TPS7H2211EVM Evaluation Module (EVM)

🐯 **TEXAS INSTRUMENTS**

Description

The TPS7H2211EVM demonstrates the operation of a single TPS7H2211 eFuse (Radiation Tolerant/ Hardened Plastic). The board provides footprints that can be populated with additional components to allow for testing of customized configurations, such as parallel or redundant eFuses.

Features

- Flexible configuration options, including single- and parallel-device circuits
- Customizable soft start, enable threshold, undervoltage threshold, and capacitance
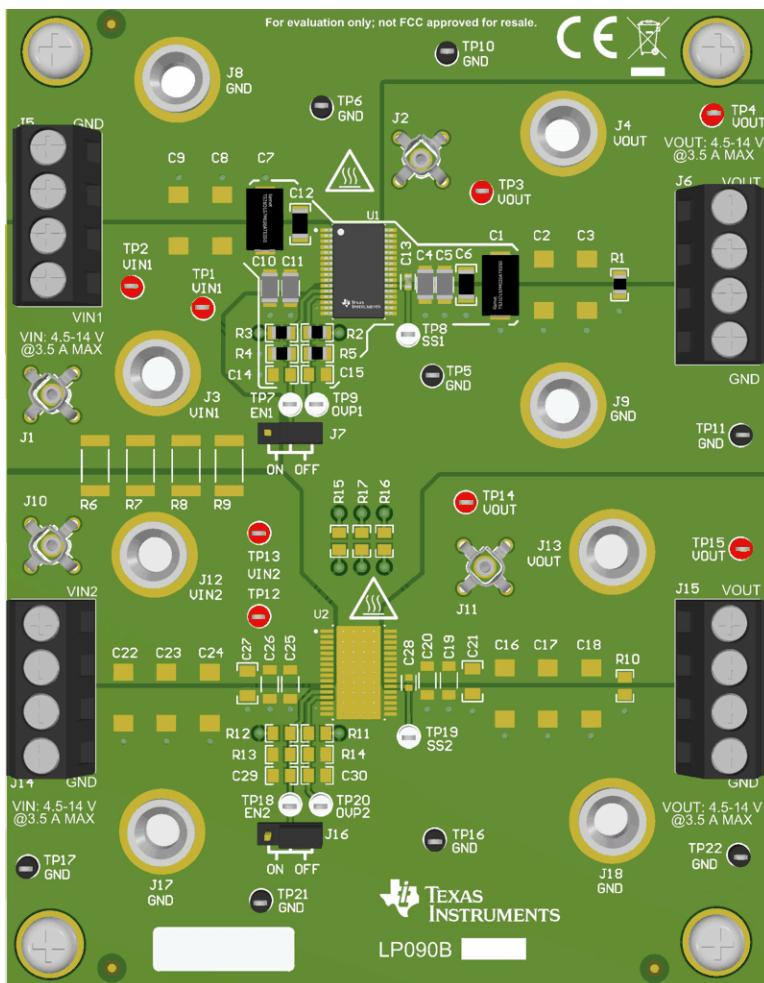
The EVM is populated for a single-device configuration. The footprints on the bottom half of the board can be populated if a parallel-device configuration is desired.

TPS7H2211EVM Board

1 Evaluation Module Overview

1.1 Introduction

The TPS7H2211EVM is the Evaluation Module (EVM) for the plastic package option of the TPS7H2211 and provides a platform to electrically evaluate the features. This user's guide provides details about the EVM, including the configuration, schematics, and BOM.

The EVM is designed to be used across the entire input voltage and output current range of the TPS7H2211 while providing flexibility in configuring the device under different conditions. By default, the device in the EVM is configured as shown in TPS7H2211EVM Default Configuration. To configure the device in a different configuration, please refer to the TPS7H2211 data sheet to calculate the values of the passives around the device that needs to be changed.

1.2 Kit Contents

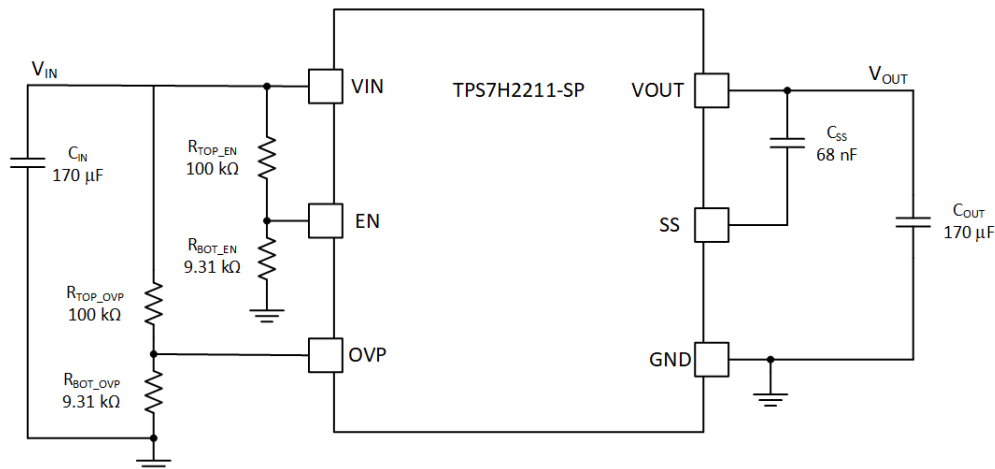- EVM board (1)
- EVM Kit User Guide (1)

1.3 Specification

Figure 1-1. Default Configuration Simplified Schematic

Table 1-1. TPS7H2211EVM Default Configuration

Specification	Value	Description
Input Voltage VIN	12 V	Falls within the recommended device input voltage range of 4.5 V to 14 V.
Output Current I_{OUT}	0 to 3.5 A	Does not exceed maximum device continuous current of 3.5 A per device.
EN Turn-on Voltage VIN_{EN_RISE}	7.4 V	Typical EN turn-on and turn-off values. Set by: R3 (R_{TOP_EN}) = 100 kΩ R4 (R_{BOT_EN}) = 9.31 kΩ
EN Turn-off Voltage VIN_{EN_FALL}	6.1 V	
OVP Enter Voltage VIN_{OVP_RISE}	13.5 V	Typical OVP enter and exit values. Set by: R2 (R_{TOP_OVP}) = 100 kΩ R5 (R_{BOT_OVP}) = 9.31 kΩ
OVP Exit Voltage VIN_{OVP_FALL}	13.4 V	
Soft Start Time t_{SS}	approx. 10 ms	Typical time to go from 10% to 90% of the final voltage. Set by: C13 (C_{SS}) = 68 nF

More detailed information about the default EVM configuration can be found in Figure 4-1 and Table 4-1.

1.3.1 Alternate Board Configurations

If a custom configuration is desired, then users need to refer to the TPS7H2211 data sheet to calculate the values of the passive components around the device and note any operational requirements.

In addition to the default EVM configuration, this user's guide provides an example for how the TPS7H2211EVM can be configured for parallel operation. The enable (EN) and overvoltage protection (OVP) specifications for the parallel configuration are the same as what is used for the default configuration. However, this configuration is capable of providing up to double the output current compared to the default configuration.

Table 1-2. TPS7H2211EVM Parallel Configuration

Specification	Value	Description
Input Voltage VIN	13 V	Falls within the recommended device input voltage range of 4.5 to 14 V.
Output Current I_{OUT}	0 to 7 A	Does not exceed maximum device continuous current of 3.5 A per device.
EN Turn-on Voltage VIN_{EN_RISE}	7.4 V	Typical EN turn-on and turn-off values. Set by: R3 (R_{TOP_EN}) = 100 kΩ R4 (R_{BOT_EN}) = 9.31 kΩ R15 populated
EN Turn-off Voltage VIN_{EN_FALL}	6.1 V	
OVP Enter Voltage VIN_{OVP_RISE}	13.5 V	Typical OVP enter and exit values. Set by: R2 (R_{TOP_OVP}) = 100 kΩ R5 (R_{BOT_OVP}) = 9.31 kΩ R17 populated
OVP Exit Voltage VIN_{OVP_FALL}	13.4 V	
Soft Start Time t_{SS}	approx. 10.9 ms	Typical time to go from 10% to 90% of the final voltage. Set by: C13 (C_{SS}) = 68 nF C28 (C_{SS}) = 68 nF R16 populated

More detailed information about the parallel EVM configuration can be found in Figure 4-2 and Table 4-2.

