

# EVM User's Guide: LMR36503MSCEVM

## LMR36503MSCEVM Evaluation Module



### Description

The LMR36503E-Q1 is a 65V DC/DC, 0.3A buck regulator that features synchronous rectification to achieve high conversion efficiency in a small footprint. The EVM operates over a wide input voltage range of 5.5V to 65V to provide a regulated 5V output up to 0.3A load at 2.2MHz switching frequency. The LMR36503MSCEVM can support output voltage regulation accuracy better than 1.5% at full load and is adjustable using an external resistor divider.

### Get Started

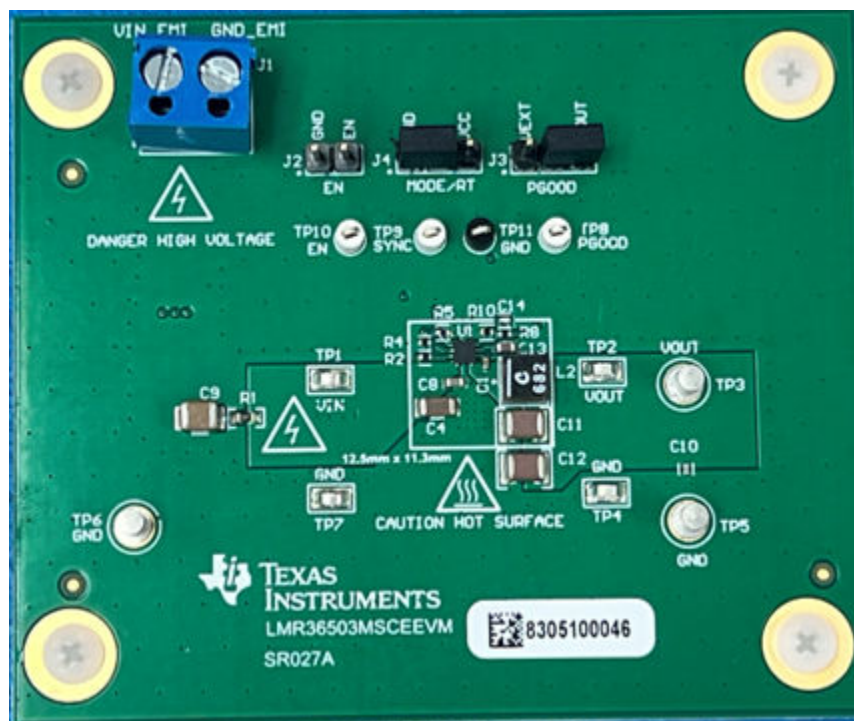
1. Order the EVM at [ti.com](https://www.ti.com).
2. Read this user's guide.
3. Prepare the bench setup per instructions.
4. Power up the EVM by following the recommended steps.
5. Run tests and measurements. Take caution of the high temperature that the EVM can be operated under during the test.

### Features

- Input voltage range: 5.5V to 65V
- Output voltage: 12V
- Load current: 0 to 0.3A
- Switching frequency: 2.2MHz
- Adjustable output voltage
- External synchronization capability
- Internal spread spectrum capability
- Selectable pulse-frequency modulation or forced pulse-width modulation at light-load
- Supports operation up to 150°C ambient
- Supports other variants of the IC by replacing some components

### Applications

- [Advanced driver assistance systems \(ADAS\)](#)
- [Body electronics and lighting](#)
- [Infotainment and cluster](#)



LMR36503E-Q1 EVM

# 1 Evaluation Module Overview

## 1.1 Introduction

The Texas Instruments LMR36503MSCEVM evaluation module help designers evaluate the operation and performance of the LMR36503E-Q1 wide-input buck converters. The LMR36503E-Q1 is an easy-to-use synchronous step-down DC/DC converter capable of driving up to 0.3A of load current from an input voltage of 3V up to 65V. The LMR36503MSCEVM features an output voltage of 5V and a switching frequency of 2.2MHz. See the [LMR36503E-Q1 3V–65V, 0.3A Ultra-Small Synchronous Buck Converter Optimized for Size and Light Load Efficiency](#) data sheet for additional features, detailed descriptions, and available options.

The LMR36503E-Q1 is available in a 9-pin VQFN package in four device variants, with preprogrammed settings to reduce component count and achieve high density designs. The LMR36503MSCEVM comes with the variant of the LMR36503MSCERPERQ1, which allows for adjustable output voltage, external synchronization, and spread spectrum options at a fixed 2.2MHz switching frequency. See the LMR36503E-Q1 data sheet for the detailed info of all four variants of the IC. The EVM utilizes the LMR36503E-Q1 with the following features:

- Wide input voltage range
- Wide duty-cycle range
- Integrated high-side and low-side power MOSFETs
- Cycle-by-cycle over current protection
- Internal loop compensation

## 1.2 Kit Contents

The package includes:

1. LMR36503E-Q1 evaluation module (LMR36503MSCEVM) that includes the LMR36503MSCERPERQ1
2. EVM Disclaimer Read Me

## 1.3 Specification

A summary of the LMR36503MSCEVM performance is provided in the table below. Due to variations in test setup, deviations from the measurements listed below can be expected.

