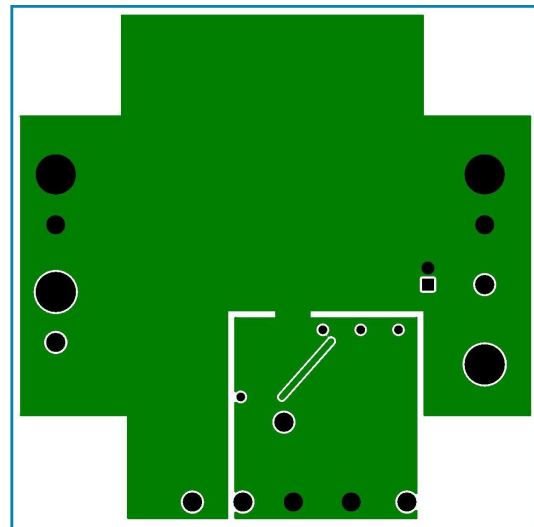


Figure 3. Bottom View

TYPICAL PERFORMANCE

Start-up

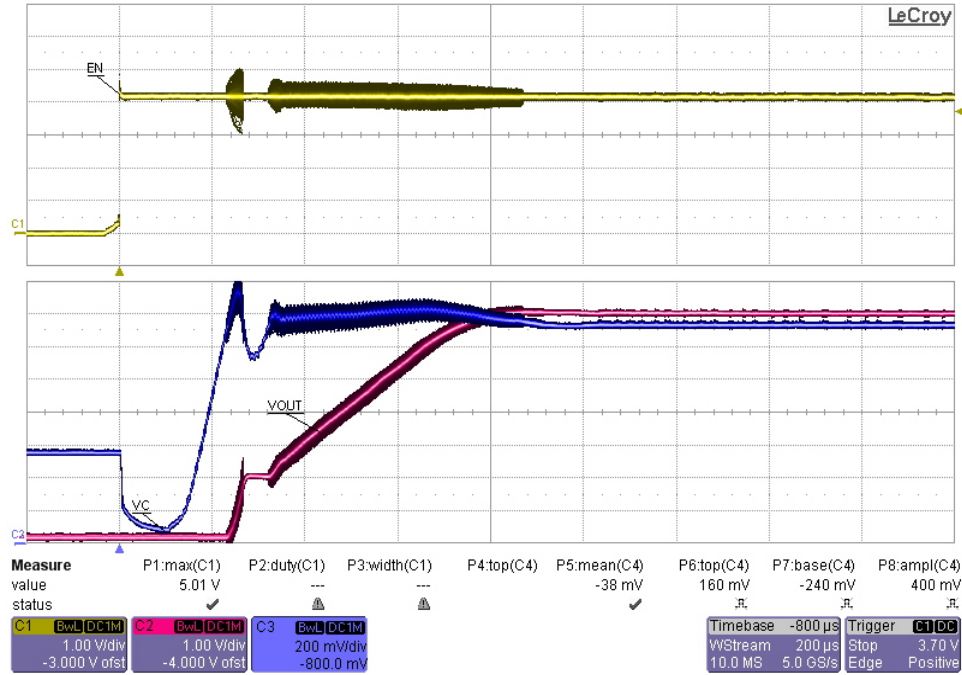


Figure 4. Typical Start-up with $V_{IN} = 12$ V, $I_{OUT} = 1.22$ A

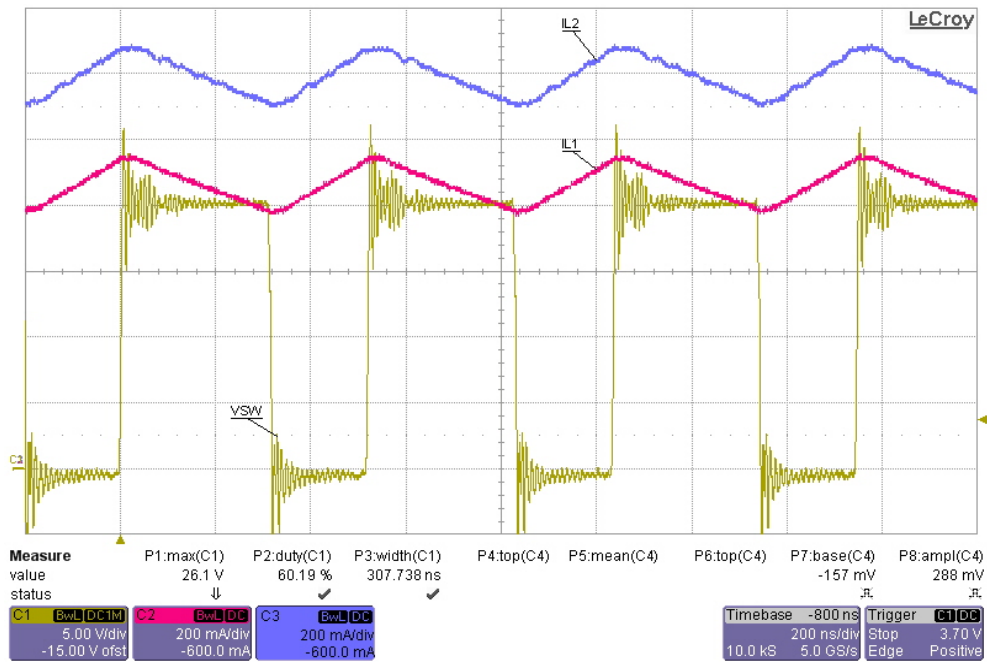


Figure 5. Operational Waveforms, $V_{IN} = 12$ V, $R_{IOUT} = 1.22$ A

SCHEMATIC

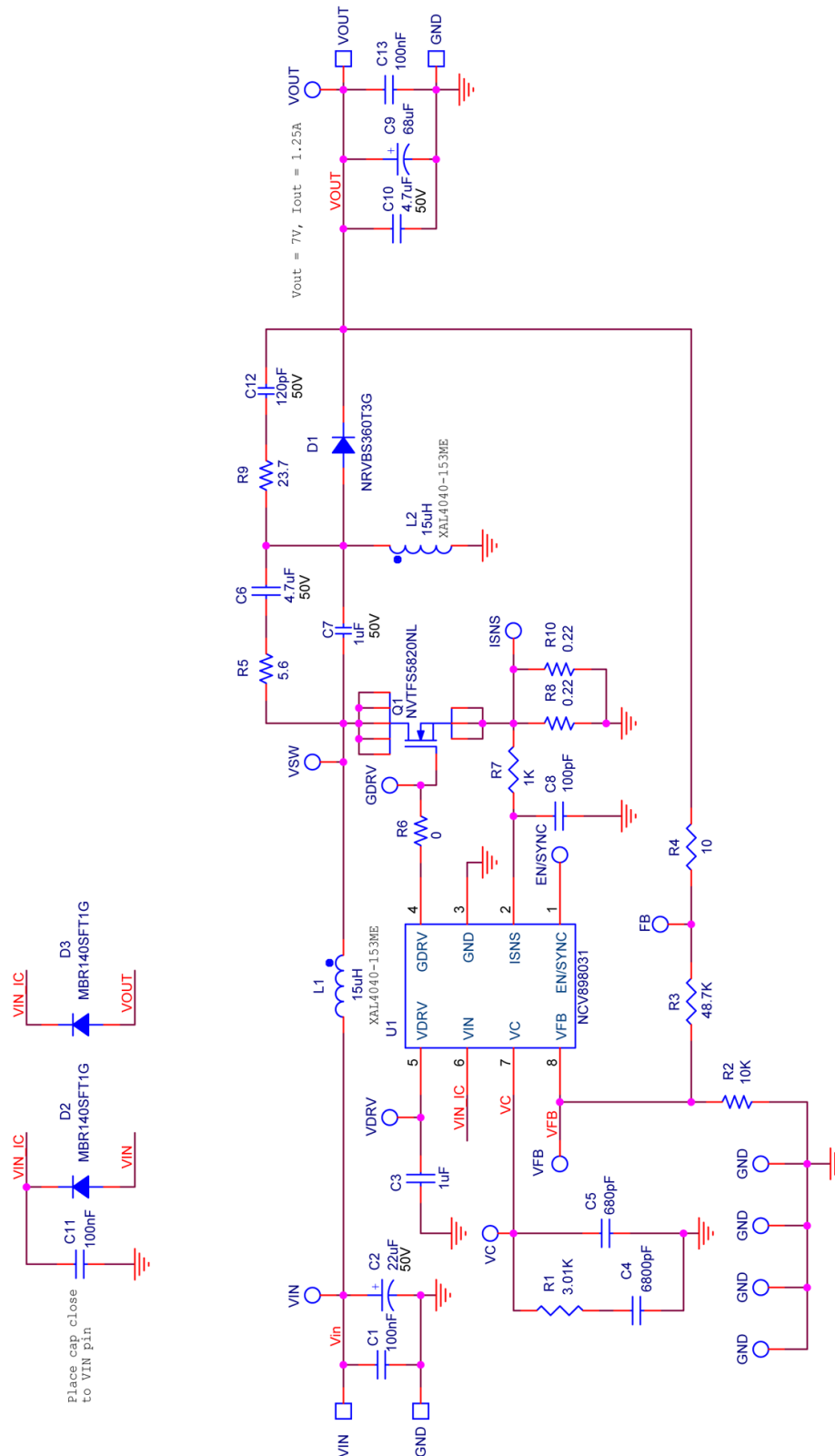


Figure 6. NCV898031 SEPIC Evaluation Board Schematic

NCV898031SEPGEVB

Table 4. BILL OF MATERIALS

Reference Designator(s)	Quantity	Description	Footprint	Manufacturer's Part Number	Vendor Part #
C1, C11, C13	3	CAP CER 0.1 μ F 50 V 10% X7R 0805	805	GRM21BR71H104KA01L	490-1666-1-ND
C2	1	CAP ALUM 10 μ F 50 V 20% RADIAL	CAP_RAD_5X11	EKZE500ELL100ME07D	565-1702-ND
C3	1	CAP CER 1 μ F 16 V 10% X7R 0603	603	GCM188R71C105KA64D	490-5241-1-ND
C4	1	CAP CER 6800PF 50 V 10% X7R 0603	603	GRM188R71H682KA01D	490-1508-1-ND
