

LM76202-Q1 Evaluation Module

This user's guide describes the evaluation module (EVM) for the Texas instruments LM76202-Q1 and LM74202-Q1 Ideal diodes. The document provides EVM configuration information and test setup details for evaluating the LM76202-Q1 or LM74202-Q1 device. The EVM schematic, board layout and bill of materials (BOM) are also included.

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Trademarks

The LM74202-Q1 device is 4.5 V to 40 V, 2.23-A ideal diode with reverse battery protection, overvoltage, short-circuit and reverse current blocking protection. are trademarks of others.

1 Introduction

The LM76202-Q1EVM allows reference circuit evaluation of TI's LM76202-Q1 and LM74202-Q1 ideal diodes. The LM76202-Q1 device is 4.5 V to 56 V, 2.23-A ideal diode with reverse battery protection, overvoltage, short-circuit and reverse current blocking protection. The LM74202-Q1 device is 4.5 V to 40 V, 2.23-A ideal diode with reverse battery protection, overvoltage, short-circuit and reverse current blocking protection.

1.1 EVM Features

LM76202-Q1EVM features include:

- 4.2-V to 60-V Operating voltage (without TVS on Input)
- 4.2-V to 33-V (with 33-V TVS on input for transient protection)
- 0.2 A to 2.23 A programmable current limit using onboard jumpers
- MODE pin configuration using onboard jumpers
- Output overvoltage protection (34 V)
- Load protection from transients: ISO 7637-2 Pulse 1 and ISO 16750-2 Pulse 5b
- UVLO configuration using onboard jumpers
- LED status indication for $\overline{\text{FLT}}$ output and VOUT

1.2 EVM Applications

- Automotive ECU protection
- Camera supply protection
- Telematics
- Industrial transport

2 Description

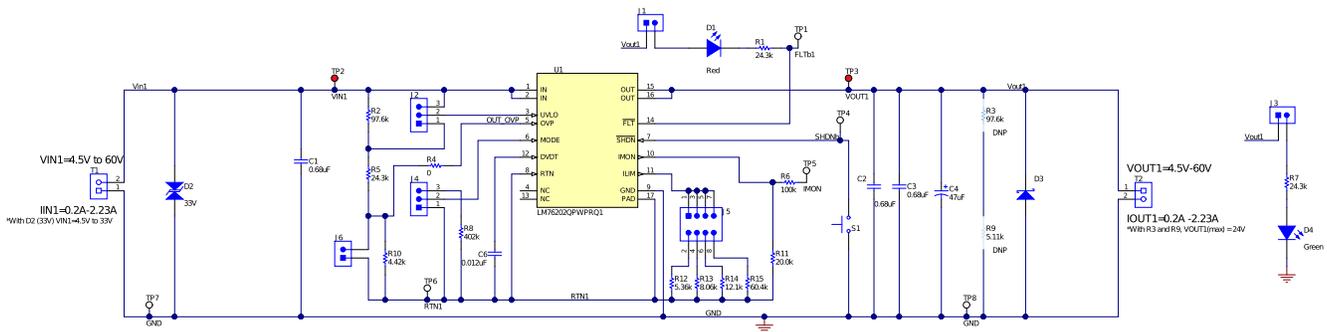
The LM76202-Q1EVM enables evaluation of LM76202-Q1 and LM74202-Q1 ideal diodes. [Table 1](#) provides the operating range and jumper settings for this EVM. To test this EVM, setup the EVM as per steps provided in [Section 5.5](#). Test procedure and results for this EVM are provided in [Section 6](#). To configure the EVM for another configuration (non-default), see [Table 4](#). To probe different signals on this EVM, see [Table 3](#). Equipments required to test this EVM are listed in [Section 5](#). To connect power supply and load to this EVM, see [Section 4.1](#).

Table 1. LM66202-Q1EVM Operating Range and Jumper Settings

Part Number	EVM Function	VIN Range (T1)	VIN UVLO (J2, J6)	Output Overvoltage	ILIM Pin Configuration (J5)	MODE Configuration (J4)
LM76202-Q1EVM	4.2 V to 60 V, 2.23 A Ideal Diode	4.2 V to 60 V 4.2 V to 33 V (with 33-VTVS)	4 V 6 V (With R2, R5)	34 V	0.2 A to 2.23 A	<ul style="list-style-type: none"> • Current Limit with Auto-Retry (Default) • Current Limit with Latch-Off • Current Limit with Latch-Off • Circuit breaker with Auto-Retry

3 Schematic

Figure 1 provides the schematic for LM76202-Q1EVM.



Do not use R9 between OVP and GND. For Programmable OV clamp, see [Overvoltage Protection](#) in the [LM76202-Q1 datasheet](#).

Figure 1. LM76202-Q1EVM Schematic

4 Connector, Jumper and LED Descriptions

4.1 Input and Output Connector Description

Table 2. Input and Output Connector Description

Connector	Label	Description
T1	VIN1	Power input connector for connecting power supply.
T2	VOUT1	Power output connector for connecting load.

4.1.1 Test Points Description

Table 3. Test Points Description

Test Points	Label	Description
TP1	FLT	FLT Signal output
TP2	VIN1	Positive voltage input
TP3	VOUT1	Positive voltage output
TP6	RTN1	RTN signal
TP7	GND	Input ground signal
TP8	GND	Output ground signal

Table 4. Jumper Description

Jumper	Label	Description
J1	Pull-up for FLT	This jumper is used for pulling up FLT to VOUT. OPEN: For pulling-up FLT with any other voltage (like VIN), Open this jumper and connect Pin 2 of J1 externally to the desired voltage (< 60 V). CLOSED: FLT is pulled-up from VOUT.
J2	UVLO Selection	This jumper is used for selecting UVLO input 1-2: UVLO configured through R2 and R5 resistors. Close Jumper J6 with this configuration. 2-3: UVLO set to 4-V (POR). Open Jumper J6 with this configuration.
J3	VOUT Indication	Close this jumper for powering D4(Green) LED from VOUT

