

SensorRF-GEVK Evaluation Board User's Manual

SensorRF-GEVK Remote User Interface

Introduction

The SensorRF-GEVK IoT Development Platform allows you to control the AMS Radon Reader to read sensor tags and send the results to a remote user through either a UART, TCP, CAN, I²C or SPI interface.

SensorRF-GEVB Remote User Interface Module

The SensorRF-GEVK Demo application implements a Remote User Interface (RUI) module which is composed of a generic interface class and specific classes for the UART, TCP, CAN, I²C, and SPI interfaces. Please see Figure 1 below for a depiction of the module. From the Demo application's main window, the user can select the

Remote Operation option and then select the interface SensorRF-GEVK should listen through for commands. When the user presses the Start button, this in effect switches in the UART, TCP, CAN, I²C, or SPI data stream, and SensorRF-GEVK is ready to process commands. When those commands are processed, SensorRF-GEVK sends back responses through the same stream.

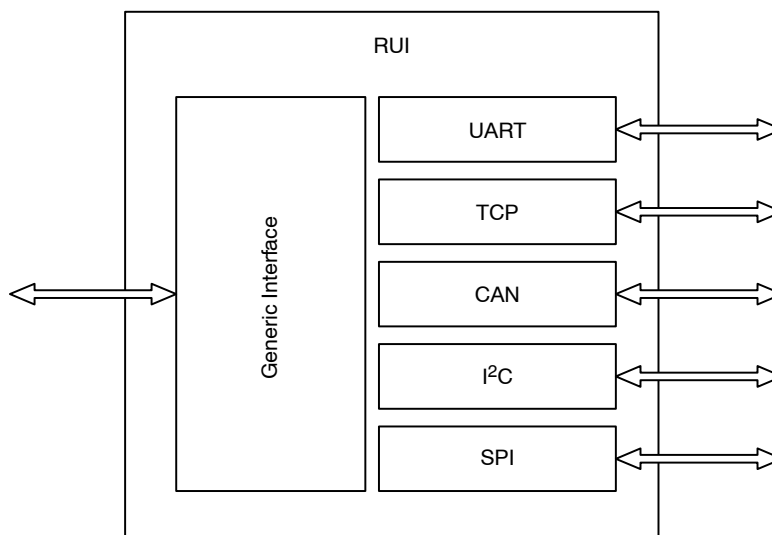


Figure 1. The Remote User Interface Module

SensorRF-GEVB Remote User Interface Protocol

Now that we have described the RUI module, we can move on to describing the protocol that flows through those interfaces. The protocol requires an external device connected through one of the interfaces to send a command to SensorRF-GEVK and SensorRF-GEVK to send

a response back, at no set time, after it has received the command. The command consists of a header and a payload. Please see Figure 2 below for a depiction of the command and response format in terms of bytes sent across the interface.