C5	1	CAP CER 680PF 50 V 5% NP0 0603	603	GRM1885C1H681JA01D	490-1447-1-ND
C6, C10	2	CAP CER 4.7 μ F 50 V 10% X7R 1206	1206	C3216X7R1H475K	445-8032-1-ND
C7	1	CAP CER 1 μ F 50 V 10% X7R 1206	1206	GCM31MR71H105KA55L	490-4795-1-ND
C8	1	CAP CER 100 pF 50 V 5% NP0 0603	603	GCM1885C1H101JA16D	490-4767-1-ND
C9	1	CAP HYBRID CONDUCTIVE POLYMER 68 μ F 10 V 20%	SUNCON_6p6CAP	10HVA68M	SUNCON
C12	1	CAP CER 120 pF 50 V 5% NP0 0603	603	GRM1885C1H121JA01D	490-1429-1-ND
D1	1	60 V, 3.0 A Schottky Rectifier	SMC_DIODE	NRVBS360T3G	ON Semiconductor
D2, D3	2	DIODE SCHOTTKY 40 V 1 A SOD123FL	SOD_123	MBR140SFT1G	ON Semiconductor
L1, L2	2	High Temp SMT Power Inductor 15 μ H 2.8 A	XAL4040	XAL4040-153ME	XAL4040-153ME
Q1	1	N-CHANNEL MOSFET, LL, 60 V 11.5 m Ω	WDFN8	NVTF55820NL	ON Semiconductor
R1	1	RES 3.01 k Ω 1/10 W 1% 0603 SMD	603	CRCW06033K01FKEA	541-3.01KHCT-ND
R2	1	RES 10.0 k Ω 1/10 W 1% 0603 SMD	603	CRCW060310K0FKEA	541-10.0KHCT-ND