Specifications		Test Conditions	Min	Typ	Max	Unit
$V_{IN}$	Input voltage		5.5	12	65	V
$V_{OUT}$	Output voltage	$V_{IN} = 12V$	5.015		5.06	V
$F_{SW}$	Switching frequency			2.2		MHz
$I_{OUT}$	Output current range		0		300	mA
Efficiency		$I_{OUT} = 300mA, V_{IN} = 12V$			87	%

## 1.4 Device Information

**Table 1-1. Device and Package Configurations**

EVM	U1	FREQUENCY	SPREAD SPECTRUM	CURRENT	PIN 1 TRIM
LMR36503MSCEVM	LMRLMR36503MSCERPERQ1	2.2MHz	Enabled	300mA	Adjustable output voltage and MODE select

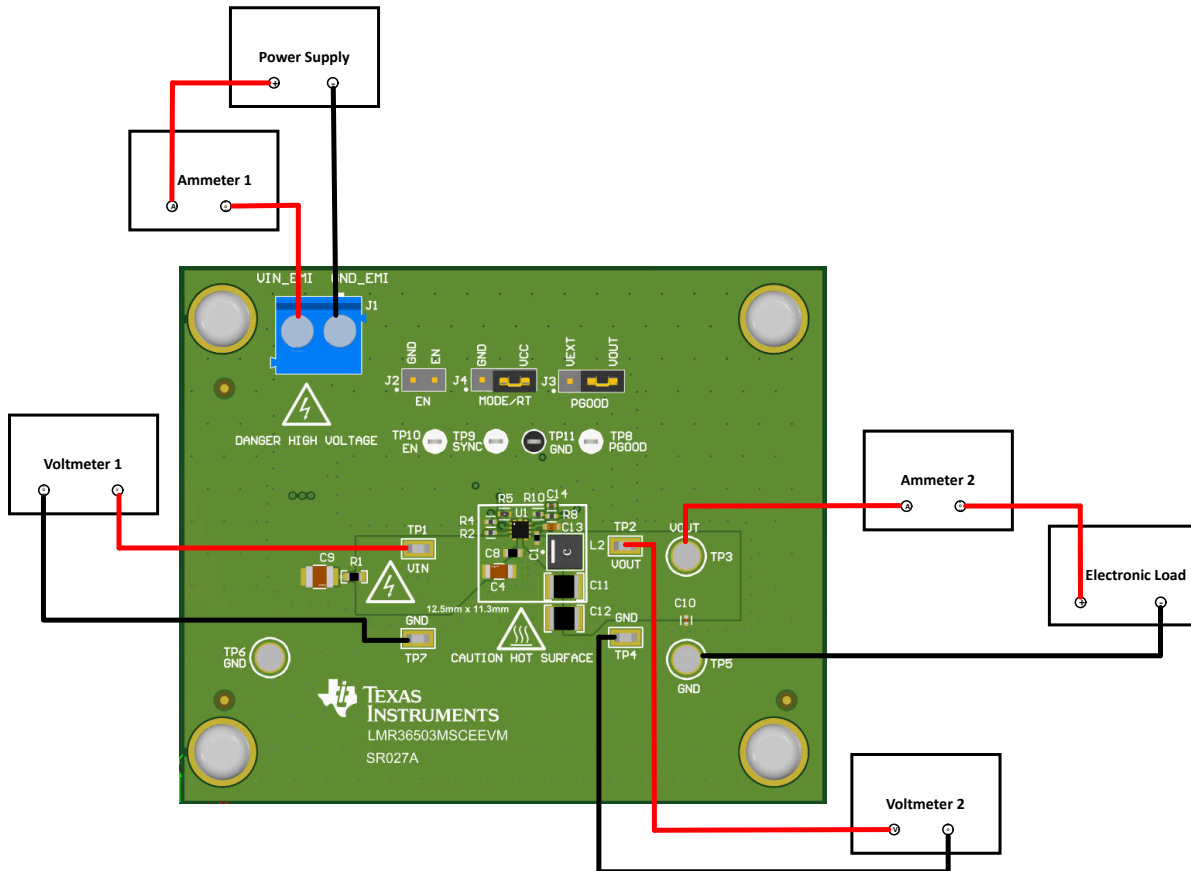
At room temperature, the LMR36503MSCEVM can support the full 300mA load at the maximum input voltage of 65V. At higher temperatures, such as 150°C ambient, the input voltage needs to be derated to a maximum of 20V to prevent the IC from entering thermal shutdown. At a input voltage of 20V and a load of 300mA at 150°C ambient temperature, the EVM does not exhibit thermal shutdown until the case temperature reaches 154°C ambient temperature with no forced air cooling.

## 2 Hardware

### 2.1 EVM Setup

This section describes the test points and connectors on the EVM and how to properly connect, set up, and use the LMR36503MSCEEVM.

By default, the EVM utilizes a MODE/SYNC trim part. The MODE/RT jumper J4 is connected between pins 1 and 2. By default, this means that the part is operating in a 2.2MHz fixed frequency, PFM light-load operating mode. To access FPWM light-load operating mode, depopulate resistor R5 and connect pins 2 and 3 of J4.



**Figure 2-1. EVM Board Connections**

The test setup consists of the following instruments in addition to the EVM board.

- **Power Supply:** The input DC voltage source must be capable of at least 65V and 2A.
- **Load:** The load must be an electronic, constant-current (CC) or constant-resistance (CR) mode load, capable of supporting up to 300mA up to 5V. For no-load input current measurements, the electronic load must be disconnected.
- **Multimeters:**
  - **Voltmeter 1:** Measures input voltage at VIN (TP1) and GND (TP7)
  - **Voltmeter 2:** Measures output voltage at VOUT (TP2) and GND (TP4)
  - **Ammeter 1:** Measures input current.
  - **Ammeter 2:** Measures output current.
- **Oscilloscope:** With the scope set to 20MHz bandwidth, and AC coupling, measure the output voltage ripple directly across an output capacitor with a short ground lead. The oscilloscope probe tip must be placed on the positive terminal of the output capacitor, and the ground lead must be placed on the negative terminal of the output capacitor. TI does not recommend using a long-leaded ground connection because the connection can induce additional noise due to a large ground loop. To measure other waveforms, adjust the oscilloscope as necessary.

### 2.1.1 Quick Start

1. Connect the voltage supply between the VIN\_EMI and GND test points.
2. Connect the load between the VOUT and GND test points.
3. Set the supply voltage at an appropriate level between 5.5V to 65V. Set the current limit of the supply to an appropriate level.
4. Turn on the power supply. With the default configuration, the EVM powers up and provides  $V_{OUT} = 5V$ .
5. Monitor the output voltage. The maximum load current must be 0.3 A with the LMR36503E-Q1 device.

