EVM User's Guide: THS3470EVM

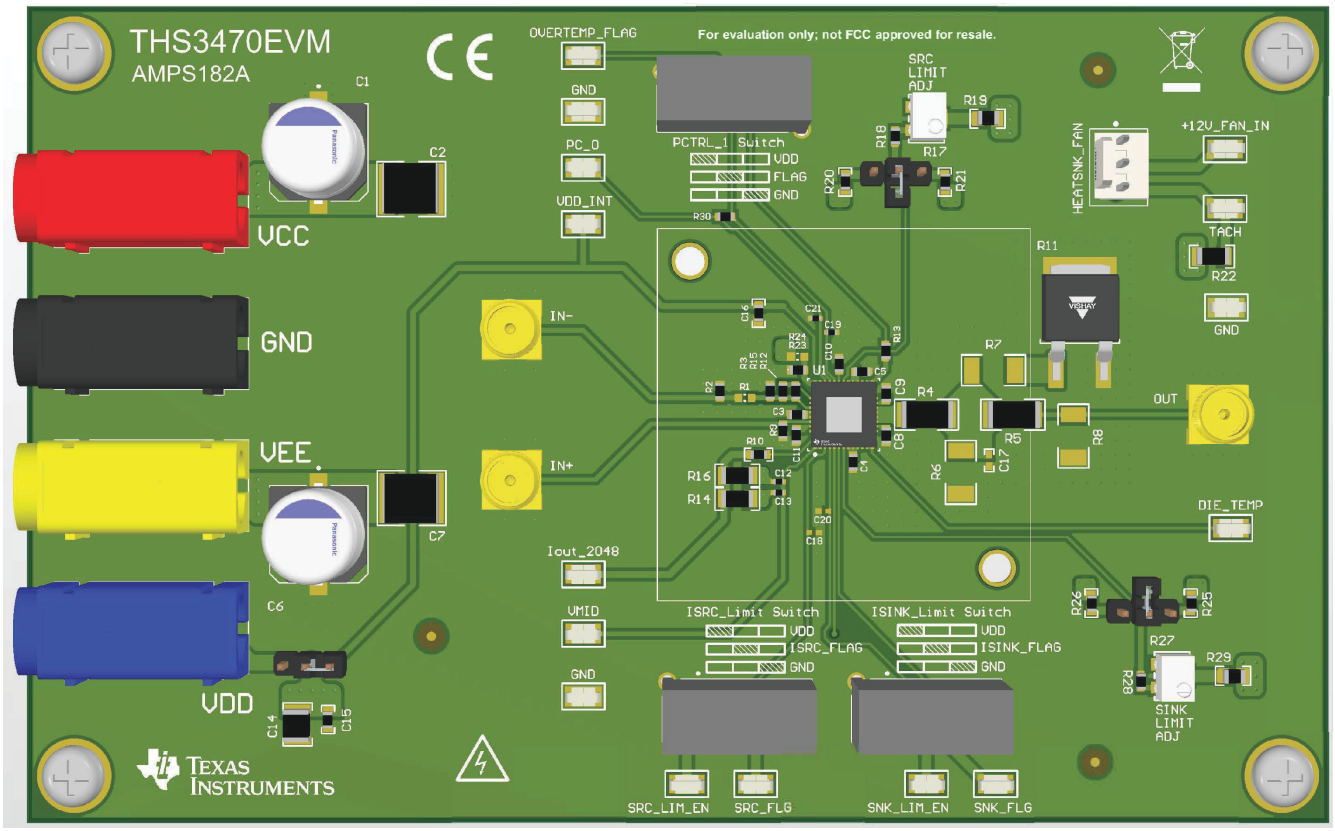
THS3470 Evaluation Module

Description

The THS3470EVM is an evaluation module (EVM) designed for easy measurement and setup of the THS3470 60V, 1A, 100MHz, high-speed power amplifier. The board features instructions to configure input and output connections easily, simple control interfaces for changing the functional modes of the device, and provisions for heat sink and fan connections.

Features

- Easy input and output connections using 50Ohm matched SMA connectors
- Configurable output loading network with optional high power load
- Easy power mode and current limit control with simple switches
- Adjustable current limits with potentiometers
- Provisions for heatink and 3-pin fan connector



THS3470EVM

1 Evaluation Module Overview

1.1 Introduction

The THS3470EVM is an easy-to-use module for evaluating the features and performance of the THS3470 Amplifier. The EVM features easy to use input and output connections as well as configurable loads and gain to simulate many different use case conditions.

This user's guide contains a detailed description on the EVM setup and usage. Each of the device functions are described in detail and a quick start guide is included to make initial setup as easy as possible. The board schematic, layout, and a complete bill of materials (BOM) are also included.

