LMP8480 / 81 EVM User's Guide

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LMP8480 / 81 EVM User's Guide

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LMP8480 / 81 EVM User's Guide

1. Introduction

The Texas Instruments LMP8480/81 evaluation module (EVM) helps designers quickly evaluate the operation and performance of the LMP8480/81 76V Precision High Side Current Sense Amplifiers. The EVM is ready to connect to power, load, and test instruments through the use of on-board terminals.

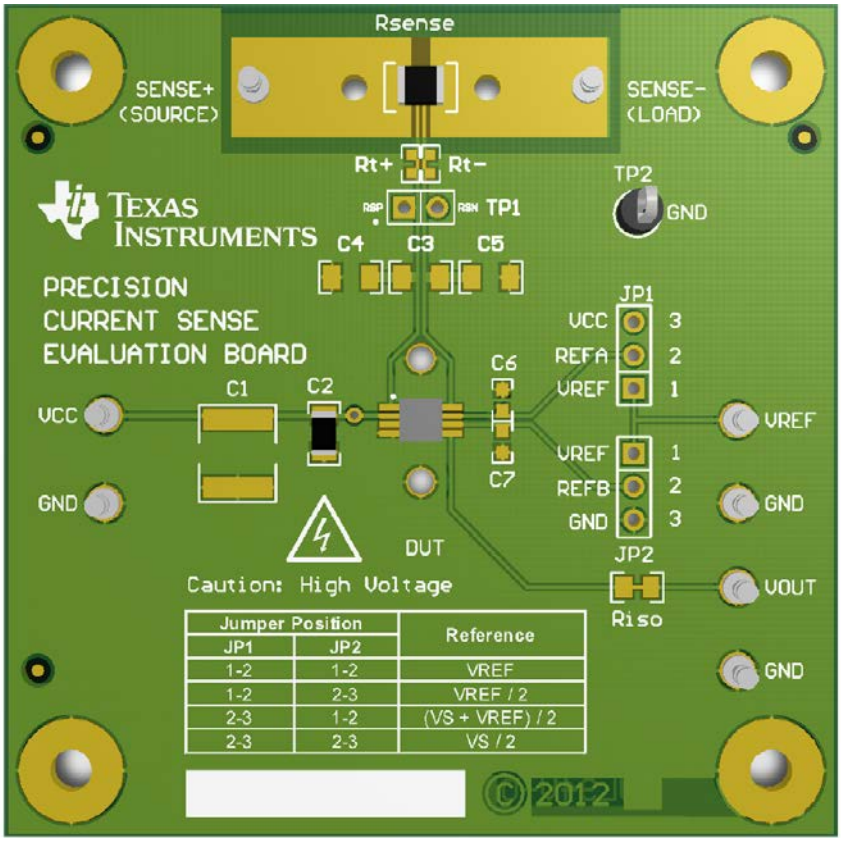

Figure 1: Picture of Evaluation Board (LMP8480 version)

The EVM contains one LMP8480 or LMP8481 high side evaluation circuit. The EVM's come pre-assembled with the LMP8480/81 device, 0.1Ω sense resistor; bypass capacitor and connection terminals installed. The Bi-Directional EVM's include the JP1 and JP2 reference jumpers and terminals.

2. Features

- Selectable reference voltage options through jumpers (LMP8481)
- On-board sense resistor or external resistor
- Optional input EMI/RFI filtering
- Separate DUT and load supplies
- Sense voltage test points
- Optional output isolation resistor

3. Board Connections and Components

This section describes the jumpers and connectors on the EVM as well and how to properly connect, set up the EVM board.

3.1. General Safety Precautions

Connections with 48V or 1A and above should be securely soldered to the terminals to prevent inadvertent disconnection. Voltages above 70V must be soldered. Clip-on leads are not recommended at high voltages. Follow all standard high voltage precautions.

