EVM User's Guide: REF54EVM

REF54 Evaluation Module

Description

The REF54EVM is a precision voltage reference evaluation module that demonstrates the performance of high precision series reference device (REF54) from Texas Instruments (TI). The REF54 is a family of high precision, low drift, low current consumption series voltage reference devices. The REF54 family offers low temperature drift coefficient (0.5 ppm/°C), low flicker noise (0.16 ppm p-p with 100uF capacitor on NR pin) and high accuracy (±0.02%),while consuming 260 µA current.

Get Started

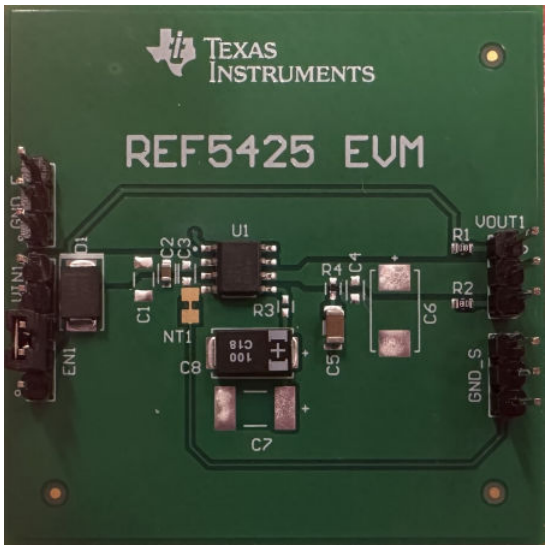
1. Order the EVM at ti.com.
2. Configure EVM jumpers (if required).
3. Connect VIN and EN (optional) to power supplies.
4. Test the output.

Features

- Enable and disable the output
- Capacitor at NR pin is configurable with 0 ohm resistor to optimize the noise performance

Applications

- Semiconductor test equipment
- Precision data acquisition systems
- Precision weight scales
- Ultrasound scanner
- X-ray systems
- Industrial instrumentation
- PLC analog I/O modules
- Field transmitters
- Power monitoring
- Battery management system



REF54EVM Board

1 Evaluation Module Overview

1.1 Introduction

The REF54EVM is a series voltage reference evaluation module that demonstrates the REF54 performance in SOIC package. The REF54 with low long-term drift (30 ppm), excellent load and line regulation helps meet strict performance requirements of high precision applications. This device also comes with a enable pin (EN) that allows the device to be set in shutdown mode to improve power efficency.

This user's guide describes the characteristics, operation, and recommended use cases of the REF54EVM. This document provides examples and instructions on how to use the REF54EVM board. Throughout this document, the terms evaluation board, evaluation module, and EVM are synonymous with the REF54EVM. This document also includes a schematic, reference printed circuit board (PCB) layouts, and a complete bill of materials (BOM).

1.2 Kit Contents

Table 1-1 details the content of the EVM kit. Contact the TI Product Information Center at (972) 644-5580 if any component is missing.

Table 1-1. Kit List

Item	Quantity
REF54EVM	1

1.3 Device Information

The documents in Table 1-2 provide information regarding Texas Instruments integrated circuits used in the assembly of the REF54EVM. This user's guide is available from the TI web site under literature number SNAU289. Any letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this document. Newer revisions are available from the TI web site at www.ti.com, or call Evaluation Module the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center at (972) 644-5580. When ordering, identify the document by both title and literature number.

Table 1-2. Related Device Documentation

Item	Literature Number
REF54250CDR product data sheet	SNAS837

2 Hardware

2.1 Setup

Schematic shown in Figure 2-1 is representative of the REF54EVM.