1.2 Kit Contents

Table 1-1 lists the contents of the EVM kit. Contact your nearest Texas Instruments Product Information Center if any component is missing.

Table 1-1. Kit Contents

ITEM	QUANTITY
THS3470EVM test board	1

1.3 Specification

The THS3470EVM is intended to provide basic functional evaluation of the device. The THS3470EVM can be used for AC, DC, or transient measurements. By default, the inputs and outputs are terminated to 50Ohms to provide easy interfacing with 50Ohm based test equipment. The layout is designed to provide configuration flexibility while minimizing parasitics and improving heat dissipation for the best device performance. The EVM includes a heat sink with a fan installed for best cooling performance under heavy load conditions. No external software or boards are required to operate or interface with the board.

1.4 Device Information

The THS3470 is a high-speed current-feedback amplifier (CFA) with a high linear-output current drive (1A), high slew rate (4000V/µs), and wide supply range (60V). The device is stable over a wide range of capacitive loads and supports up to 2A of peak output current that these applications require. The THS3470 has a bandwidth of 100MHz with low-noise and distortion providing great large-signal performance for heavy resistive loads as well.

In addition to high speed and power performance, the THS3470 features a number of useful features such as temperature monitoring, output current monitoring, output current limiting, and output current protection. The output current features of the device can be manually enabled or driven by various flag outputs from the device providing even greater modularity in the use case of the device.

2 Configuration Details

2.1 Heat Sink Usage

The THS3470 package is designed for a top-side heat sink to help dissipate heat under high-power load conditions. Many types of heat sinks can be used with the device, but the THS3470EVM includes the FSP40-25M31-0M06 by Alpha Novatech, Inc. This is a 40 by 40mm aluminum heat sink with 25mm tall fins and included 30 by 30mm 10,000 rpm 12V fan. All heat sinks must also include a low thermal resistance interface material between the heat sink and top-side thermal pad of the THS3470. The EVM includes a standard 3-pin header J9 to connect the heat sink fan to a power supply. The supply voltage for the fan must be provided externally using test point TP12. For the included heat sink the fan power supply voltage is 12V.

When using a heat sink that is larger than the area of the THS3470 device, any additional components under the area of the heat sink must have a height less than 1mm so that the components do not interfere with the contact between the heat sink and THS3470 package. Additionally, if the heat sink is not electrically insulative, put an electrically insulative covering on the bottom of the heat sink in all areas that do not contact the THS3470. The additional insluative coating is to protect against any accidental contact with heat sink or other component causing an electrical connection to the top-side thermal pad of the THS3470, which is biased to the negative supply voltage. A simple insulative coating can be achieved using Kapton® tape to cover the bottom of the heat sink where the heat sink does not contact the THS3470.

2.2 Power Connections

Ths THS3470EVM includes four separate power connections. VCC for the positive supply to the device, VEE for the negative supply to the device, GND to connect the board ground, and an optional VDD connection to set the digital logic high level for the control signals. The typical power configuration is a split supply with a range of VCC/VEE = +12V/-12V to VCC/VEE = +30V/-30V. The VDD jack is disconnected by default as the board logic reference is connected to the parts internal VDD supply. To connect to an external VDD, move the jumper to short pins 1 and 2 of J4. The board can also be operated in single-supply with VEE = GND, but be aware that many of the components to the board are terminated to ground which can introduce a DC load in single-supply conditions.

2.3 Input and Output Connections

The THS3470EVM features a simple input network with a 50Ω terminated connection on the positive amplifier input (J7). By default, the feedback network is connected in a non-inverting gain of approximately 5V/V. The amplifier can be driven in an inverting configuration through the input J6 by populating R1 and reconfiguring the gain as needed.

The default output of the THS3470EVM includes a simple series 5.1Ω isolation resistor R4 located close to the device output along with a 44.2Ω series output resistor R2 to provide a 50Ω matched impedance from the output connector J8. The output also includes an optional high power load through R11, which is a 10Ω 25W resistor by default. To connect R11, short the unpopulated jumper resistor R7. Additional unpopulated loads to ground R6, C17, and R8 are provided for use as needed.

WARNING

Driving very high output voltage DC or slow transient signals into a resistive load does have potential to damage the device. Please use caution to maintain the device operation within the safe-operating region.

2.4 Output Current Limits

The THS3470 features both a sinking and sourcing output current limit function. The current limit values are set by the ISRC_LIMIT_2048 (pin 28) and ISINK_LIMIT_2048 (pin 7) pins with a resistor. The default EVM configuration features a resistor and potentiometer to adjust the limit and can be altered to change the total limit range as desired. Table 2-1 describes the relationship to properly set the current limits using the EVM resistors.

