

TPS40490MHEVM User's Guide

Contents

1	INTRODUCTION	2
2	APPLICATIONS	2
3	FEATURES	2
4	BOARD LAYOUT	3
5	BENCH TEST SETUP CONDITIONS	7
5.1	Connector and Test Point Description	7
5.2	Input Power Supply Jumper – JP1	7
5.3	I ² C Jumpers – JP4, JP5	7
5.4	Synchronization Input – JP6	7
5.5	Jumpers to Set Dead Time – JP7, JP15, JP16	7
5.6	Enable Jumper– JPx	8
5.7	Test Point Descriptions	8
6	TEST SETUP	9
6.1	Equipment	9
6.2	Equipment Setup Procedure	9
6.3	Forced Air Cooling	9
6.4	Start-Up Procedure	9
6.5	Shut-Down Procedure	9
6.6	Efficiency Measurement Procedure	9
6.7	Output Ripple Voltage Measurement Procedure	10
6.8	Switch Node Measurement Procedure	10
7	CURRENT SOURCE OPERATION	11
8	SCHEMATIC AND BILL OF MATERIALS	11

List of Figures

1	Silk-Screen (Top Layer)	3
2	Silk-Screen (Bottom Layer)	3
3	Board Layout (Top Layer).....	4
4	Board Layout (Middle Layer One)	4
5	Board Layout (Middle Layer Two)	5
6	Board Layout (Middle Layer Three)	5
7	Board Layout (Middle Layer Four)	6
8	Board Layout (Bottom Layer).....	6
9	Connector and Test Point Description	7
10	Testing Switch Node	10
11	Current Source Configuration Schematic	11
12	Current Source Configuration.....	11
13	TPS40490MHEVM Schematic.....	12

1 INTRODUCTION

TPS40490MH is designed to be used as a full-featured, synchronous PWM buck controller with an input voltage between 6 V and 60 V. The TPS40490MHEVM is designed to demonstrate the capabilities of the TPS40490MH. TPS40490MH is optimized for high-power density, high-reliability DC/DC converter applications for the latest generation of MOSFET transistors.

2 APPLICATIONS

- Isolated DC-DC modules
- POL module
- Wide input voltage, high-power density DC/DC converters for industrial, networking and telecom equipment
- Notebook and tablet computers
- Envelope tracking systems

3 FEATURES

- 6-V to 60-V wide input voltage rating
- 600-mV reference voltage with 1% Accuracy and external modulation capabilities
- 10-A output current
- Programmable UVLO and hysteresis
- 1-MHz operation and up to 5-MHz switching programmable frequency

Table 1. TPS40490MHEVM Electrical Performance Specifications

PARAMETER		MIN	TYP	MAX	UNITS
V_{IN}	Input voltage	6		60	V
V_{OUT}	Output voltage		12		V
I_{OUT}	Output current	0		10	A
f_{SW}	Switching frequency		2		MHz

4 BOARD LAYOUT

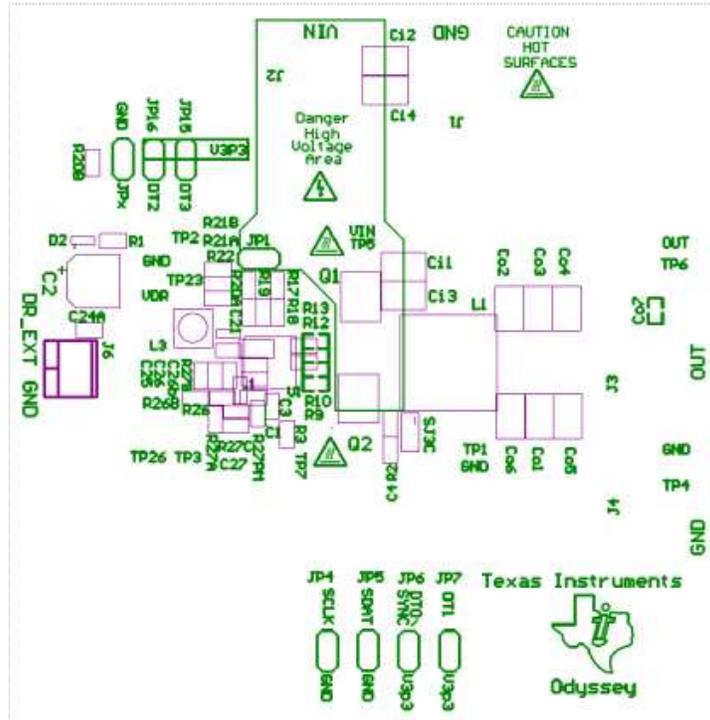


Figure 1. Silk-Screen (Top Layer)

