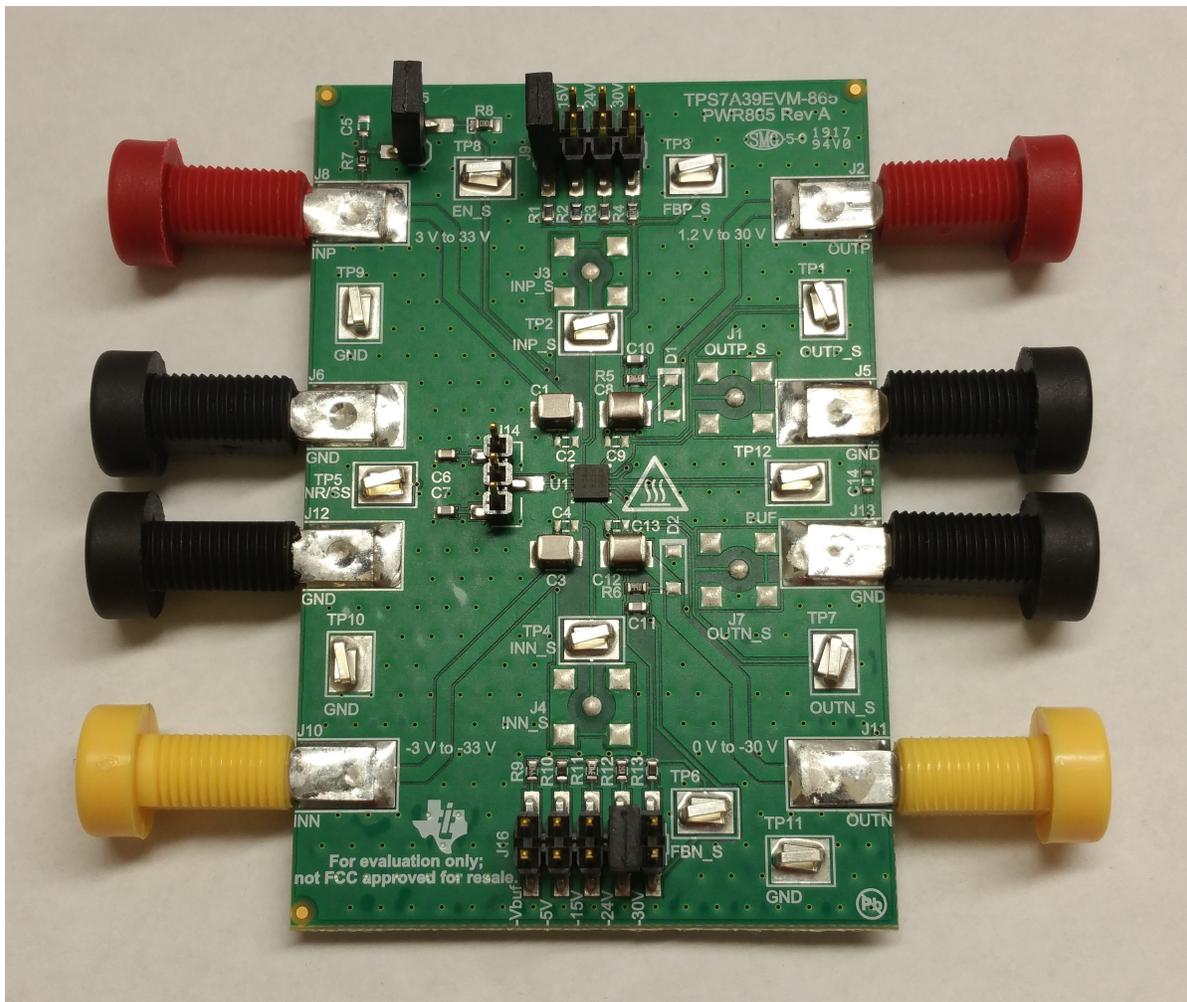


TPS7A39EVM-865 Evaluation Module



This user's guide describes the operational use of the TPS7A39EVM-865 evaluation module (EVM) as a reference design for engineering demonstration and evaluation of the TPS7A3901DSC, low-dropout linear regulator (LDO). Included in this user's guide are setup and operating instructions, layout guidelines, a printed circuit board (PCB) layout, a schematic diagram, and a bill of materials (BOM).