### 2.1.2 Test Points

The test points on the top of the board can be used for connecting to the input and output of the EVM. See [Table 2-1](#) for a description of the test points.

**Table 2-1. EVM Test Points**

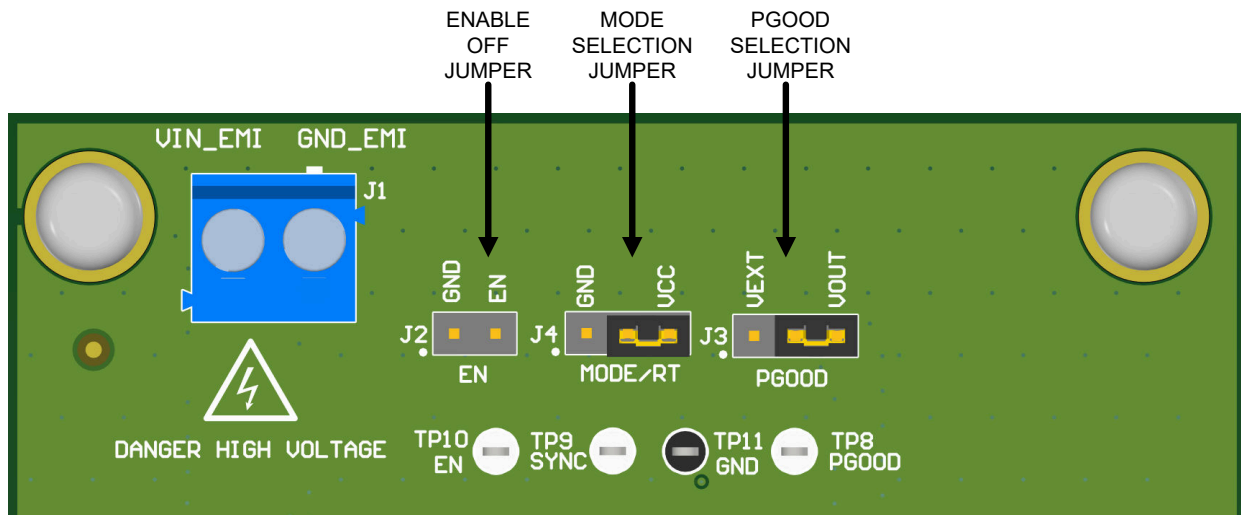
Test Point	Signal	Description
J1	VIN_EMI	Input supply to EVM including an EMI filter. Connect to a good input supply. Connect at this point for conducted EMI test.
	GND_EMI	Ground connection for the input supply
TP1	VIN	Input supply to the IC. Can be connected to DMM to measure input voltage after EMI filter
TP2, TP3	VOUT	Output voltage test point of EVM. Can be connected to a desired load
TP4, TP5, TP6, TP7, TP11	GND	Ground connection for the input supply as well as test points for ground connection
TP8	PGOOD	This test point is connected to the PGOOD pin from the IC. The test point is an open-drain output of the PGOOD pin. Using the jumper J3, the PGOOD pin can be tied to external supply through a pullup resistor or left open.
TP9	SYNC	In a MODE/SYNC trim part, this test point is connected to the SYNC pin of the IC. The test point can operate in user-selectable PFM/FPWM mode and can be connected to an external clock to synchronize the IC. Make sure R7 (RMODE) is installed and R5 (RT) is not installed.
		In a <b>RT</b> trim part, this test point is connected to the RT pin of the IC when the R4 (RMODE) is installed.
TP10	EN	This test point is connected to the EN pin. By default, there is a pullup resistor R2 to VIN to enable the IC.

### 2.1.3 Jumpers

See [Table 2-2](#) for jumper descriptions. The following figure illustrates the jumper locations, as well as a possible configuration. See the data sheet for more information on switching frequency configuration.

**Table 2-2. EVM Jumpers**

Jumper	Signal	Description
J2	EN	This jumper allows the ENABLE input to be connected to GND to disable the IC. By default, this jumper is left open since there is a pullup resistor R2 (RENT) to VIN to enable the IC.
J3	PGOOD	This jumper is used to select how the PGOOD pin can be connected. A jumper can be used to connect pin 2 and 3. In this configuration, the PGOOD pin is pulled up to VOUT through R9 with a value of 100kΩ. If a jumper is used to connect pin 1 and 2, then the PGOOD pin is pulled up to an external voltage through R9. By default, this jumper has pin 2 and pin 3 connected.
J4	MODE	Use this jumper to select the mode of operation in a MODE/SYNC trim part. Connecting a jumper between pin 1 and 2 cause the IC to operate in PFM (Pulse Frequency Modulation) mode for a higher efficiency at light load. A jumper between pin 2 and pin 3 causes the IC to operate in FPWM mode (Forced Pulse Width Modulation) mode.
	RT	In an RT trim part, connecting this jumper from pin 1 and 2 sets the switching frequency to 2.2MHz and connecting this jumper from pin 2 and 3 sets the switching frequency to 1MHz.



**Figure 2-2. Jumper Locations**

### 3 Implementation Results

#### 3.1 Performance Data and Results

Actual performance data can be affected by measurement techniques and environmental variables, these curves are presented for reference and can differ from actual field measurements. Unless otherwise stated,  $V_{in} = 12V$ ,  $V_{out} = 5V$ , and  $F_{sw} = 2.2MHz$