All power should be removed when changing connections, even in the low voltage sections. The use of hand-held probes while powered is not recommended. Connections should be hard wired.

3.2. Power Supply Input - VCC

The device power supply is connected to the VCC and GND pins. Positions for 4.7uF (optional) and 0.1uF ceramic bypass capacitors are provided on the VCC lines. Note that these capacitors should be rated for 100V or more. EVM supply voltage is limited to 75V max.

3.3. Current Sense Resistor and Sense Terminals - RSP and RSN

The large current sense resistor pads allow for multiple mounting configurations of both through-hole and surface mount resistors.

WARNING: The area around the sense resistor can get warm. Use caution when handling or probing.

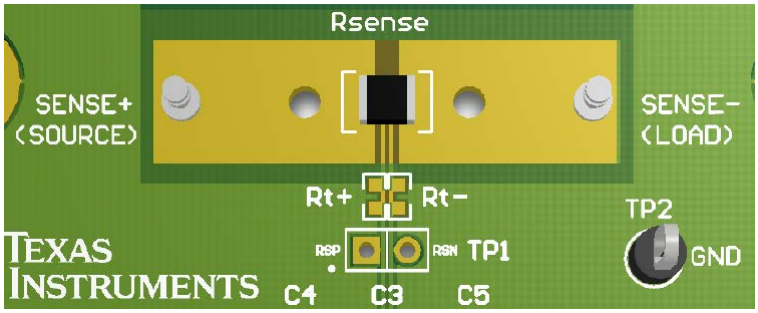

Figure 2: Rsense Terminals

These pads are bare copper to allow for mounting of any size or shape of resistor, as well as providing heat dissipation. The larger inner holes are for optional pin socket receptacles (see Bill of Materials) to allow easy swapping of through-hole resistors for prototyping.

Customer provided sense resistor power dissipation should be limited to less than 1W. The TI supplied 0.1 Ohm resistor power dissipation must be less than 0.5W. Currents higher than 5A should be soldered directly to the sense pads. Currents above 10A should use an off-board shunt resistor with its own heat sink.

For off-board current sense resistors, the sense lines can be connected to the SENSE+ and SENSE- turret terminals (with on-board sense resistor removed). It is recommended that these wires be twisted to prevent noise pickup and to provide some EMI rejection.

For 4-wire, or “Kelvin” resistors, Figure 2 shows how the sense traces can be cut with an E-Xacto knife to attach to the “sense” terminals on a 4-Wire surface mount resistor.

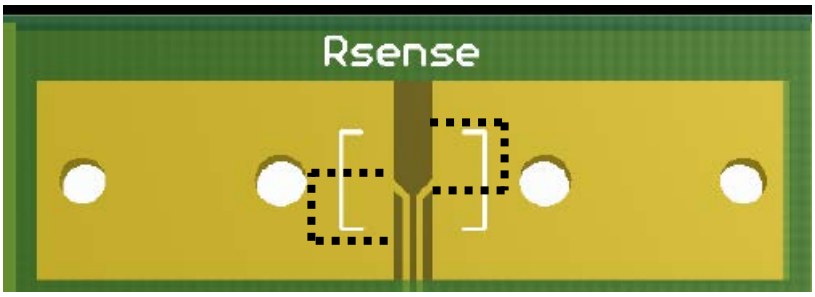

Figure 3: Cutting pads to accommodate 4-wire resistors

Load ground currents should be kept off the board. Load current should be returned directly to the power supply terminals and not through the demo board grounds.

3.4. Optional Input Filtering

The optional Rt+ and Rt- resistor pads are provided to add, in conjunction with C3, C4 and C5, EMI/Noise filtering to the input. These can be series resistors or inductors. To maintain a continuous solid copper path, the Rt pads have shorting traces across them. To use these pads, the shorting traces must be be cut before installing Rt.