Table 4. Jumper Description (continued)

Jumper	Label	Description
J4	MODE Configuration	This jumper configures the device mode for overcurrent and over-load conditions. OPEN: Circuit breaker mode with auto-retry (MODE = Open) 1-2: Current limit with auto-retry (MODE = RTN, Default) 2-3: Current limit with latch-off. (402-kΩ resistor connected MODE and RTN)
J5	ILIM Configuration	This jumper sets the overcurrent limit. 1-2: ILIM = 2.23 A 3-4: ILIM = 1.5 A 5-6: ILIM = 1 A 7-8: ILIM = 0.2 A
J6	UVLO Configuration	This jumper configures the input voltage level for UVLO. OPEN: R2 and R5 resistor are not used for setting UVLO. CLOSED: R2 and R5 resistor are used for setting UVLO

5 Test Equipment and Setup

5.1 Power Supplies

One adjustable power supply 0-V to 60-V output, 0-A to 10-A output current limit. UCS 200N and LD 200N for generating transient voltages as per ISO 7637-2 and ISO 16750-2 specifications

5.2 Meters

One DMM needed

5.3 Oscilloscope

A DPO2024 or equivalent, three 10x voltage probes, and a DC current probe

5.4 Loads

One resistive load or equivalent which can tolerate up to 10-A DC load at 60 V and capable of the output short.

5.5 Test Setup

Before performing any of the test listed in [Section 6](#), setup the EVM as per steps below:

- Make sure that jumper settings on EVM are set to default position as shown in [Table 5](#)
- Connect the power supply, load, oscilloscope and voltmeter to the EVM as shown in [Figure 2](#)
- Set the power supply output to zero volts.
- Turn ON the power supply and set the power supply output to 12.5 V and current limit to 10 A.
- Turn OFF the power supply

Table 5. Default Jumper Setting for LM76202-Q1EVM

Jumper	J1	J2	J3	J4	J5	J6
Position	Closed	Closed between Pin 2 and 3	Closed	Closed between Pin 1 and 2	Closed between Pin 1 and 2	Open
Description	D1 (RED) Is powered from VOUT	UVLO = 4 V	D4 (Green) Is powered from VOUT	Current limit with auto-retry (MODE = RTN)	ILIM = 2.23 A	UVLO is not set from R2 and R5 resistors.

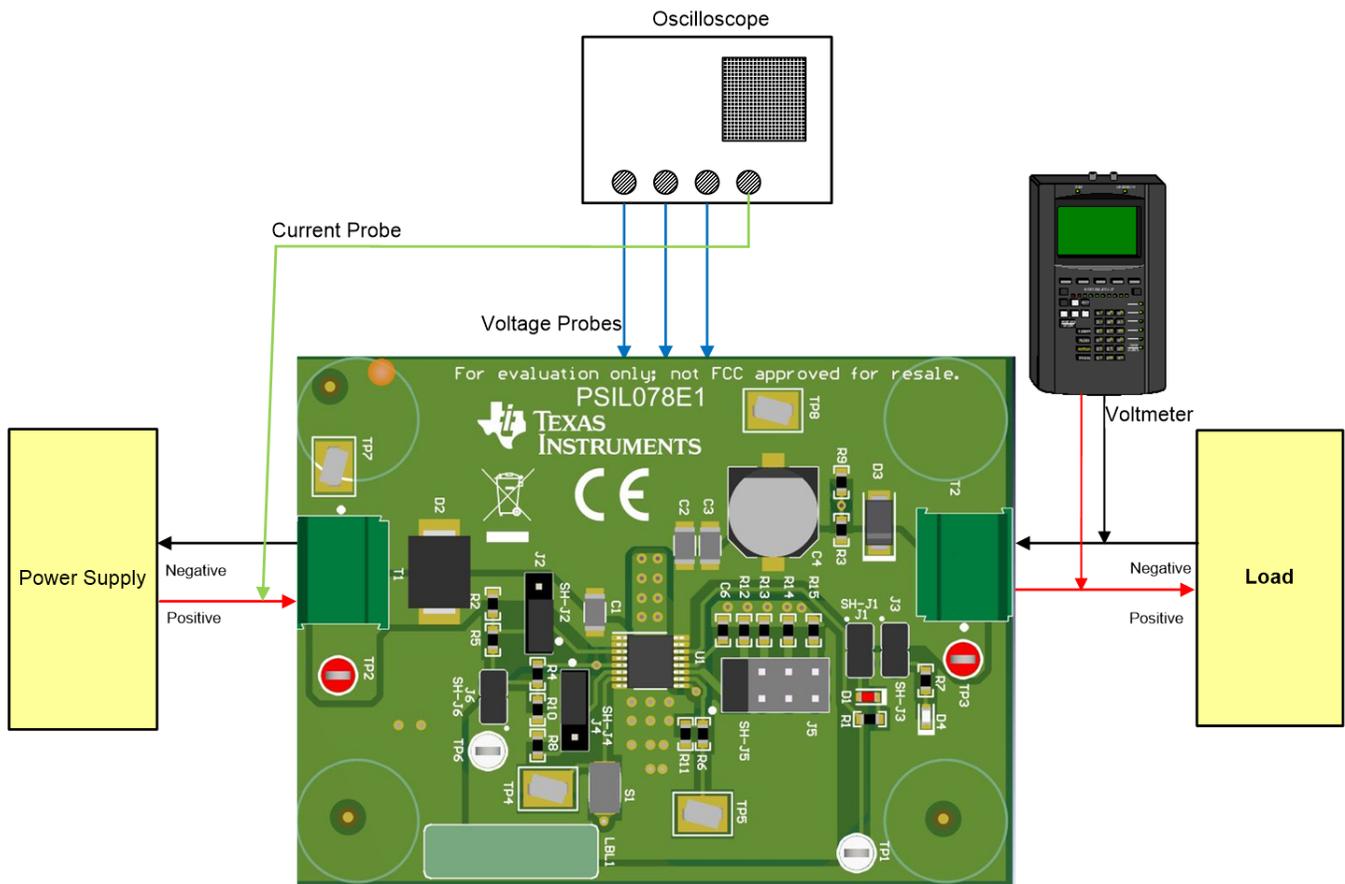


Figure 2. LM76202-Q1 EVM Setup

6 Test Procedure and Results

6.1 Hot-Plug Test

Use the following instructions to measure the output slew rate and input inrush current during Hot-Plug event.