Table 2-1. THS3470 Current Limit Settings

Current Limit	Pin Number	Current Limit Equation	EVM Resistors
Sourcing	28	ILIMIT = [(VSMID – VEE)/RISRC] * 2048	RISRC = R18 + R19
Sinking	7	ILIMIT = [(VCC – VSMID)/RISNK] * 2048	RISNK = R28 + R29

Alternatively, to using the potentiometers, the limits can be shorted to resistors using jumpers J10 and J11 for quick switching between different values. If users are using this method, then R18 and R28 needs to be removed.

The current limiting function is enabled by setting pin 3 low for the source limit or pin 4 low for the sink limit. The EVM includes switches S1 and S2 to control the current limit enable function. The switches can be set to GND to enable the limits, VDD to disable the limits, or the the overcurrent source and sink flag voltages to automatically enable the current limit when the flag is tripped.

2.5 Power Control Modes

The THS3470 features two power mode control pins PWR_CTL_0 (pin 31) and PWR_CTL_1 (pin 30) that set the power level of the device. These pins are controlled by switch S3 on the EVM, which can be set three different positions to connect to VDD, ground, or the overtemperature flag pins. Connect to the overtemperature flag (pins 22 and 23) to automatically shut down the device if the device passes the maximum temperature threshold. Table 2-2 shows a truth table of the different power control connections on the EVM.

Table 2-2. THS3470EVM Bias Control Modes

PWR_CTL_1	PWR_CTL_0	Mode
VDD	VDD	Full bias
GND	GND	Power down mode
Overtemp flag	Overtemp flag	Full bias unless the overtemp flag is triggered, then the part shuts down

2.6 Die Temperature and Output Current Readings

The THS3470 also features a die temperature output (pins 12 and 13) and a output current monitor (pin 42). The die temperature produces a voltage output proportional to the internal junction temperature of the device to monitor the change in temperature over load conditions. The output current pin produces a current that is 1/2048 of the actual output current of the device.

3 Quick Start Instructions

The following instructions describe the basic setup procedure to measure simple input and output signals on the THS3470 Evaluation Module.

3.1 Required Equipment for Basic Evaluation

1. Dual output (positive and negative) floating power supply with output up to 60V and approximately 3A.
   - Two channels or supplies can be used in series to achieve higher voltage. For more information, see Section 3.3.
   - Output current requirements depends on the device load and signal voltages.
2. Voltage source or function generator to create input voltage signal.
3. Multimeter to measure DC output voltages or oscilloscope to measure AC output voltages.
4. *Optional*: Additional +12V power supply to power heat sink fan.

Figure 3-1 shows a typical setup using the THS3470 EVM, a dual output power supply, function generator, and oscilloscope.

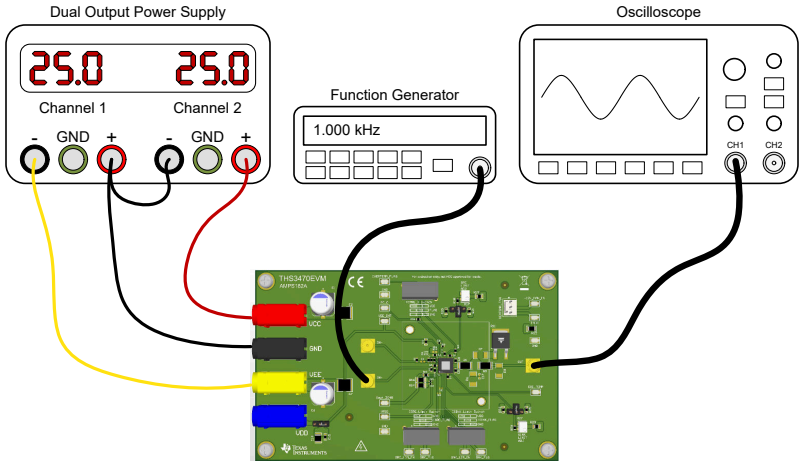


Figure 3-1. Example Configuration Diagram

3.2 Steps for Standard AC or DC Evaluation

1. Configure the power supply output to generate a voltage between ±6V to ±30V. A value such as ±25V is suggested to use for basic evaluation.
2. With the power supply output off, connect the positive output to the EVM VCC input, the negative output to the EVM VEE input, and the common ground point to the EVM GND input.
3. Make sure the power control switch is set to either the VDD or FLAG position.
4. Turn on the power supply. The power supply current reads approximately 30mA. The current value changes slightly depending on the supply voltage.
5. Provide either an AC or DC 10mV input signal to the IN+ SMA connector on the EVM.
6. Connect a multimeter to the OUT SMA connector when using a DC input signal OR connect an oscilloscope to the OUT SMA connector when using an AC input signal.
7. The output voltage reads approximately 50mV.
8. Increase or decrease the input voltage as desired.