1.4 Device Information

The TPS7H2211 is a single-channel eFuse that provides reverse current protection, overvoltage protection, and a configurable rise time to minimize inrush current (soft start). The device contains P-channel MOSFETs that operate over an input voltage range of 4.5 V to 14 V and supports a maximum continuous current of 3.5 A. The device is controlled by an on and off input (EN), that is capable of interfacing directly with low-voltage control signals. Overvoltage protection and soft start are programmable with few external components through the OVP and SS pins.

• Data sheet: TPS7H2211-SP and TPS7H2211-SEP Radiation-Hardness-Assured (RHA) 14-V, 3.5-A eFuse
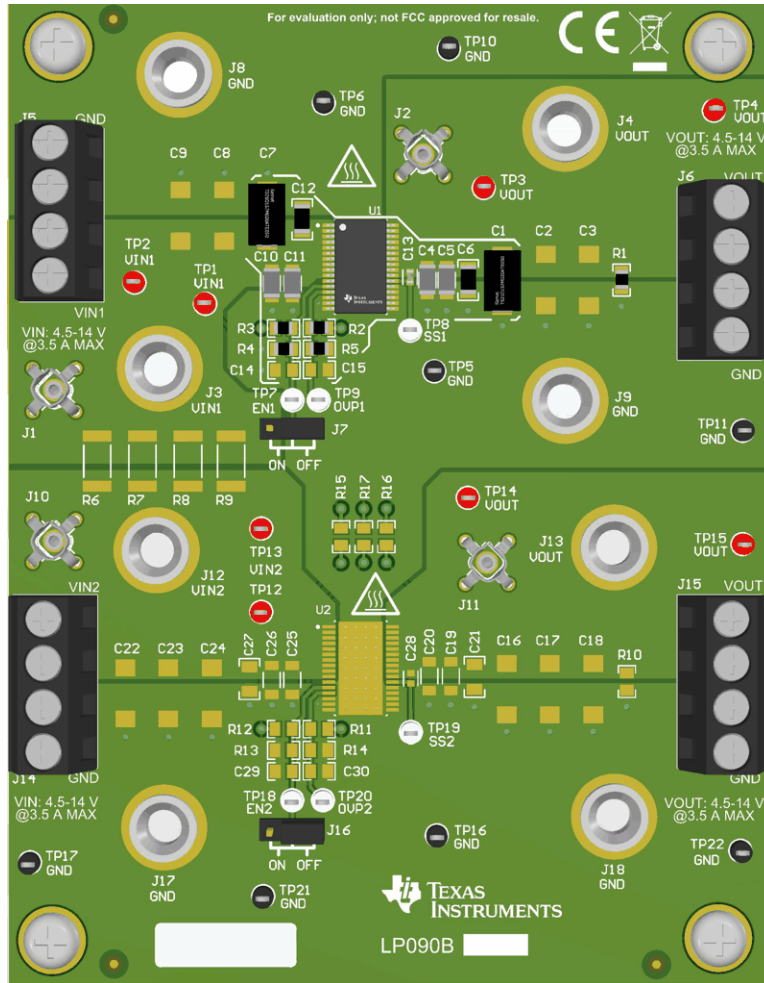
2 Hardware

2.1 EVM Connectors and Test Points

Figure 2-1. TPS7H2211EVM 3D Rendering (Top)

Table 2-1. Summary of Connectors and Test Points

Reference Designator	Function	
J3, J5 (pins 3 & 4)	VIN1	Input Voltage and Current for U1
J8, J5 (pins 1 & 2)	GND	
J12, J14 (pins 1 & 2)	VIN2	Input Voltage and Current for U2
J17, J14 (pins 3 & 4)	GND	
J4, J13, J6 (pins 3 & 4), J15 (pins 3 & 4)	VOUT	Output Voltage and Current for Board
J9, J18, J6 (pins 1 & 2), J15 (pins 1 & 2)	GND	

Table 2-1. Summary of Connectors and Test Points (continued)

Reference Designator	Function	
J1, TP1, TP2	VIN1	Test Point
J10, TP12, TP13	VIN2	
J2, J11, TP3, TP4, TP14, TP15	VOUT	
TP5, TP6, TP10, TP11, TP16, TP17, TP21, TP22	GND	
TP8	SS1	
TP19	SS2	
TP7	EN1	
TP18	EN2	
TP9	OVP1	
TP20	OVP2	
J7	VIN1-EN1-GND	Shunt for mode selection
J16	VIN2-EN2-GND	

3 Implementation Results

Test results are shown for both the default configuration and the parallel configuration shown in this document. For each configuration, the following tests were performed:

1. Startup
2. Shutdown
3. OVP Assertion
4. OVP Deassertion

3.1 Default Configuration Results

The results shown in Figure 3-1 through Figure 3-4 were observed using the TPS7H2211EVM in the default configuration with VIN = 12 V.
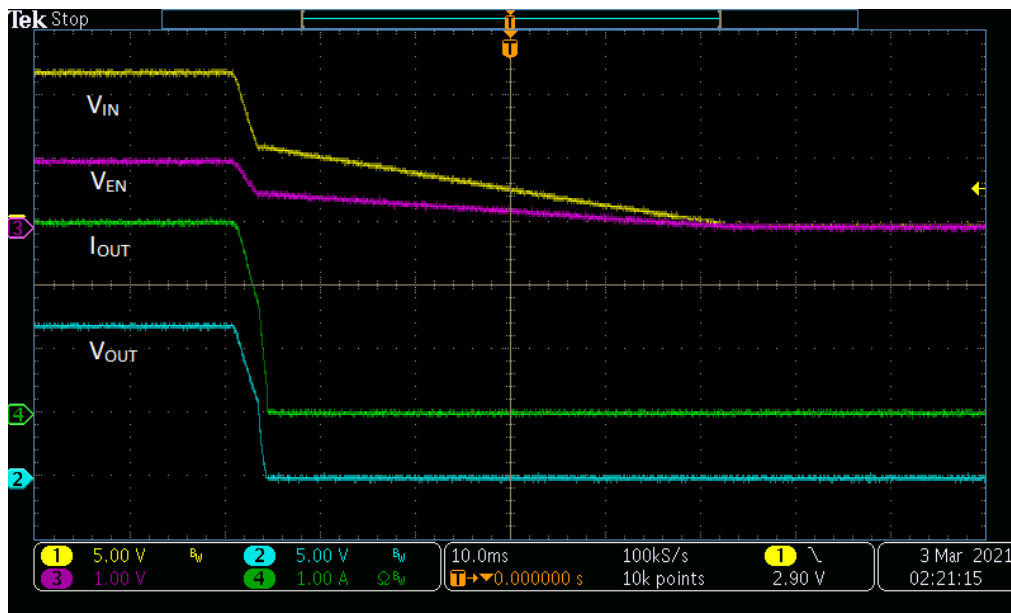

