TPS7H1201HTEVM User's Guide

Contents

List of Figures

1 INTRODUCTION

This user's guide describes the characteristics, operation, and use of the TPS7H1201HT evaluation module (EVM). This EVM demonstrates the Texas Instruments TPS7H1201HT ultra-low Dropout LDO regulator. It is rated for 0.5-A ultra low-dropout (LDO) voltage regulator. This user's guide includes setup instructions, a schematic diagram, a bill of materials (BOM), and PCB layout drawings for the EVM.

1.1 Related Documentation

1. TPS7H1201-HT Datasheet (SLVSAS4)

2 BACKGROUND

The TPS7H1201HTEVM helps designers evaluate the operation and performance of the TPS7H1201HT ultra low drop out regulator.

Table 1. Summary of Performance

TEST CONDITIONS	OUTPUT CURRENT RANGE
V_{IN} = 1.5 V to 7 V	Max 0.5 A

The evaluation module is designed to provide access to the features of the TPS7H1201. Some modifications can be made to this module to test performance at different input and output voltages, current and switching frequency. Please contact TI Field Applications Group for advice on these matters.

3 SAFETY

3.1 Eye Protection

Safety glasses are to be worn while performing all testing on the EVM.

3.2 General Risks

This test must be performed by qualified personnel trained in electronics theory and understand the risks and hazards of the assembly to be tested.

3.3 Electrostatic Discharge

ESD precautions must be followed while handling electronic assemblies.

3.4 Thermal/Shock Hazards

Precautions should be observed to avoid touching areas of the assembly that may get hot or present a shock hazard during testing.

4 APPAREL

- Electrostatic smock
- Electrostatic gloves or finger cots
- Safety glasses
- Ground ESD wrist strap

5 EQUIPMENT

5.1 Power Supplies

Power Supply #1 (PS#1): a power supply capable of supplying 7-V at 1-A or higher is required.

5.2 Load #1

Electronic load, i.e. Chroma 63640-80-80 module along with 63600-2 DC electronic load Mainframe or Decade Resistor Box.

5.3 Meters

Four (4) Fluke 75, (equivalent or better) or two (2) equivalent voltage meters and two (2) equivalent current meters.

The current meters must be able to measure 3 A current. Note: Shunt along with DVM can be used to monitor output current.

5.4 Oscilloscope

An Tektronix Oscilloscope, i.e. DPO 7104CCurrent Probe Tektronix TCP202 or equivalent.

6 BOARD LAYOUT

6.1 EVM Layout Flexibility

The EVM is layed out to provide flexibility for the customer evaluation thus providing test points and or cold nose probes to monitor various critical nodes of the design as highlighted in the schematic.

Additionally, placeholder is provided thus one can add esr in series with the output capacitor (R47 in series with C39) thus making it easier to evaluate performance with increased capacitor esr.

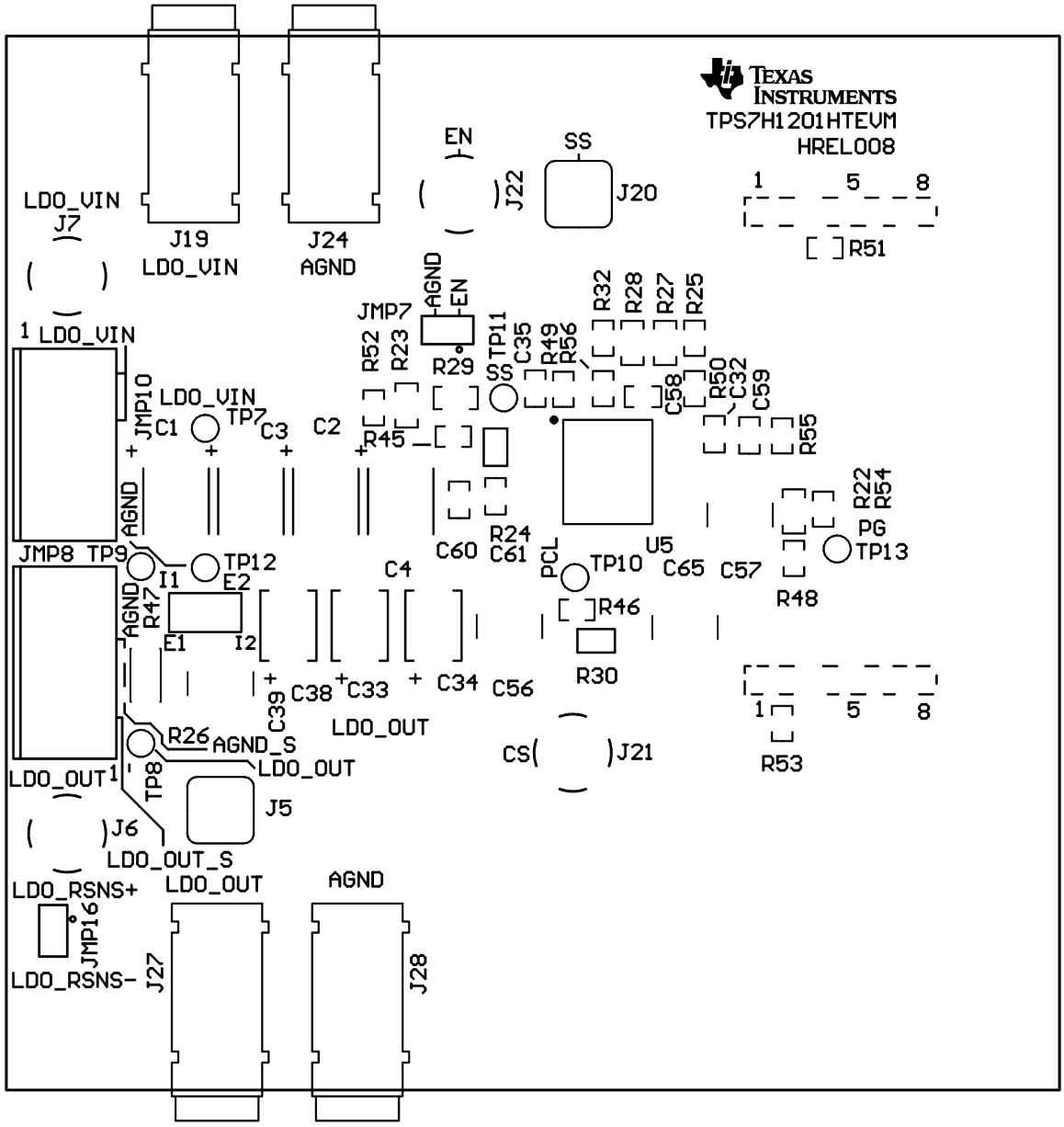

Figure 1. Component Placement (Top Side)