Throughout this document, the terms *demonstration kit*, *evaluation board*, and *evaluation module* are synonymous with the TPS7A39EVM-865.

The following related documents are available through the Texas Instruments web site at www.ti.com.

Related Documentation

Device	Literature Number
TPS7A39	SBVS263

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1 Introduction

The Texas Instruments' TPS7A39EVM-865 EVM helps design engineers evaluate the operation and performance of the TPS7A39 for possible use in their own circuit application. This particular EVM configuration contains a single TPS7A39 device which integrates a positive and a negative monolithic bipolar LDO to simplify signal chain dual-rail power-supply design. The regulator is capable of delivering up to 150 mA per channel to the load. For stability, use a 10- μ F (or larger) input and a 10- μ F (or larger) output capacitor for each channel of the TPS7A39.

1.1 Before You Begin

The following warnings and cautions are noted for the safety of anyone using or working close to the TPS7A39EVM-865. Observe all safety precautions.



Warning

Warning Hot surface. Contact may cause burns. Do not touch.

CAUTION

The circuit module may be damaged by overtemperature. To avoid damage, monitor the temperature during evaluation and provide cooling, as needed, for your system environment.

CAUTION

Some power supplies can be damaged by application of external voltages. If using more than one power supply, check your equipment requirements and use blocking diodes or other isolation techniques, as needed, to prevent damage to your equipment.

CAUTION

The circuit module is not a finished product or electrical appliance. The module does not contain current or voltage thresholds for circuit protection. It must be used by qualified personnel with additional equipment for evaluation only.

2 EVM Setup

This section describes how to properly connect and setup the TPS7A39EVM-865, including the jumpers and connectors on the EVM board.

2.1 *Input/Output Connectors and Jumper Descriptions*

2.1.1 J1 – OUTP_S

Positive output sense test point. An SMA connector (not provided) can be added here.

2.1.2 J2 – OUTP

Regulated positive output voltage connector.

2.1.3 J3 – INP_S

Positive input sense test point. An SMA connector (not provided) can be added here.

2.1.4 J4 – INN_S

Negative input sense test point. An SMA connector (not provided) can be added here.

2.1.5 J5 – GND

Positive output ground return connector.

2.1.6 J6 – GND

Positive input ground return connector.

2.1.7 J7 – OUTN_S

Negative output sense test point. An SMA connector (not provided) can be added here.

2.1.8 J8 – INP

Positive input voltage power-supply connector. Keep the positive input lead as short as possible to minimize input inductance.

2.1.9 J9 – Positive LDO Resistor Divider

TPS7A39EVM-865 is prepopulated with four resistor dividers for the positive output voltage. Place a short to select the desired output voltage from the silkscreen.

2.1.10 J10 – INN

Negative input voltage power-supply connector. Keep the negative input lead as short as possible to minimize input inductance.

2.1.11 J11 – OUTN

Regulated negative output voltage connector.

2.1.12 J12 – GND

Negative input ground return connector.

2.1.13 J13 – GND

Negative output ground return connector.

2.1.14 J14 – NR/SS

TPS7A39EVM-865 is prepopulated with two NR/SS capacitors. Select the desired value.

2.1.15 J15 – EN

Output enable. To enable the outputs, connect a jumper to short INP to EN.

2.1.16 J16 – Negative LDO Resistor Divider

TPS7A39EVM-865 is prepopulated with five options for the negative output voltage. Place a short to select the desired output voltage from the silkscreen.

2.1.17 TP1 – OUTP_S

Positive output sense test point.

2.1.18 TP2 – INP_S

Positive input sense test point.

2.1.19 TP3 – FBP_S

Positive feedback sense test point.

2.1.20 TP4 – INN_S

Negative input sense test point.

2.1.21 TP5 – NR/SS

NR/SS sense test point.

2.1.22 TP6 – FBN_S

Negative feedback sense test point.

2.1.23 TP7 – OUTN_S

Negative output sense test point.

2.1.24 TP8 – EN_S

Enable sense test point.

2.1.25 TP9 – GND

Ground test point.

2.1.26 TP10 – GND

Ground test point.