ON Semiconductor®

www.onsemi.com

EVAL BOARD USER'S MANUAL

SensorRF-GEVK

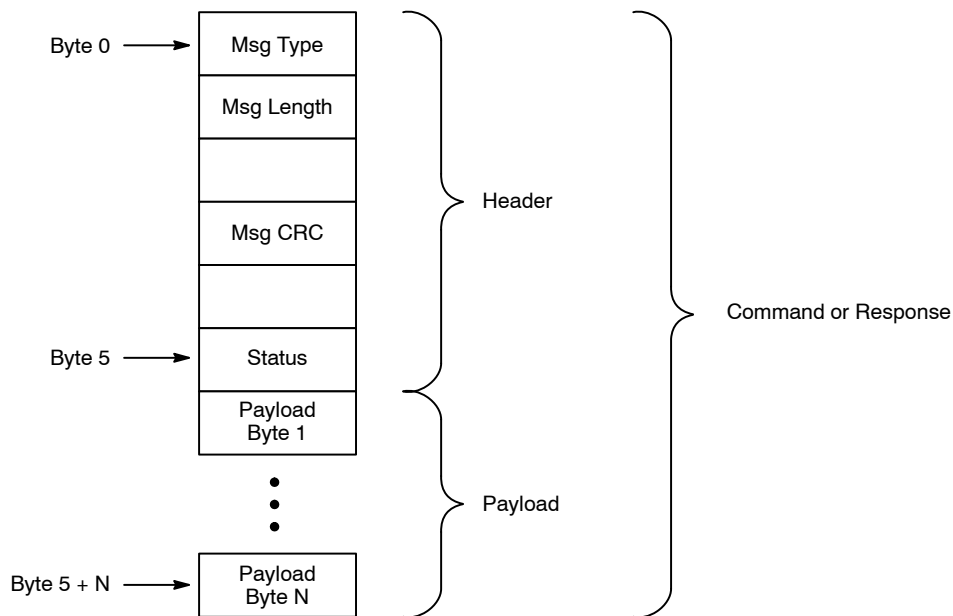


Figure 2. The Command and Response Format for the RUI Protocol

As you can see, the command and response are made up of a header and a payload. The header consists of a Message Type field one byte long, a Message Length field two bytes long, a Message CRC field two bytes long, a Status field one byte long, and a Payload field N bytes long. The Message Type field is used to specify the command being sent. Please see the next section for a list of commands available. The Message Length field contains the length of the entire command or response, header + payload. The Message CRC field contains the CRC-16 value calculated for the entire message, header + payload. The Status field is used in the response and contains the status or result of the operation

performed per the command. Note that the Least Significant Byte of the Message Length is put at the lower byte address and the Most Significant Byte at the higher byte address. The same is true for the Message CRC.

This command and response format is valid for the UART, TCP, I²C, and SPI interfaces. For the CAN interface, the response format is different because of the way CAN sensors operate. In the CAN network, a sensor typically broadcasts periodic responses in frames containing an 8-byte data field the sensor can use to send data. In our Demo application, we use that field as depicted in Figure 3 below.

Msg Type	Tag#	Param Byte 1	Param Byte 2	Param Byte 3	Param Byte 4	Param Byte 5	Param Byte 6
----------	------	--------------	--------------	--------------	--------------	--------------	--------------

Figure 3.

The Message Type field is one byte long and it contains the response type or the command this response corresponds to. The Tag Number field is one byte long and it contains the

Tag's number in the list of tags found generated as a result of a search for tags command.

SensorRF-GEVK

Commands and Responses of the RUI

Now that we have defined the protocol that flows through the interfaces, we can define the specific commands and

responses that make use of it. The commands available through the RUI are listed in Table 1 below.

Table 1. COMMANDS AND RESPONSES OF THE RUI

Command/Response Message Types	ID
SEARCH_FOR_TEMP_TAGS	1
SEARCH_FOR_TEMP_TAGS_RESP	2
SEARCH_FOR_MOISTURE_TAGS	3
SEARCH_FOR_MOISTURE_TAGS_RESP	4
MEASURE_TEMP_TAGS	5
MEASURE_TEMP_TAGS_RESP	6
MEASURE_MOISTURE_TAGS	7
MEASURE_MOISTURE_TAGS_RESP	8
GET_TEMP_DEMO_SETTINGS	9
GET_TEMP_DEMO_SETTINGS_RESP	10
GET_MOISTURE_DEMO_SETTINGS	11
GET_MOISTURE_DEMO_SETTINGS_RESP	12
SET_TEMP_DEMO_SETTINGS	13
SET_TEMP_DEMO_SETTINGS_RESP	14
SET_MOISTURE_DEMO_SETTINGS	15
SET_MOISTURE_DEMO_SETTINGS_RESP	16

For the CAN interface, only commands to search and measure temperature and moisture tags are available. Also, the responses to those commands are different. Only certain parameters, as described later, are sent back and

they are sent in frames with 8-byte data fields. Each frame has a Message Type field that is defined in Table 2 below.