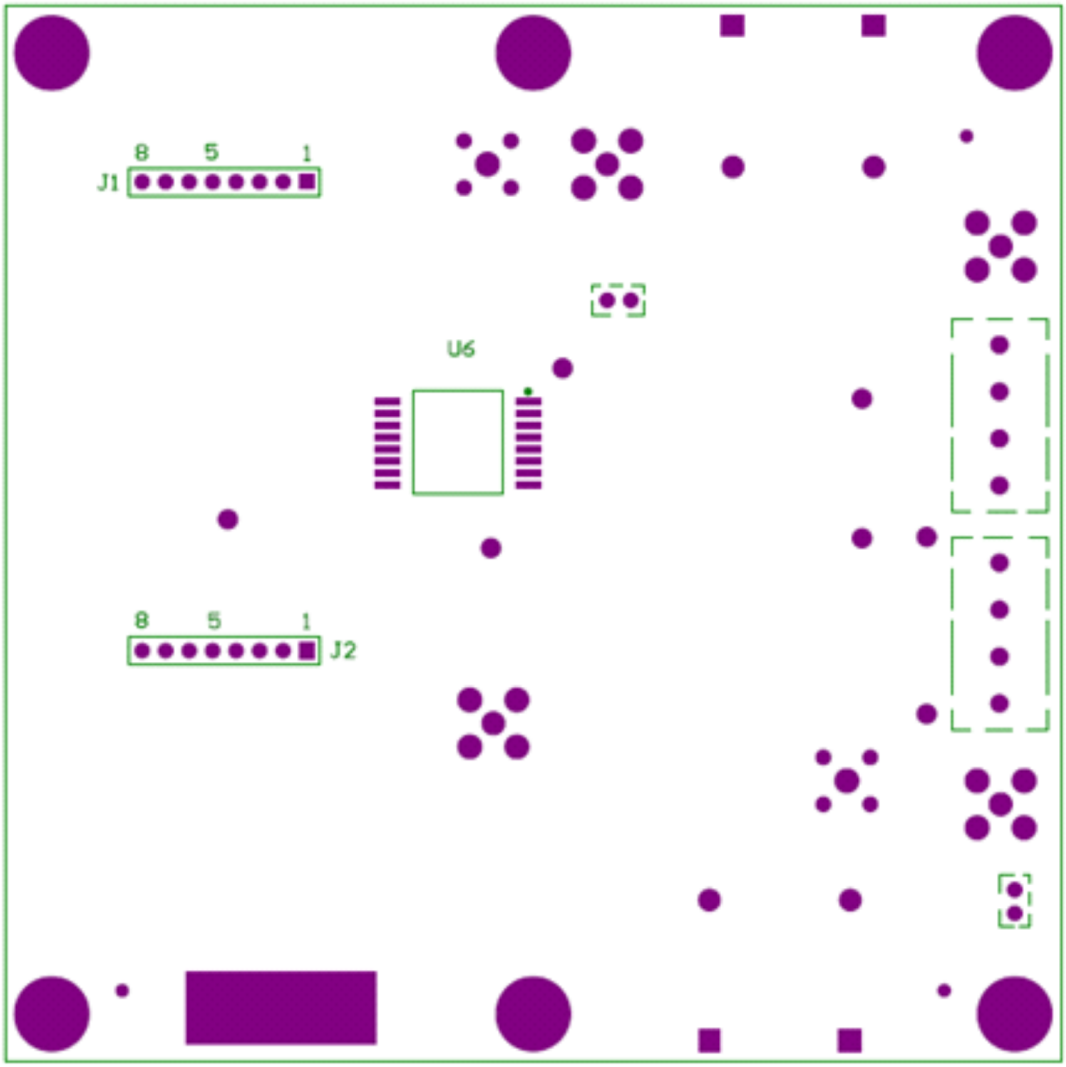

Figure 2. Component Placement (Bottom Side)

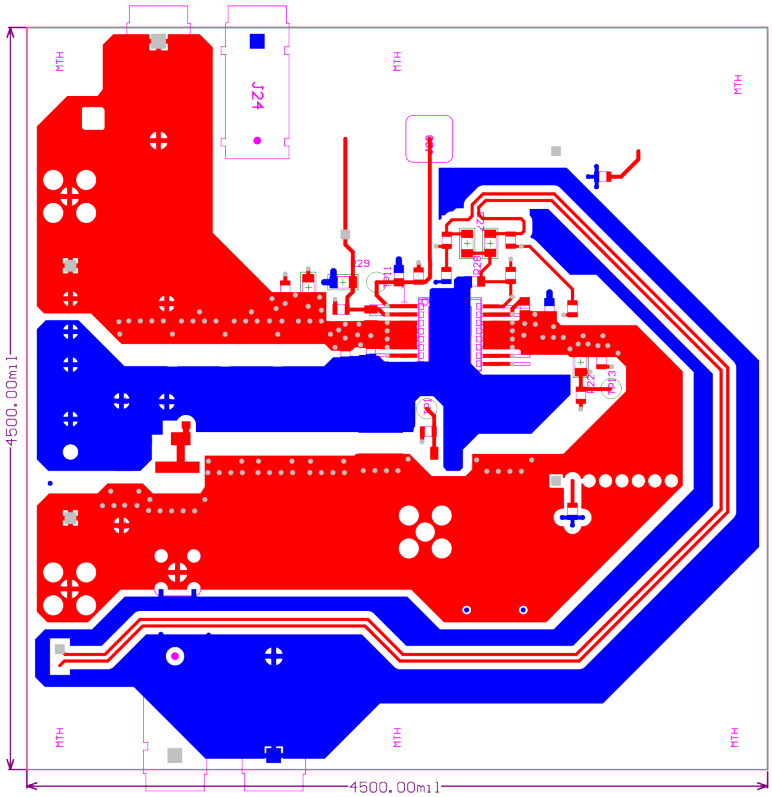

Figure 3. PCB Layout (Top Layer)

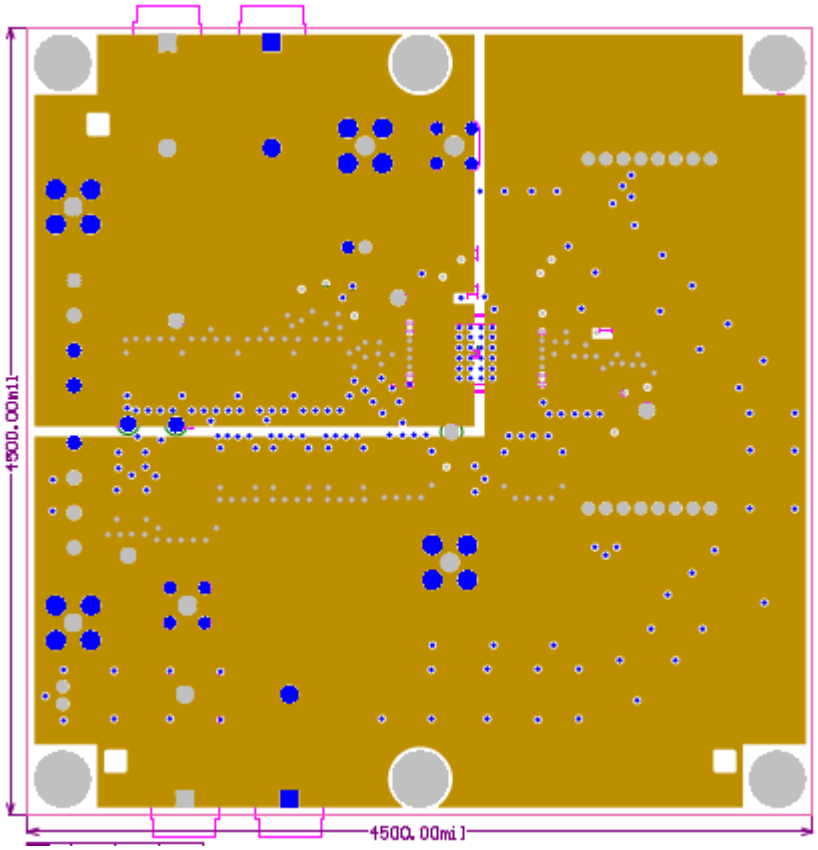

Figure 4. Board Layout - Second Layer (Mid Layer 1)

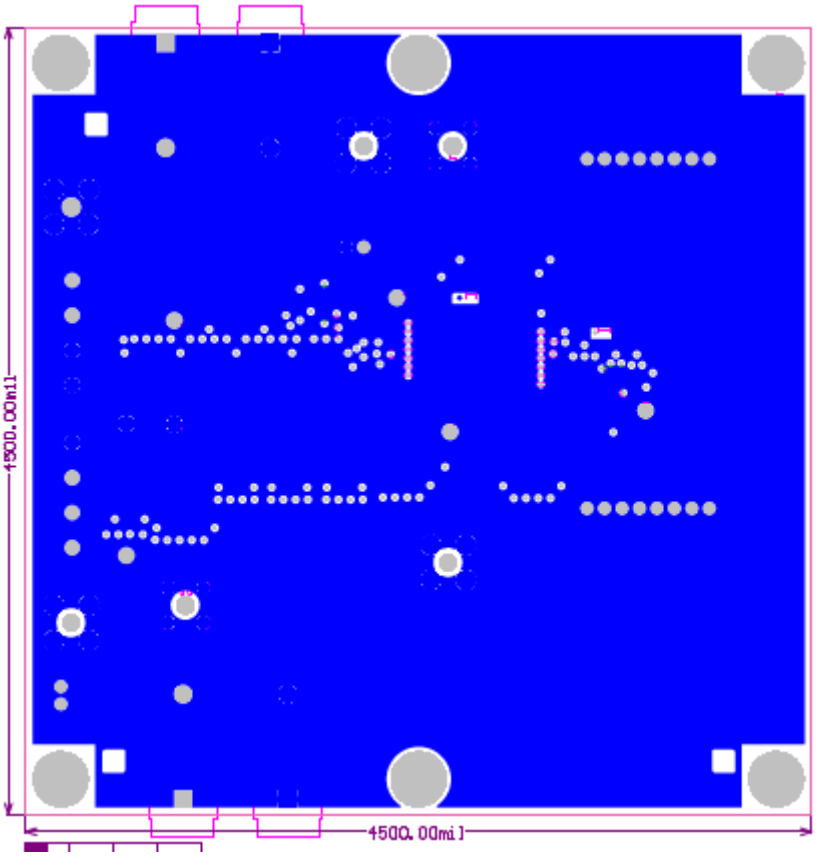

Figure 5. Board Layout - Third Layer (Mid Layer 2)