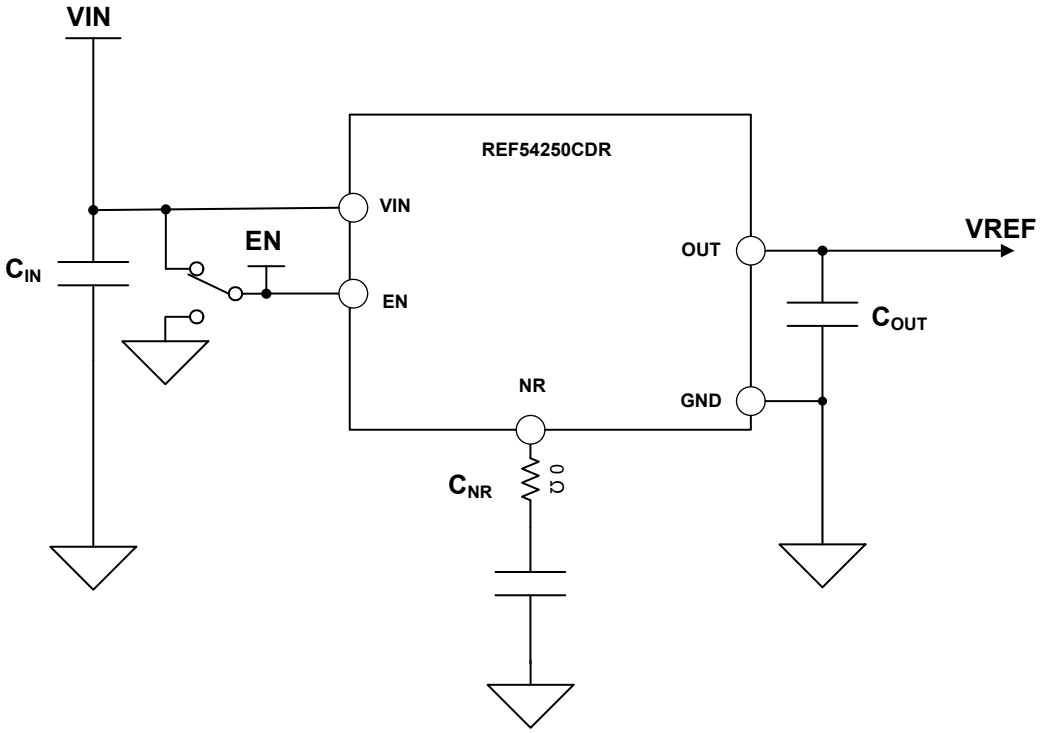


Figure 2-1. REF54 EVM Setup

The REF54EVM is designed to allow users to evaluate the configuration shown in Figure 2-1. Multiple footprints are provided for passive input, output and NR pin capacitors, so that the user can change the passive components for best performance in the application. Enable can be connected to individual voltage source, VIN or ground with jumper settings to enable or disable the device.

2.2 EVM Connection

The headers of REF54EVM are named similar to pin name of REF54250CDR for easy understanding. Default EVM setup is shown in Figure 2-2. Input power supply must be connected between VIN1 and GND1 header. Pin 2 of EN1 header can be connected to power supply directly or pin 1 of EN1 header to enable the device. The user can also leave EN1 header floating to enable the output. PIN 2 of EN is connected to PIN 3 to disable the device. Output is measured between pin 2 of VOUT1 header and GND_S header. The user can connect R3 to get lower noise output with NR pin. Please refer to the REF54 data sheet for more details on NR pin.