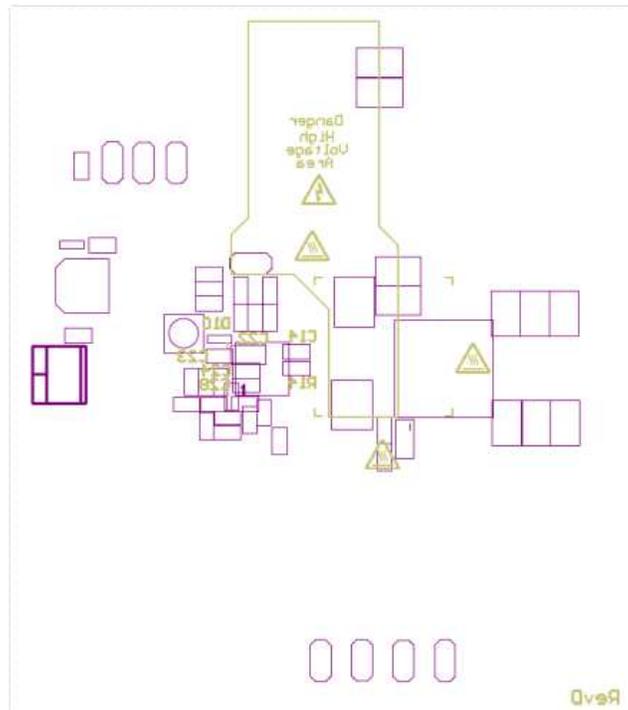


Figure 2. Silk-Screen (Bottom Layer)

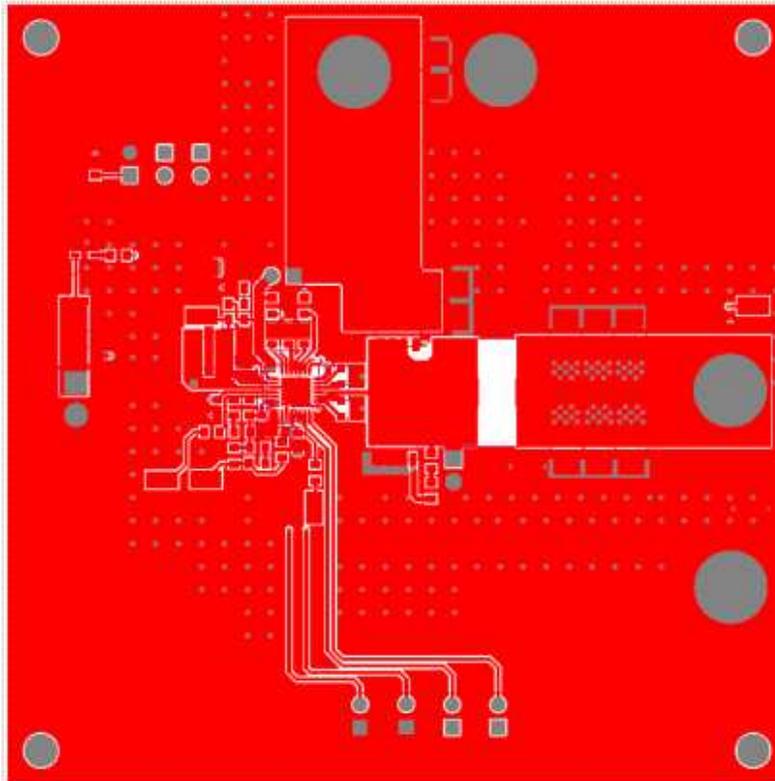


Figure 3. Board Layout (Top Layer)

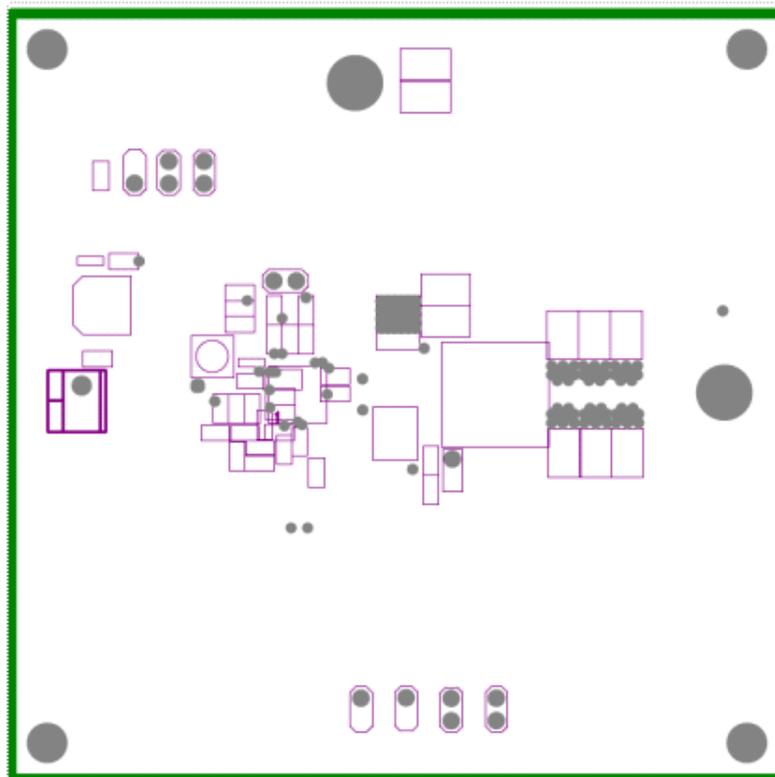


Figure 4. Board Layout (Middle Layer One)