- Set the input supply voltage V_{IN} to 12.5 V and current limit of 10 A. Enable the power supply.
- Hot-plug the supply at input connector T1.
- Observe the waveform at V_{IN} , V_{OUT} , \overline{FLT} and I_{IN} with an oscilloscope to measure the output slew rate and rise time .

Figure 3 shows an example of inrush current captured on the LM76202-Q1EVM.

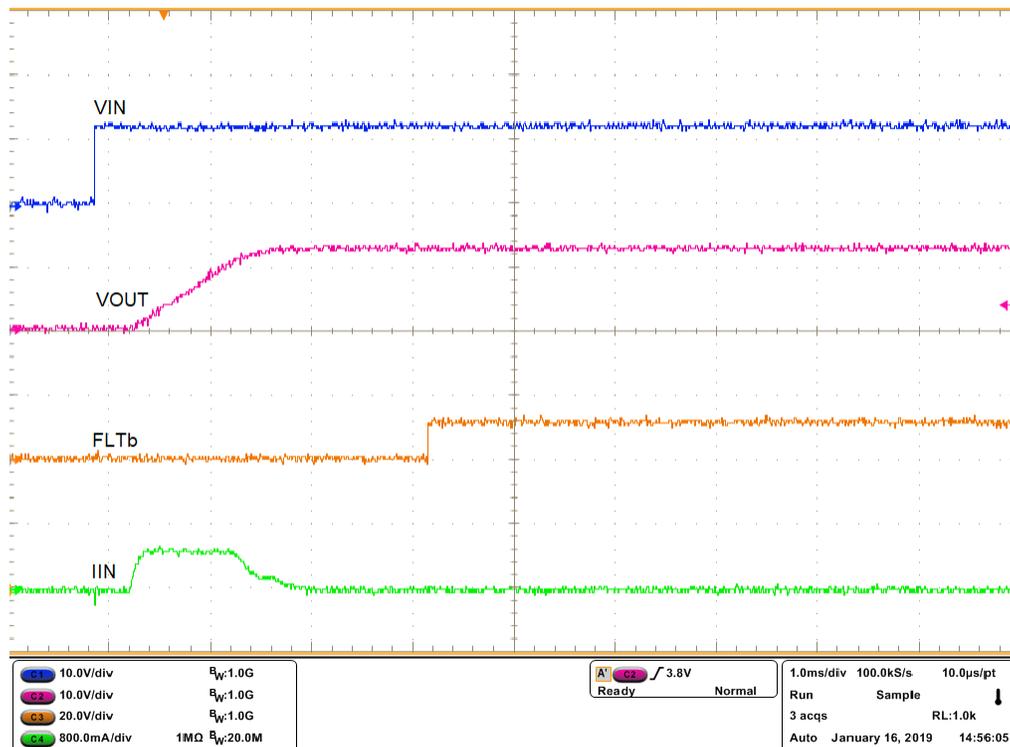


Figure 3. LM76202-Q1EVM Output Slew Rate with Inrush Current Limiting (VIN = 12.5 V, CdVdT = 12 nF, COUt = 47 µF, No-load)

6.2 Current Limit Test

Use the following instructions to perform current limit test.

- Set the input supply voltage VIN to 12.5 V and current limit of 10 A and enable the power supply.
- Connect the power supply on connector T1 of the EVM.
- By default, the EVM is configured for 2.23 A current limit.
- Connect a load of 3 Ω (20 W) at connector T2 of the EVM.
- The device limits the current to 2.23 A, turns off the internal MOSFET after reaching the thermal shutdown temperature (TSD) and auto-retries after a time of t_{retry} (512 ms)