Table 2. RESPONSES OF THE RUI SPECIFIC TO THE CAN INTERFACE

Response Message Types for CAN	ID
EPC_LEN_RESP	1
EPC_RESP	2
TID_LEN_RESP	3
TID_RESP	4
TEMP_CAL_C1_RESP	5
TEMP_CAL_T1_RESP	6
TEMP_CAL_C2_RESP	7
TEMP_CAL_T2_RESP	8
CRCVALID_RESP	9
TEMP_VALUE_RESP	10
SENSOR_VALUE_RESP	11
ONCHIPRSSI_VALUE_RESP	12
DONE_RESP	13
EPC_LEN_RESP	14
EPC_RESP	15
TID_LEN_RESP	16

SensorRF-GEVK

Search for Temp Tags Command

The Search for Temp Tags Command allows the user to search for Temp tags in the area. The command is defined in Table 3 below.

Table 3. THE SEARCH FOR TEMP TAGS COMMAND

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	

Search for Temp Tags Response

The Search for Temp Tags Response is defined in Table 4 below.

Table 4. THE SEARCH FOR TEMP TAGS RESPONSE

Byte	Message Field	Field Value	Notes
0	Message Type		
1	Message Length		
2			
3	Message CRC		
4			
5	Status		
6	Number of Tags Found		
7	Tag Number		Repeats 'Number of Tags Found' Times
8	Tag's Data Length (Number of bytes that follow contain the data for this tag)		
9	EPC Length		
10 + EPC Length – 1 (= N)	EPC		
N + 1	TID Length		
N + 1 + TID Length – 1 (= M)	TID		
M + 1	Temp Cal C1		
M + 2			
M + 3			
M + 4			
M + 5	Temp Cal T1		
M + 6			
M + 7			
M + 8			

SensorRF-GEVK

Table 4. THE SEARCH FOR TEMP TAGS RESPONSE (continued)

Byte	Message Field	Field Value	Notes
M + 9	Temp Cal C2		Repeats 'Number of Tags Found' Times
M + 10			
M + 11			
M + 12			
M + 13	Temp Cal T2		
M + 14			
M + 15			
M + 16			
M + 17	CRC Valid		

Search for Temp Tags Response (CAN)

The Search for Temp Tags Response for CAN is define in Table 5 below.

Table 5. THE SEARCH FOR TEMP TAGS RESPONSE (CAN)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Notes
EPC_LEN_RESP	Tag Number	EPC Length				0	0	
EPC_RESP	Tag Number	EPC Characters						Frames repeat until all characters sent. Total Frames = EPC Length / 6
TID_LEN_RESP	Tag Number	TID Length				0	0	
TID_RESP	Tag Number	TID Characters						Frames repeat until all characters sent. Total Frames = TID Length / 6
TEMP_CAL_C1_RESP	Tag Number	EPC Length				0	0	
TEMP_CAL_T1_RESP	Tag Number	EPC Length				0	0	
TEMP_CAL_C2_RESP	Tag Number	EPC Length				0	0	
TEMP_CAL_T2_RESP	Tag Number	EPC Length				0	0	
CRCVALID_RESP	Tag Number	CRC Valid	0	0	0	0	0	
DONE_RESP	0	0	0	0	0	0	0	

Search for Moisture Tags Command

The Search for Moisture Tags Command allows the user to search for Moisture tags in the area. The command is defined in Table 6 below.

Table 6. THE SEARCH FOR MOISTURE TAGS COMMAND

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	

SensorRF-GEVK

Search for Moisture Tags Response

The Search for Moisture Tags response is defined in Table 7 below.