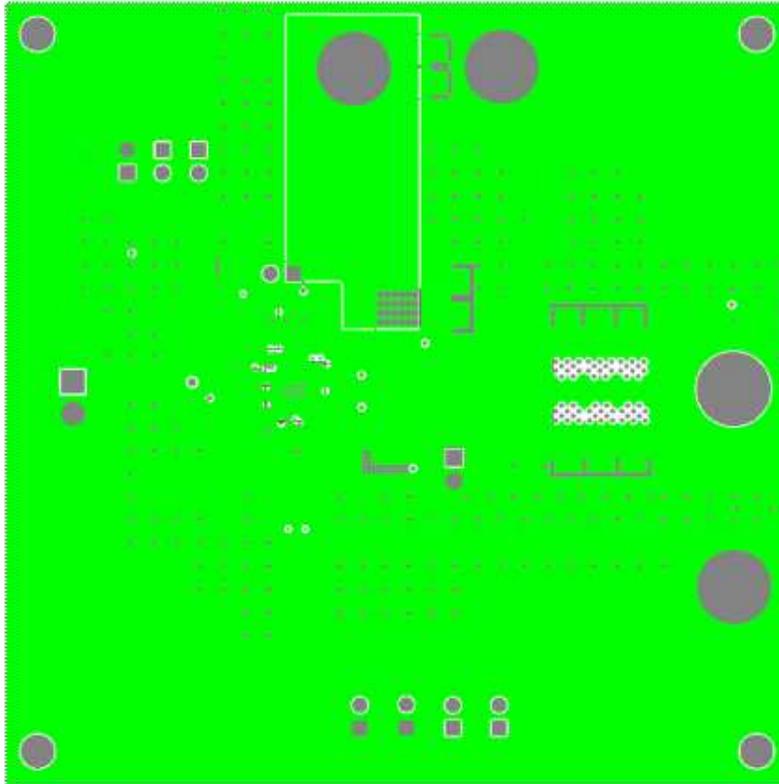


Figure 5. Board Layout (Middle Layer Two)

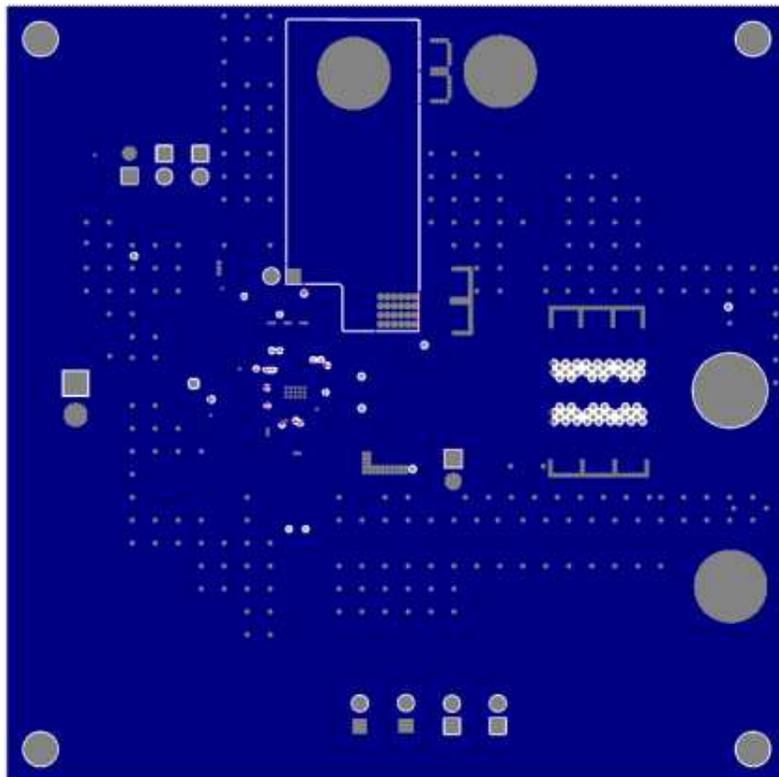


Figure 6. Board Layout (Middle Layer Three)

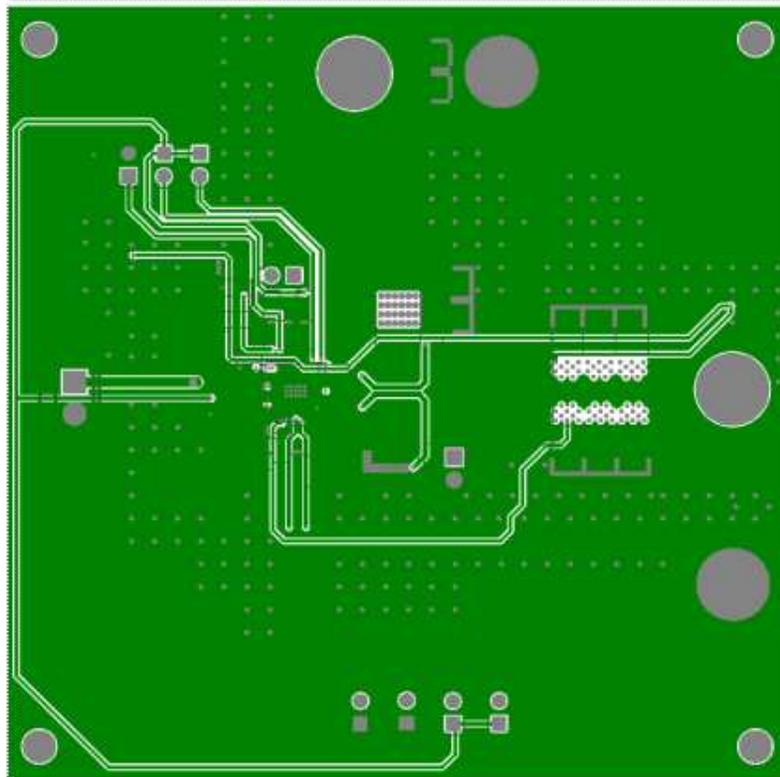


Figure 7. Board Layout (Middle Layer Four)