WARNING

If using a load that causes the part to output a large amount of current, then increasing the input voltage can result in a significant amount of device heating. When driving significant amounts of output current, have a heat sink installed or the device can be damaged easily. TI recommends to always use a heat sink to avoid accidental device damage.

Table 3-1 shows a list of simple DC input and output measurements for the standard EVM configuration as shown in Figure 4-1.

Table 3-1. THS3470 EVM DC Input and Output Measurements

Input Voltage (V)	Output Voltage (V)
-4	-20.0
-2	-9.98
-1	-4.99
-0.5	-2.51
-0.1	-0.51
0.1	0.48
0.5	2.48
1	4.96
2	9.95
4	19.9

3.3 Using Multiple Power Supplies

Using two separate power supplies or both channels of a two-channel power supply to generate a higher power supply voltage can be necessary. Figure 3-1 shows an example of this configuration using a two-channel power supply to generate 50V total. For this type of configuration, the power supply outputs MUST be floating. The outputs are then connected in series with the midpoint of the two supplies forming the common ground point for the EVM. Connecting the mid-point to the earth ground reference of the power supply if present is not a requirement.

3.4 TI Evaluation Setup Images

Figure 3-2 and Figure 3-3 show example measurement setup's for both DC and AC measurements using the THS3470 EVM.