Figure 4 shows an example of current limit at 2.23 A on the LM76202-Q1EVM

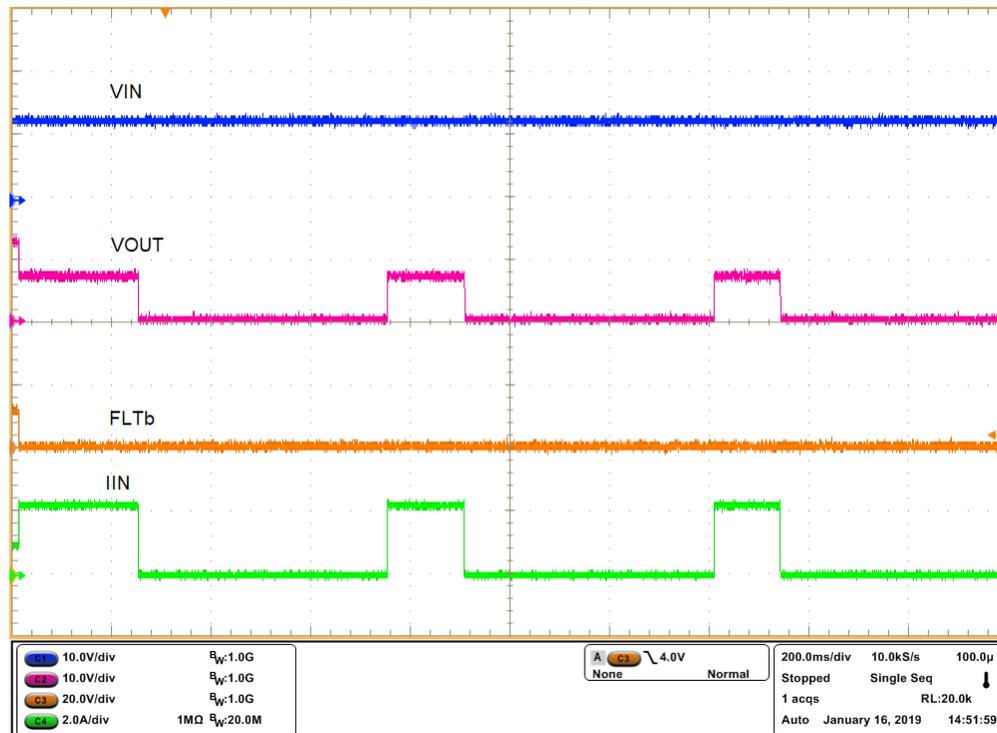


Figure 4. LM76202-Q1EVM Current Limit Operation ($V_{IN} = 12.5\text{ V}$, $I_{LIM} = 2.23\text{ A}$, $R_{OUT} = 3\ \Omega$, $MODE = RTN$)

6.3 Output Hot-Short Test

Use the following instructions to perform output Hot-Short test

- Set the input supply voltage V_{IN} to 12.5 V and current limit of 10 A and enable the power supply.
- Short the output of the device on connector T2, V_{OUT} to GND with a short and thick wire (5cm long and 4 sq. mm thick).
- Observe the waveforms of V_{IN} , V_{OUT} , \overline{FLT} and I_{IN} using an oscilloscope.

Figure 5 shows an example of output hot short on the LM76202-Q1EVM. \overline{FLT} is pulled-up from V_{IN} for this test.

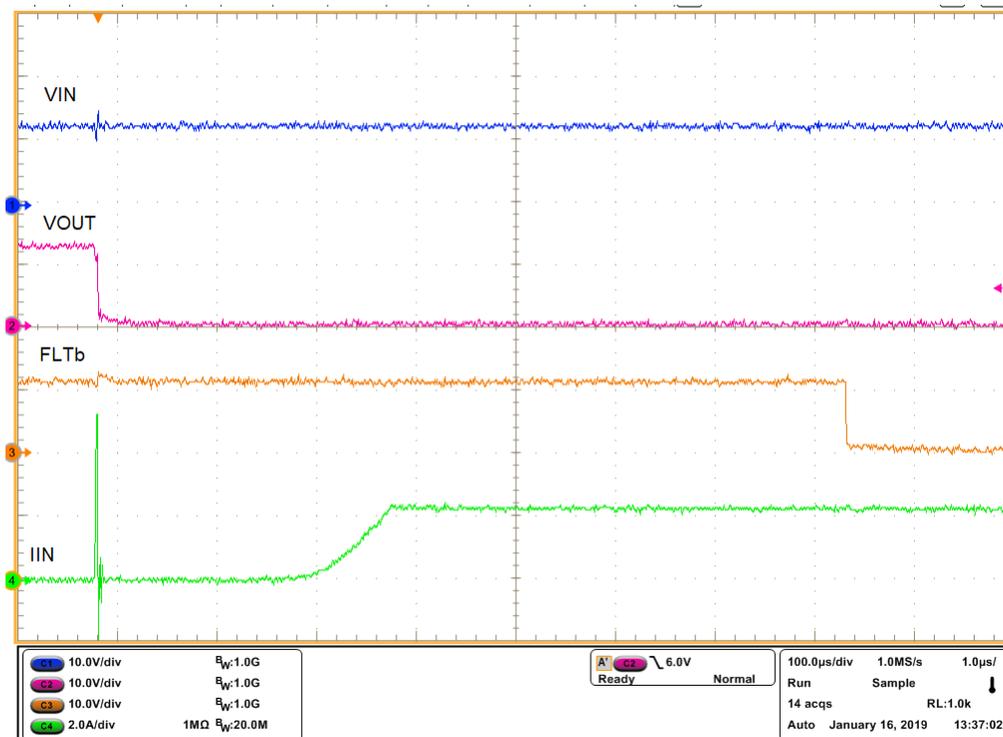


Figure 5. LM76202-Q1EVM Output Hot Short ($V_{IN} = 12.5\text{ V}$, $I_{LIM} = 2.23\text{ A}$, $MODE = RTN$)

6.4 Overvoltage Cut-off Protection Test

Use the following instructions to perform output overvoltage protection test

- Set the input supply voltage V_{IN} to 36 V and current limit of 10 A and enable the power supply.
- Connect a load of $28\ \Omega$ (30 W) at connector T2 of the EVM.
- Observe the waveforms of V_{IN} , V_{OUT} , \overline{FLT} and I_{OUT} using an oscilloscope.

Figure 6 shows an example of overvoltage cutoff protection on the LM76202-Q1EVM. \overline{FLT} is pulled-up from V_{IN} for this test.