Figure 3-1. Default Configuration: Start Up

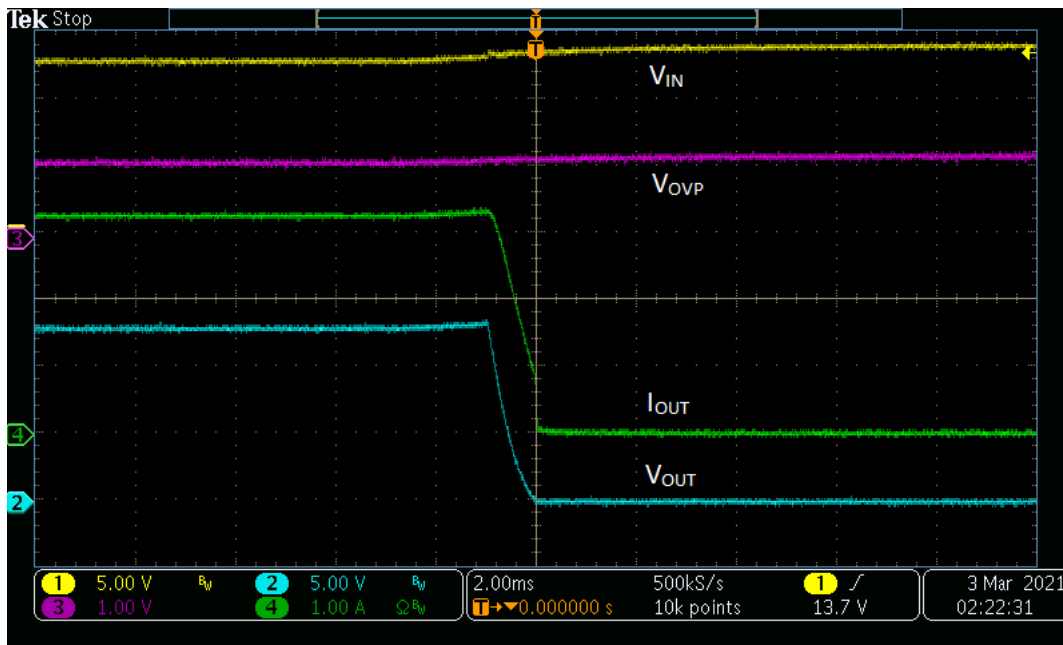**Figure 3-2. Default Configuration: Shutdown**

Figure 3-3. Default Configuration: Assertion of OVP Due to Input Voltage

Figure 3-4. Default Configuration: Deassertion of OVP Due to Input Voltage

3.2 Parallel Configuration Results

The results shown in Figure 3-5 through Figure 3-8 were observed using the TPS7H2211EVM in the parallel configuration shown in this document with VIN = 13 V.
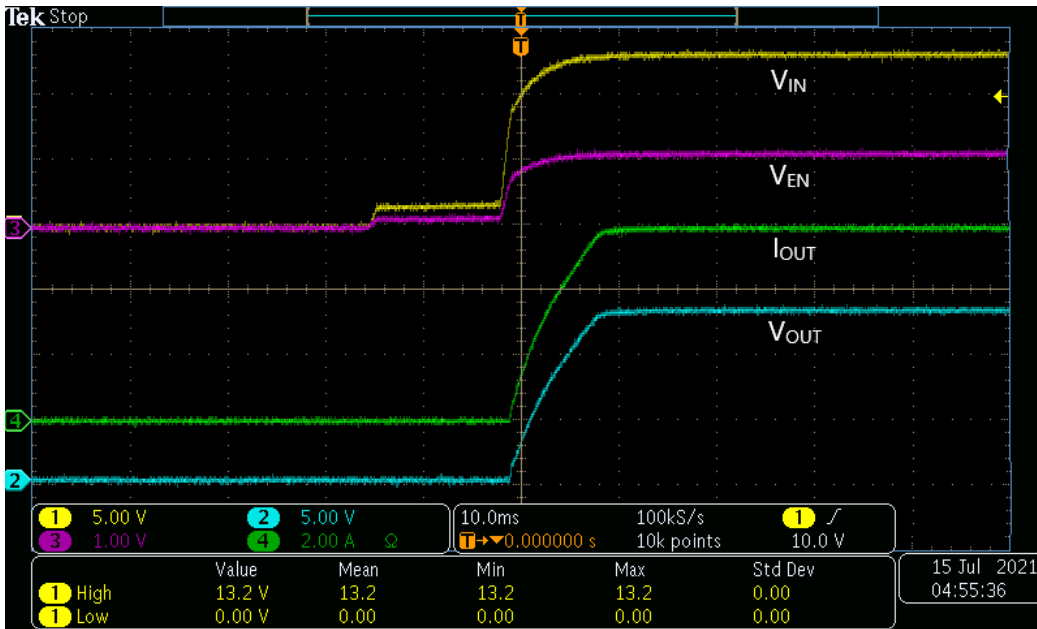

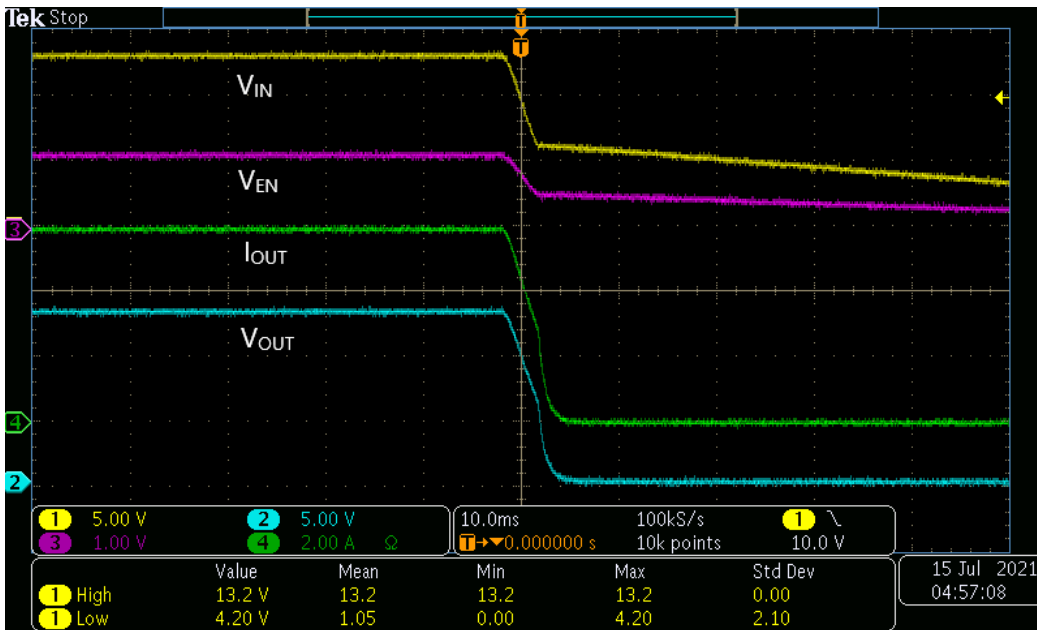**Figure 3-5. Parallel Configuration: Start Up**

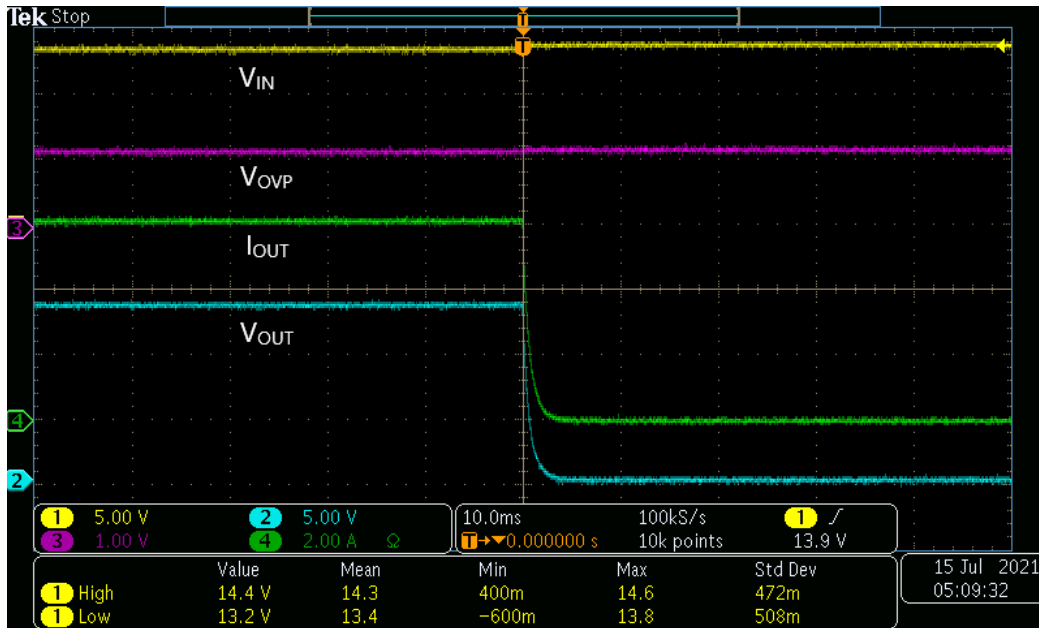**Figure 3-6. Parallel Configuration: Shutdown**