##### 3.1.1 Efficiency, Load Regulation, and Dropout

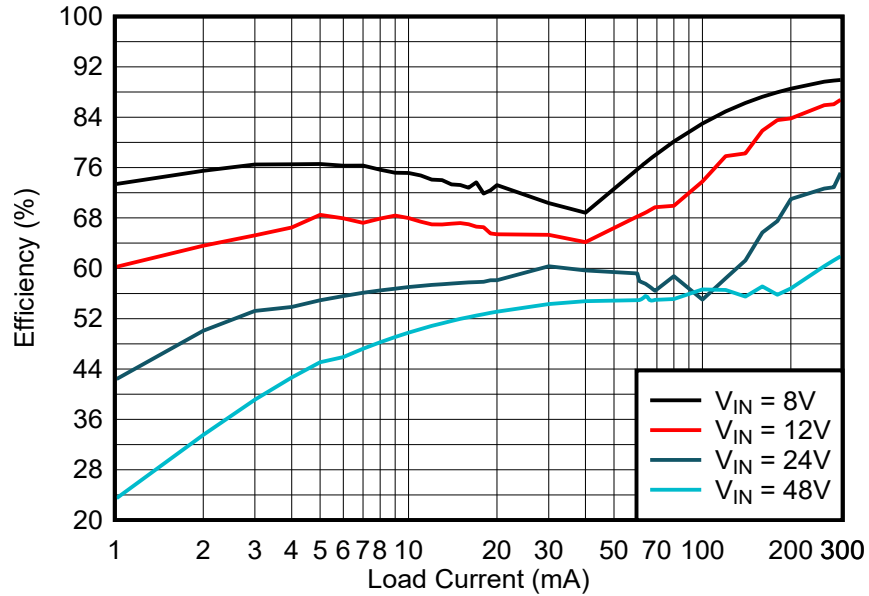


Figure 3-1. Conversion Efficiency

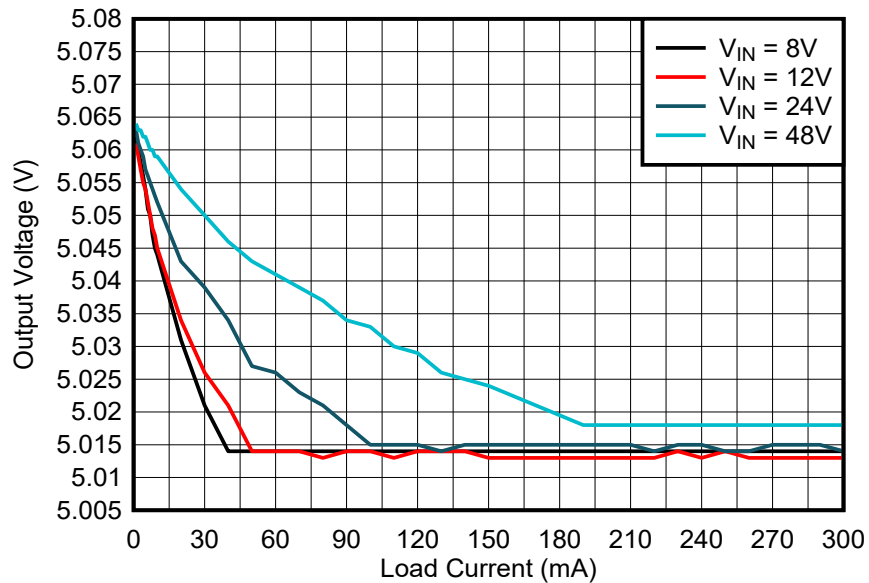


Figure 3-2. Output Voltage Regulation

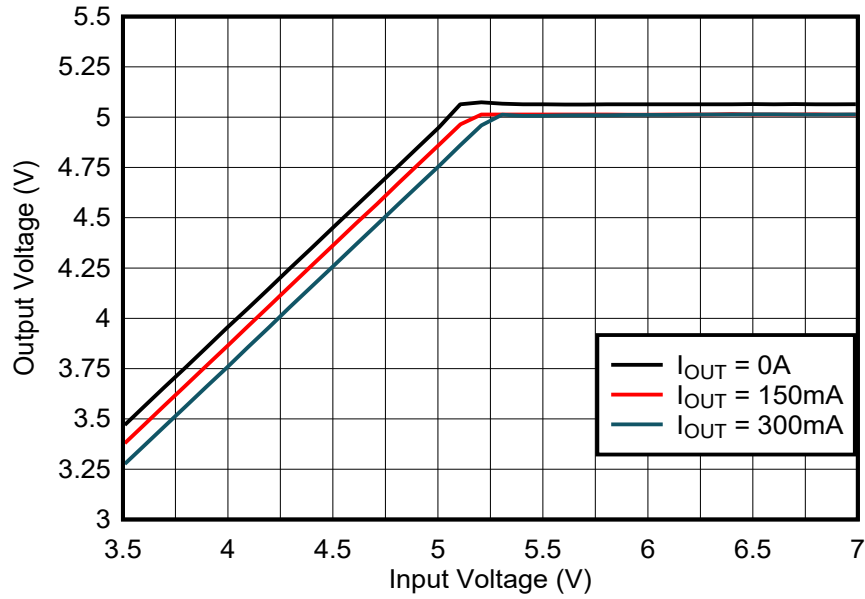


Figure 3-3. Dropout

### 3.1.2 Load Transients

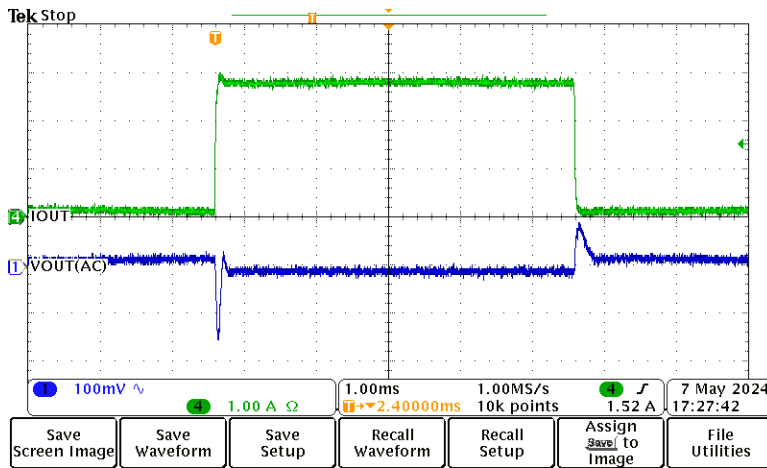