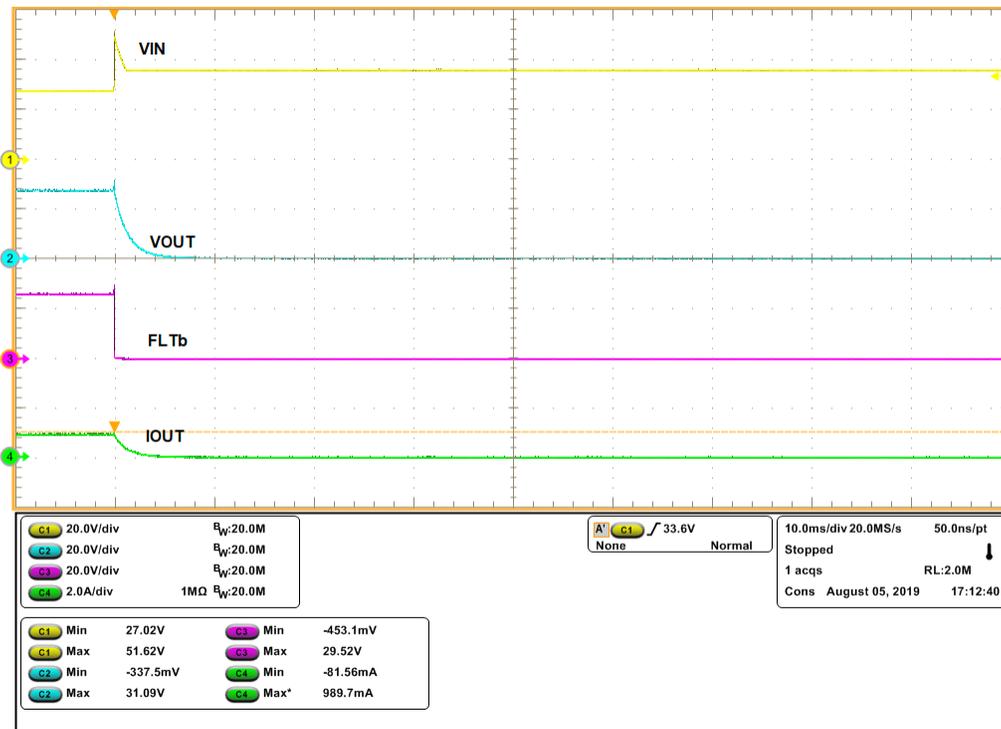


Figure 6. LM76202-Q1EVM Output Overvoltage Protection (VIN = 36 V, ILIM = 2.23 A, ROUT = 28 Ω, MODE = RTN)

6.5 Wake-up Into Short Test

Use the following instructions to perform Wake-up into Short test

- Set the input supply voltage VIN to 12.5 V and current limit of 10 A and enable the power supply.
- Short the output of the device on connector T2, VOUT to GND with a short and thick wire (5cm long and 4 sq. mm thick).
- Observe the waveforms of VIN, VOUT, \overline{FLT} and IIN using an oscilloscope.

Figure 7 shows an example of Wake-up into Short on the LM76202-Q1EVM. \overline{FLT} is pulled-up from VOUT for this test.

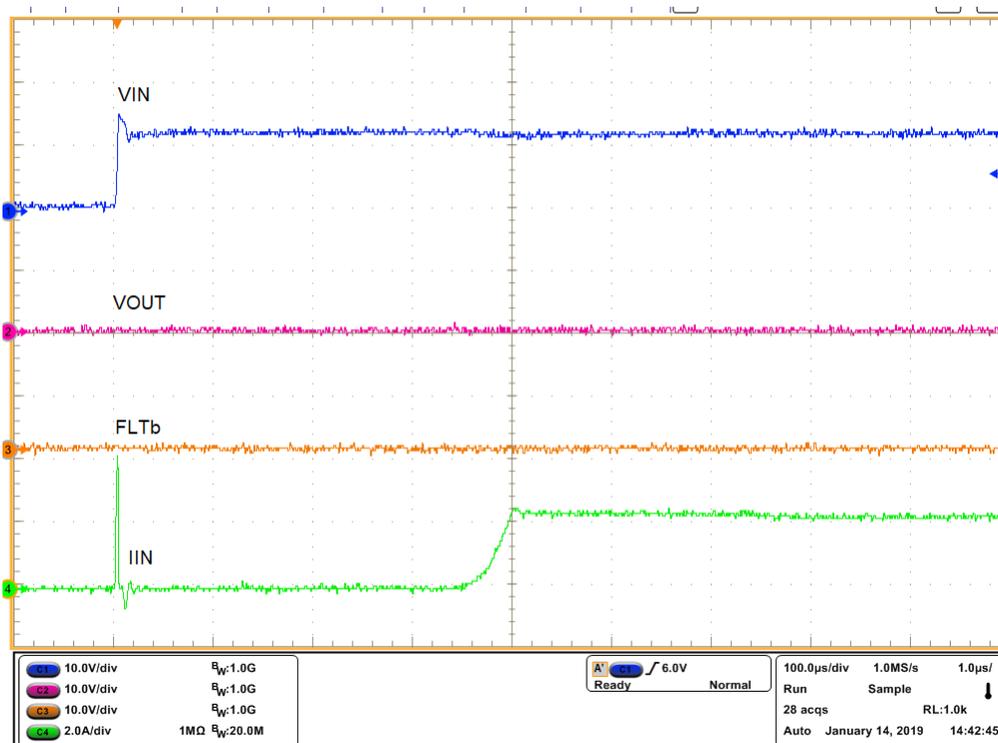


Figure 7. LM76202-Q1EVM Wake-up Into Short (VIN = 12.5 V, ILIM = 2.23 A, MODE = RTN)

6.6 Negative Input Voltage Transient Test (ISO 7637-2 Pulse 1)

Use the following instructions to perform negative input voltage transient test

- Select the ISO 7637-2 Pulse 1 in UCS 200N simulator.
- Set the parameters for pulse as:
 - Battery voltage = 12 V
 - $U_s = -150$ V
 - $R_i = 10$ Ω
 - $t_r = 1$ μ s
 - $t_1 = 0.5$ s
 - $t_2 = 200$ ms
- Connect the output of UCS 200N to input connector T1 of the EVM.
- Connect a load of 12 Ω on the output connector T2 of the EVM.
- Enable the output of UCS 200N and start the test.
- Observe the waveforms of VIN, VOUT and IOU using an oscilloscope.

Figure 8 shows the protection of load during a negative input voltage transient of -150 V (with specifications as per ISO 7637-2 pulse 1). The TVS diode D2 clamps the input voltage to -40 V during the transient event.