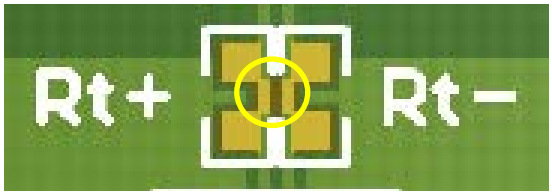

Figure 4: Rt shorting traces must be cut before use

To maintain accuracy, these resistors should be of equal value and well matched, as they are in series with the device’s internal thin-film resistors and will effect the Gain, CMRR and gain accuracy specifications. The values of these resistors should not exceed a few hundred ohms, and should be kept as low as possible.

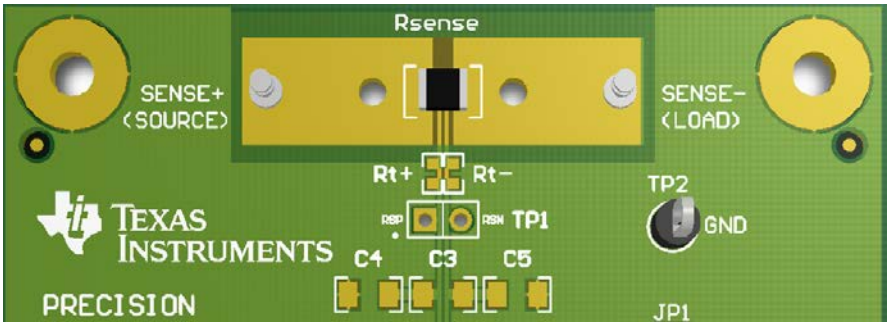

Figure 5: Optional Input Filtering Capacitors

Pads C3, C4 and C5 are provided for optional EMI rejection. For RF/EMI protection, values in the 10 to 100pF range are recommended. For lower frequencies, a lowpass filter can be formed with the Rt series input resistors.

3.5. Reference Inputs (Bi-Directional Devices Only)

For Bi-Directional devices, the “zero” output level can be set by a voltage applied to the reference pins. The reference voltages may be applied externally through the VREF pin, or sourced from the VCC line. ***These jumpers will have no effect on devices without reference pins!!!***

C6 and C7 are available if reference line bypassing or filtering is desired.

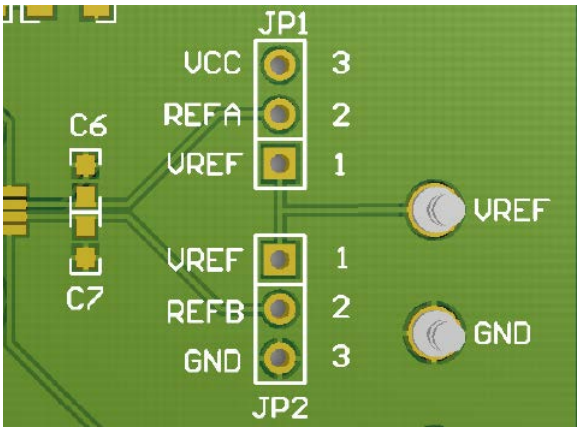

Figure 6: Reference Jumper Pins

Table 1 below shows the jumper positions and the input configuration.

Jumper Position		Reference
JP1	JP2	
1-2	1-2	VREF
1-2	2-3	VREF / 2
2-3	1-2	(VS + VREF) / 2
2-3	2-3	VS / 2

Table 1: Reference Jumper Settings

3.6. Output - VOUT

Similar to the Rt resistors, Riso is available for output isolation when driving capacitive loads or for output short circuit protection. If the output must drive large capacitive loads (like a coax cable), Riso may be needed to prevent oscillations. The jumper trace between the pads must be cut to use Riso.