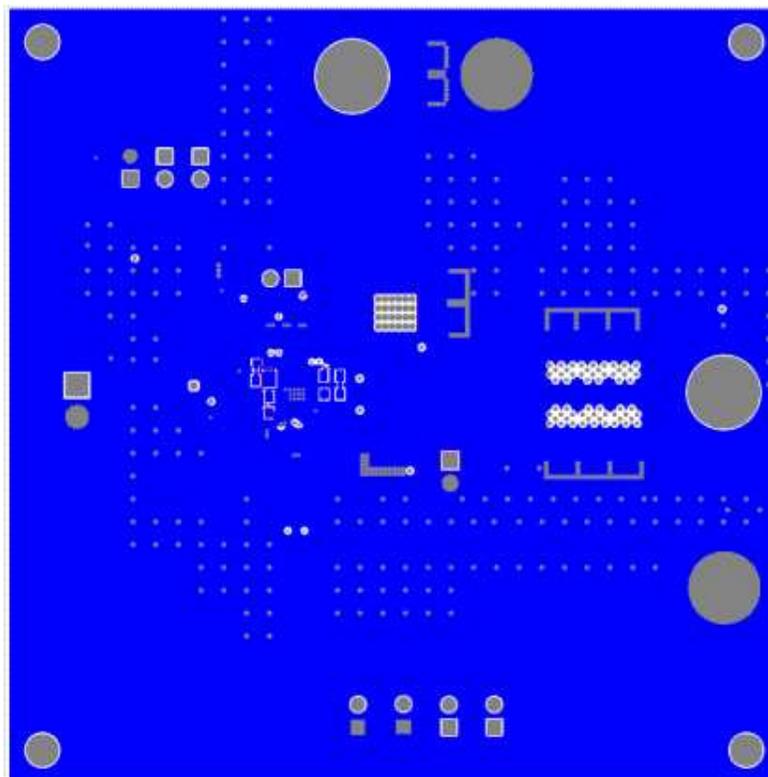


Figure 8. Board Layout (Bottom Layer)

5 BENCH TEST SETUP CONDITIONS

5.1 Connector and Test Point Description

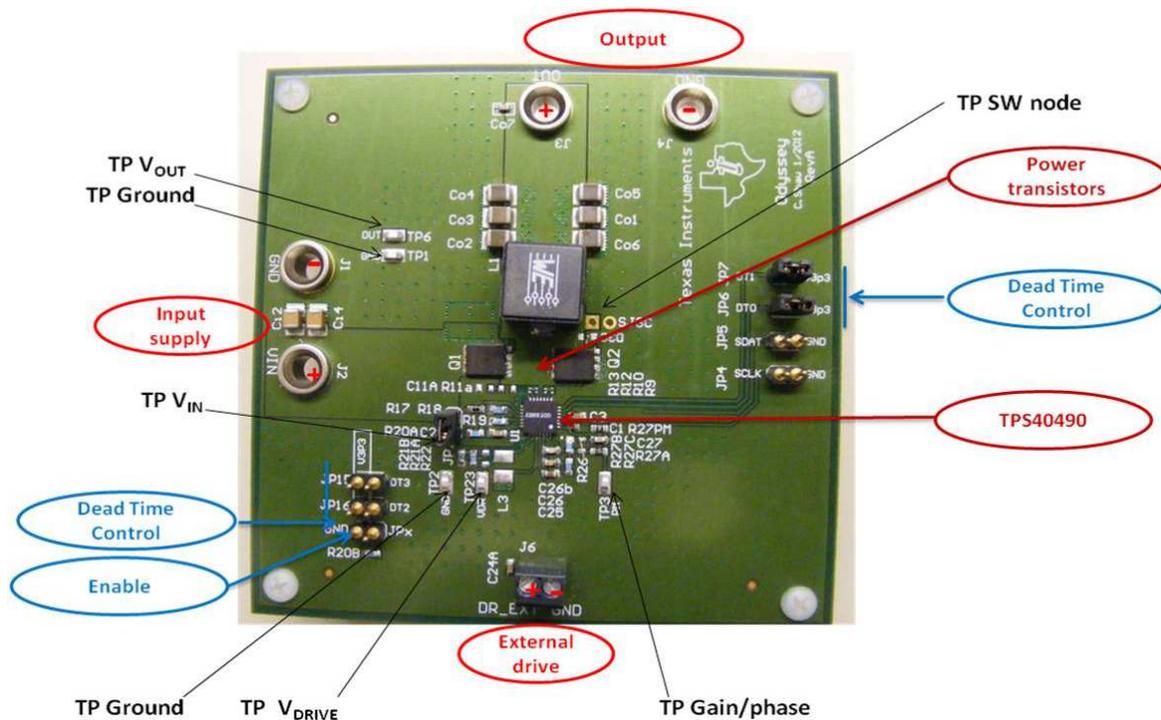


Figure 9. Connector and Test Point Description

5.2 Input Power Supply Jumper – JP1

TPS40490MHEVM is designed with an input jumper (JP1). Installing a jumper shunt in the JP1 connects VIN to VINa to power-up EVM. Removing the shunt will cut off the power supply to the TPS40490MH controller (the other parts of the EVM are still powered-up).