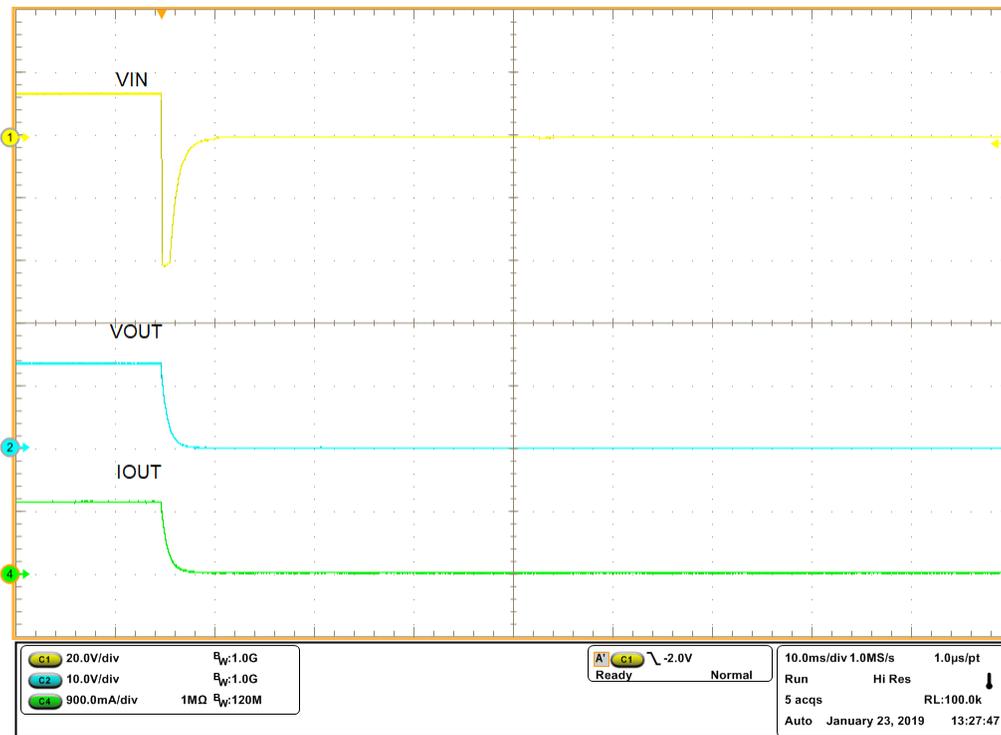


Figure 8. LM76202-Q1EVM Negative Input Voltage Transient Test (12-V battery voltage, transient voltage = -150 V , $R_{LOAD} = 12 \Omega$)

6.7 Positive Input Voltage Transient Test (ISO 16750-2 Pulse 5b)

Use the following instructions to perform positive input voltage transient test

- Select the ISO 16750-2 Pulse 5b in LD 200N simulator.
- Set the parameters for pulse as:
 - U_s^* or $V_p = 21 \text{ V}$
 - $R_i = 0.5 \Omega$
 - $t_r = 5 \text{ ms}$
 - $t_1 = 60 \text{ s}$
 - $t_d = 100 \text{ ms}$
- Connect the output of LD 200N to input connector T1 of the EVM.
- Connect a load of 14Ω on the output connector T2 of the EVM.
- Enable the output of LD 200N and start the test.
- Observe the waveforms of VIN, VOUT and IOOUT using an oscilloscope

Figure 9 shows the protection of load during a positive input voltage transient of 36 V (with specifications as per ISO 16750-2 pulse 5b) . The output is cut off from input during the transient and it returns to nominal value after the transient.