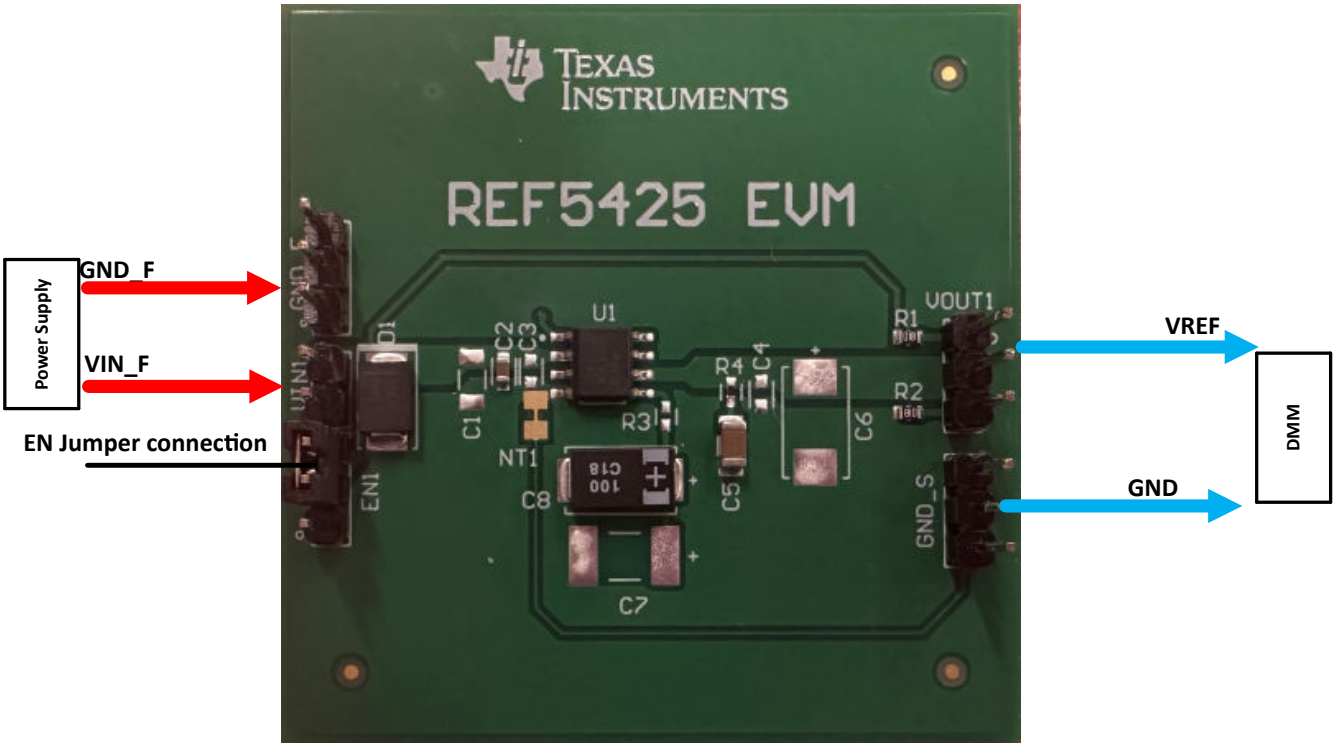


Figure 2-2. REF54EVM Default Setup

Table 2-1 lists the detailed function of VIN1 and EN1 header.

Table 2-1. REF54 EVM Input Connection

Terminal	Pin Connection	Function
VIN1	VIN	Connect to power supply.
EN1	EN	Connect jumper between pin 2 and 3 to enable the output Connect Jumper between pin 2 and 1 to disable the output

2.3 Jumper Information

REF54EVM can be configured to enable or disable the output through jumpers ate EN1 header..

Table 2-2. REF54 EVM Input connection

Terminal	Pin Connection	Jumper Function
EN	EN	Connect jumper between pin 2 and 3 to enable the output Connect Jumper between pin 2 and 1 to disable the output

2.4 Best Practices

- Use the power supply which has very good PSRR.
- Measure the output with high resolution instrument (DMM , oscilloscope) for best performance.
- Connect VOUT1 and GND_S pin to data converter EVM for best performance.

3 Implementation Results

3.1 Evaluation Setup

EVM is tested with the conditions listed below.

VIN : Connect the force_high pin of the SMU 2420 at VIN1 pin and Force_low pin at GND_F connector.
VREF : Connect the DMM 3548 A between pin 2 of VOUT1 and GND
Enable test case : Check the output for EN1 floating , connected to GND and connected to VIN through the jumper

3.2 Performance Data and Results

Output voltage of REF54 is measured with dropout conditions meets the initial accuracy and temperature drift spec limit. Device meets line regulation spec and shutdown condition for relevant tests.