Figure 3-4. Load Transient,  $I_{OUT} = 20mA$  to 300mA

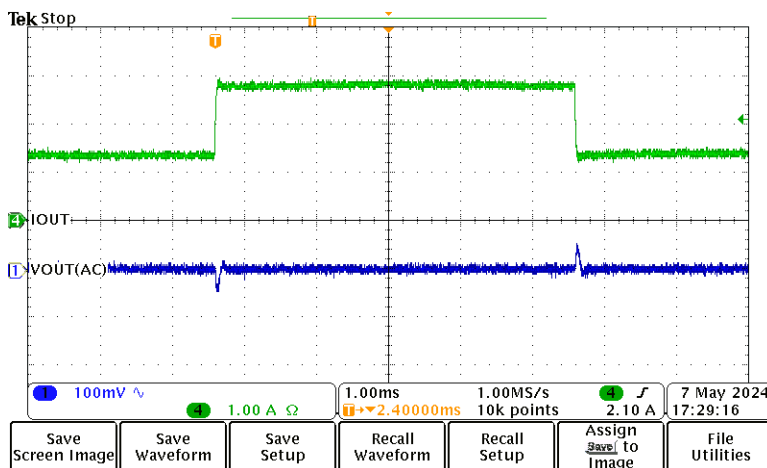


Figure 3-5. Load Transient,  $I_{OUT} = 150mA$  to 300mA

### 3.1.3 Steady State

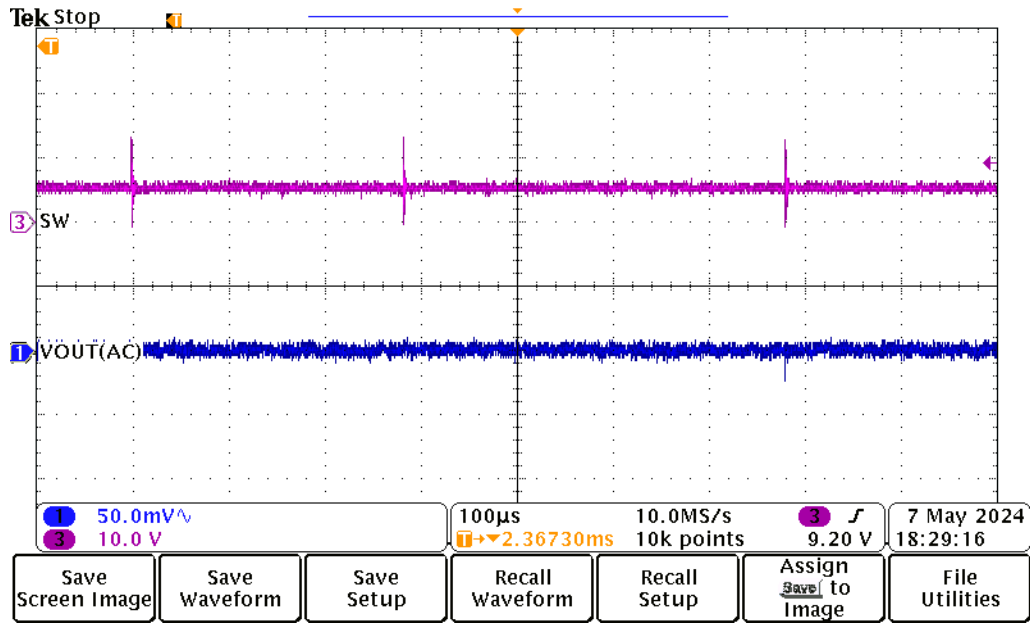


Figure 3-6. Steady State,  $I_{OUT} = 0A$

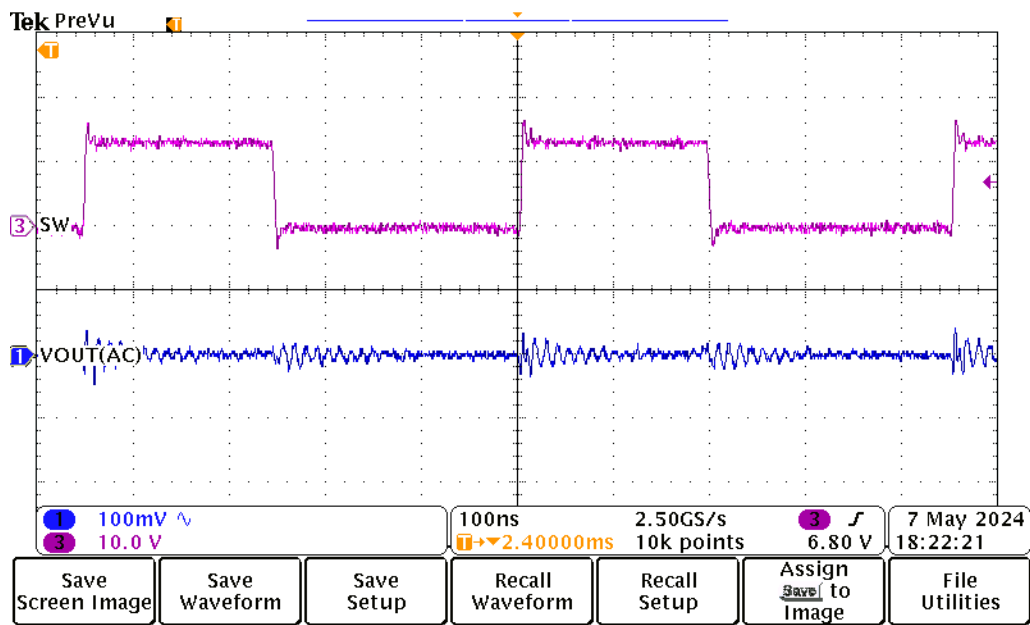


Figure 3-7. Steady State,  $I_{OUT} = 300mA$