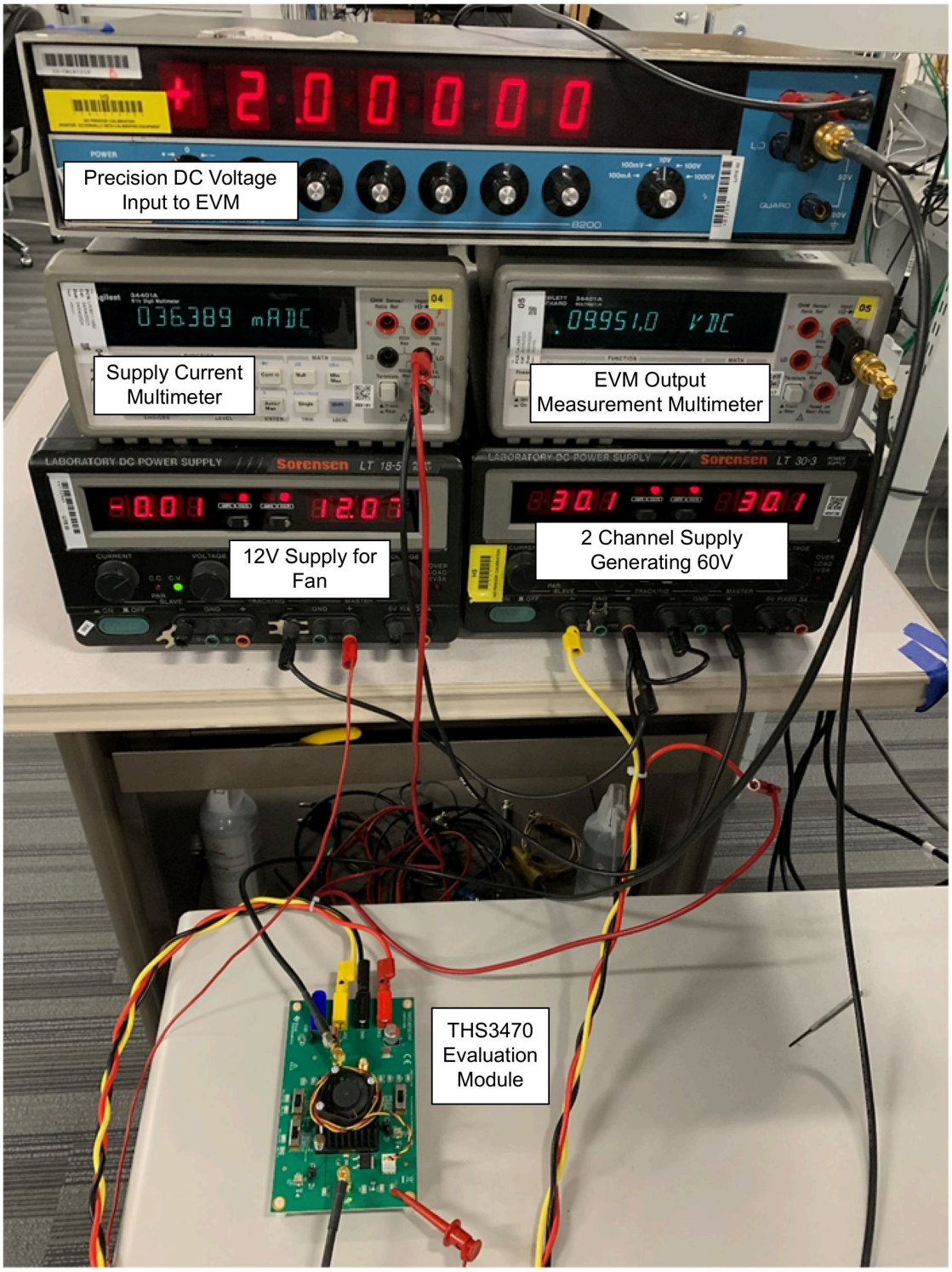


Figure 3-2. DC Measurement Setup

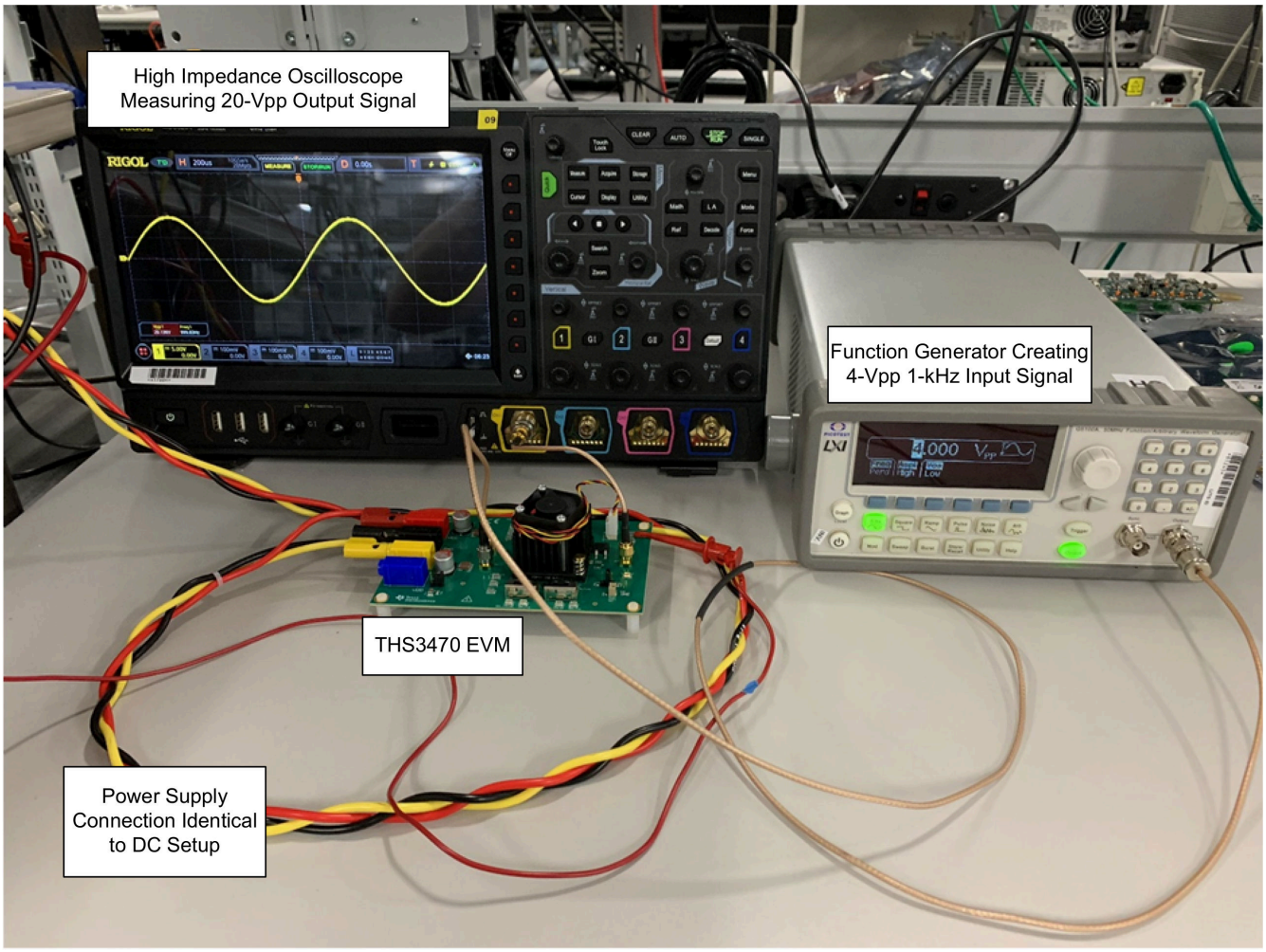


Figure 3-3. AC Measurement Setup

4 Hardware Design Files

4.1 Schematics

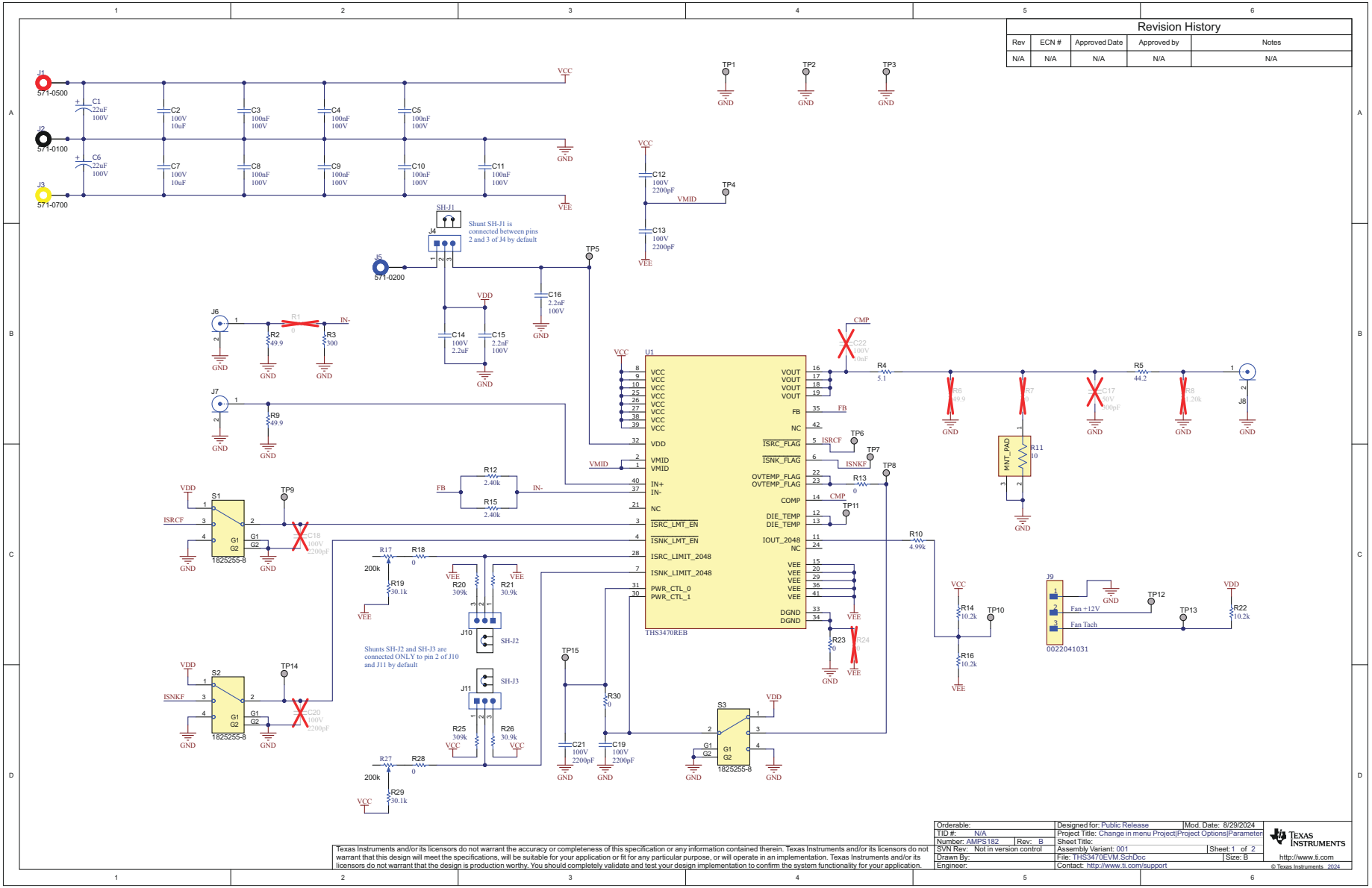


Figure 4-1. THS3470EVM Schematic

4.2 PCB Layouts

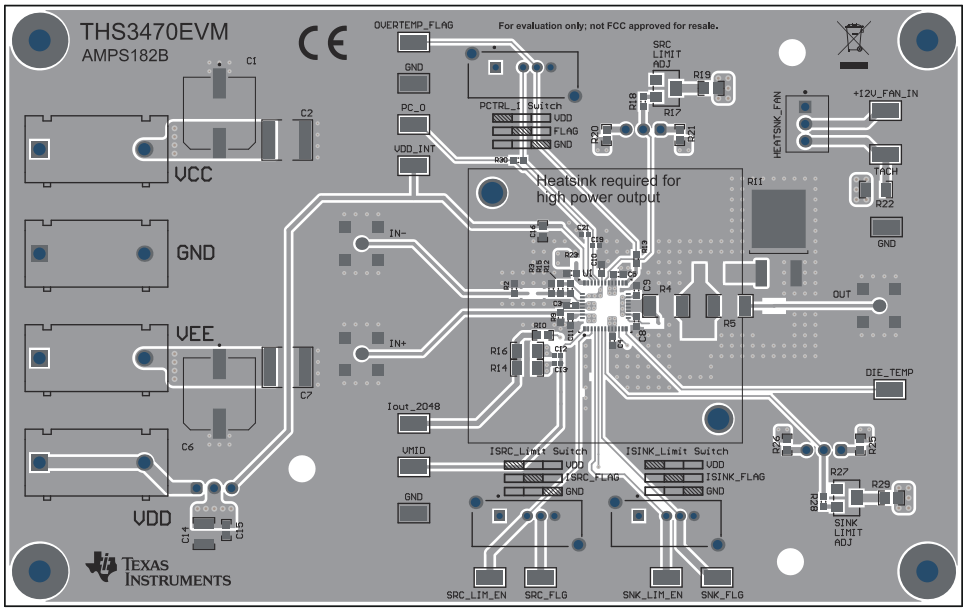


Figure 4-2. THS3470EVM Top Layers

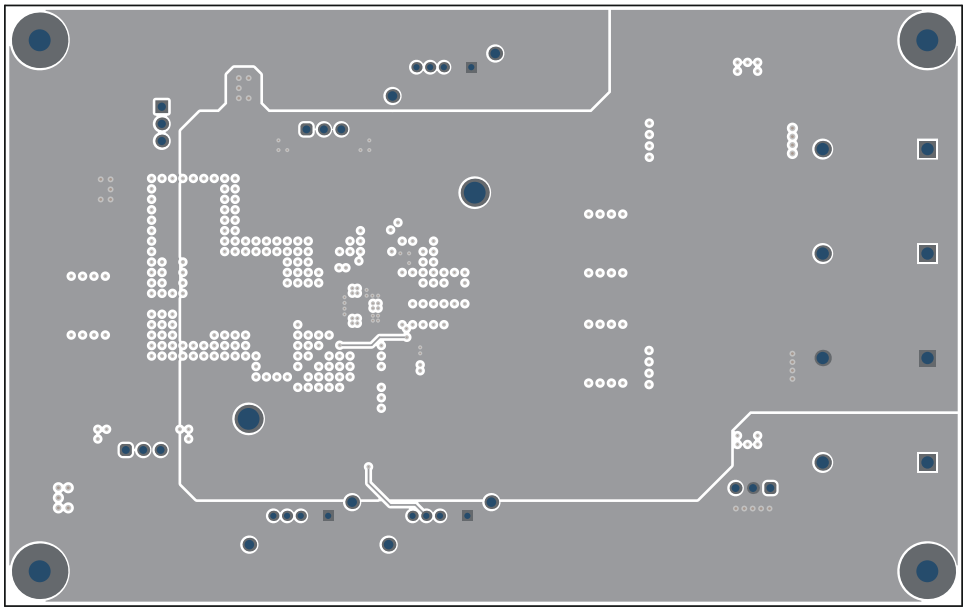


Figure 4-3. THS3470EVM Bottom Layers

4.3 Bill of Materials (BOM)

Table 4-1. Bill of Materials

Designator	Quantity	Value	Description	Part Number	Manufacturer	Package Reference
C1, C6	2	22µF	22µF 100V Aluminum - Polymer Capacitors Radial, Can - SMD 30mOhm 1000 Hrs at 125°C	100SXV22M	Panasonic	RADIAL
C2, C7	2	10uF	CAP, CERM, 10uF, 100V, +/- 20%, X7S,	C5750X7S2A106M230KB	TDK	
C3, C4, C5, C8, C9, C10, C11	7	0.1uF	CAP, CERM, 0.1µF, VAC/100 VDC,+/- 20%, X7R, AEC-Q200 Grade 1, 0603	HMK107B7104MAHT	Taiyo Yuden	0603
C12, C13, C19, C21	4	2200pF	CAP, CERM, 2200pF, 100V, +/- 10%, X7R, 0402	GRM155R72A222KA01D	MuRata	0402
C14	1	2.2uF	CAP, CERM, 2.2uF, 100V, +/- 10%, X7R, 1210	GRM32ER72A225KA35L	MuRata	1210
C15, C16	2	2200pF	CAP, CERM, 2200pF, 100V, +/- 10%, X7R, 0603	06031C222KAT2A	AVX	0603
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	Screw
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	1902C	Keystone	Standoff