4 Hardware Design Files

4.1 Schematics

The schematic for the REF70EVM is illustrated in Figure 3-3

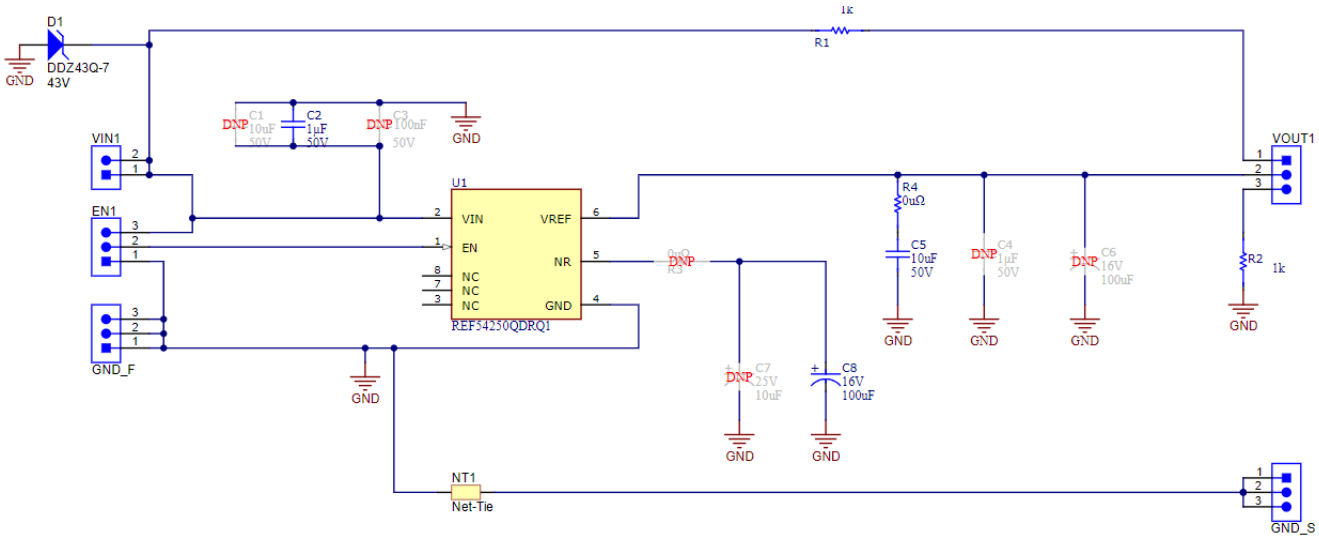


Figure 4-1. REF54 EVM schematic

4.2 PCB Layouts

REF54EVM is a two layer board. The layout is illustrated in this section.