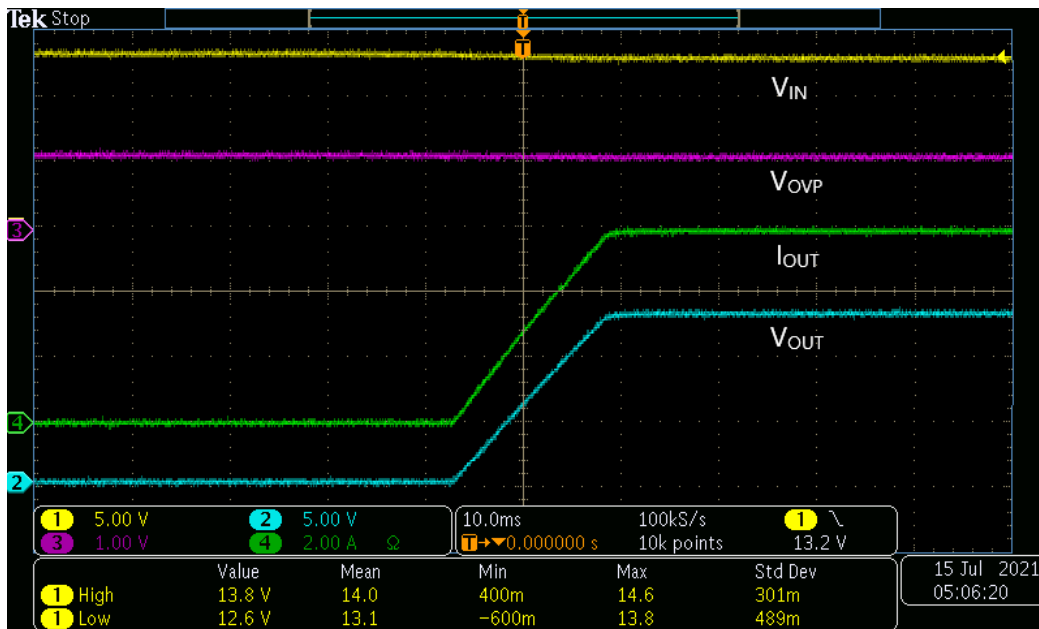**Figure 3-7. Parallel Configuration: Assertion of OVP due to Input Voltage**

Figure 3-8. Parallel Configuration: Deassertion of OVP due to Input Voltage

4 Hardware Design Files

4.1 Schematic

Figure 4-1 shows the default TPS7H2211EVM schematic. Figure 4-2 is the schematic for the parallel configuration of the EVM shown in this document.
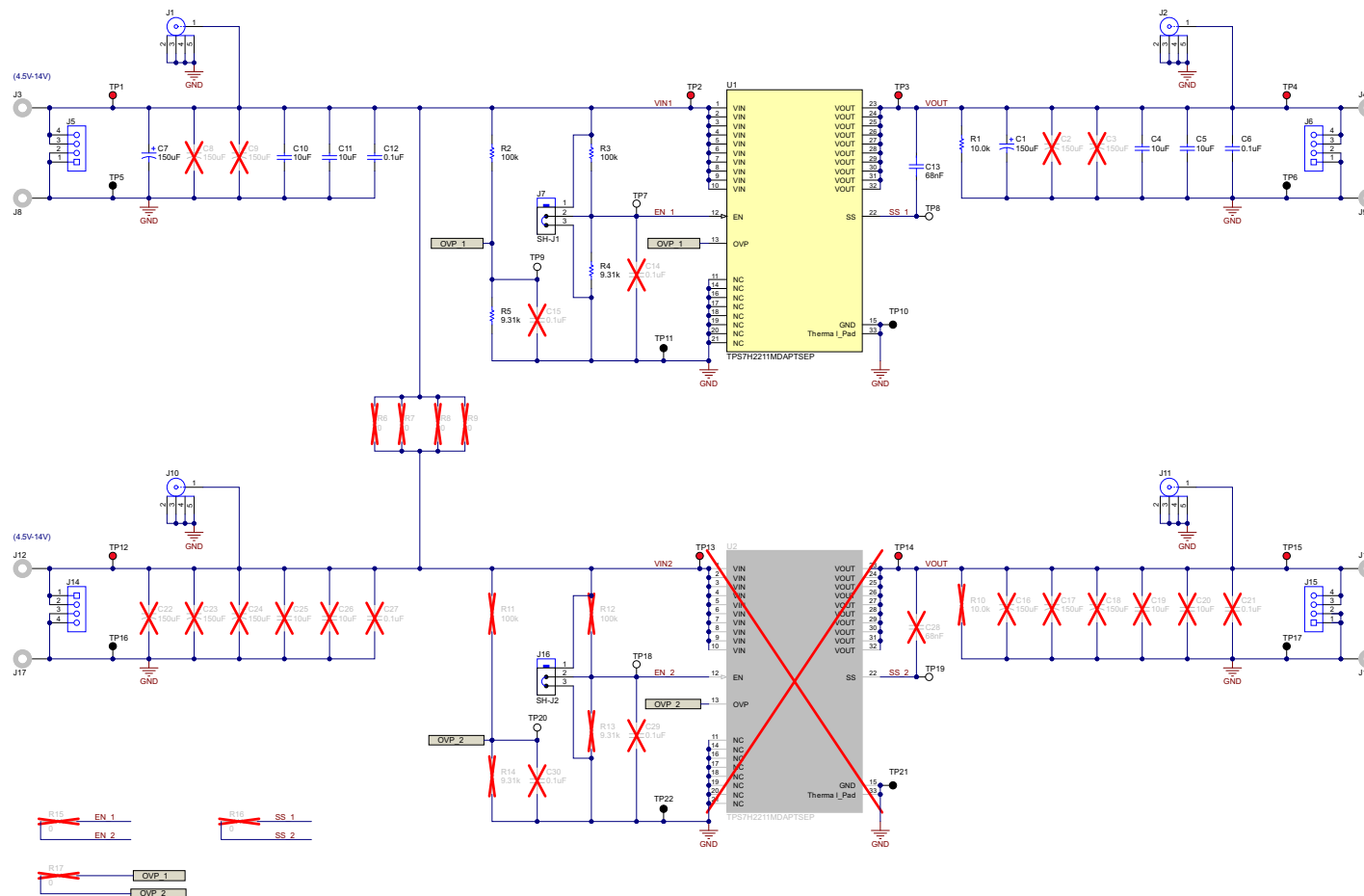