5.3 I²C Jumpers – JP4, JP5

TPS40490MHEVM is designed with I²C jumpers (JP4, JP5). During normal operation, I²C function is not needed. It's recommended to install shunt jumpers on JP4 and JP5 to pull SDAT and SCLK, respectively, to GND to disable the I²C function.

5.4 Synchronization Input – JP6

If the part does not need to be synchronized to an external clock connect JP6. To synchronize to an external clock make sure that its frequency is around 20% higher than the internal frequency of the device (2 MHz).

5.5 Jumpers to Set Dead Time – JP7, JP15, JP16

The jumpers JP7/15/16 are designed to set the dead time bits DT₁ to DT₃. For example, installing a jumper shunt in JP7 will pull DT₁ to V3p3 (3.3 V), thus setting DT₁ to a digital 1. Leaving JP7 open will set DT₁ to a digital 0. Please refer to the TPS40490 datasheet ([SLVSCB4](#)) for dead time settings.

5.6 Enable Jumper– JPx

Installing a jumper shunt in the JPx will pull the EN pin (enable) to GND and this will disable the TPS40490MH controller. Removing the jumper shunt JPx will pull the EN pin to high and the controller is enabled to operate.

5.7 Test Point Descriptions

Table 2. Test Point Descriptions

TEST POINT	LABEL	USE
TP1, TP4	GND	Ground test point for input/output
TP3	PM	Measurement test point for frequency response analysis
TP5	IN	Measurement test point for input voltage
TP6	OUT	Measurement test point for output voltage
TP23	V _{DR}	Measurement test point for regulated output for gate driver
TP26	Ext_Dr	External PWM drive
TP27	Vref	External reference modulation
SJ3C	SW	Measurement test point for switching node

5.7.1 Input Voltage Monitoring – TP5

TPS40490MHEVM provides TP5 and TP4 for measuring the input voltage applied to the module. This allows the user to measure the actual input module voltage without losses from input cables and connectors. To measure input, connect a voltmeter's positive input to TP5 and negative input to TP4.

5.7.2 Output Voltage Monitoring – TP6

TPS40490MHEVM provides TP6 and TP1 for measuring the output voltage of the module. This allows the user to measure the actual module output voltage without losses from cables and connectors. To measure output, connect a voltmeter positive input to TP6 and negative input to TP1.

5.7.3 Gate Driver Regulated Output Monitoring – TP3

TPS40490MHEVM provides TP3 for measuring the frequency response of the controller's output. This allows the user to measure the loop gain of the control loop. To measure the frequency response, connect a oscilloscope's positive input to TP3 and negative input to TP2 (GND).

5.7.4 Switch Node – SJ3C

TPS40490MHEVM provides SJ3C for measuring the switch node point. It is recommended to use minimum loop when testing switch node. Insert the positive end of the probe into the entry point closest to the inductor and the negative end at the point further away.

5.7.5 Regulated Output (V_{DR}) for Gate Driver – TP23

The TPS40490MHEVM provides test point TP23 for measuring regulated output voltage (V_{DR}) for the gate driver. The voltage applied to the gate is the voltage of the driver (V_{DR}) minus 0.7 V (the voltage of the diode drop). To measure the voltage applied to the gate, connect a voltmeter positive input to TP23 and negative input to TP2 (GND).

6 TEST SETUP

6.1 Equipment

(a) Voltage Source

VIN: The input voltage (VIN) source needs to be a 6-V to 60-V variable DC source capable of supplying 4-A DC current.

(b) Meters

V1: Input voltage meter. 0-V to 48-V voltmeter.

V2: Output voltage meter. 0-V to 20-V voltmeter.

(c) Loads

LOAD1: Output load. Electronic load set for constant current or constant resistance capable of 8-A DC.

6.2 Equipment Setup Procedure

1. Always use an ESD workstation. Ensure that any wrist straps, bootstraps, or mats are connected referencing the user to earth ground before power is applied to the EVM. Electrostatic smock and safety glasses must also be worn.
2. Connect the DC input source, VIN. Insert power supply positive end to J2 and negative (GND) to J1. It is advisable to limit the source current of VIN to 8 A maximum. Ensure that VIN is initially set to 0-V DC.
3. Put the jumper shunt on JP1.
4. Connect the voltmeter V1 positive end to TP5 and negative end to TP2.
5. Connect the output load source, LOAD1. Insert the Load1 positive end to J3 and negative end to J4. Ensure that Load1 is initially set to 0-A DC.
6. Connect the voltmeter V2 positive end to TP6 and negative end to TP1.
7. Connect the oscilloscope probes to desired testing points.

6.3 Forced Air Cooling

The TPS40490MH evaluation module includes components that can get hot to the touch when operating. Because this evaluation module is not enclosed to allow probing of circuit nodes, a small fan capable of 200-400 LFM is recommended to reduce component temperatures when operating.

6.4 Start-Up Procedure

1. Ensure all jumper shunt positions are in place for desired operating configuration.
2. Increase VIN from 0 V to desired operating voltage between 6-V and 60-V DC.
3. Increase LOAD1 from 0 A to desired operating current between 0-A and 8A DC.