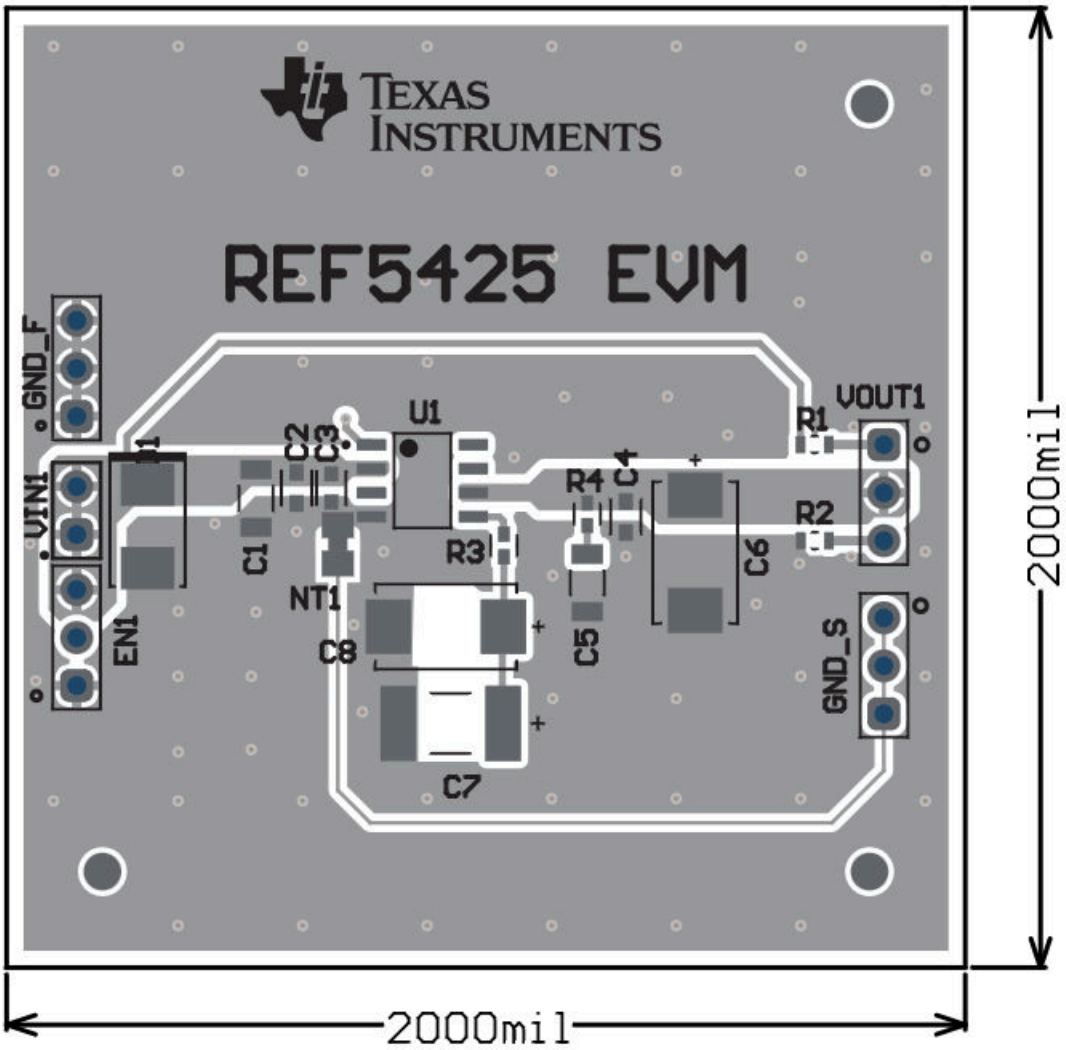


Figure 4-2. REF54EVM Top Layer

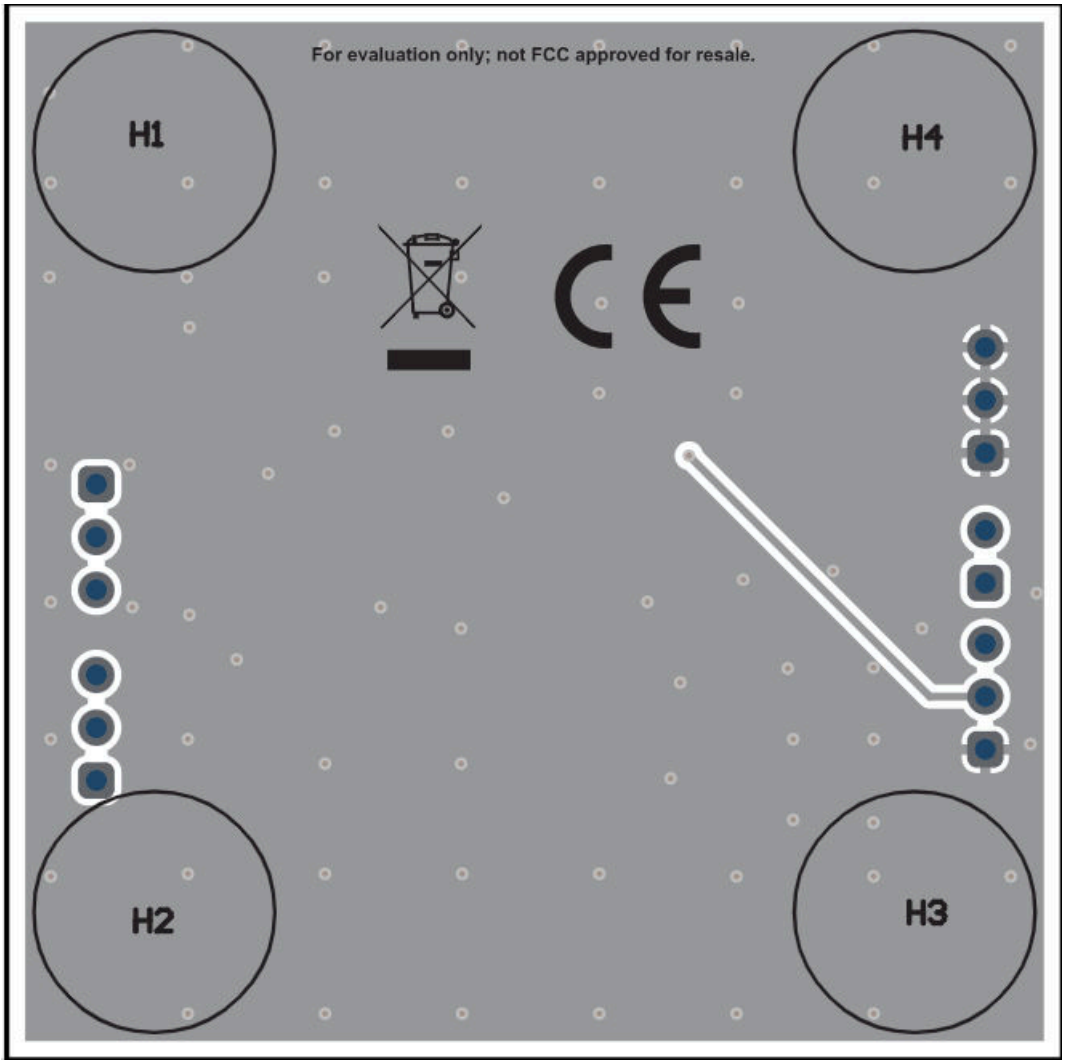


Figure 4-3. REF54EVM Bottom Layer

4.3 Bill of Materials (BOM)

Table 4-1 lists the bill of materials for REF54EVM.

Table 4-1. Bill of Materials

Designator	Qty	Description	Footprint	Package Reference	Part Number	Manufacturer
C1, C5	2	10 µF ±10% 50 V Ceramic Capacitor X7R 1206 (3216 Metric)	FP-GMC31X7R106K50NT_1206-MFG	CMP-0093201-1	GMC31X7R106K50NT	Cal-Chip Electronics
C2, C4	2	1 µF ±10% 50 V Ceramic Capacitor X7R 0603 (1608 Metric)	FP-GMC10X7R105K50NT_0603-MFG	CMP-0095295-1	GMC10X7R105K50NT	Cal-Chip Electronics
C3	1	0.1 µF ±5% 50 V Ceramic Capacitor X7R 0603 (1608 Metric)	FP-06035C104J4Z2A_0603-MFG	CMP-0094511-1	06035C104J4Z2A	KYOCERA AVX
C6, C8	2	100 µF Molded Tantalum Polymer Capacitor 16 V 2917 (7343 Metric) 50mOhm @ 100 kHz	FP-16TDC100MYF_2917-MFG	CMP-0095356-1	16TDC100MYF	Panasonic
C7	1	10 µF Molded Tantalum Capacitors 25 V 0201 (0603 Metric) 1.4Ohm @ 100 kHz	TAZG106K025CRSZ0000-Footprint-1	CMP-0089355-2	TAZG106K025CRSZ0000	AVX
D1	1	Diode, Zener, 43 V, 500 mW, AEC-Q101, SOD-123	SOD-123	CMP-0085174-1	DDZ43Q-7	Diodes Inc.
EN1, GND_F, GND_S, VOUT1	4	Header, 100mil, 3x1, Gold, TH	TSW-103-07-G-S	CMP-0075407-2	TSW-103-07-G-S	Samtec
FID1, FID2, FID3	3	Fiducial mark. There is nothing to buy or mount.	Fiducial10-20	CMP-0077181-1	N/A	N/A
H1, H2, H3, H4	4	Bumpon, Hemisphere, 0.44 X 0.20, Clear	Bumpon_SJ5003Transparent	CMP-0003620-1	SJ-5303 (CLEAR)	3M
R1, R2	2	1 kOhms ±1% 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Thick Film	FP-CRCW06031K00FKEAC_0603-MFG	CMP-0090742-1	CRCW06031K00FKEAC	Vishay
R3, R4	2	0 Ohms Jumper 0.1W, 1/10W Chip Resistor 0402 (1005 Metric) - Thick Film	FP-CR0402-10W-000T_0402-MFG	CMP-0094948-1	CR0402-10W-000T	Venkel
SH-J1, SH-J2, SH-J3, SH-J4	4	Shunt, 100mil, Flash Gold, Black	SPC02SYAN	CMP-0003642-1	SPC02SYAN	Sullins Connector Solutions
U1	1	0.5 ppm/°C Maximum Drift, 0.1 ppmp-p 1/f Noise, 350 µA current, Precision Voltage Reference	D0008A-MFG	CMP-0095913-1	REF54250QDRQ1	Texas Instruments
VIN1	1	Header, 100mil, 2x1, Gold, TH	TSW-102-07-G-S	CMP-0075405-3	TSW-102-07-G-S	Samtec

5 Compliance Information

5.1 Compliance and Certifications

REF54EVM EU Declaration of Conformity (DoC) for Restricting the Use of Hazardous Substances (RoHS) (SSZQR85).

6 Additional Information

6.1 Trademarks

All trademarks are the property of their respective owners.

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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 DEGREDATION 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*

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

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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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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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4.2 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.

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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.

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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, INDEMITY 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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