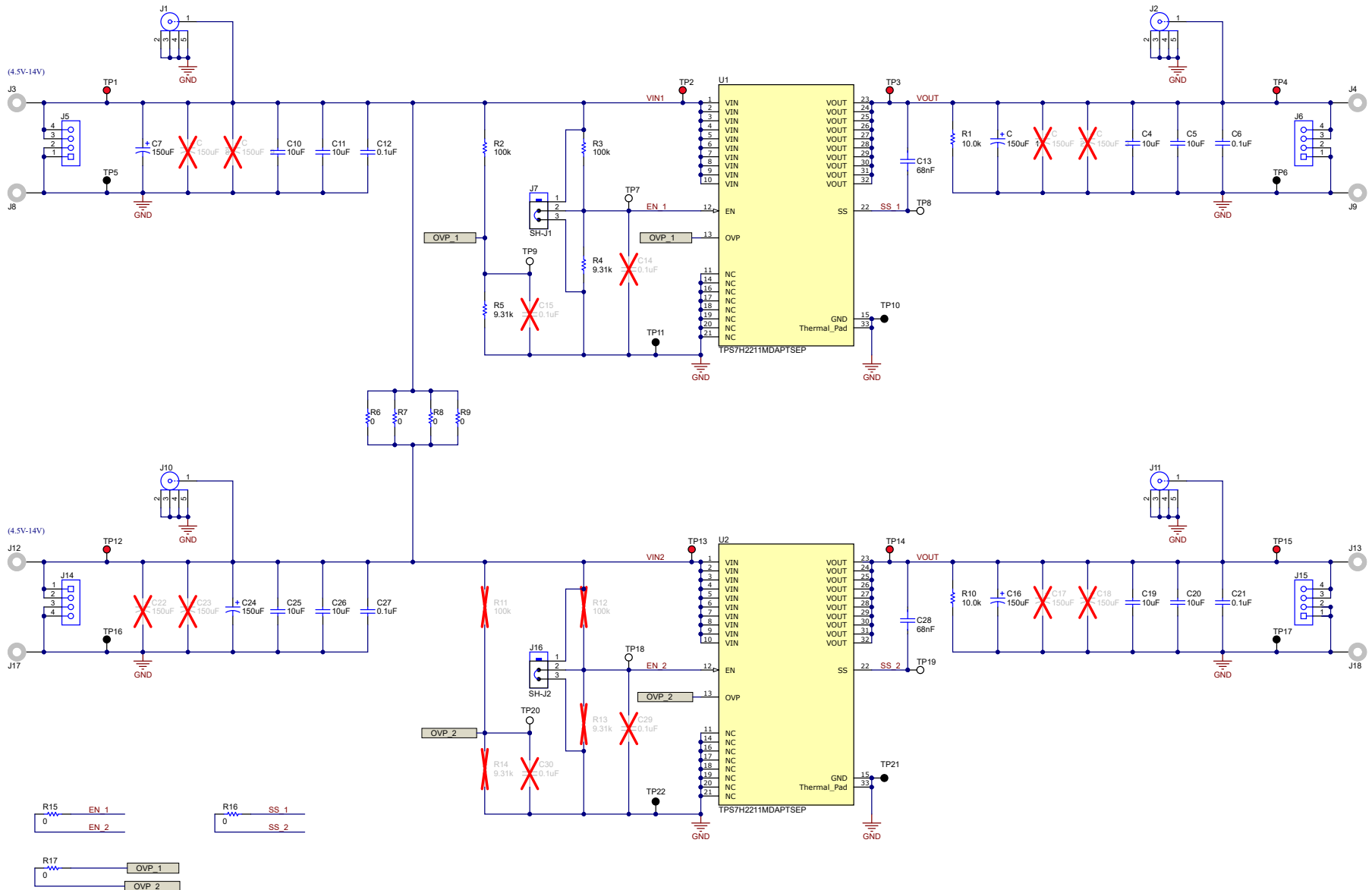**Figure 4-1. TPS7H2211EVM Default Schematic**

Figure 4-2. Example: TPS7H2211EVM Parallel Schematic

4.2 Board Layout

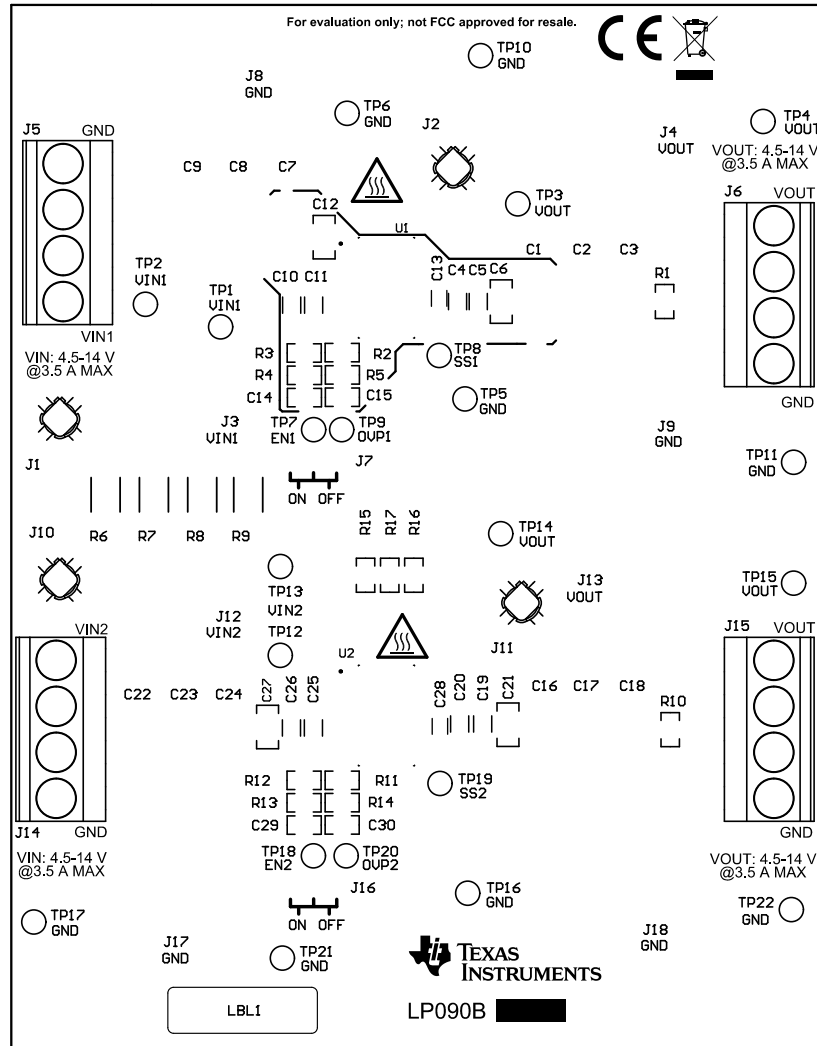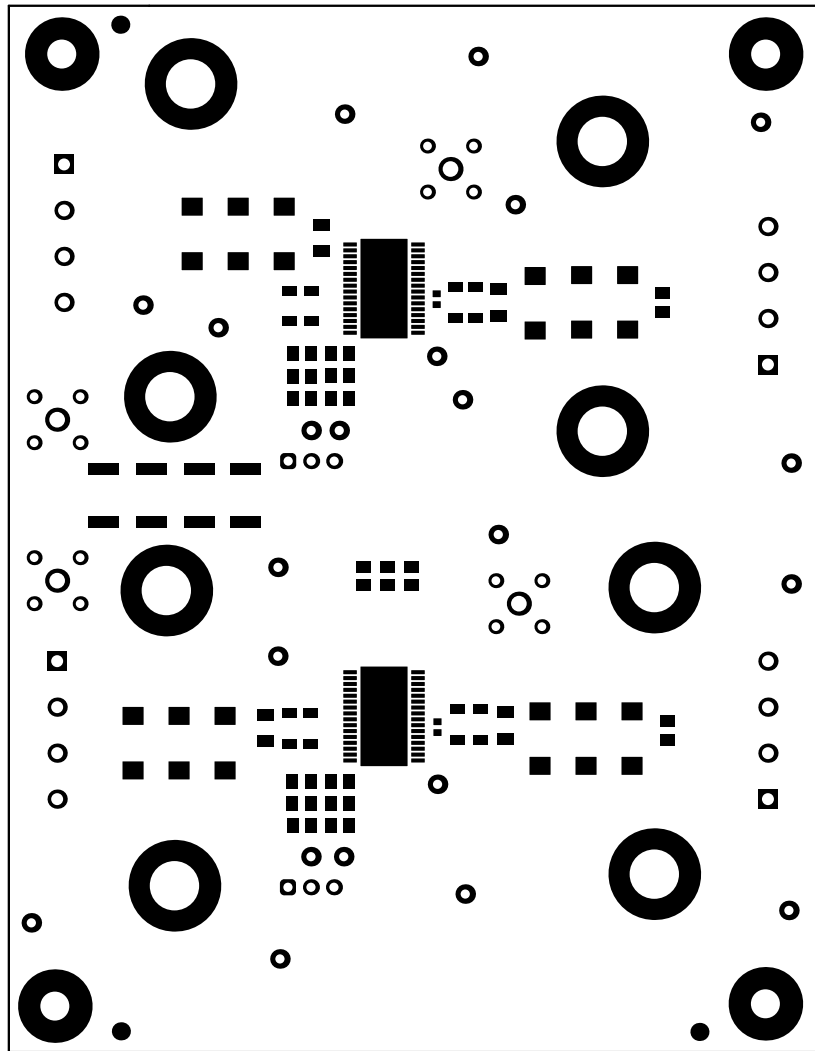Figure 4-3 through Figure 4-9 show the layout of the TPS7H2211EVM.