Table 7. THE SEARCH FOR MOISTURE TAGS RESPONSE

Byte	Message Field	Field Value	Notes
0	Message Type		
1	Message Length		
2			
3	Message CRC		
4			
5	Status		
6	Number of Tags Found		
7	Tag Number		Repeats 'Number of Tags Found' Times
8	Tag's Data Length		
9	EPC Length		
10 + EPC Length – 1 (= N)	EPC		
N + 1	TID Length		
N + 1 + TID Length – 1 (= M)	TID		
M + 1	Temp Cal C1		
M + 2			
M + 3			
M + 4			
M + 5	Temp Cal T1		
M + 6			
M + 7			
M + 8			
M + 9	Temp Cal C2		
M + 10			
M + 11			
M + 12			
M + 13	Temp Cal T2		
M + 14			
M + 15			
M + 16			
M + 17	CRC Valid		

SensorRF-GEVK

Search for Moisture Tags Response (CAN)

The Search for Moisture Tags response for CAN is defined per Table 8 below.

Table 8. THE SEARCH FOR MOISTURE TAGS RESPONSE (CAN)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Notes
EPC_LEN_RESP	Tag Number	EPC Length				0	0	
EPC_RESP	Tag Number	EPC Characters						Frames repeat until all characters sent. Total Frames = EPC Length / 6
TID_LEN_RESP	Tag Number	TID Length				0	0	
TID_RESP	Tag Number	TID Characters						Frames repeat until all characters sent. Total Frames = TID Length / 6
TEMP_CAL_C1_RESP	Tag Number	EPC Length				0	0	
TEMP_CAL_T1_RESP	Tag Number	EPC Length				0	0	
TEMP_CAL_C2_RESP	Tag Number	EPC Length				0	0	
TEMP_CAL_T2_RESP	Tag Number	EPC Length				0	0	
CRCVALID_RESP	Tag Number	CRC Valid	0	0	0	0	0	
DONE_RESP	0	0	0	0	0	0	0	

Measure Temp Tags Command

The Measure Temp Tags Command allows the user to the tag's On-Chip RSSI code and Temp code. The command is defined in Table 9 below.

Table 9. THE MEASURE TEMP TAGS COMMAND

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	

SensorRF-GEVK

Measure Temp Tags Response

The Measure Temp Tags Response is defined in Table 10 below.

Table 10. THE MEASURE TEMP TAGS RESPONSE

Byte	Message Field	Field Value	Notes
0	Message Type		
0	Message Type		
1	Message Length		
2			
3	Message CRC		
4			
5	Status		
6	Number of Tags Found		
7	Tag Number		Repeats 'Number of Tags Found' Times
8	Tag's Data Length (Number of bytes that follow contain the data for this tag)		
9			
10	Frequency		
11			
12			
13			
14	On-Chip RSSI Code		
15			
16			
17			
18	Temp Code		
19			
20			
21			

Measure Temp Tags Response (CAN)

The Measure Temp Tags Response for CAN is defined in Table 11 below.

Table 11. THE MEASURE TEMP TAGS RESPONSE (CAN)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
TEMP_VALUE_RESP	Tag Number	Temp Value				0	0
ONCHIPRSSI_VALUE_RESP	Tag Number	On-Chip RSSI Value				0	0
DONE_RESP	0	0	0	0	0	0	0

SensorRF-GEVK

Measure Moisture Tags Command

The Measure Moisture Tags Command allows the user to read a tag's On-Chip RSSI code and Sensor code. The command is defined in Table 12 below.

Table 12. THE MEASURE MOISTURE TAGS COMMAND

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	

Measure Moisture Tags Response

The Measure Moisture Tags Response is defined in Table 13 below.

Table 13. THE MEASURE MOISTURE TAGS RESPONSE

Byte	Message Field	Field Value	Inputs
0	Message Type		
1	Message Length		
2			
3	Message CRC		
4			
5	Status		
6	Number of Tags Found		
7	Tag Number		Repeats 'Number of Tags Found' Times
8	Tag's Data Length (Number of bytes that follow contain the data for this tag)		
9			
10	Frequency		
11			
12			
13			
14	On-Chip RSSI Code		
15			
16			
17			
18	Sensor Code		
19			
20			
21			

SensorRF-GEVK

Measure Moisture Tags Response (CAN)

The Measure Moisture Tags Response for CAN is defined in Table 14 below.