### 3.1.4 Line Transient



Figure 3-8. Waterfall Test, Iout = 300mA



Figure 3-9. Waterfall Test, Iout = 0A

### 3.2 Thermal Images

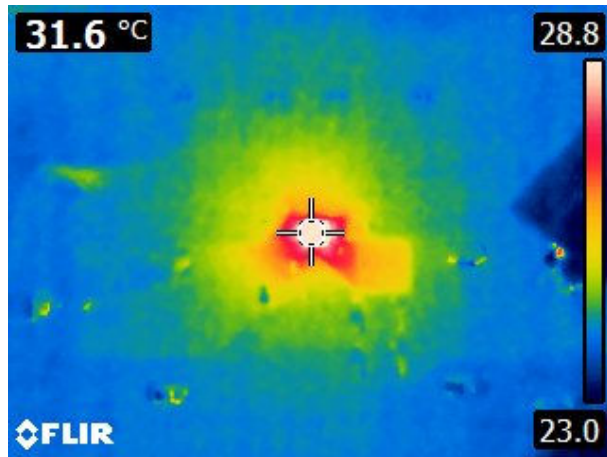


Figure 3-10. 12-Vin, 300mA load, 25C ambient

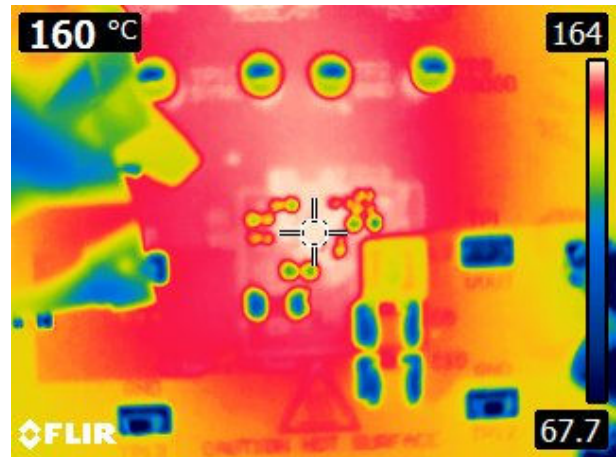


Figure 3-11. 20-Vin, 300mA load, 150C ambient

## 4 Hardware Design Files

### 4.1 Schematic

Ambient Temperature	Maximum Input Voltage