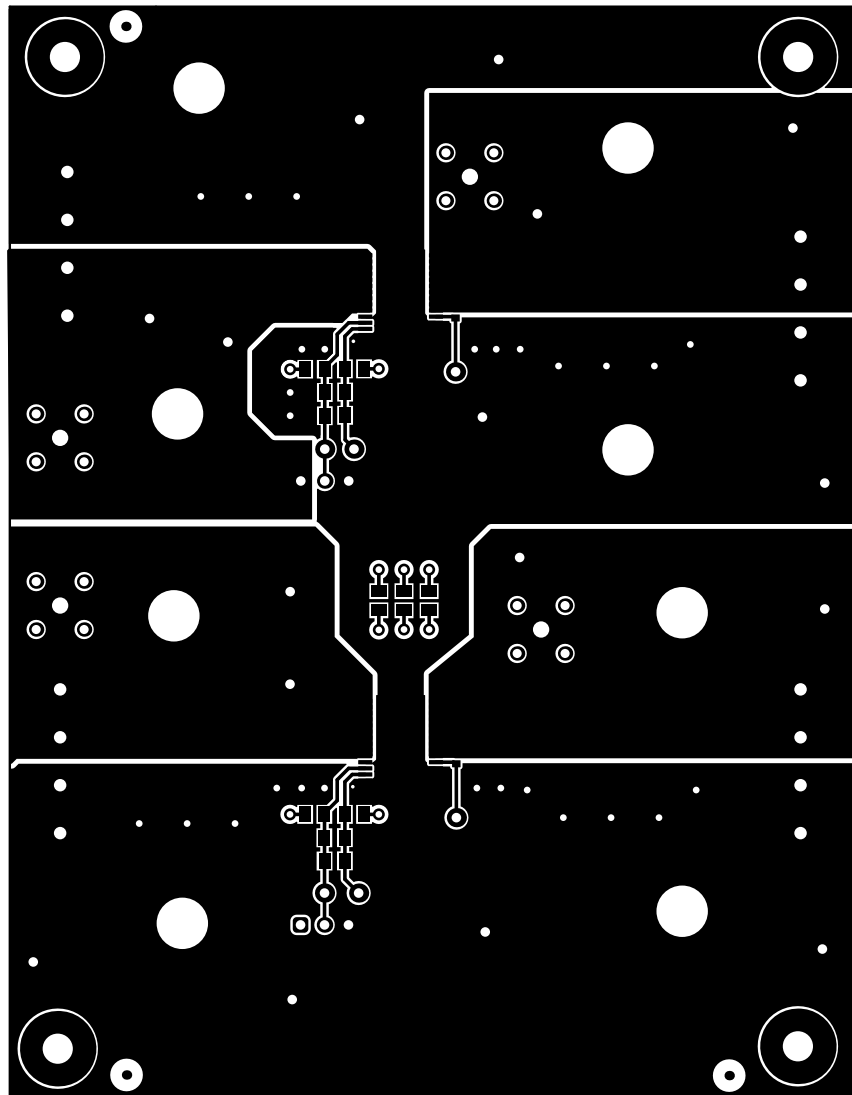
Figure 4-3. Top Overlay

Figure 4-4. Top Solder Mask
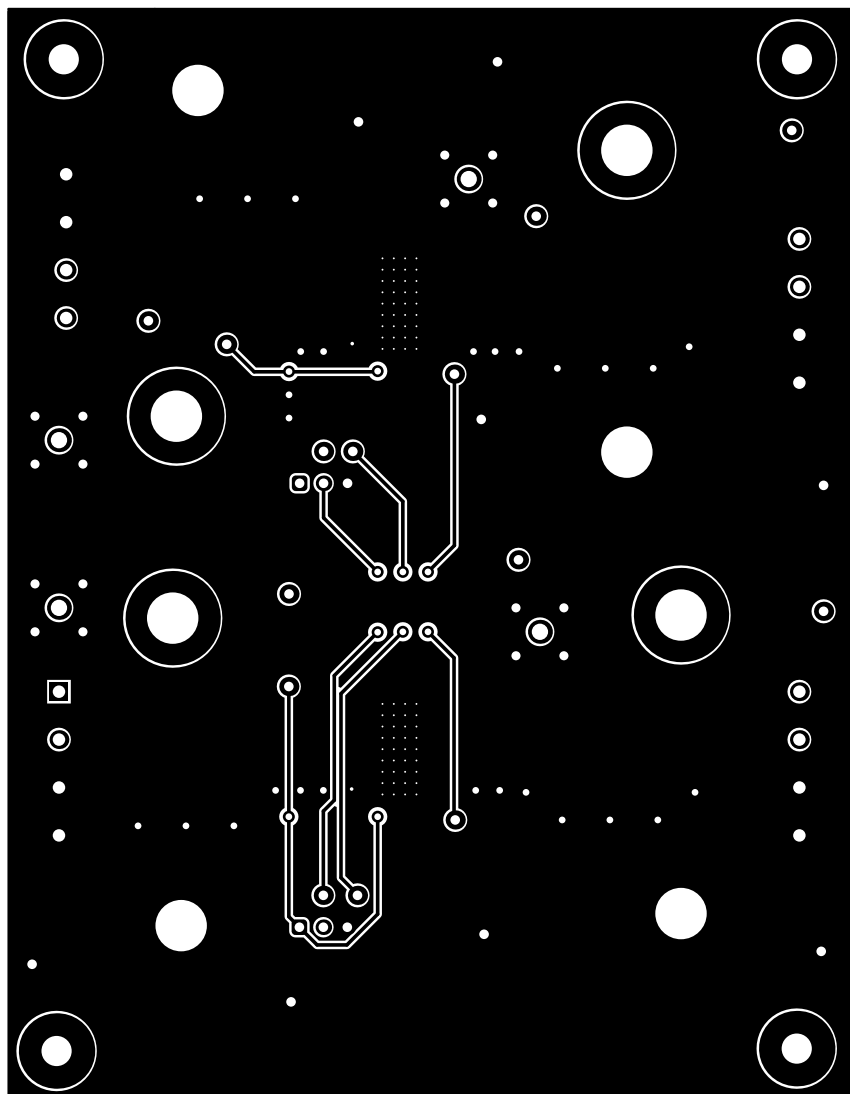
Figure 4-5. Layer 1 (Top)
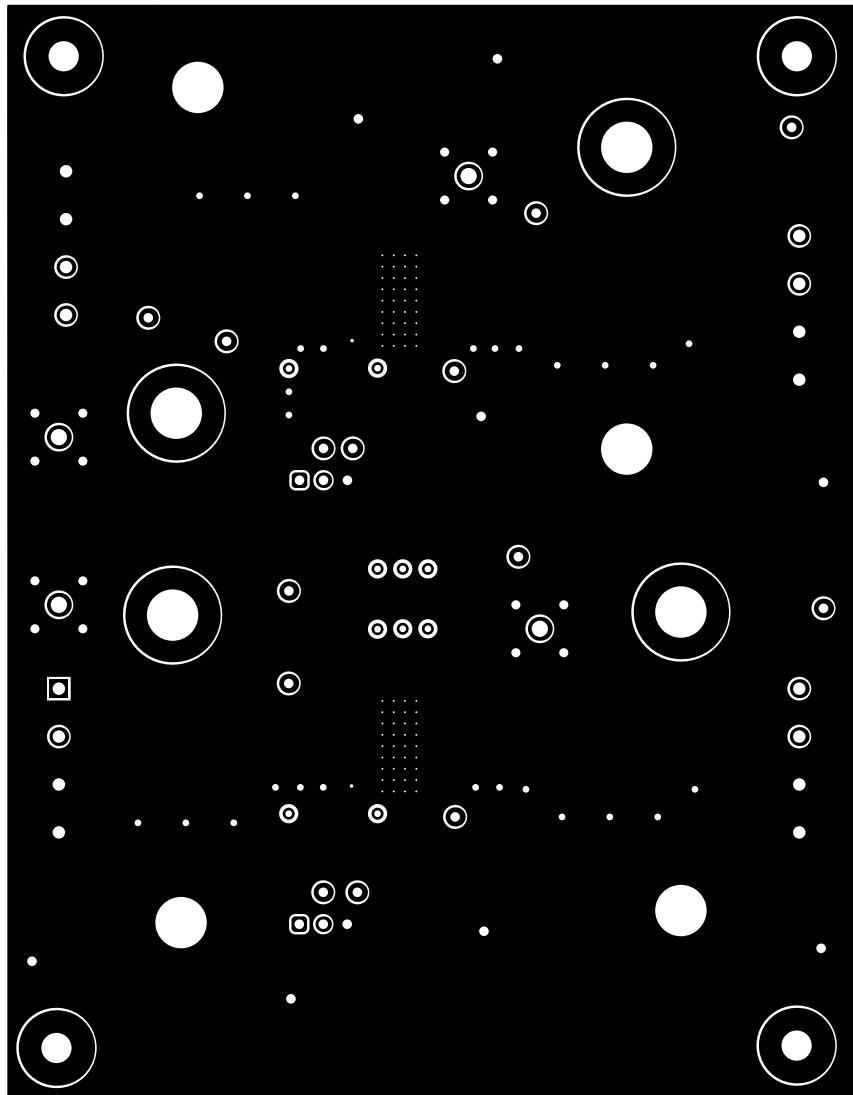
Figure 4-6. Layer 2
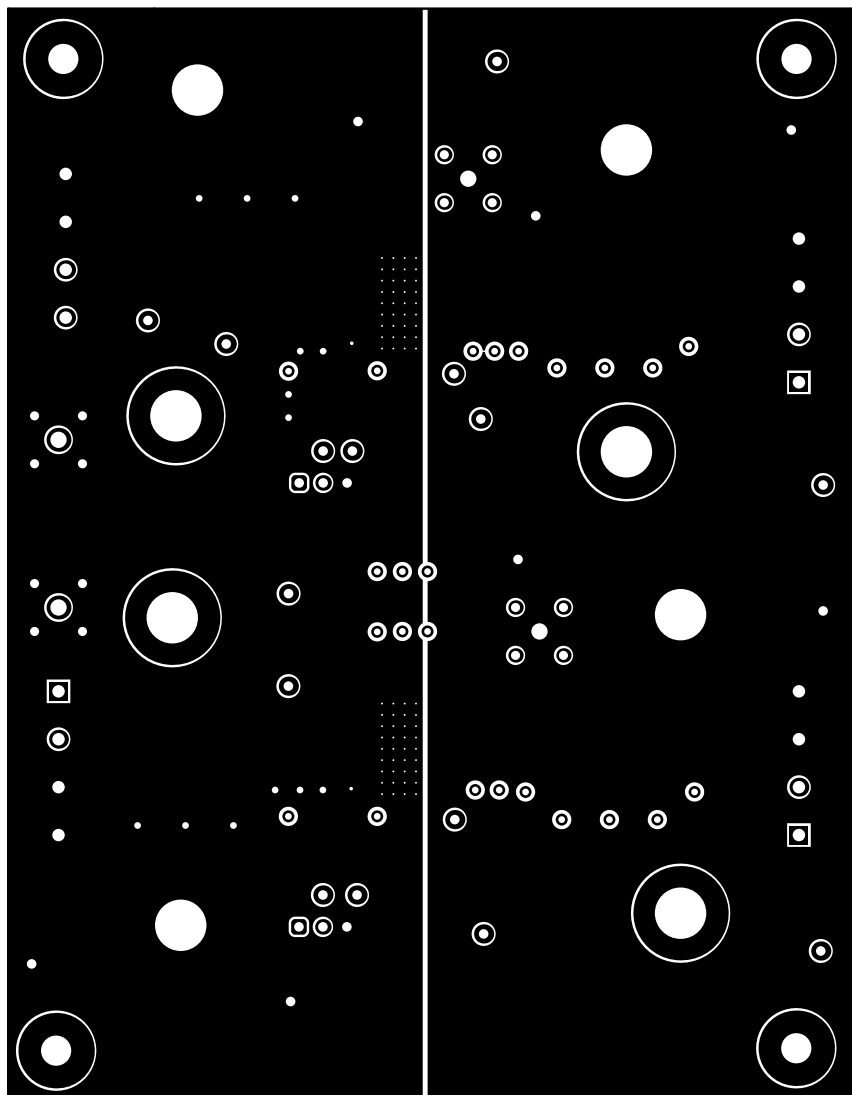
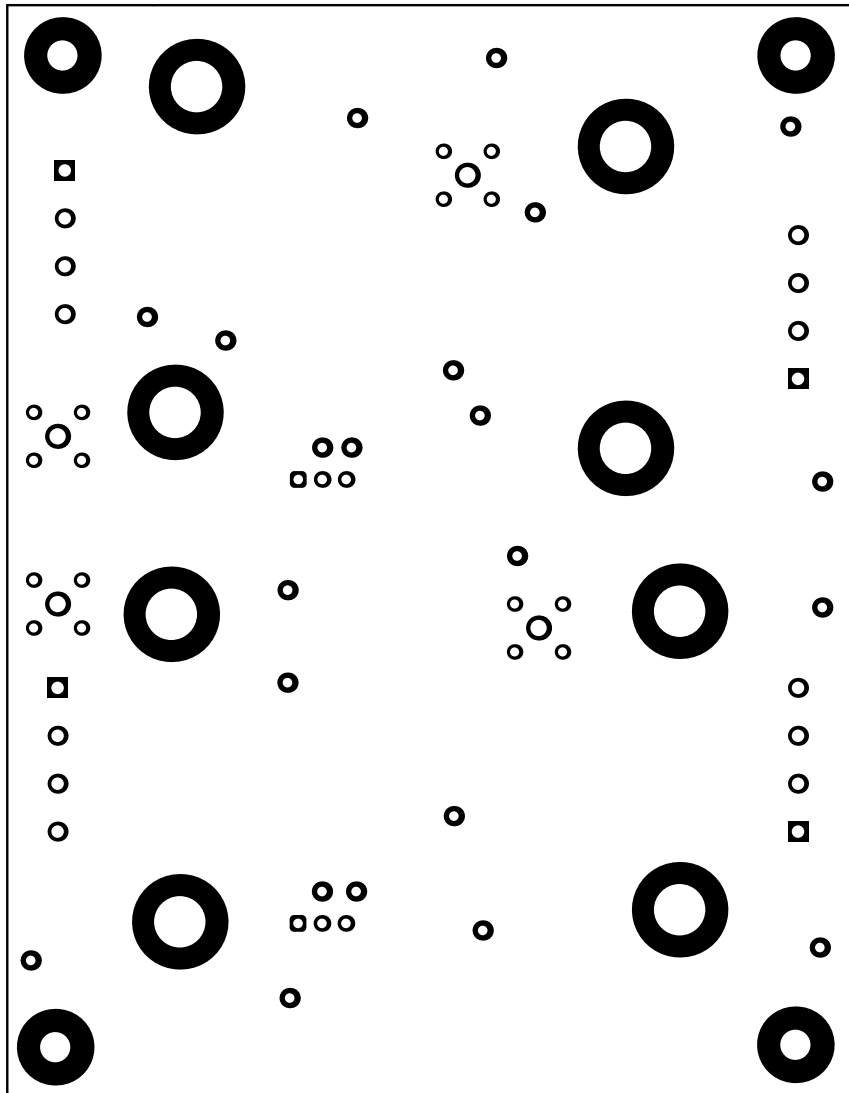**Figure 4-7. Layer 3-7**

Figure 4-8. Layer 8 (Bottom)

Figure 4-9. Bottom Solder

4.3 Bill of Materials (BOM)

Default Configuration Bill of Materials (BOM) lists the BOM for the default EVM configuration. Parallel Configuration Bill of Materials (BOM) lists the BOM for the parallel configuration of the EVM shown in this document.