Table 14. THE MEASURE MOISTURE TAGS RESPONSE (CAN)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
SENSOR_VALUE_RESP	Tag Number	Sensor Value				0	0
ONCHIPRSSI_VALUE_RESP	Tag Number	On-Chip RSSI Value				0	0
DONE_RESP	0	0	0	0	0	0	0

Get Temp Demo Settings Command

The Get Temp Demo Settings commands allows the user to get the current setting for the Temperature Demo. The command is defined in Table 15 below.

Table 15. THE GET TEMP DEMO SETTINGS COMMAND

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	

Get Temp Demo Settings Response

The Get Temp Demo Settings Response is defined in Table 16 below.

Table 16. THE GET TEMP DEMO SETTINGS RESPONSE

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	
6	Current Frequency Band	
7		
8		
9		
10	Temp Auto Power	
11	Temp Max Power	
12	Temp Target On-Chip RSSI Min	
13		
14		
15		
16	Temp Target On-Chip RSSI Max	
17		
18		
19		

SensorRF-GEVK

Table 16. THE GET TEMP DEMO SETTINGS RESPONSE (continued)

Byte	Message Field	Field Value
20	Temp Min Samples per Measurement	
21		
22		
23		

Get Moisture Demo Settings Command

The Get Moisture Demo Settings Command allows the user to get the current settings for the Moisture Demo. The command is defined in Table 17 below.

Table 17. THE GET MOISTURE DEMO SETTINGS COMMAND

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	

Get Moisture Demo Settings Response

The Get Moisture Demo Settings Response is defined in Table 18 below.

Table 18. THE GET MOISTURE DEMO SETTINGS RESPONSE

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	
6	Current Frequency Band	
7		
8		
9		
10	Moisture Auto Power	
11	Moisture Max Power	
12	Moisture Target On-Chip RSSI Min	
13		
14		
15		
16	Moisture Target On-Chip RSSI Max	
17		
18		
19		

SensorRF-GEVK

Table 18. THE GET MOISTURE DEMO SETTINGS RESPONSE (continued)

Byte	Message Field	Field Value
20	Moisture Min Samples per Measurement	
21		
22		
23		

Set Temp Demo Settings Command

The Set Temp Demo Settings Command allows the user to set the settings for the Temp Demo. The command is defined in Table 19 below.

Table 19. THE SET TEMP DEMO SETTINGS COMMAND

Byte	Message Field	Field Value
0	Message Type	
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	
6	Current Frequency Band	0–5
7		
8		
9		
10	Temp Auto Power	0 or 1
11	Temp Max Power	18–30
12	Temp Target On-Chip RSSI Min	0–31, Min < Max
13		
14		
15		
16	Temp Target On-Chip RSSI Max	0–31, Min < Max
17		
18		
19		
20	Temp Min Samples per Measurement	2, 5, 10, 20
21		
22		
23		

SensorRF-GEVK

Set Temp Demo Settings Response

The Set Temp Demo Settings Response is defined in Table 20 below.

Table 20. THE SET TEMP DEMO SETTINGS RESPONSE

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	0 = Success

Set Moisture Demo Settings Command

The Set Moisture Demo Settings Command allows the user to set the settings for the Moisture Demo. The command is defined in Table 21 below.

Table 21. THE SET MOISTURE DEMO SETTINGS COMMAND

Byte	Message Field	Field Value
0	Message Type	
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	
6	Current Frequency Band	0–5
7		
8		
9		
10	Moisture Auto Power	0 or 1
11	Moisture Max Power	18–30
12	Moisture Target On-Chip RSSI Min	0–31, Min < Max
13		
14		
15		
16	Moisture Target On-Chip RSSI Max	0–31, Min < Max
17		
18		
19		
20	Moisture Min Samples per Measurement	2, 5, 10, 20
21		
22		
23		

SensorRF-GEVK

Set Moisture Demo Settings Response

The Set Moisture Demo Settings Response is defined in Table 22 below.

Table 22. THE SET MOISTURE DEMO SETTINGS RESPONSE

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	0 = Success

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