R3	1	RES 48.7 k Ω 1/10 W 1% 0603 SMD	603	CRCW060348K7FKEA	541-48.7KHCT-ND
R4	1	RES 10.0 Ω 1/10 W 1% 0603 SMD	603	CRCW060310R0FKEA	541-10.0HCT-ND
R5	1	RES 5.6 Ω 1/10 W 5% 0603 SMD	603	CRCW06035R60JNEA	541-5.6GCT-ND
R6	1	RES 0.0 Ω 1/8 W 0805 SMD	805	CRCW08050000Z0EA	541-0.0ACT-ND
R7	1	RES 1.00 k Ω 1/10 W 1% 0603 SMD	603	CRCW06031K00FKEA	541-1.00KHCT-ND
R8, R10	2	RES .22 Ω 1/3 W 1% 0805 SMD	805	RL1220S-R22-F	CSR1206FK25L0TR-ND
R9	1	RES 23.7 Ω 1/10 W 1% 0603 SMD	603	CRCW060323R7FKEA	541-23.7HCT-ND
TP1, TP3, TP4, TP7, TP8, TP14, TP15, TP16, TP17	9	PIN INBOARD .042" HOLE 1000/PKG	TP	K24C/M	V1055-ND
TP2, TP5, TP6, TP9	4	CIRCUIT PIN PRNTD .020"D .425"L	SMALLTP	3128-2-00-15-00-00-08-0	ED90324-ND
TP10, TP11, TP12, TP13	4	TERM SOLDER TURRET .219" .109"L	TURRET	2501-2-00-44-00-00-07-0	2501-200440000070-ND
U1	1	2 MHz Non-Synchronous SEPIC/Boost Controller	SOIC8_N_ADJ	NCV898031D1R2G	ON Semiconductor