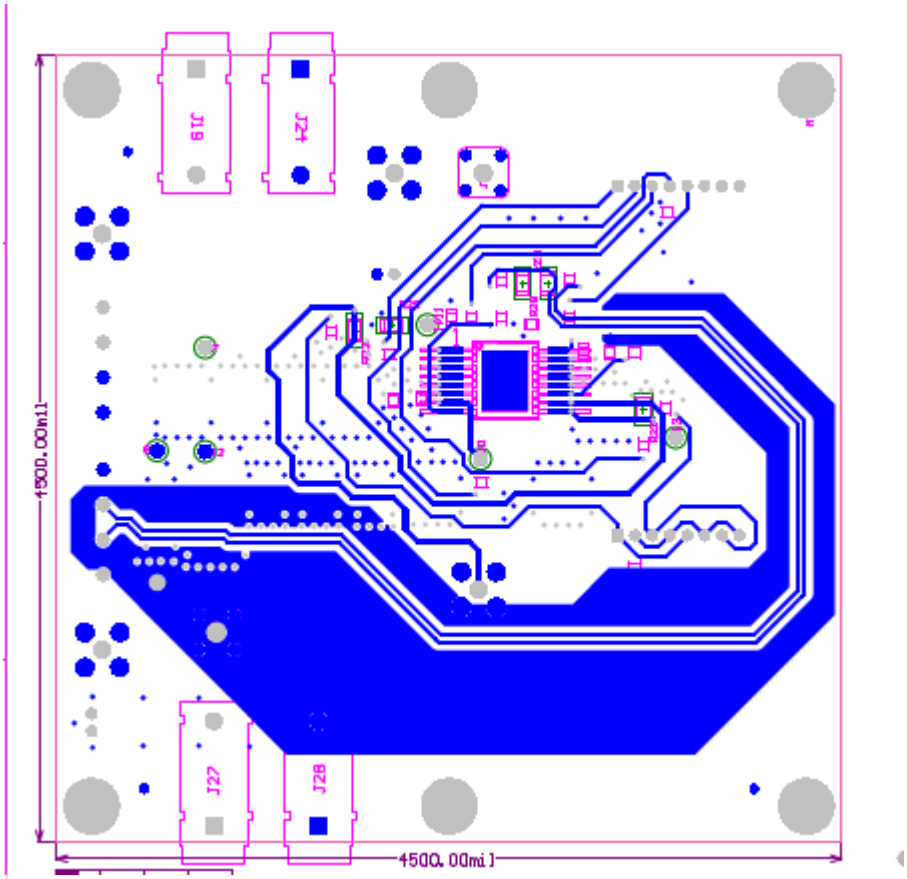

Figure 6. Board Layout - Fourth Layer (Bottom Layer)

7 BENCH TEST SETUP CONDITIONS

7.1 Headers Description and Jumper Placement

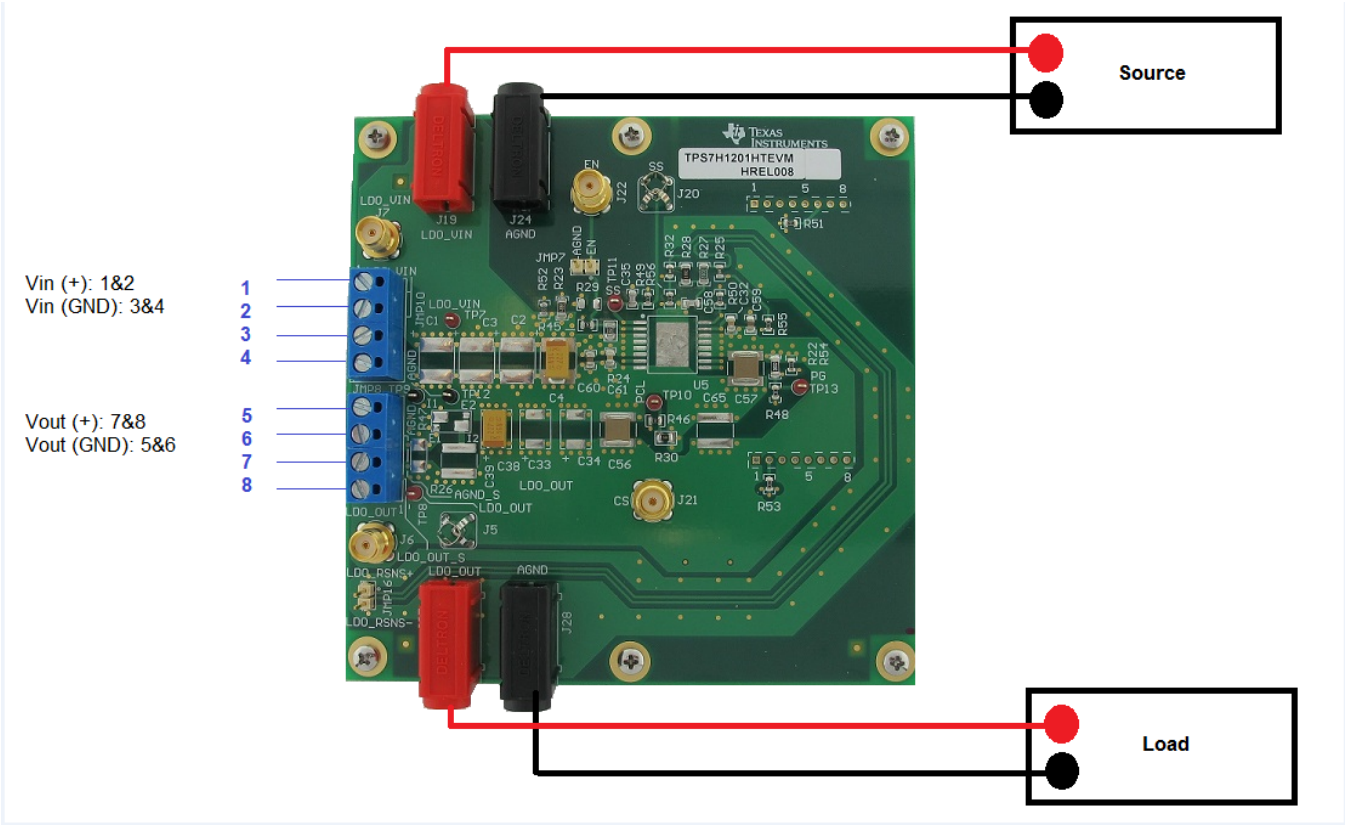

Figure 7. Headers Description and Jumper Placement

7.2 Testing

Table 2. Power Connectors

NO.	FUNCTION
J19	V_{IN} input voltage connector (see for V_{IN} range)
J24	V_{IN} input voltage connector to ground
J27	V_{OUT} output voltage connector
J28	V_{OUT} output connector to ground
J7	Vin_SMA
J22	EN_SMA
J20	SS_Probe
J5	LDO_OUT_Probe
TP8	LDO Vout measure point (+)
TP9	LDO Vout measure point (GND)
J6	LDO_OUT_SMA
TP7	LDO Vin measure point (+)
TP12	LDO Vin measure point (GND)
TP10	PCL
J21	CS_SMA
TP13	PGOOD
TP11	SS
JMP10	V_{IN} alternative connection: 1,2 (+) and 3,4 (GND)
JMP8	V_{OUT} alternative connection 3,4 (+) and 1,2 (GND)