25°C	65VDC
150°C	20VDC

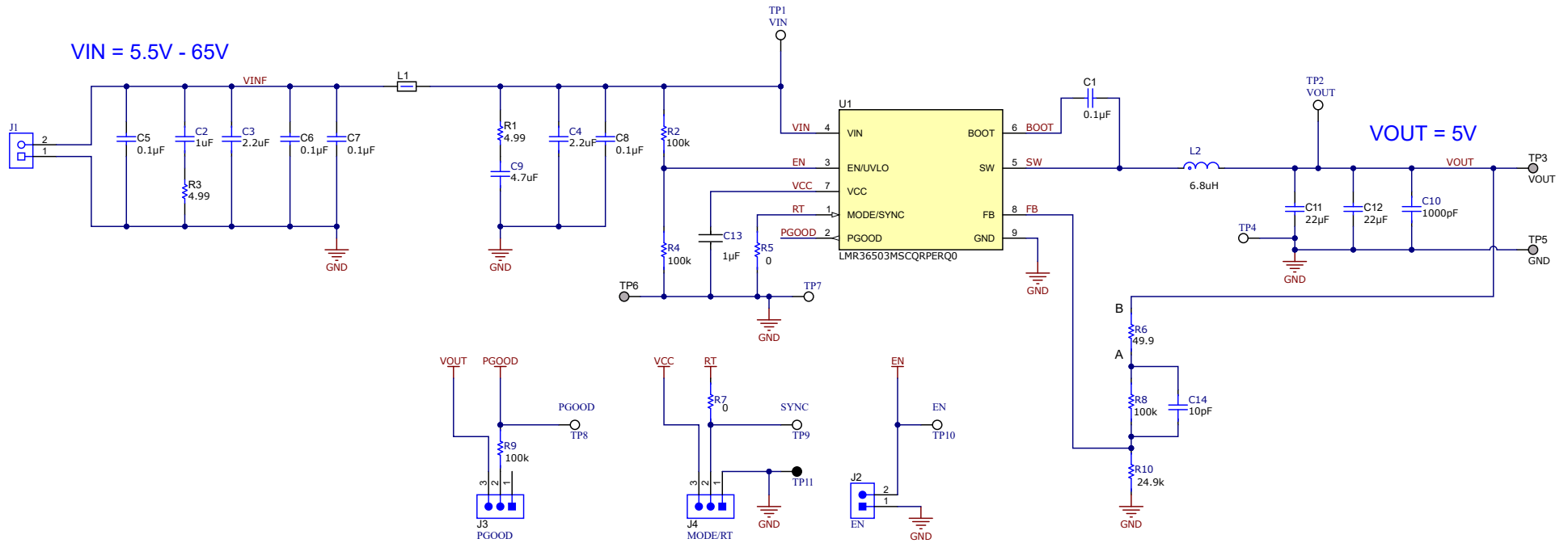


Figure 4-1. LMR36503MSCEVM Schematic

## 4.2 Board Layout

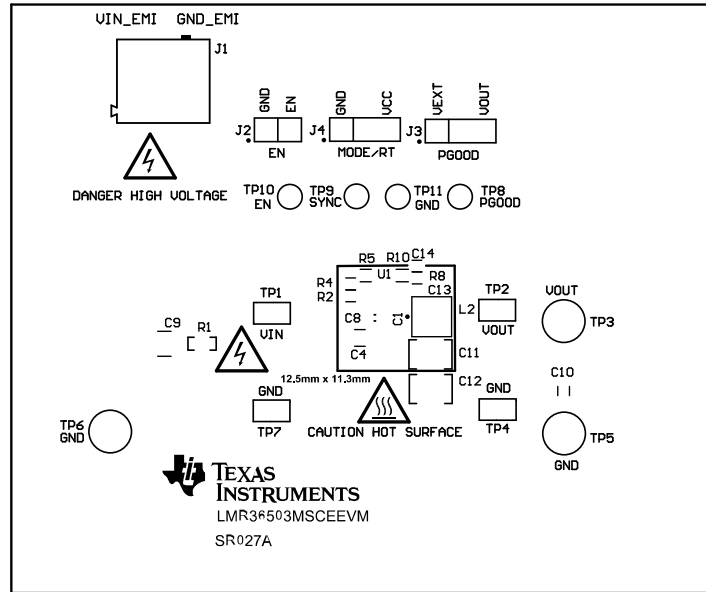


Figure 4-2. EVM Top Overlay

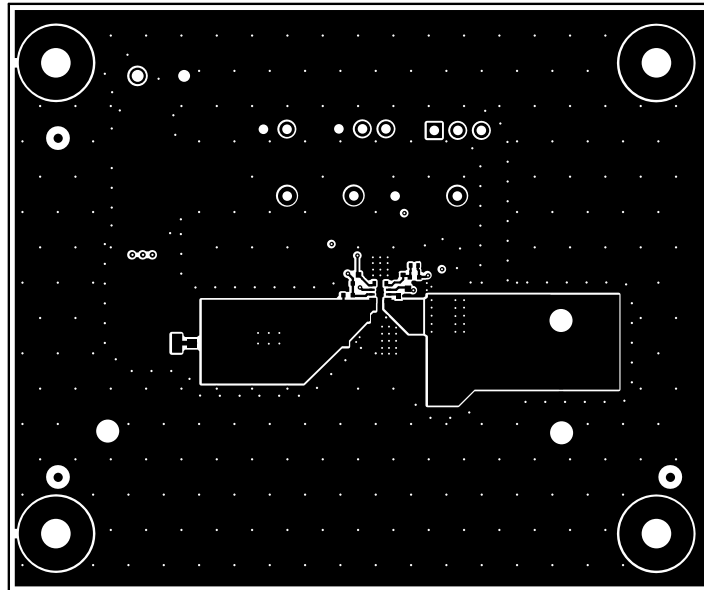
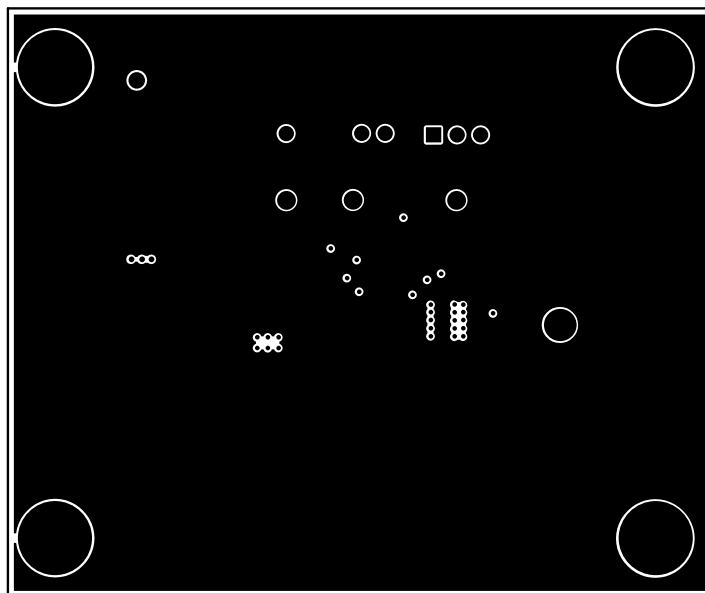
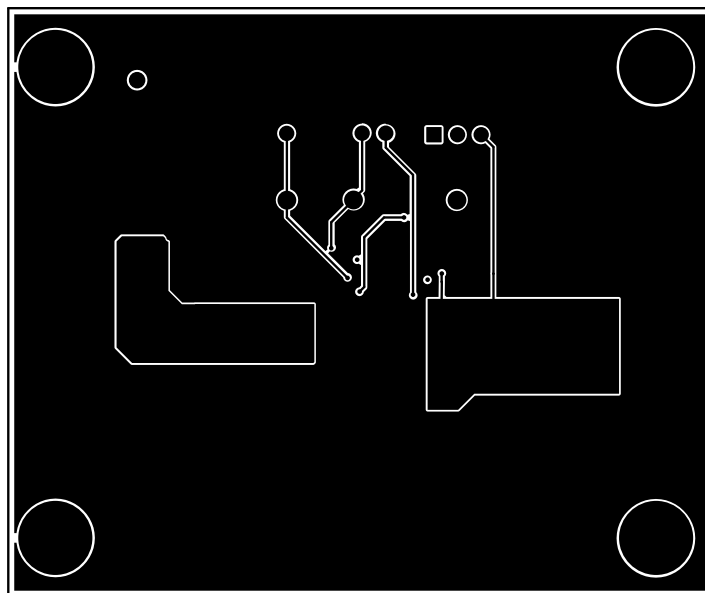