6.5 Shut-Down Procedure

1. Decrease VIN to 0 V.
2. Decrease LOAD1 to 0 A.

6.6 Efficiency Measurement Procedure

1. Follow [Section 6.4](#) to set VIN and LOAD1 to desired operating condition.
2. Connect voltmeter positive end (V1) to TP5 and negative end to TP2.
3. Connect voltmeter positive end (V2) to TP6 and negative end to TP1.
4. Read the input voltage from voltmeter V1, input current from power supply instrument, output voltage from voltage meter V2 and output current from LOAD1.
5. Follow [Section 6.5](#) to power down.

6.7 Output Ripple Voltage Measurement Procedure

1. Follow [Section 6.4](#) to set VIN and LOAD1 to desired operating condition.
2. Connect oscilloscope probe positive end to TP6.
3. Connect oscilloscope probe terminal end to TP1.
4. Set Oscilloscope.
5. Read the Oscilloscope data.
6. Follow [Section 6.5](#) to power down.

6.8 Switch Node Measurement Procedure

1. Follow [Section 6.4](#) to set VIN and LOAD1 to desired operating condition.
2. Recommend to use minimum loop when testing switch node as shown in [Figure 10](#).
3. Insert oscilloscope probe positive end to the left side (closer to inductor) of SJ3C.
4. Insert oscilloscope probe negative end to the right side of SJ3C.
5. Read the oscilloscope data.
6. Follow [Section 6.5](#) to power down.



Figure 10. Testing Switch Node

7 CURRENT SOURCE OPERATION

The EVM can be configured as a current source with the following configuration, where the reference voltage has been programmed to 200 mV and a 100 mΩ shunt has been added to set the current loop to 2 A. Note that the constant current source is fitted between connectors A and B.

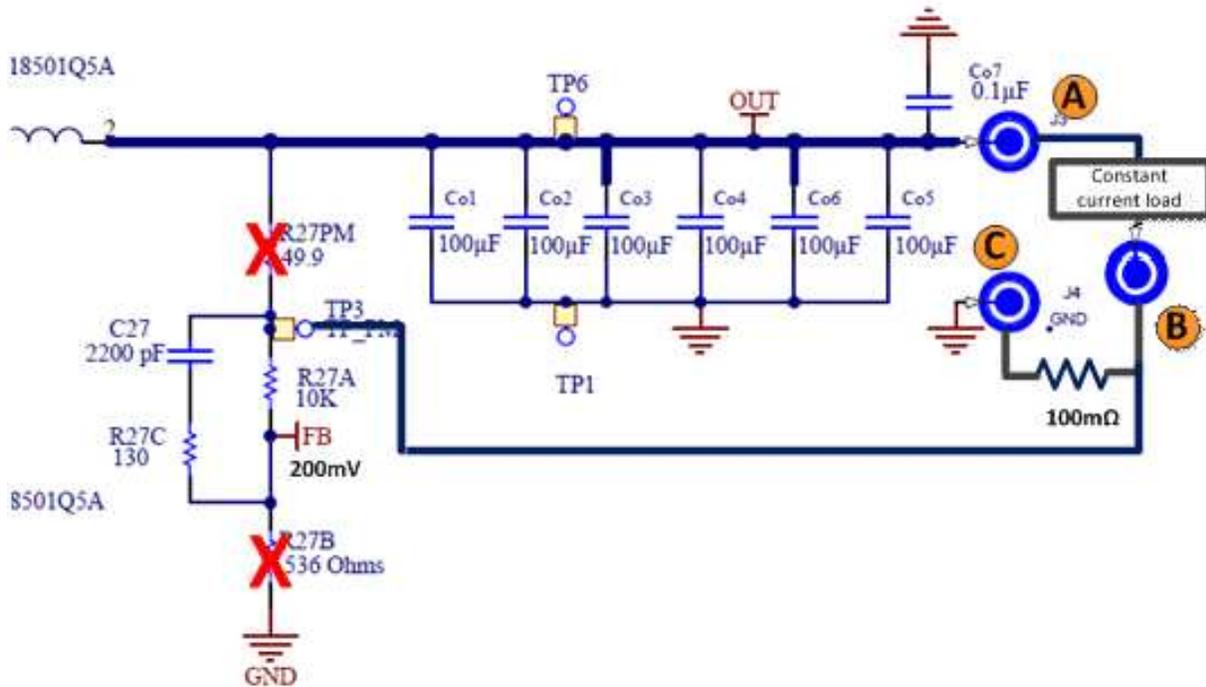


Figure 11. Current Source Configuration Schematic

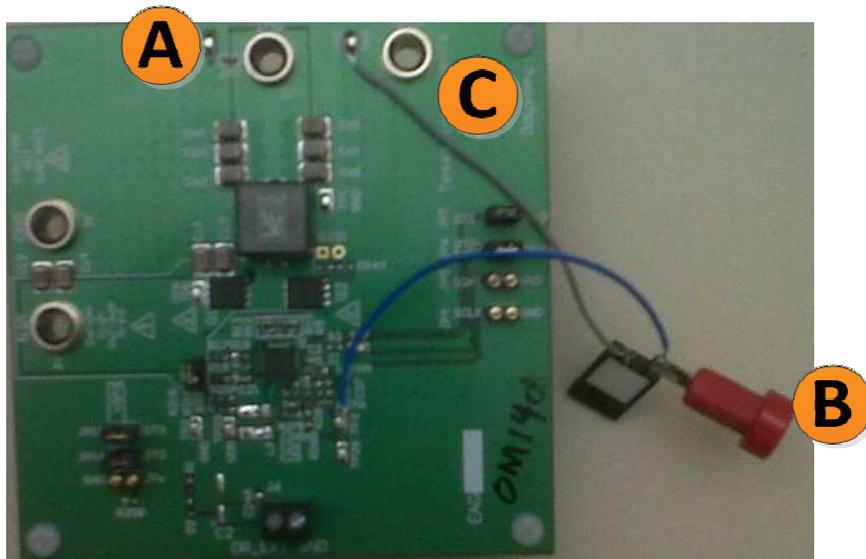


Figure 12. Current Source Configuration

8 SCHEMATIC AND BILL OF MATERIALS

The following pages contain the schematic and BOM.