8 POWER-UP PROCEDURE

Table 3. Test Results

	V_{OUTMIN}	V_{OUTMAX}	CURRENT LIMIT	
V_{OUT} = 1.8 V	1.76 V	1.836 V	< 0.7 A	**OUTPUT SET POINT**
I_{OUT} = 0.5 A	1.8166 V		0.6 A	**CURRENT LIMIT**

8.1 I_{OUT} and V_{OUT} Measurements

1. Make sure all power supplies in workstation are OFF.
2. Locate connectors J19 and J24.
3. Connect V_{IN}(+) to J19 and V(GND) to J24. Set it to 2.3 V.
4. Locate measure points TP7 and TP12.
5. Connect voltmeter: V_{IN}(+) to TP7 and V(GND) to TP12.
6. Locate connectors J27 and J28 and connect load here (be aware of polarities).
7. Locate measure points TP8 and TP9.
8. Connect voltmeter: V_{OUT}(+) to TP8 and V(GND) to TP9.
9. Output voltage should be per Table 1. This is done by setting R27 = 19.8 kΩ and R28 = 10 kΩ. V_{OUT} can be determined by equation highlighted below or per equation 1 in the datasheet.

$$V_{OUT} = \frac{(R_{27} + R_{28}) \bullet V_{REF}}{R_{28}} \quad (1)$$

Where V_{REF} = 0.605 V.

8.2 Output Current Limiting

A resistor value R30 connected from PCL pin to GND determines the output current limit set point based on Equation 2.

Maximum programmable current limit is 700 mA.

$$R_{pcl} = R_{30} = \frac{CSR(V_{ref})}{PCL_{cl} - 0.0216} \quad (2)$$

Where V_{REF} = 0.605 V, PCL_{cl} = programmabe current limit (A), CSR = Current sense ratio (typical value = 51436).

CSR between I_{cs} pin and I_{OUT} can be measured as shown in Figure 8.

- Make sure all power supplies in workstation are OFF.
- Connect V_{IN}(+) to J19 & V(GND) to J24 and set it to 2.3 V.
- Set V_{OUT} to 1.8V. (R27 = 19.8 kΩ and R28 = 10 kΩ)
- Connect load as previously instructed, set it to zero.
- Increase I_{load} (steps of 0.100 A are suggested) until V_{load} starts to drop.
- Current limit trip point < 0.7 A.

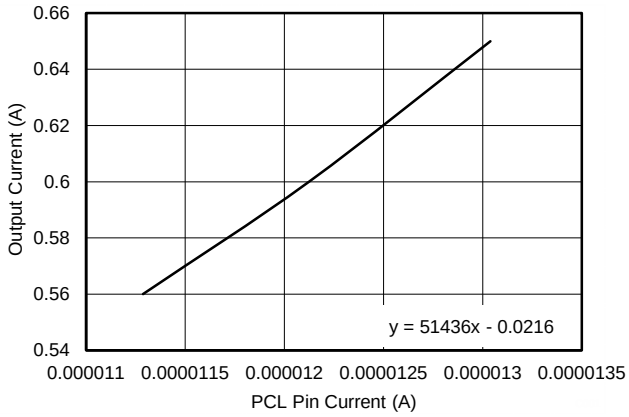

Figure 8. I_{OUT} (A) vs I_{PCL} (A)

8.3 High Side Current Sense

Monitoring the voltage at the CS pin will indicate voltage proportional to the output current. Figure 9 shows typical curve V_{CS} vs I_{OUT} for Vin = 2.28 V and R23 = 3.65 kΩ.

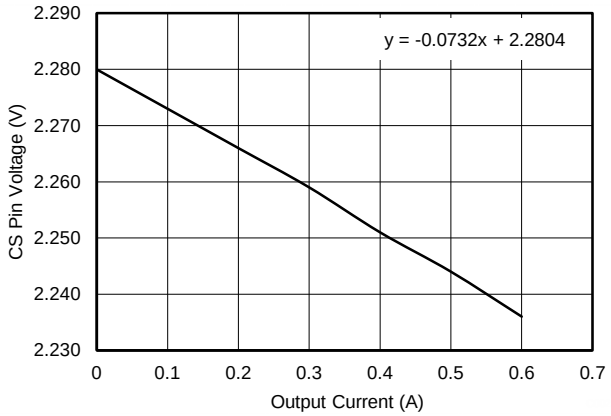

Figure 9. V_{CS} (V) vs I_{OUT} (A)

Monitoring current in CS pin (I_{CS} vs I_{OUT}) indicates the current sense ratio between the main PMosFET and the current sense Mosfet as shown in Figure 10.

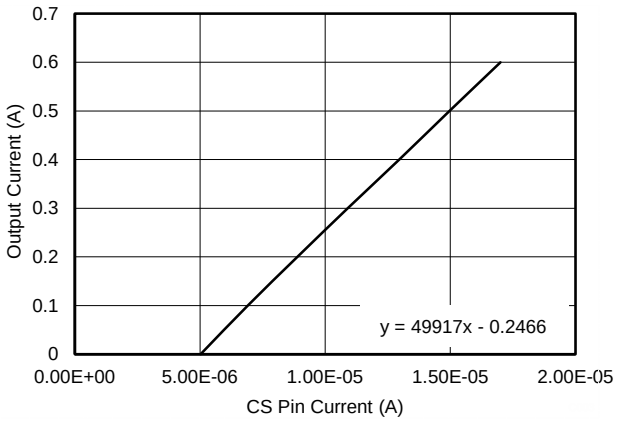

Figure 10. I_{OUT} (A) vs I_{CS} (A)

Figure 11 shows I_{OUT} vs I_{CS} when the voltage on CS pin is varied from 0.3 V to 7 V.

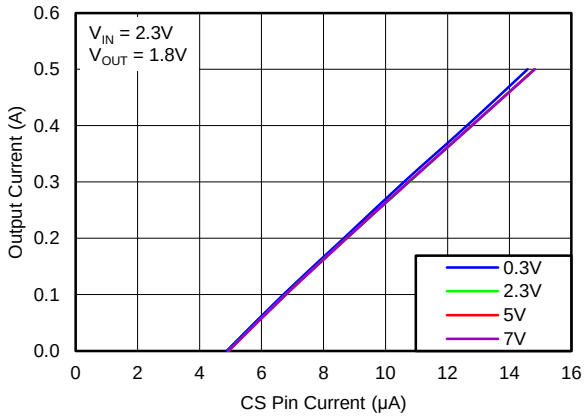

Figure 11. I_{OUT} (A) vs I_{CS} (A)

8.4 Power Good

Power good pin is an open drain connection, connect it high via pull up resistor to external voltage source. Power Good pin indicates the status of the output voltage.

8.5 Dropout Voltage

Drop out voltage (V_{do}) is the difference between the input voltage and output voltage needed to maintain regulation. V_{do} vs I_{OUT} is highlighted in Figure 12.

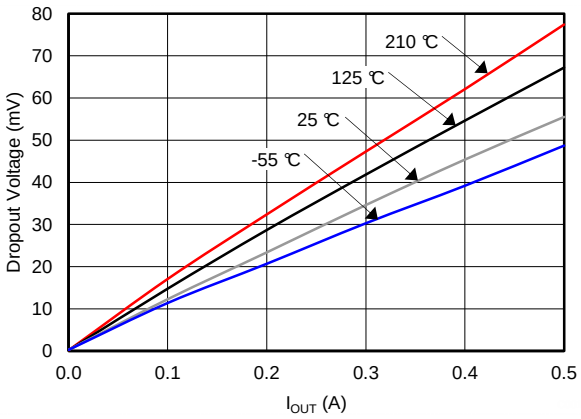

Figure 12. V_{do} vs I_{OUT}

8.6 Transient Response

Waveforms below indicate the transient response behavior of the LDO for 50% step load change.