J1	1		Standard Banana Jack, insulated, 10A, red	571-0500	DEM Manufacturing	571-0500
J2	1		Standard Banana Jack, insulated, 10A, black	571-0100	DEM Manufacturing	571-0100
J3	1		Standard Banana Jack, insulated, 10A, yellow	571-0700	DEM Manufacturing	571-0700
J4, J10, J11	3		Header, 2.54mm, 3x1, Gold, TH	61300311121	Wurth Elektronik	Header, 2.54mm, 3x1, TH
J5	1		Standard Banana Jack, insulated, 10A, blue	571-0200	DEM Manufacturing	571-0200
J6, J7, J8	3		Connector, SMA Jack, Vertical, Gold, SMD	142-0711-201	Cinch Connectivity	SMA
J9	1		Mini-Latch / KK Wire-to-Board Header, Vertical, with Friction Ramp, 3 Circuits, Tin (Sn) Plating, Natural	22041031	Molex	HDR3
R2, R9	2	49.9	RES, 49.9, 1%, 0.1 W, 0603	RC0603FR-0749R9L	Yageo	0603
R3	1	300	RES, 300, 1%, 0.1 W, 0603	RC0603FR-07300RL	Yageo	0603
R4	1	5.1	RES, 5.1, 5%, 0.75 W, AEC-Q200 Grade 0, 2010	CRCW20105R10JNEF	Vishay-Dale	2010
R5	1	44.2	RES, 44.2, 1%, 0.75 W, AEC-Q200 Grade 0, 2010	CRCW201044R2FKEF	Vishay-Dale	2010
R10	1	4.99k	RES, 4.99 k, 1%, 0.1 W, 0603	RC0603FR-074K99L	Yageo	0603
R11	1	10	10 Ohms ±5% 25W Chip Resistor TO-252-3, DPak (2 Leads + Tab), SC-63 Automotive AEC-Q200, Non-Inductive Thick Film	DTO025C10R00JTE3	Vishay	DPAK
R12, R15	2	2.40k	RES, 2.40 k, 1%, 0.1 W, 0603	RC0603FR-072K4L	Yageo	0603
R13, R18, R23, R28, R30	5	0	RES, 0, 5%, 0.1 W, 0603	RC0603JR-070RL	Yageo	0603