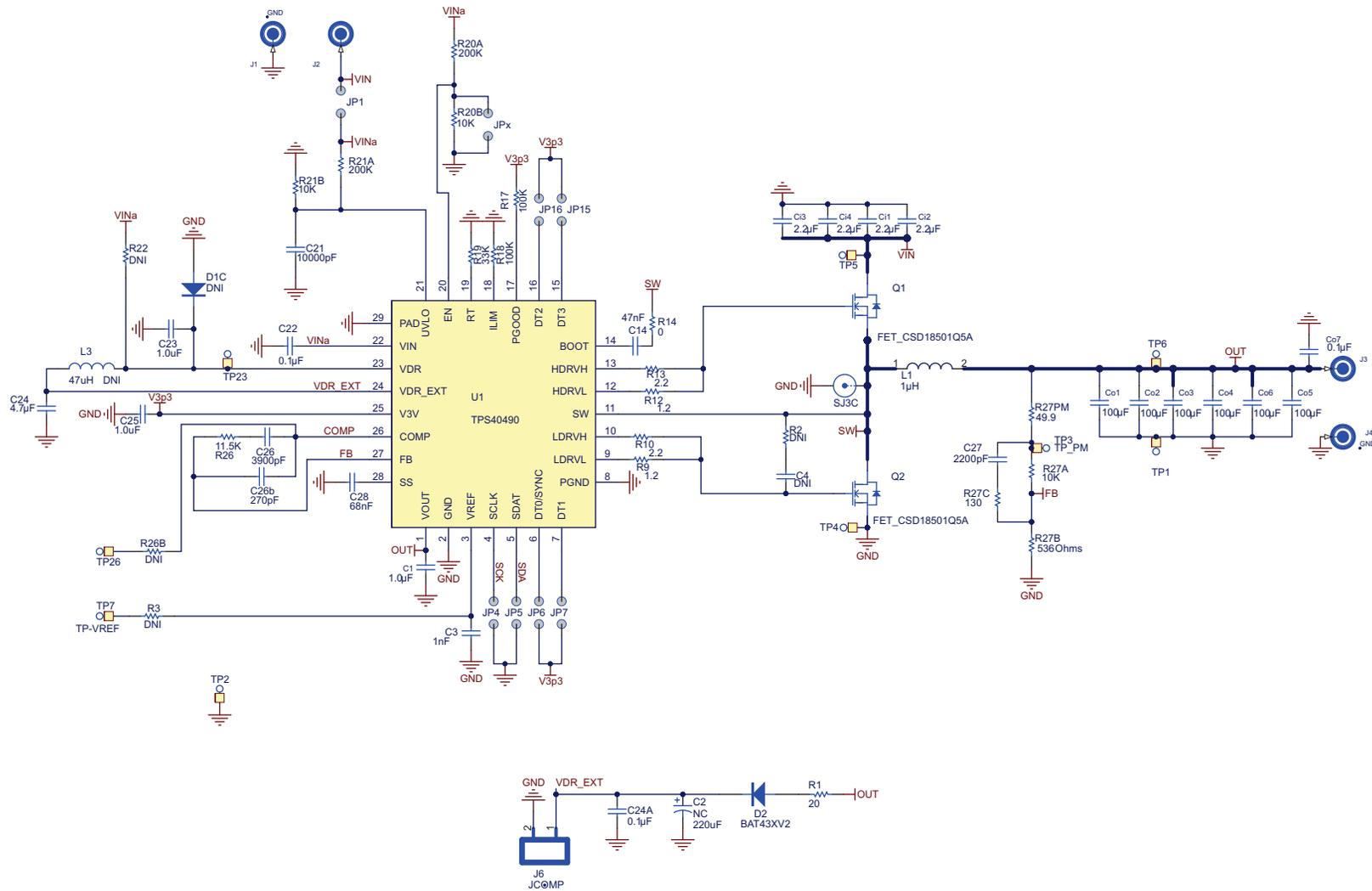


Figure 13. TPS40490MHEVM Schematic

Table 3. TPS40490MHEVM Bill of Materials⁽¹⁾

Item No.	Qty	Designator	Value	Footprint	Manufacturer	Part No.	Description
1	3	C1, C23, C25	1uF	603	EMK107B7105KA-T	EMK107B7105KA-T	CAP CER 1UF 16V 10% X7R 0603
2	1	C2	220uF	.26x.26"	EEE-1CA221XP	EEE-1CA221XP	CAP ALUM 220UF 16V 20% SMD
3	3	C3	1nF	603	C1608X7R1H102K	C1608X7R1H102K	CAP CER 1000PF 50V 10% X7R 0603
4	1	C4					
5	1	C14	47nF	603	C1608X7R1H473K	C1608X7R1H473K	CAP CER 0.047UF 50V 10% X7R 0603
6	1	C21	10nF	603	GRM188R71H103MA 01D	GRM188R71H103MA 01D	CAP CER 10000PF 50V 20% X7R 0603
7	3	C22, C24a, Co7	100nF	603	490-3285-1-ND	490-3285-1-ND	CAP CER 0.1UF 100V 10% X7R 0603
8	1	C24	4.7uF	603	EMK107ABJ475KA-T	EMK107ABJ475KA-T	CAP CER 4.7UF 16V 10% X5R 0603
9	1	C26b	120pF	603	C1608C0G1H121J08 0AA	C1608C0G1H121J08 0AA	CAP CER 120PF 50V 5% NP0 0603
10	1	C28	68nF	603	C1608X7R1H682K	C1608X7R1H682K	
11	4	Ci1, Ci2, Ci3, Ci4	2.2uF	1210	HMK325B7225KN-T	HMK325B7225KN-T	CAP CER 2.2UF 100V 10% X7R 1210
12	6	Co1, Co2, Co3, Co4, Co5, Co6	47uF	1210	EMK325BJ476MM-T	EMK325BJ476MM-T	CAP CER 47UF 16V 20% X5R 1210
13	1	D1C					
14	1	D2		SC-79	BAT43XV2	BAT43XV2	DIODE SCHOTTKY 30V 200MA SOD523F
15	4	J1, J2, J3, J4			575-4	575-4	JACK NON-INSULATED .218"
16	1	J6		TB_2X3.5MM	ED555/2DS	ED555/2DS	Terminal Block, 2-pin, 6-A, 3.5mm
17	AR	JP1, JP4, JP5, JP6, JP7, JP15, JP16, JPx		JMP0.2	800-10-064-10-001000	800-10-064-10-001000	SIP HEADER 64 POS STRAIGHT PCB
18	1	L1	1uH		732-2138-1-ND	732-2138-1-ND	INDUCTOR POWER 1.0UH 24A SMD
19	1	L3					
20	7		NA	NA	969102-0000-DA	969102-0000-DA	SHUNT JUMPER .1" BLACK GOLD
21	4		NA	NA	1902E	1902E	STANDOFF HEX 1.00"L 4-40THR NYL
22	4		NA	NA	NY PMS 440 0025 PH	NY PMS 440 0025 PH	SCREW MACH PHIL 4-40X1/4 NYLON
23	2	Q1,Q2			BSC123N08NS3 G	BSC123N08NS3 G	MOSFET N-CH 80V 55A TDSO8-8
24	1	R1	20	603			RES 20 OHM 1/10W 5% 0603 SMD
25	1	R2		603			
26	2	R9, R12	1.2	603	ERJ-3GEYJ1R2V	ERJ-3GEYJ1R2V	RESISTOR 1.2 OHM 1/10W 5% 0603
27	2	R10, R13	2.2	603	ERJ-3GEYJ2R2V	ERJ-3GEYJ2R2V	RESISTOR 2.2 OHM 1/10W 5% 0603