Channel 1: Output voltage overshoot / undershoot

Channel 2 : Step load in current

Channel 3: Input voltage

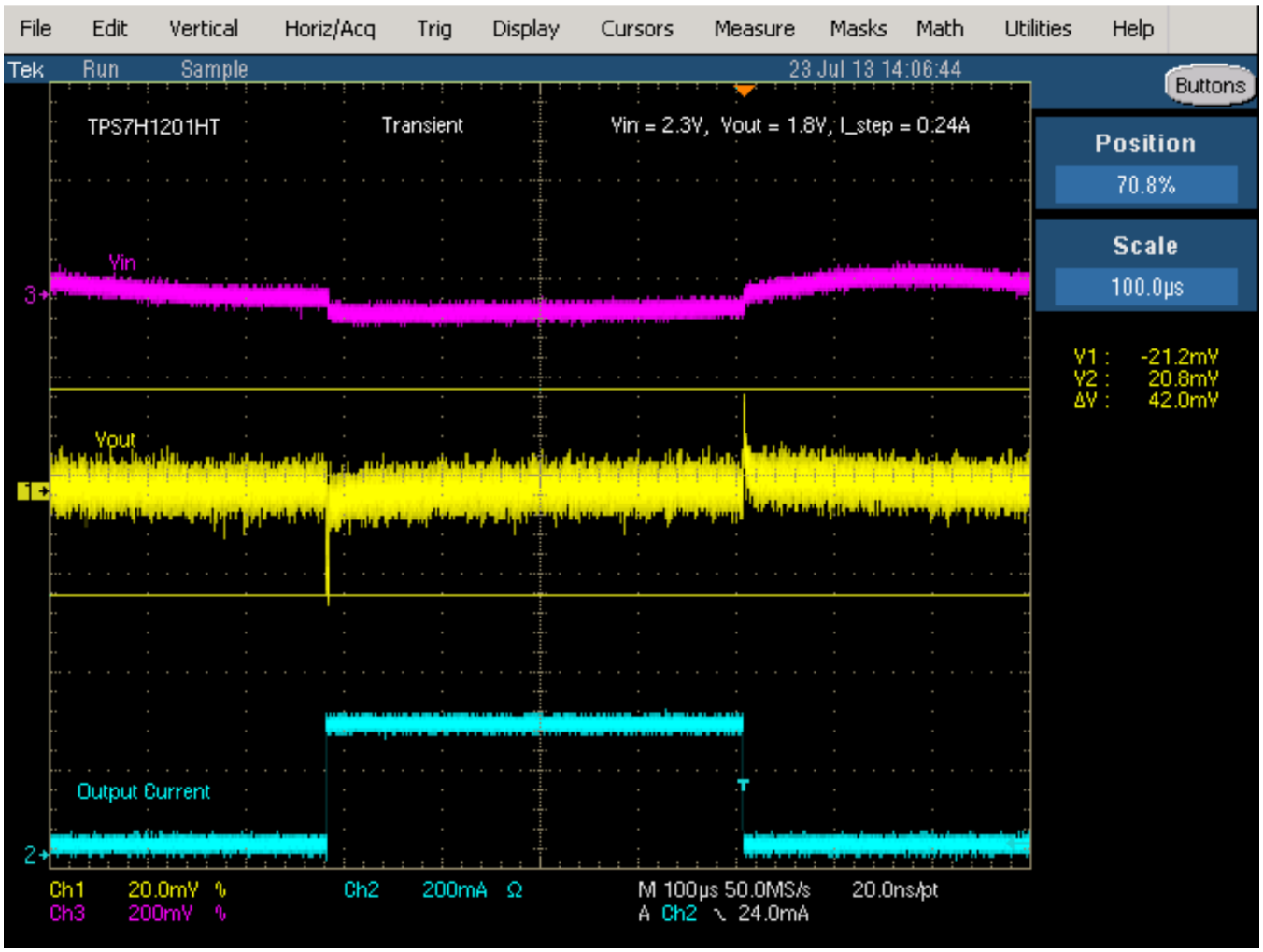

Figure 13. Load Transient Response: Step Load 0 A to 250 mA

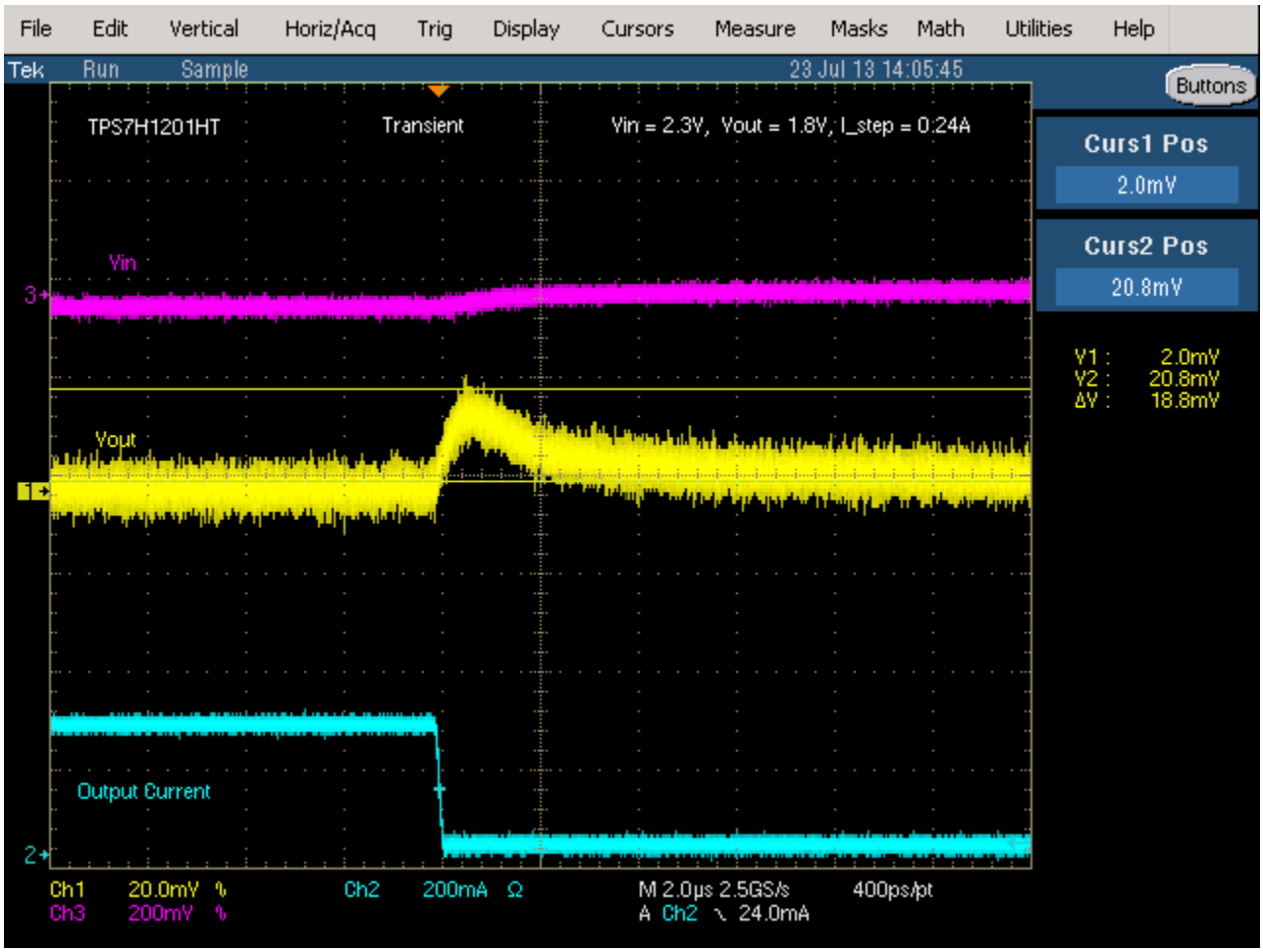

Figure 14. Expanded View Overshoot

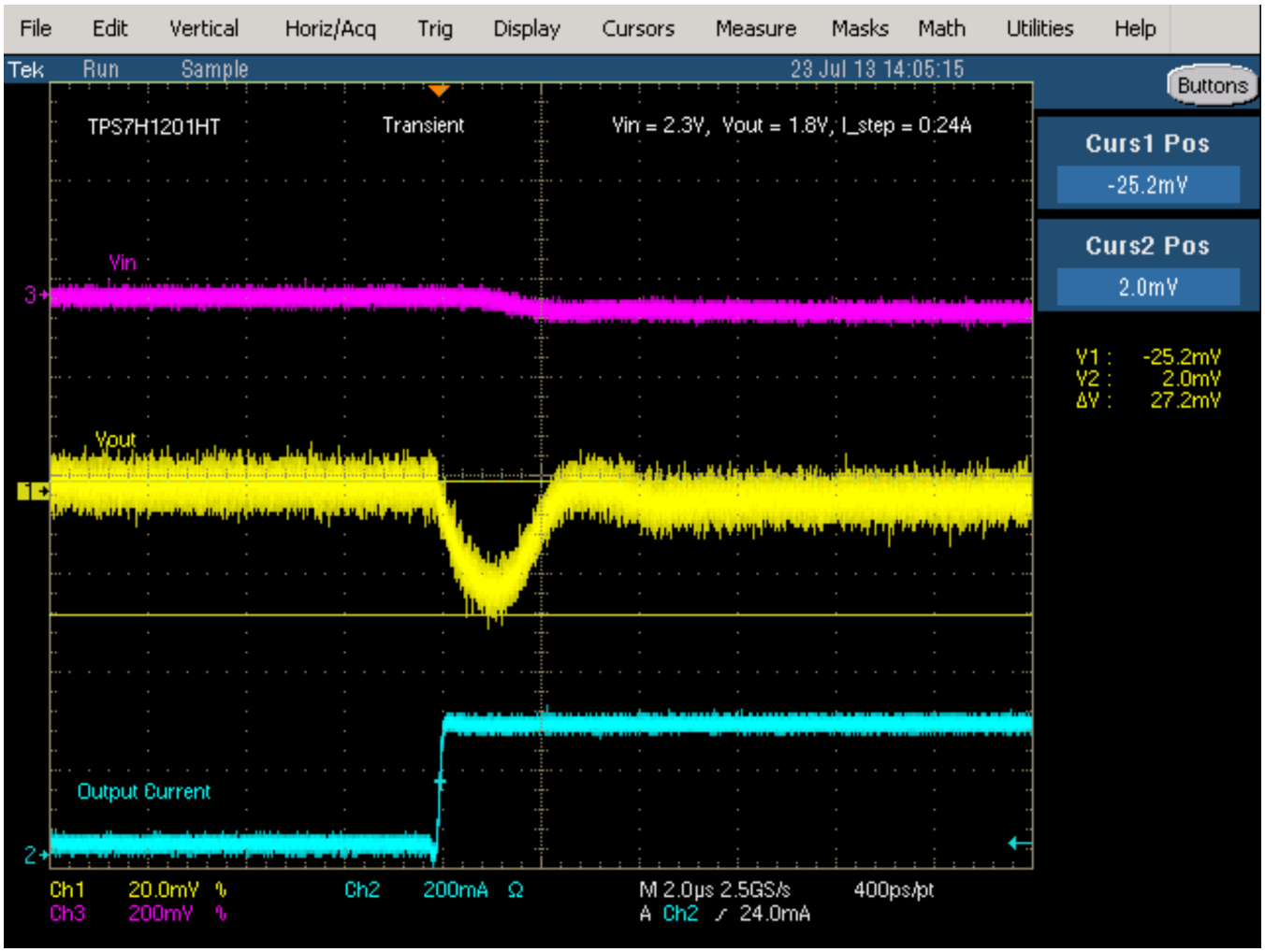

Figure 15. Expanded View Undershoot

8.7 Current Sharing

For demanding load requirements, multiple LDOs can be paralleled.

- In parallel mode CS pin of LDO#1 must be connected to PCL pin of LDO#2 via a series resistor (41.5 kΩ) and CS pin of LDO#2 must be connected to PCL pin of LDO#1 via series resistor (41.5 kΩ).
- In parallel configuration R30 (resistor from PCL to GND) and R23 (resistor from CS pin to V_{IN}) must be left open (unpopulated).