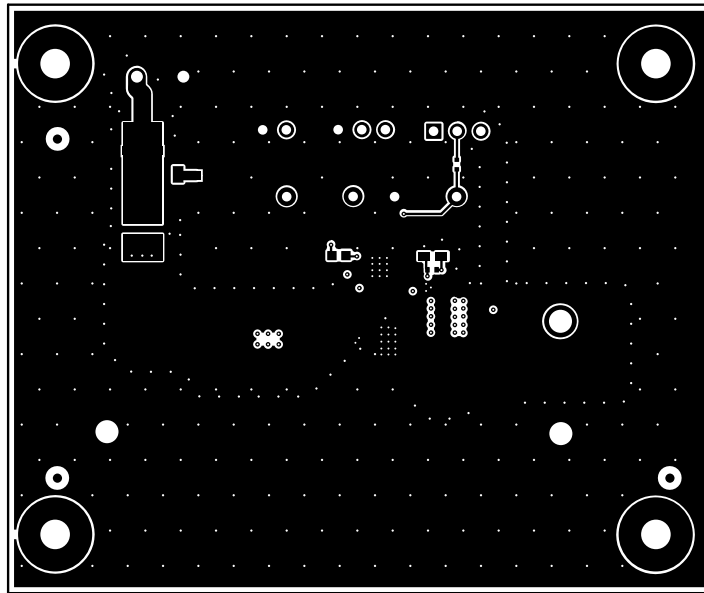
Figure 4-3. EVM Top Copper Layer



**Figure 4-4. EVM Mid Layer One**



**Figure 4-5. EVM Mid Layer Two**



**Figure 4-6. EVM Bottom Copper Layer**

### 4.3 Bill of Materials

**Table 4-1. Bill Of Materials**

DESIGNATOR	Quantity	Value	DESCRIPTION	Part Number	MANUFACTURER
C1	1	0.1 $\mu$ F	CAP, CERM, 0.1 $\mu$ F, 25V,+/- 10%, X8L, AEC-Q200 Grade 0, 0402	GCM155L81E104KE02D	MuRata
C2	1	1 $\mu$ F	1 $\mu$ F $\pm$ 10% 100V Ceramic Capacitor X8L 1206 (3216 Metric)	GCJ31CL8EL105KA07L	MuRata
C3, C4	2	2.2 $\mu$ F	Chip Multilayer Ceramic Capacitors for General Purpose 2.2 $\mu$ F $\pm$ 10% 100Vdc	GRM31CL8EL225KE07L	MuRata
C5, C6, C7, C8	4	0.1 $\mu$ F	CAP, CERM, 0.1 $\mu$ F, 100V,+/- 10%, X8L, AEC-Q200 Grade 0, 0603	GCJ188L8EL104KA07D	Wurth Elektronik
C9	1	4.7 $\mu$ F	Chip Multilayer Ceramic Capacitors for General Purpose 4.7 $\pm$ 10% 100VDC SMD 1210	GRM32DL8EL475KE07K	MuRata
C10	1	1nF	1000pF $\pm$ 5% 100V Ceramic Capacitor COG, NP0 0402 (1005 Metric)	C0402H102J1GAC7867	KEMET
C11, C12	2	22 $\mu$ F	CAP, CERM, 22 $\mu$ F, 16V,+/- 20%, X8L, AEC-Q200 Grade 0, 1210	CGA6P1X8L1C226M250AC	TDK
C13	1	1 $\mu$ F	CAP CER X8L 16V 1.0UF 10% 0.80MM	CGA3E1X8L1C105K080AC	TDK
C14	1	10pF	Cap Ceramic 10pF 50V NP0 0.5pF Pad SMD 0402 +150°C Automotive T/R	CGA2B2NP01H100D050BA	TDK
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff	1902C	Keystone
J1	1		Terminal Block, 5mm, 2x1, Tin, TH	691 101 710 002	Wurth Elektronik
J2	1		Header, 100mil, 2x1, Gold, TH	HTSW-102-07-G-S	Samtec
J3, J4	2		Header, 100 mil, 3x1, Gold, TH	HTSW-103-07-G-S	Samtec
L1	1	600 ohm	Ferrite Bead, 600 ohm at 100MHz, 3A, 1210	FBMH3225HM601NT	Taiyo Yuden
L2	1	6.8 $\mu$ H	6.8 $\mu$ H Shielded Molded Inductor 4.7A 47.9mOhm Max 1616 (4040 Metric)	XGL4030-682MEC	Coilcraft
R1, R3	2	4.99	RES, 4.99, 1%, 0.1 W, 0603	RC0603FR-074R99L	Yageo
R2, R4, R8, R9	4	100k	100 kOhms $\pm$ 1% 0.1W, 1/10W Chip Resistor 0402 (1005 Metric) Automotive AEC-Q200 Thick Film	ERJ-H2RF1003X	Panasonic
R5	1	0	0 Ohms Jumper Chip Resistor 0402 (1005 Metric) Anti-Sulfur, Current Sense, Flame Retardant Coating, Moisture Resistant, Safety Metal Foil	D1LPC0402CJUMPF-T10	Thin Film Technology
R6	1	49.9	49.9 Ohms $\pm$ 0.1% 0.063W, 1/16W Chip Resistor 0402 (1005 Metric) Thin Film	RT0402BRD0749R9L	Yageo
R7	1	0	0 Ohms Jumper Chip Resistor 0603 (1608 Metric) Metal Element	WSL060300000ZEA9	Vishay
R10	1	24.9k	24.9 kOhms $\pm$ 0.1% 0.063W, 1/16W Chip Resistor 0402 (1005 Metric) Thin Film	RT0402BRE0724K9L	Yageo

**Table 4-1. Bill Of Materials (continued)**

DESIGNATOR	Quantity	Value	DESCRIPTION	Part Number	MANUFACTURER
SH-J1, SH-J2	2		Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
TP1, TP2, TP4, TP7	4		Test Point, Miniature, SMT	5015	Keystone Electronics
TP3, TP5, TP6	3		Terminal, Turret, TH, Double	1502-2	Keystone
TP8, TP9, TP10	3		Test Point, Miniature, White, TH	5002	Keystone Electronics
TP11	1		Test Point, Miniature, Black, TH	5001	Keystone Electronics
U1	1		LMR36503/06-Q1 Wide Input 60V Synchronous, DC-DC Buck Converter, RPE0009A (VQFN-9)	LMR36503MSCQPERQ0	Texas Instruments
FID1, FID2, FID3, FID4, FID5, FID6	6		Fiducial mark. There is nothing to buy or mount.		



## **5 Additional Information**

### **5.1 Trademarks**

All trademarks are the property of their respective owners.

## 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](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。

<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

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.

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1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
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。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

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ンスツルメンツ株式会社

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](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page)

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#### 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.
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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.

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