Default Configuration Bill of Materials (BOM)

Table 4-1. TPS7H2211EVM Default Bill of Materials (BOM)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
C1, C7	2		150 µF Molded Tantalum Polymer Capacitor 20 V 2917 (7343 Metric) 50mOhm @ 100 kHz	2917	T521D157M020ATE050	Kemet
C4, C5, C10, C11	4	10uF	CAP, CERM, 10 uF, 50 V, +/- 10%, X5R, 1206_190	1206_190	CL31A106KBHNNNE	Samsung Electro-Mechanics
C6, C12	2	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 5%, X7R, 1206	1206	12065C104JAT2A	AVX
C13	1	68 nF	Cap Ceramic 0.068uF 50 V X7R 10% SMD 0603 125°C Paper T/R	603	C0603C683K5RAC7867	KemeT
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1, J2, J10, J11	4		Compact Probe Tip Circuit Board Test Points, TH, 25 per	TH Scope Probe	131-5031-00	Tektronix
J3, J4, J8, J9, J12, J13, J17, J18	8		Standard Banana Jack, Uninsulated, 5.5mm	Keystone_575-4	575-4	Keystone
J5, J6, J14, J15	4		Terminal Block, 4x1, 5.08mm, TH	4x1 Terminal Block	39544-3004	Molex
J7, J16	2		Header, 100mil, 3x1, Gold, TH	3x1 Header	TSW-103-07-G-S	Samtec
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650 x 0.200 inch	THT-14-423-10	Brady
R1	1	10.0k	RES, 10.0 k, 1%, 0.2 W, 0805	805	MCU08050C1002FP500	Vishay/Beyschlag
R2, R3	2	100k	RES, 100 k, 1%, 0.125 W, 0805	805	CRG0805F100K	TE Connectivity
R4, R5	2	9.31k	RES, 9.31 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	805	CRCW08059K31FKEA	Vishay-Dale
SH-J1, SH-J2	2	1x2	Shunt, 100mil, Flash Gold, Black	Closed Top 100mil Shunt	SPC02SYAN	Sullins Connector Solutions
TP1, TP2, TP3, TP4, TP12, TP13, TP14, TP15	8		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone
TP5, TP6, TP10, TP11, TP16, TP17, TP21, TP22	8		Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone
TP7, TP8, TP9, TP18, TP19, TP20	6		Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone
U1	1		Radiation-Hardness-Assured (RHA) 14-V, 3.5-A eFuse	TSSOP32	TPS7H2211MDAPTSEP	Texas Instruments

Table 4-1. TPS7H2211EVM Default Bill of Materials (BOM) (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
C2, C3, C8, C9, C16, C17, C18, C22, C23, C24	0		150 µF Molded Tantalum Polymer Capacitor 20 V 2917 (7343 Metric) 50mOhm @ 100 kHz	2917	T521D157M020ATE050	Kemet
C14, C15, C29, C30	0	0.1uF	CAP, CERM, 0.1 uF, 25 V, +/- 5%, X7R, 0805	805	08053C104JAZ2A	AVX
C19, C20, C25, C26	0	10uF	CAP, CERM, 10 uF, 50 V, +/- 10%, X5R, 1206_190	1206_190	CL31A106KBHNNNE	Samsung Electro-Mechanics
C21, C27	0	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 5%, X7R, 1206	1206	12065C104JAT2A	AVX
C28	0	68 nF	Cap Ceramic 0.068uF 50 V X7R 10% SMD 0603 125°C Paper T/R	603	C0603C683K5RAC7867	Kemet
R6, R7, R8, R9	0	0	RES, 0, 5%, 1 W, 2512	2512	RC6432J000CS	Samsung
R10	0	10.0k	RES, 10.0 k, 1%, 0.2 W, 0805	805	MCU08050C1002FP500	Vishay/Beyschlag
R11, R12	0	100k	RES, 100 k, 1%, 0.125 W, 0805	805	CRG0805F100K	TE Connectivity
R13, R14	0	9.31k	RES, 9.31 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	805	CRCW08059K31FKEA	Vishay-Dale
R15, R16, R17	0	0	RES, 0, 5%, 0.125 W, AEC-Q200 Grade 0, 0805	805	CRCW08050000Z0EA	Vishay-Dale
U2	0		Radiation-Hardness-Assured (RHA) 14-V, 3.5-A eFuse	TSSOP32	TPS7H2211MDAPTSEP	Texas Instruments

Parallel Configuration Bill of Materials (BOM)

An example BOM for the EVM configured for parallel operation is provided below.

Table 4-2. Example: TPS7H2211EVM Parallel Bill of Materials (BOM

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
C1, C7, C16, C24	4		150 µF Molded Tantalum Polymer Capacitor 20 V 2917 (7343 Metric) 50mOhm @ 100 kHz	2917	T521D157M020ATE050	Kemet
C4, C5, C10, C11, C19, C20, C25, C26	8	10uF	CAP, CERM, 10 uF, 50 V, +/- 10%, X5R, 1206_190	1206_190	CL31A106KBHNNNE	Samsung Electro-Mechanics
C6, C12, C21, C27	4	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 5%, X7R, 1206	1206	12065C104JAT2A	AVX
C13, C28	2	68 nF	Cap Ceramic 0.068uF 50 V X7R 10% SMD 0603 125°C Paper T/R	603	C0603C683K5RAC7867	KEMET
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1, J2, J10, J11	4		Compact Probe Tip Circuit Board Test Points, TH, 25 per	TH Scope Probe	131-5031-00	Tektronix
J3, J4, J8, J9, J12, J13, J17, J18	8		Standard Banana Jack, Uninsulated, 5.5mm	Keystone_575-4	575-4	Keystone
J5, J6, J14, J15	4		Terminal Block, 4x1, 5.08mm, TH	4x1 Terminal Block	39544-3004	Molex
J7, J16	2		Header, 100mil, 3x1, Gold, TH	3x1 Header	TSW-103-07-G-S	Samtec
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650 x 0.200 inch	THT-14-423-10	Brady
R1, R10	2	10.0k	RES, 10.0 k, 1%, 0.2 W, 0805	805	MCU08050C1002FP500	Vishay/Beyschlag
R2, R3, R11, R12	4	100k	RES, 100 k, 1%, 0.125 W, 0805	805	CRG0805F100K	TE Connectivity
R4, R5, R13, R14	4	9.31k	RES, 9.31 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	805	CRCW08059K31FKEA	Vishay-Dale
R6, R7, R8, R9	4	0	RES, 0, 5%, 1 W, 2512	2512	RC6432J000CS	Samsung
R15, R16, R17	3	0	RES, 0, 5%, 0.125 W, AEC-Q200 Grade 0, 0805	805	CRCW08050000Z0EA	Vishay-Dale
SH-J1, SH-J2	2	1x2	Shunt, 100mil, Flash Gold, Black	Closed Top 100mil Shunt	SPC02SYAN	Sullins Connector Solutions
TP1, TP2, TP3, TP4, TP12, TP13, TP14, TP15	8		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone
TP5, TP6, TP10, TP11, TP16, TP17, TP21, TP22	8		Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone
TP7, TP8, TP9, TP18, TP19, TP20	6		Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone

Table 4-2. Example: TPS7H2211EVM Parallel Bill of Materials (BOM (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
U1, U2	2		Radiation-Hardness-Assured (RHA) 14-V, 3.5-A eFuse	TSSOP32	TPS7H2211MDAPTSEP	Texas Instruments
C2, C3, C8, C9, C17, C18, C22, C23	0		150 µF Molded Tantalum Polymer Capacitor 20 V 2917 (7343 Metric) 50mOhm @ 100 kHz	2917	T521D157M020ATE050	Kemet
C14, C15, C29, C30	0	0.1uF	CAP, CERM, 0.1 uF, 25 V, +/- 5%, X7R, 0805	805	08053C104JAZ2A	AVX

5 Related Documentation

- Texas Instruments, Standard Terms for Evaluation Modules

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

    1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

    1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

    2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

    2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

    2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.

User shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3   *Regulatory Notices:*

3.1   *United States*

3.1.1   *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2   *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2   *Canada*

3.2.1   *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

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

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,

2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or

3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けて

いないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの

措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。 　　　上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・イ

ンスツルメンツ株式会社

東京都新宿区西新宿６丁目２４番１号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page 電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4   *EVM Use Restrictions and Warnings:*

    4.1   EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

    4.2   User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

    4.3   *Safety-Related Warnings and Restrictions:*

        4.3.1   User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

        4.3.2   EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

    4.4   User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5.   *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6.   *Disclaimers:*

    6.1   EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

    6.2   EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7.   *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

IMPORTANT NOTICE AND DISCLAIMER