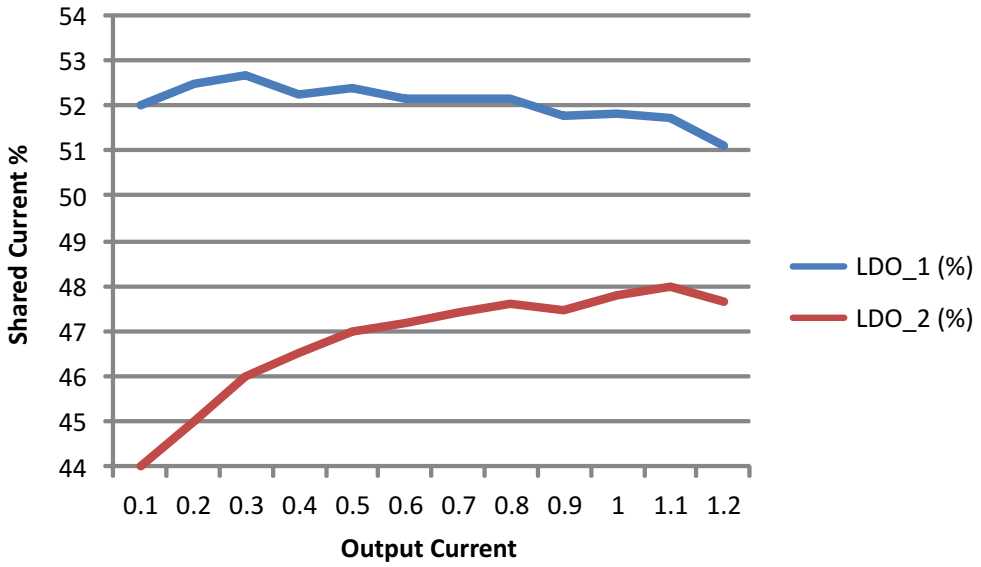

Figure 16. Current Sharing LDO_1 and LDO_2

8.8 Soft-Start

Connecting a capacitor on CS pin to GND (C_{35}) slows down the output voltage ramp rate. The soft-start capacitor will charge up to 1.2 V.

$$C_{35} = \frac{t_{ss} \bullet I_{ss}}{V_{REF}} \quad (3)$$

Where:

t_{ss} = Soft-start time

I_{ss} = 2.5 µA

V_{REF} = 0.605 V

8.9 Enable/Disable

EVM can be disabled via pulling the enable pin low via shorting JMP7-1 (Enable) to JMP7-2 (GND). Enable pin is tied high to V_{IN} via R24 (20 kΩ) resistor, thus keeping the EVM enabled.

Alternately, EVM can also be disabled via pulling SS pin (U6 pin 1) low via an external circuit comprising of 2N7002 MOSFET as shown in Figure 17. A high signal at the gate of Q100 will discharge the SS pin and disable the device.