R14, R16, R22	3	10.2k	RES, 10.2 k, 1%, 0.25 W, AEC-Q200 Grade 0, 1206	ERJ-8ENF1022V	Panasonic	1206
R17, R27	2	200k	Trimmer, 200 K, 0.25 W, SMD	3224W-1-204E	Bourns	3.5x5.3x4.8mm
R19, R29	2	30.1k	RES, 30.1 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	ERJ-6ENF3012V	Panasonic	0805
R20, R25	2	309k	RES, 309 k, 1%, 0.1 W, 0603	RC0603FR-07309KL	Yageo	0603
R21, R26	2	30.9k	RES, 30.9 k, 1%, 0.1 W, 0603	RC0603FR-0730K9L	Yageo	0603
S1, S2, S3	3		Switch, Slide, SP3T, 3 Pos, 0.4A, 20 VAC, TH	1825255-8	TE Connectivity	Switch, 4-Leads, SP3T, Body 16x6.7mm, TH
SH-J1, SH-J2, SH-J3	3		Shunt, 2.54mm, Gold, Black	60900213421	Wurth Elektronik	Shunt, 2.54mm, Black

Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	Part Number	Manufacturer	Package Reference
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15	15		Test Point, Miniature, SMT	5019	Keystone	Test Point, Miniature, SMT
U1	1		THS3470REB	THS3470REB	Texas Instruments	VQFN42
C17	0	300pF	CAP, CERM, 300pF, 50V, +/- 2%, C0G/NP0, 0402	GRM1555C1H301GA01D	MuRata	0402
C18, C20	0	2200pF	CAP, CERM, 2200pF, 100V, +/- 10%, X7R, 0402	GRM155R72A222KA01D	MuRata	0402
C22	0	0.01uF	CAP, CERM, 0.01µF, 100V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	GCM188R72A103KA37J	MuRata	0603
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
R1, R24	0	0	RES, 0, 5%, 0.1 W, 0603	RC0603JR-070RL	Yageo	0603
R6	0	49.9	RES, 49.9, 1%, 0.75 W, AEC-Q200 Grade 0, 2010	CRCW201049R9FKEF	Vishay-Dale	2010
R7	0	0	RES, 0, 5%, 0.75 W, AEC-Q200 Grade 0, 2010	CRCW20100000Z0EF	Vishay-Dale	2010
R8	0	1.20k	RES, 1.20 k, 1%, 0.75 W, AEC-Q200 Grade 0, 2010	CRCW20101K20FKEF	Vishay-Dale	2010

5 Additional Information

5.1 Trademarks

Kapton® is a registered trademark of DuPont Electronics, Inc.
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 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*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/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.

【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。

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。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・イ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/lsds/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。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

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.

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.

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, 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.

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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265