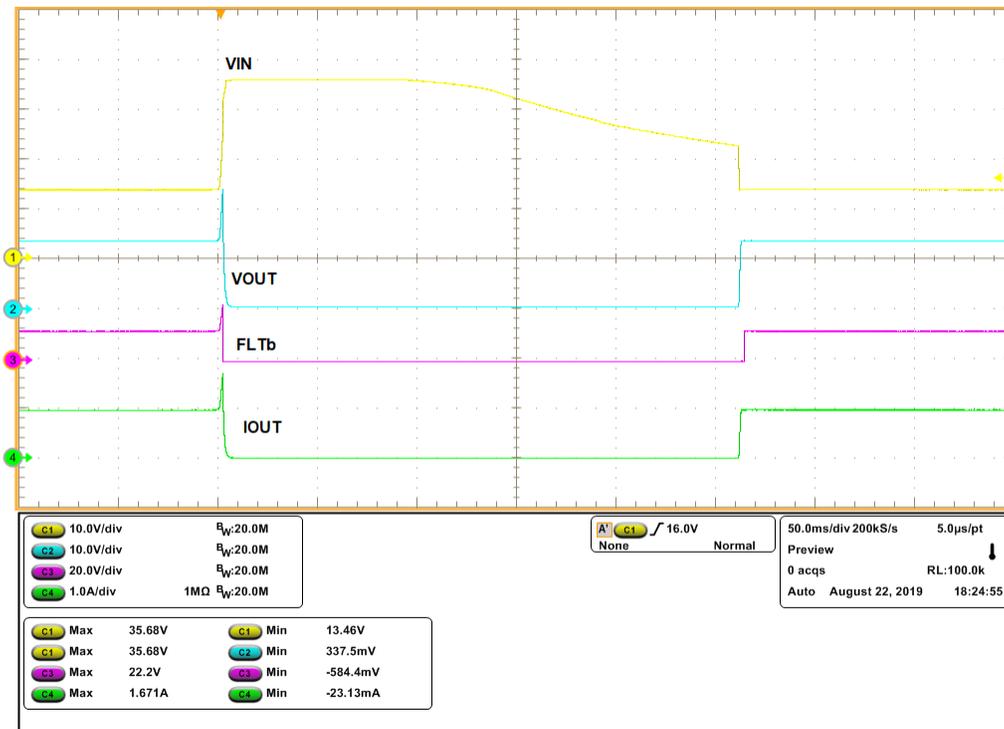
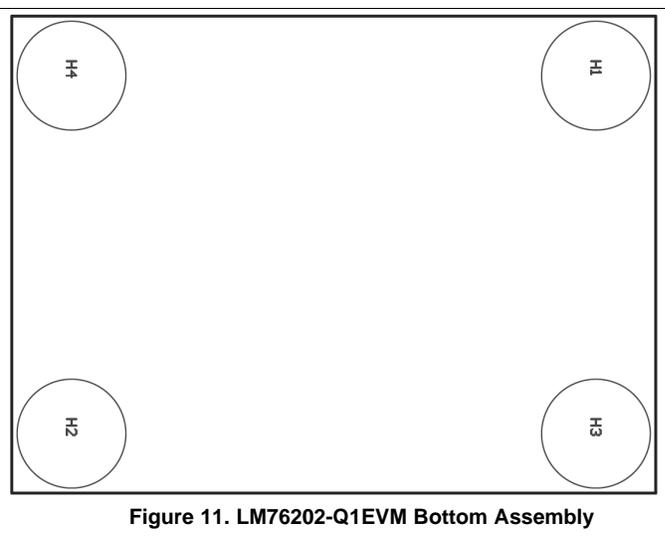
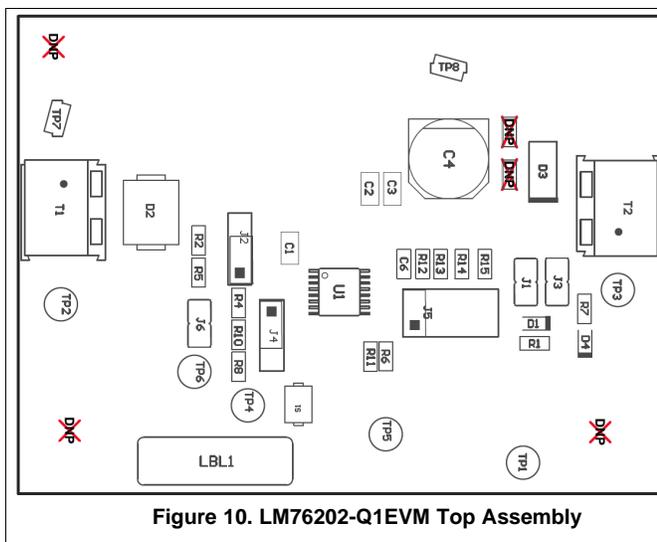
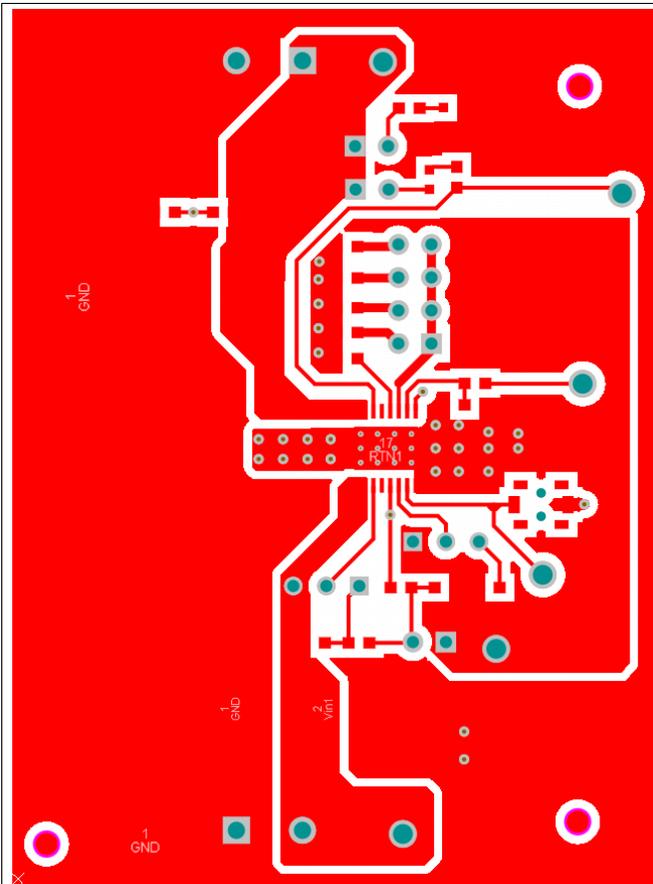
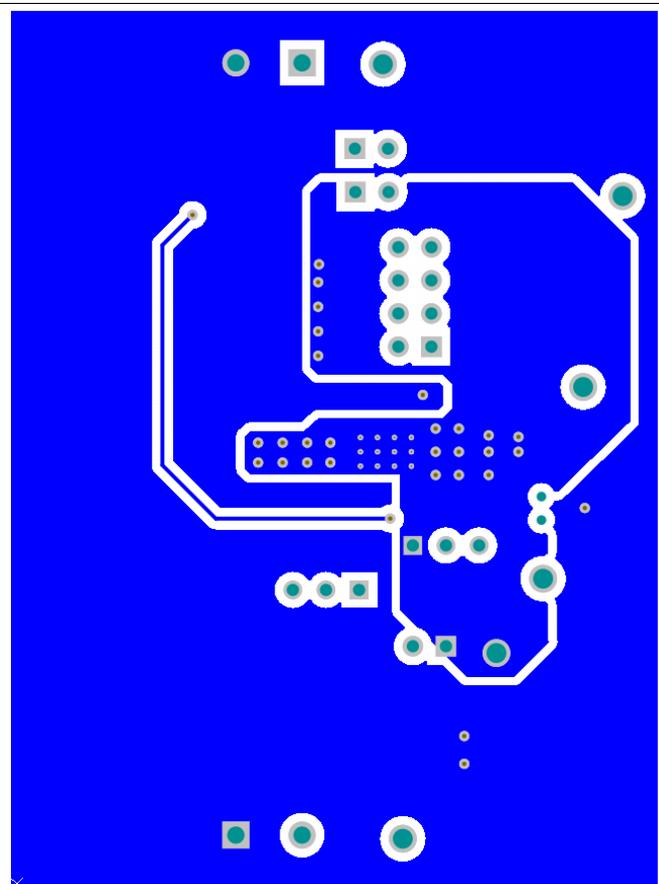


Figure 9. LM76202-Q1EVM Positive Input Voltage Transient Test (12-V battery voltage, transient voltage = 36 V , R_{LOAD} = 14 Ω)

7 Board Layout

Figure 10 and Figure 11 show component placement of the EVM Board. Figure 12 and Figure 13 show PCB layout for top and bottom layers of the EVM.