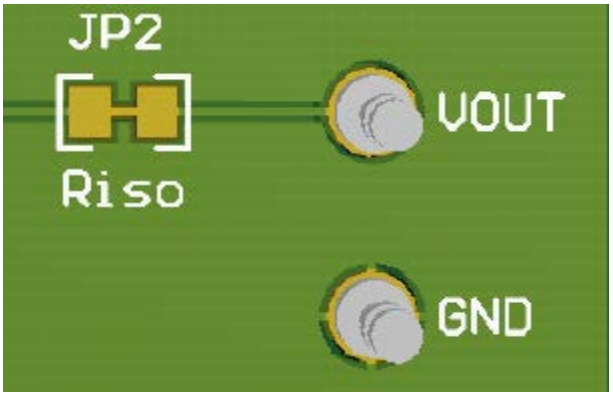

Figure 7: Optional Riso and Shorting Pad

3.7. Input VSENSE Test Point – TP1

TP1 allows for the monitoring of the VSENSE voltage through a standard 0.1” header. TP2 provides a convenient ground if needed. The meters terminals need to be “floating” (not grounded) and will be at the common mode voltage (Vsource) potential.

3.8. DUT Mounting Options

For applications where the DUT must be swapped-out, mounting holes are provided for a reusable “Rainbow Clamp” socket from Rainbow Labs (See Bill of Materials). Otherwise, the DUT may be soldered directly to the pads.

4. Board Test Procedure for Uni-Directional Devices (LMP8480-S)

Required Equipment:

- 1 ea. 20V, >1A power supply
- 2 ea. 4.5 digit or better DMM (Agilent 34401 or equiv)
- 1 ea. 20 ohm, >25W power resistor or programmable load sinking 1A.
- Misc test leads for connections.

Connect board as shown, but do not connect SENSE- to load yet.

1. Connect 20V power supply as VSOURCE (turn off power for now).
2. Connect DMM1 to the output and ground terminals (+ to output, - to GND)
3. Connect DMM2 to the TP1 terminals or sense terminals (+ to RSP, - to RSN)
4. Confirm SENSE- is not connected and turn on power.
5. DMM1 should be between 0V and 5.5mV.
6. Now connect RLOAD to SENSE- as shown.
7. Record reading from DMM1 (should be around 6V for the “S” device)
8. Record reading from DMM2 (should be around 100mV – depending on accuracy of RLOAD)
9. The reading of DMM1 should be within 0.1% of the gain (60 for “S” version) times the DMM2 reading.
10. Turn off Vsource or disconnect RLOAD to prevent excessive heating.

Keep in mind that heating of the load and sense resistors may cause drift between steps 7 and 8. DMM measurements should be taken quickly or simultaneously (use manual trigger function to trigger the readings at the same time).