28	2	R14, R27PM	0	603	ERJ-3GEY0R00V	ERJ-3GEY0R00V	RES 0.0 OHM 1/10W 0603 SMD
29	2	R17, R18	100K	603	ERJ-3EKF1003V	ERJ-3EKF1003V	RES 100K OHM 1/10W 1% 0603 SMD
30	1	R19	16.5k	603	ERA-3AEB1652V	ERA-3AEB1652V	RES 16.5K OHM 1/10W .1% 0603 SMD
31	2	R20A, R21A	200k	603	ERJ-3EKF2003V	ERJ-3EKF2003V	RES 200K OHM 1/10W 1% 0603 SMD
32	2	R20B, R21B	10k	603	ERJ-3EKF1002V	ERJ-3EKF1002V	RES 10K OHM 1/10W 1% 0603 SMD
33	1	R22					

⁽¹⁾ Red background indicates not fitted.

Table 3. TPS40490MHEVM Bill of Materials⁽¹⁾ (continued)

Item No.	Qty	Designator	Value	Footprint	Manufacturer	Part No.	Description
34	1	R26	10.5k	603	ERJ-3EKF1052V	ERJ-3EKF1052V	RES 10.5K OHM 1/10W 1% 0603 SMD
35	1	R26B	0				
36	1	R27A	10k	603	ERA-3AEB103V	ERA-3AEB103V	RES 10K OHM 1/10W .1% 0603 SMD
37	1	R27B	523	603	ERA-3AEB5230V	ERA-3AEB5230V	RES 523 OHM 1/10W .1% 0603 SMD
38	1	C26	2700pF	603	CGA3E2C0G1H272J 080AA	CGA3E2C0G1H272J 080AA	CAP CER 2700PF 50V 5% NP0 0603
39	1	C27	1.5nF	603	39	C1608X8R1H152K08 0AA	CAP CER 1500PF 50V 10% X8R 0603
40	1	R27C	95.3	603	40	ERA-3AEB95R3V	RES 95.3 OHM 1/10W .1% 0603 SMD
41	5	TP1, TP2, TP3, TP6, TP23, TP4, TP5, TP7, TP26			41	5015	
42	1	U1			42	TPS40490MHSMDR HD	dc-dc CONTROLLER

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.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used. TI currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

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 EVMs for RF Products 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
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

<http://www.tij.co.jp>

【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】

本開発キットは技術基準適合証明を受けておりません。

本製品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

<http://www.tij.co.jp>

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. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. 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.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2013, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com