Figure 12. LM76202-Q1EVM Top Layer

Figure 13. LM76202-Q1EVM Bottom Layer

8 Bill of Materials

Table 6 lists the bill of material for LM76202-Q1EVM.

Table 6. Bill of Materials

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
!PCB1	1		Printed Circuit Board		PSIL078	Any
C1, C2, C3	3	0.68 uF	CAP, CERM, 0.68 uF, 100 V, +/- 10%, X7R, 1206	1206	C3216X7R2A684K160 AA	TDK
C4	1	47 uF	CAP, AL, 47 uF, 63 V, +/- 20%, AEC-Q200 Grade 2, SMD	D8xL10.2mm	EEE-HA1J470UP	Panasonic
C6	1	0.012 uF	CAP, CERM, 0.012 uF, 100 V, +/- 10%, X7R, 0603	0603	C0603C123K1RACTU	Kemet
D1	1	Red	LED, Red, SMD	Red LED, 1.6x0.8x0.8mm	SML-D12U1WT86	Rohm Semiconductor
D2	1	33 V	Diode, TVS, Bi, 33 V, SMC	SMC	SMCJ33CA-13-F	Diodes Inc.
D3	1	60 V	Diode, Schottky, 60 V, 2 A, SMA	SMA	B260A-13-F	Diodes Inc.
D4	1	Green	LED, Green, SMD	1.6x0.8x0.8mm	SML-D12M8WT86	Rohm Semiconductor
H9, H10, H11, H12	4		Bumpon, Hemisphere, 0.44 X 0.20, Clear	Transparent Bumpon	SJ-5303 (CLEAR)	3M
J1, J3, J6	3		Header, 100mil, 2x1, Gold, TH	Sullins 100mil, 1x2, 230 mil above insulator	PBC02SAAN	Sullins Connector Solutions
J2, J4	2		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions

Table 6. Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
J5	1		Header, 100mil, 4x2, Tin, TH	Header, 4x2, 100mil, Tin	PEC04DAAN	Sullins Connector Solutions
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650 x 0.200 inch	THT-14-423-10	Brady
R1, R5, R7	3	24.3 k	RES, 24.3 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060324K3FKEA	Vishay-Dale
R2	1	97.6 k	RES, 97.6 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060397K6FKEA	Vishay-Dale
R4	1	0	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	RMCF0603ZT0R00	Stackpole Electronics Inc
R6	1	100 k	RES, 100 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW0603100KFKEA	Vishay-Dale
R8	1	402 k	RES, 402 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW0603402KFKEA	Vishay-Dale
R10	1	4.42k	RES, 4.42k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06034K42FKEA	Vishay-Dale
R11	1	20.0 k	RES, 20.0 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060320K0FKEA	Vishay-Dale
R12	1	5.36 k	RES, 5.36 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06035K36FKEA	Vishay-Dale
R13	1	8.06 k	RES, 8.06 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06038K06FKEA	Vishay-Dale
R14	1	12.1 k	RES, 12.1 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060312K1FKEA	Vishay-Dale
R15	1	60.4 k	RES, 60.4 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060360K4FKEA	Vishay-Dale
TP1, TP6 , TP4, TP5	4		Test Point, Multipurpose, White, TH	White Multipurpose Testpoint	5012	Keystone
TP2, TP3	2		Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone
TP7, TP8	2		Test Point, Compact, SMT	Testpoint_Keystone_Compact	5016	Keystone
S1	1		Switch, SPST-NO, Off-Mom, 0.05A, 12VDC, SMD	3.9x2.9mm	PTS820 J20M SMTR LFS	C&K Components
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6	6	1x2	Shunt, 100mil, Flash Gold, Black	Closed Top 100mil Shunt	SPC02SYAN	Sullins Connector Solutions
U1	1		60-V, 2-A Integrated Ideal Diode with Overvoltage and Overcurrent protection, PWP0016J (HTSSOP-16)	PWP0016J	LM76202QPWPRQ1	Texas Instruments
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
R9	0	5.11 k	RES, 5.11 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06035K11FKEA	Vishay-Dale
R3	0	97.6 k	RES, 97.6 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060397K6FKEA	Vishay-Dale

9 Evaluating LM74202-Q1 on LM76202-Q1EVM

For evaluating LM74202-Q1 device on LM76202-Q1EVM, replace U1 with LM74202-Q1 and D2 with SMCJ28CA.

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from A Revision (September 2019) to B Revision	Page
• Updated Section 1	2
• Updated Section 2	2
• Added Section 9	14

Changes from Original (January 2019) to A Revision	Page
• Changed 10-A DC load from 55 V to 60 V in Section 5.4	4
• Changes made in Section 6.4	8
• Updated Figure 6	9
• Changes made in Section 6.7	11
• Updated Figure 9	12
• Updated Figure 10 and Figure 11	12
• Updated the <i>Bill of Materials</i> table in Section 8	13

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
 - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software
 - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. *Limited Warranty and Related Remedies/Disclaimers:*
 - 2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
 - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.
 - 2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.

User shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 Regulatory Notices:

3.1 United States

3.1.1 Notice applicable to EVMs not FCC-Approved:

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないものご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

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2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

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東京都新宿区西新宿 6 丁目 2 4 番 1 号
西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page 電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。
http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page

3.4 European Union

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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4. *EVM Use Restrictions and Warnings:*
 - 4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.
 - 4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.
 - 4.3 *Safety-Related Warnings and Restrictions:*
 - 4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.
 - 4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.
 - 4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.
 5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.
 6. *Disclaimers:*
 - 6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.
 - 6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.
 7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.
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8. *Limitations on Damages and Liability:*

8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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