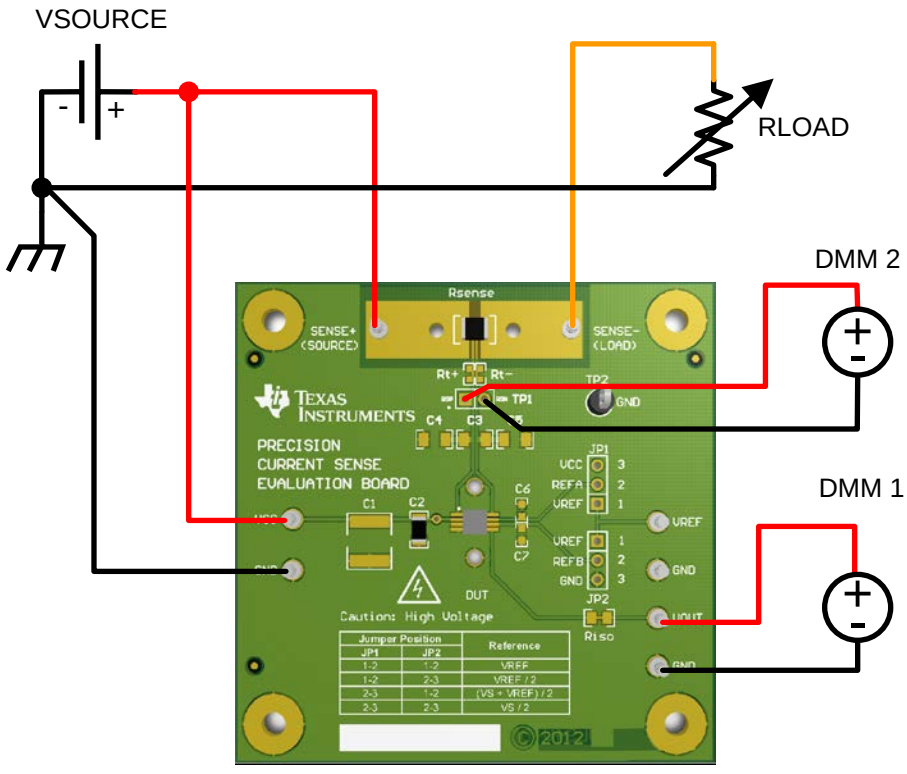

Figure 8: Setup for Uni-Directional Devices

5. Board Test Procedure for Bi-Directional Devices (LMP8481-S)

Required Equipment:

- 1 ea. 10V, >1A power supply
- 2 ea. 4.5 digit or better DMM (Agilent 34401 or equiv)
- 1 ea. 20 ohm, >20W power resistor or programmable load sinking 0.5A.
- 2 ea 0.1" Jumper blocks
- Misc test leads for connections

Connect board as shown, but **do not** connect SENSE- to load yet.

1. Connect 10V power supply as VSOURCE (turn off power for now).
2. Connect DMM1 to the output and ground terminals (+ to output, - to GND)
3. Connect DMM2 to the TP1 terminals or sense terminals (+ to RSP, - to RSN)
4. Place jumpers across JP1 2&3 and JP2 2&3 to set reference to VS/2.
5. Confirm SENSE- (load) is not connected.
6. Turn on power and record DMM1 reading (should be 5V* - this is the VREF voltage).
7. Now connect RLOAD to SENSE- as shown.
8. Record reading from DMM1 (should be around 8V for the "S" device)
9. Record reading from DMM2 (should be around 50mV)
10. The difference in the two readings of DMM1 should be within 0.1% of device gain (60) times the DMM2 reading plus the VREF reading in step 6.
11. Reverse the SENSE+ and SENSE- leads. DMM2 should measure -100mV and the output should be at 3V for the "S" device.
12. Turn off Vsource or disconnect RLOAD to prevent excessive heating.