TEST PROCEDURE

1. Connect a DC input voltage, within the 6 V to 40 V range, between V_{IN} 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 7 V/1.22 A output power at a minimum input voltage of 6 V. The NCV898031 V_{IN} has its operational voltage diode-oriented between the

converter output and input voltages. The converter turns-on typically at 6.7 V (V_{IN} rising). Once energized, the output voltage supplies power to the IC when the battery voltage is less than the IC V_{IN} input voltage. 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.

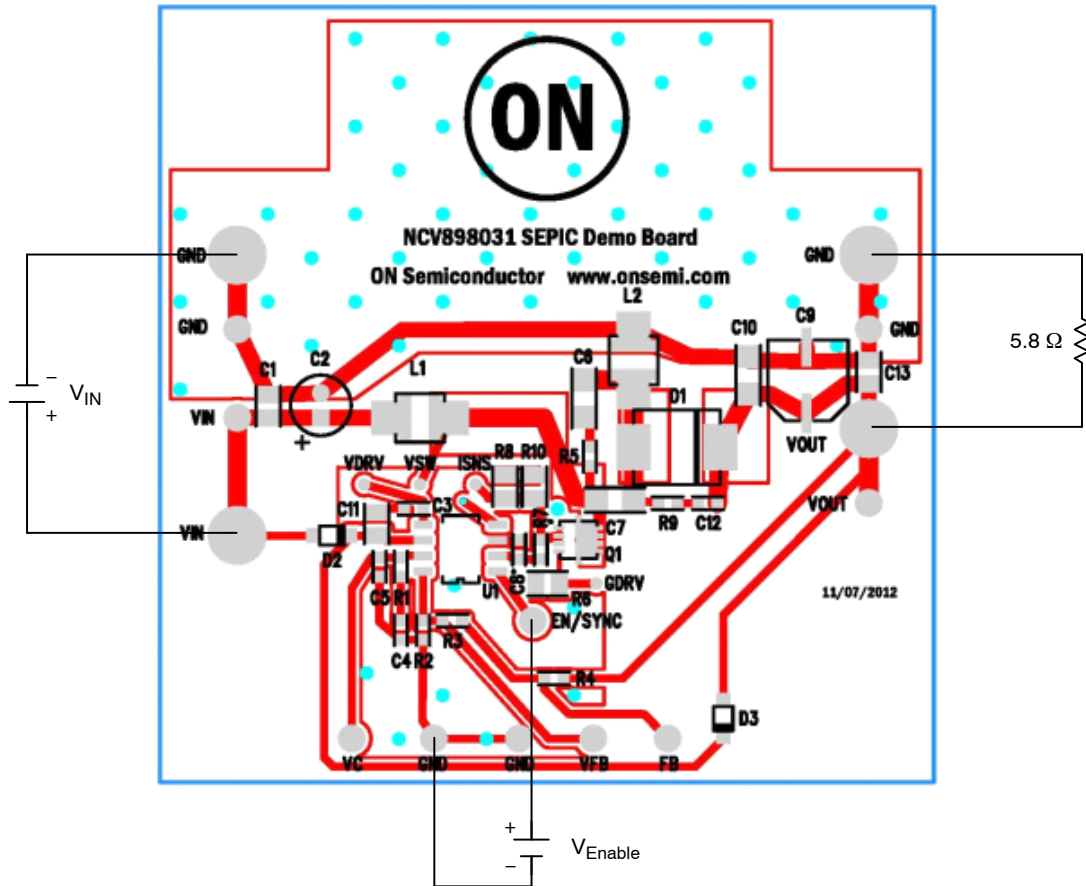


Figure 7. Evaluation Board Connections

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