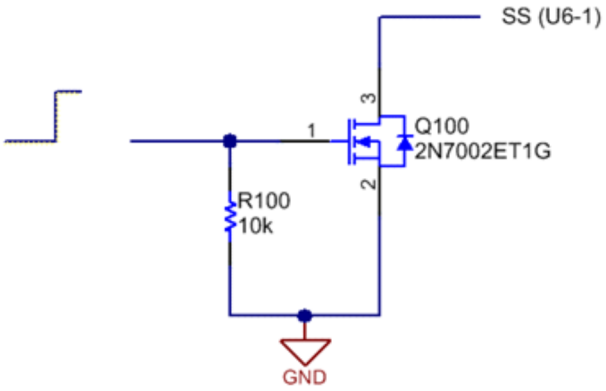

Figure 17. Disabling the LDO via Soft-Start Pin

8.10 Turn-Off

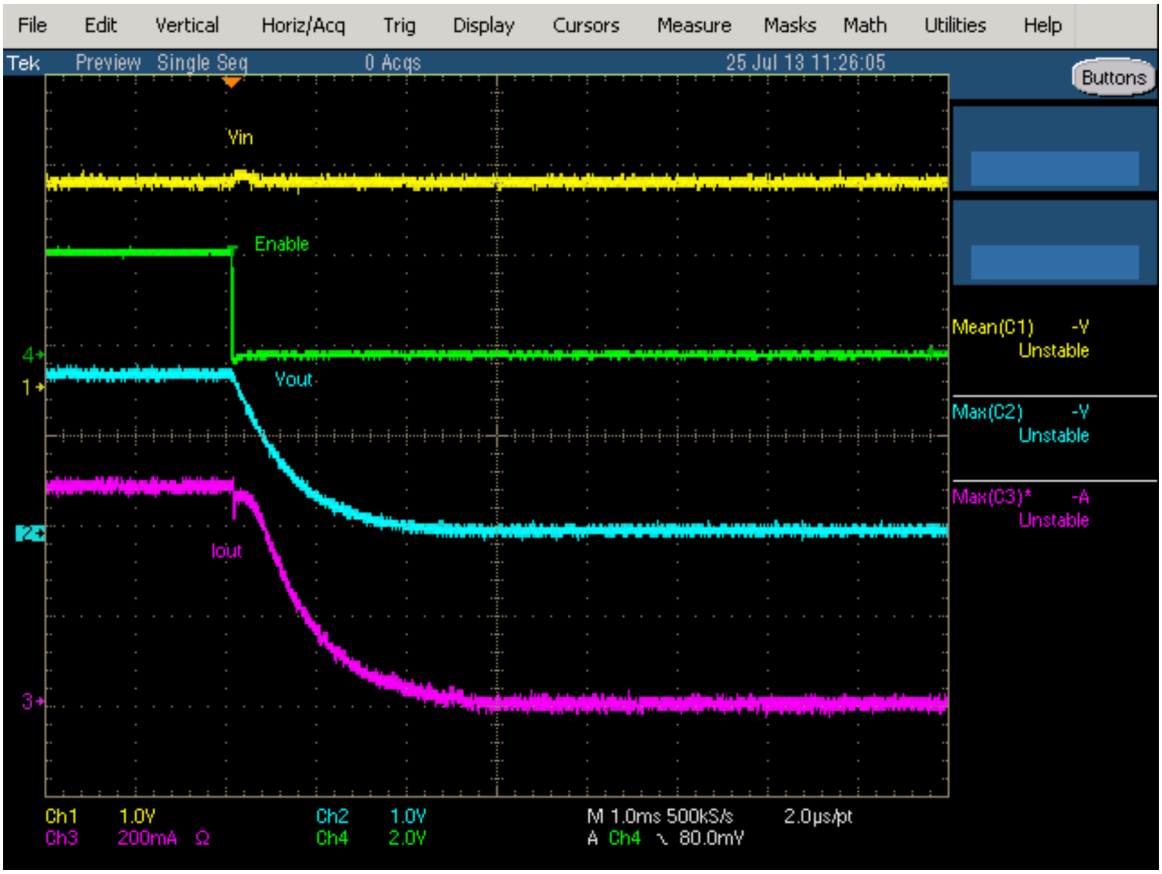

Figure 18. Turn-Off

8.11 Output Noise

Output noise is measured using HP3495A. For details on the setup see “Output Noise Measurement Setup” document. Plots below shows noise in µV/√Hz vs Frequency.

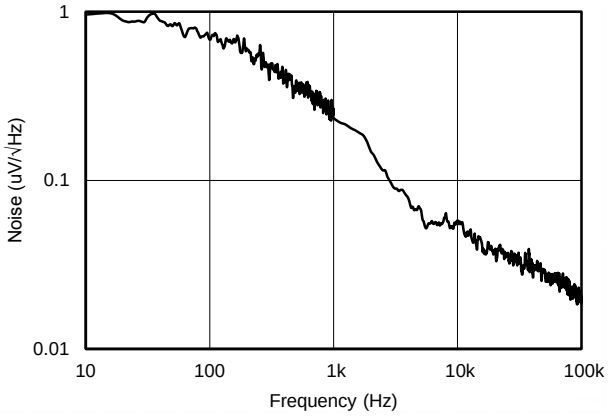

Figure 19. RMS Noise (10 Hz - 100 kHz) = 19.4113538 µVrms, V_{IN} = 2 V, V_{OUT} = 1.8 V at 0 A.

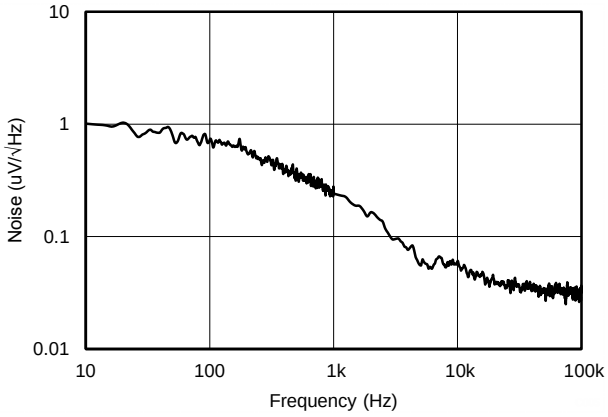

Figure 20. RMS Noise (10 Hz - 100 kHz) = 20.12 µVrms, V_{IN} = 2 V, V_{OUT} = 1.8 V at 0.25 A.

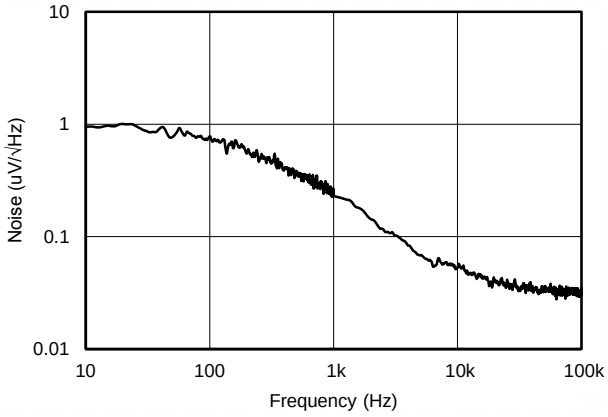

Figure 21. RMS Noise (10 Hz - 100 kHz) = 20.26 µVrms, V_{IN} = 2 V, V_{OUT} = 1.8 V at 0.5 A.

9 SCHEMATIC AND BILL OF MATERIALS

The following pages contain the TPS7H1201HTEVM schematic and bill of materials.