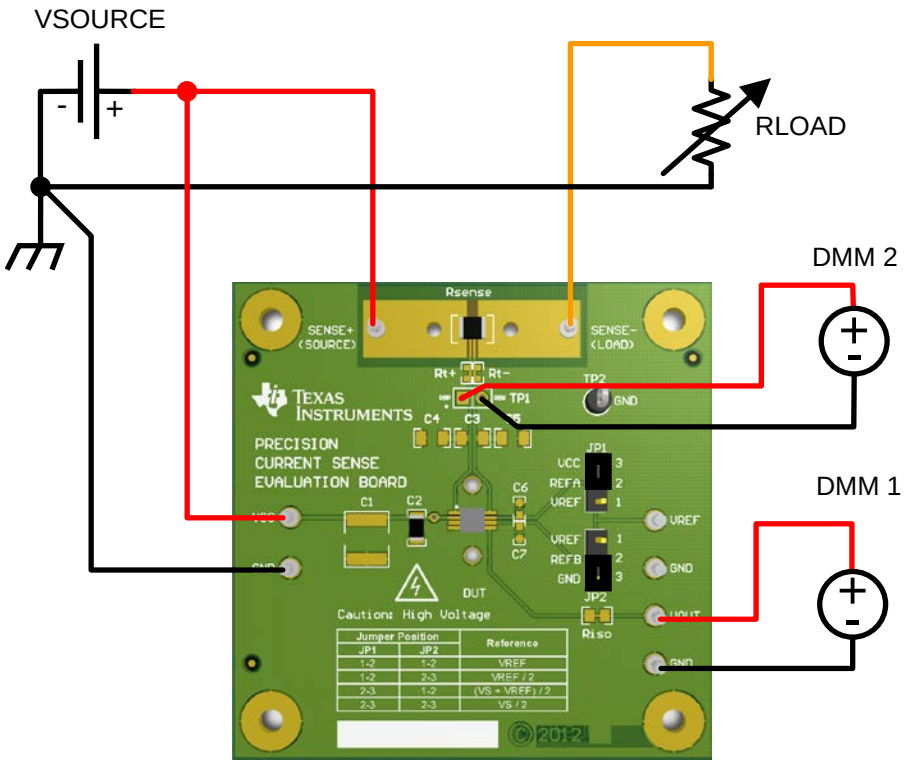

Figure 9: Setup for Bi-Directional Devices

6. Schematic

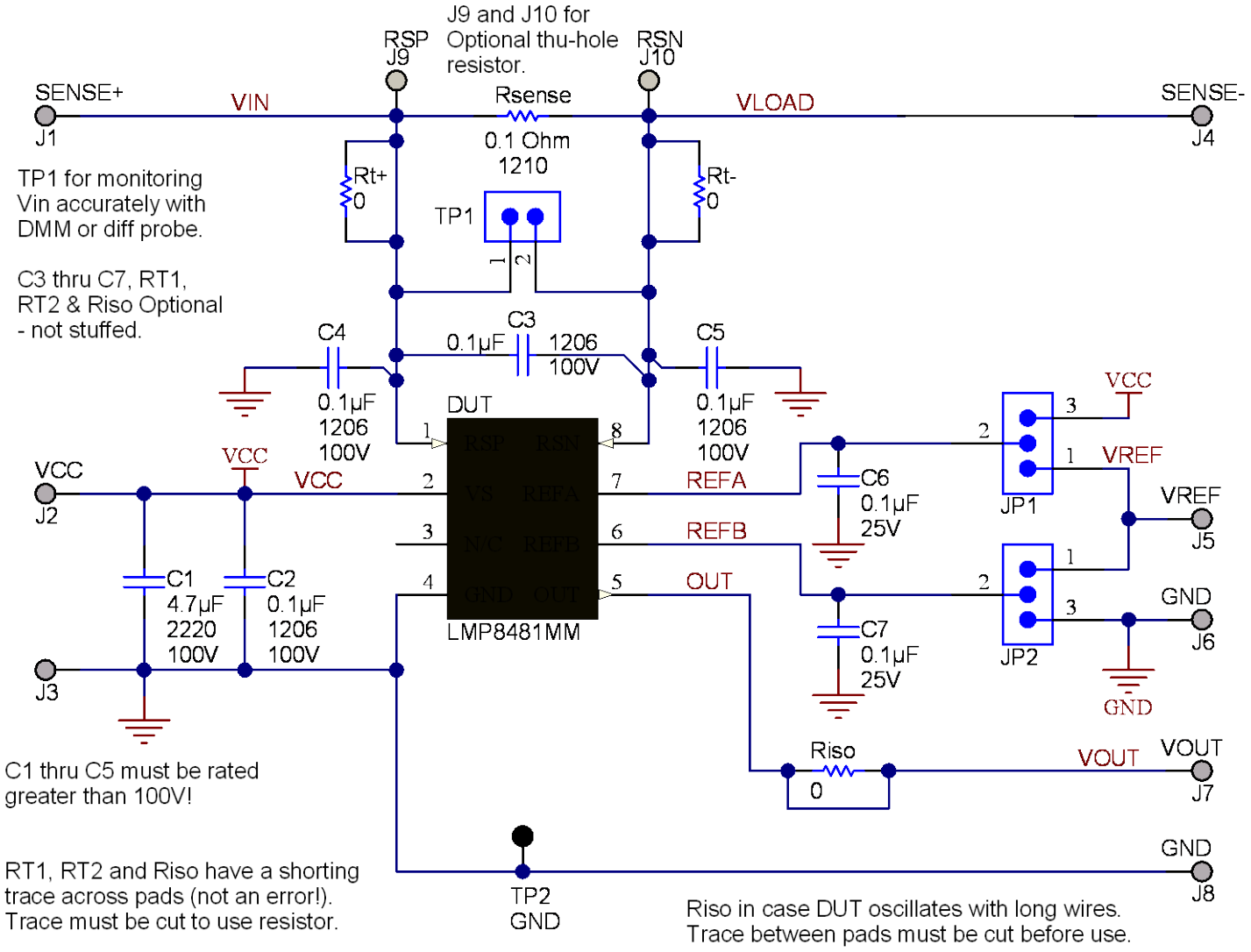

Figure 10: EVM Schematic

7. Bill of Materials

Table 2: Bill of Materials

Designator	Description	Manufacturer	PartNumber
EVB	Current Sense Evaluation Board	Texas Instruments	551600825-001
C1†	CAP, CERM, 4.7uF, 100V, +/-20%, X7R, 2220	TDK	C5750X7R2A475M
C2, C3†, C4†, C5†	CAP, CERM, 0.1uF, 100V, +/-10%, X7R, 1206	TDK	C3216X7R2A104K
C6†, C7†	CAP, CERM, 0.1uF, 25V, +/-10%, X7R, 0603	TDK	C1608X7R1E104K
C8†	CAP, CERM, 1000pF, 100V, +/-5%, C0G/NP0, 0603	TDK	C1608C0G2A102J
DUT1	76V Common Mode, Precision Current Sensing Amplifier, 8-pin MSOP	Texas Instruments	LMP8480MM-x or LMP8481MM-x
H1†, H2†, H3†, H4†	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	B&F Fastener Supply	NY PMS 440 0025 PH
H5†, H6†, H7†, H8†	Standoff, Hex, 0.5"L #4-40 Nylon	Keystone	1902C
J1, J2, J3, J4, J5‡, J6‡, J7, J8	Terminal, Turret, TH, Double	Keystone	1593-2
J9†, J10†	PCB Socket, solderless Pressfit, Large, .032 to .046	Mill-Max	0328-0-15-15-34-27-10-0
JP1‡, JP2‡	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec Inc.	TSW-103-07-G-S
Riso†	RES, 0 ohm, 5%, 0.125W, 0805	Panasonic	ERJ-6GEY0R00V
Rsense	RES, 0.1 ohm, 1%, 0.5W, 1210	IRC	LRC-LR1206LF-01_R100_F
Rt+†, Rt-†	RES, 0 ohm, 5%, 0.1W, 0603	Yageo America	RC0603JR-070RL
TP1†	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec Inc.	TSW-102-07-G-S
TP2	Test Point, TH, Multipurpose, Black	Keystone	5011
SKT†	8-PIN Mini-SO .118W Clamp Socket	Rainbow Technologies	MSO8SD

† User Option – not installed
‡ Installed on devices with reference pins

EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of of 4.0V to +75V; a supply voltage (Vs) range of +4.5V to +75V; and the output voltage range of GND + 0.05V to (Vs – 0.4V or 13.6 – whichever is less). Total dissipation of the TI installed sense resistor shall not exceed 0.5W. Turret terminals are rated for 5A max.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's 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, some circuit components may have case temperatures greater than +25°C. The EVM is designed to operate properly with certain components above +25°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User’s Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

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REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User’s Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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
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
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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant
This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters
This device complies with Industry Canada licence-exempt RSS standard(s). 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.

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Texas Instruments Japan Limited
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EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to 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 use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

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