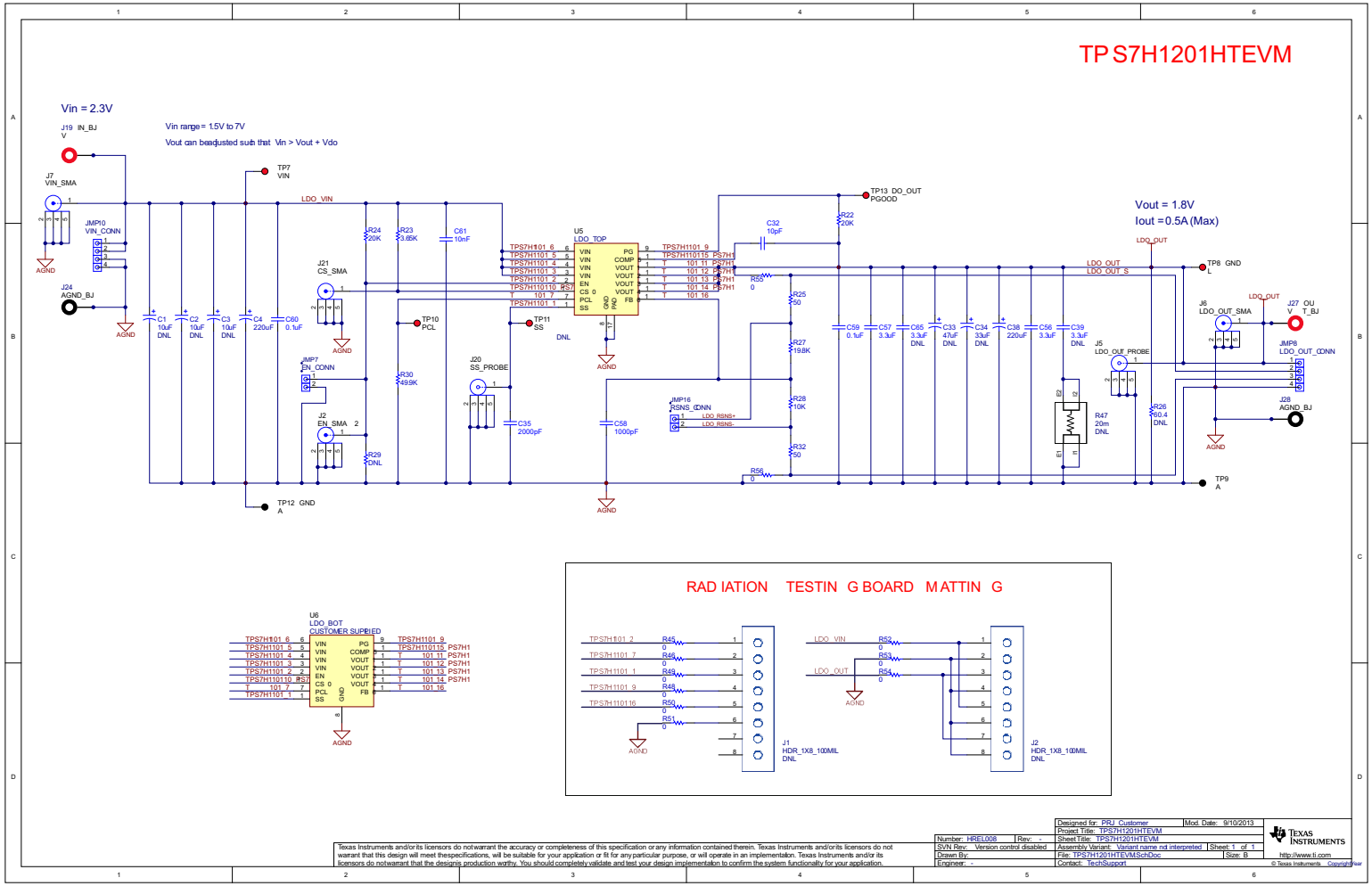

Figure 22. TPS7H1201HTEVM Schematic

Table 4. TPS7H1201HTEVM Bill of Materials

Item No.	Qty	Designator	Value	Footprint	Manufacturer	Part No.	Description
1	1	C4	220uF	7260-38	Kemet	T543X227M016ATE035	CAP TANT 220UF 16V 20% 2917
2	2	C32,C61	10nF	0805	Kemet	C0805C103K3RACTU	CAP CER 10000PF 25V 10% X7R 0805
3	1	C35	2000pF	0805	Kemet	C0805C202J3GACTU	CAP CER 2000PF 25V 5% NP0 0805
4	1	C38	220uF	7260-38	Kemet	T543X227M016ATE035	CAP TANT 220UF 16V 20% 2917
5	2	C56,C57	3.3uF	2225	MURATA	GRM55DR71H335KA01L	CAP CER 3.3UF 50V 10% X7R 2220
6	1	C58	1000pF	0805	Kemet	C0805C102J3GACTU	CAP CER 1000PF 25V 5% NP0 0805
7	2	C59,C60	0.1uF	0805	Kemet	C0805C104K3RACTU	CAP CER 0.1UF 25V 10% X7R 0805
8	1	J5			Tektronix	131-5031-00	Compact Probe Tip Circuit Board Test Points, TH
9	1	J6			Emerson	142-0701-231	Connector, TH, SMA, 50 ohms
10	1	J7			Emerson	142-0701-231	Connector, TH, SMA, 50 ohms
11	1	J19			DEM Manufacturing	571-0500	Standard Banana Jack, insulated, 10A, red
12	1	J27			DEM Manufacturing	571-0500	Standard Banana Jack, insulated, 10A, red
13	1	J20			Tektronix	131-5031-00	Compact Probe Tip Circuit Board Test Points, TH
14	1	J21			Emerson	142-0701-231	Connector, TH, SMA, 50 ohms
15	1	J22			Emerson	142-0701-231	Connector, TH, SMA, 50 ohms
16	2	J24,J28			DEM Manufacturing	571-0100	Standard Banana Jack, insulated, 10A, black
17	1	JMP7		HDR_1X2_TSW	Samtec	TSW-102-07-G-S	CONN HEADER 2POS .100 SGL GOLD"
18	1	JMP8		HDR_1X4_39544	Molex	39544-3004	CONN TERMINAL BLOCK 4POS 5.08MM
19	1	JMP10		HDR_1X4_39544	Molex	39544-3004	CONN TERMINAL BLOCK 4POS 5.08MM
20	1	JMP16		HDR_1X2_TSW	Samtec	TSW-102-07-G-S	CONN HEADER 2POS .100 SGL GOLD"
21	1	R22	20kΩ	1206	Stackpole	RNCP1206FTD20K0	RES 20K OHM 1/2W 1% 1206 SMD
22	1	R23	3.65kΩ	1206	Panasonic	ERJ-8ENF3651V	RES 3.65k, 1/4W, 1%, 100ppm/C 1206
23	1	R24	20kΩ	0805	Stackpole	RNCP0805FTD20K0	RES 20K OHM 1/4W 1% 0805 SMD
24	2	R25,R32	50Ω	0603	Panasonic	ERJ-3EKF49R9V	RES 49.9 OHM 1/10W 1% 0603 SMD
25	1	R27	19.8kΩ	1206	Stackpole	RNCF1206BTE19K8	RES 19.8K OHM 1/8W 0.1% 1206
26	1	R28	10kΩ	1206	Stackpole	RNCS1206BKE10K0	RES 1/8W 10K OHM 0.1% 1206
27	1	R30	49.9kΩ	0805	Stackpole	RMCF0805FT49K9	RES 49.9K OHM 1/8W 1% 0805 SMD
28	11	R45,R46,R48, R49,R50,R51, R52,R53,R54, R55,R56	0Ω	0603	Panasonic	ERJ-3GEY0R00V	RES 0.0 OHM 1/10W 0603 SMD
29	1	TP7			Keystone	5000	Test Point, TH, Miniature, Red
30	1	TP8			Keystone	5000	Test Point, TH, Miniature, Red
31	2	TP9,TP12			Keystone	5001	Test Point, TH, Miniature, Black
32	1	TP10			Keystone	5000	Test Point, TH, Miniature, Red
33	1	TP11			Keystone	5000	Test Point, TH, Miniature, Red
34	1	TP13			Keystone	5000	Test Point, TH, Miniature, Red

Table 4. TPS7H1201HTEVM Bill of Materials (continued)

Item No.	Qty	Designator	Value	Footprint	Manufacturer	Part No.	Description
35	1	U6		CFP (HKS)	Texas Instruments	TPS7H1201SHKS	IC installed as lid down at the back of the board
36	4				Keystone	2029K-ND	Standoffs
37	4				Pencom	4-40X1/4PH-PN-MS-SS	Screws for standoffs
38	1		HREL008		Any	HREL008	PCB
39	1				Brady	THT-13-457-10	Label on the EVM under TI logo = TPS7H1201HTEVM
							HREL008-001
40	0	C1,C2,C3	10uF	7260-38_1	Vishay	T95R106K050LSAL	CAP TANT 10UF 50V 10% 2824
41	0	C33	47uF	7260-38	Kemet	T491X476M035AT	CAP TANT 47UF 35V 20% 2917
42	0	C34	33uF	7260-38	Kemet	T491X336K035AT	CAP TANT 33UF 35V 10% 2917
43	0	C39,C65	3.3uF	2225	MURATA	GRM55DR71H335KA01L	CAP CER 3.3UF 50V 10% X7R 2220
44	0	J1,J2	HDR_1X8_100MIL	HDR_1X8_BCS	SAMTEC	BCS-108-F-S-TE	SKT 8 POS 2.54mm Solder ST Thru-Hole
45	0	R29	DNL	1206	TBD	TBD	TBD
46	0	R26	60.4Ω	2010	Rohm	MCR50JZHF60R4	RES 60.4 OHM 1/2W 1% 2010 SMD
47	0	R47	20mΩ	RES_Y14870R02000B0R	VISHAY	Y14870R02000B0R	Current sensing chip resistor, 20m OHM, 0.1%
48	0	U5		CFP (HKR)	Texas Instruments	TPS7H1201SHKR	IC installed as lid up at the top of the board

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２４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

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		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

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