2.1.27 TP11 – GND

Ground test point.

2.2 TP12 – BUF

Buffer pin test point.

2.3 Soldering Guidelines

To avoid damaging the integrated circuit (IC), use a hot-air system for any solder rework to modify the EVM for the purpose of repair or other application reasons.

2.4 Equipment Connection

Use the following guidelines when connecting the equipment:

1. Set the positive input supply to 33 V (max), and turn the power supply off.
2. Set the negative input supply to -33 V (min), and turn the power supply off.
3. Connect the positive voltage lead from the input power supply to INP at the J8 connector of the EVM.
4. Connect the negative voltage lead from the input power supply to INN at the J10 connector of the EVM.
5. Connect the ground lead from the input power supply to GND at the J6 and J12 connector of the EVM.
6. Connect a 0 mA to 150 mA load between OUTP and GND.
7. Connect a 0 mA to 150 mA load between OUTN and GND.
8. Disable the output by floating J15.

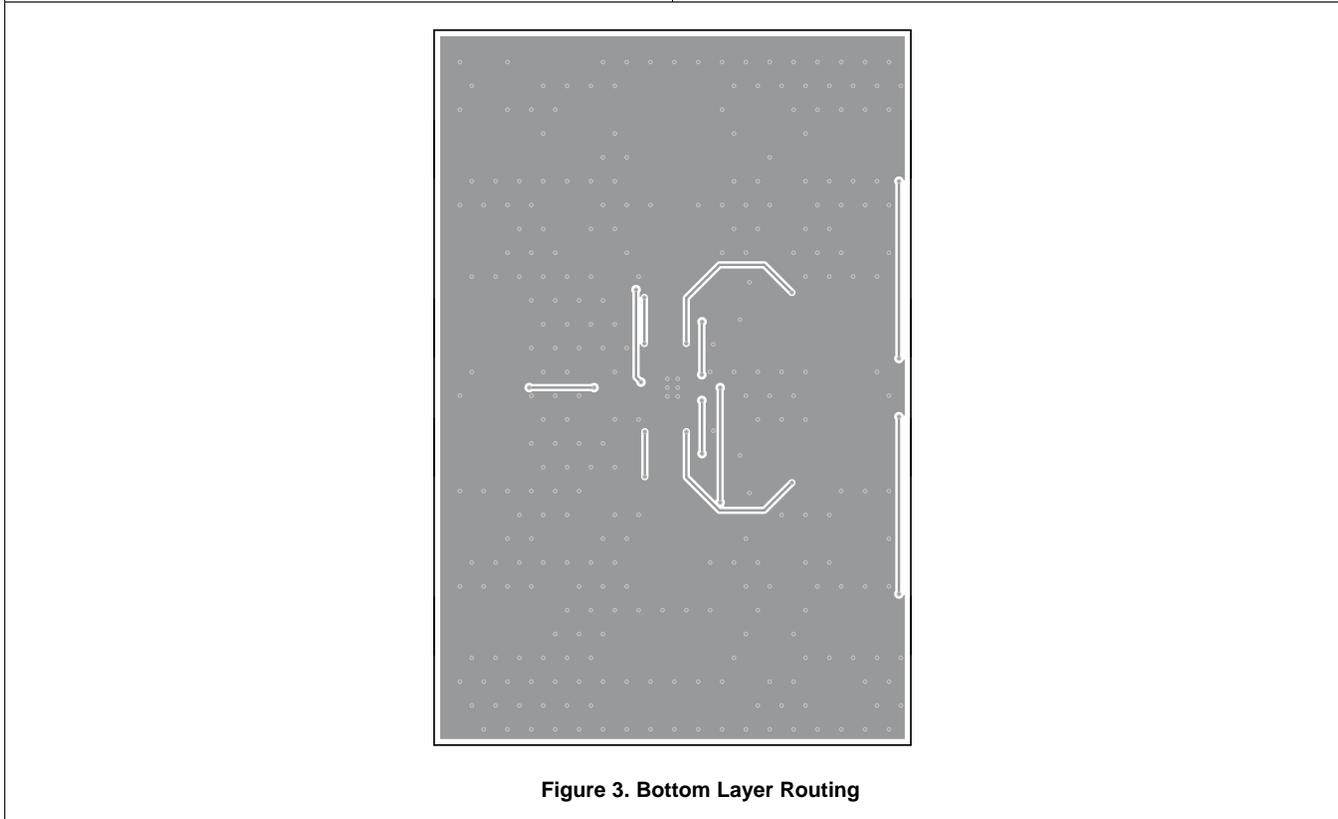
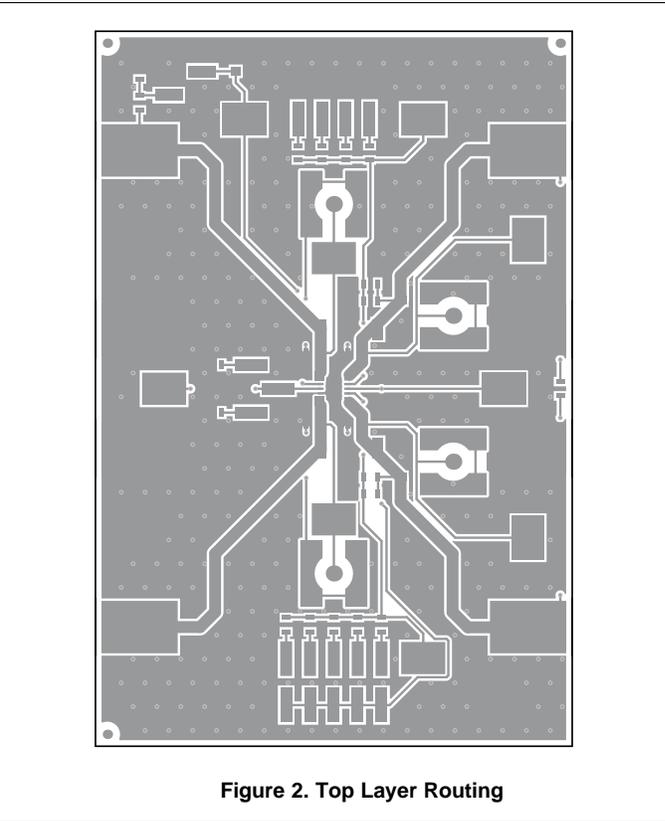
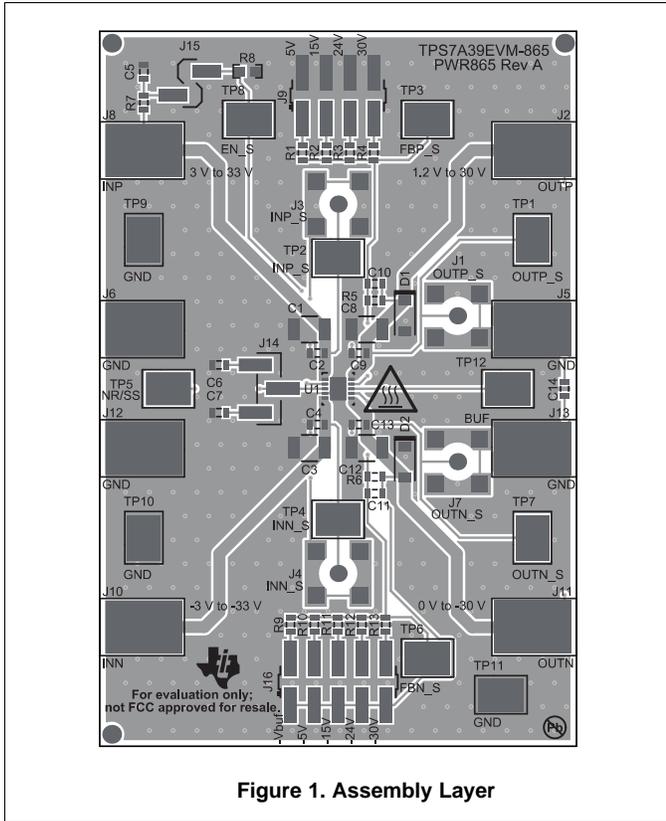
3 Operation

Operate the EVM using the following steps:

1. Turn on the power supplies.
2. Enable the output by jumping J15, the EN pin, to VIN.
3. Vary the respective load and input voltage, as necessary, for test purposes.

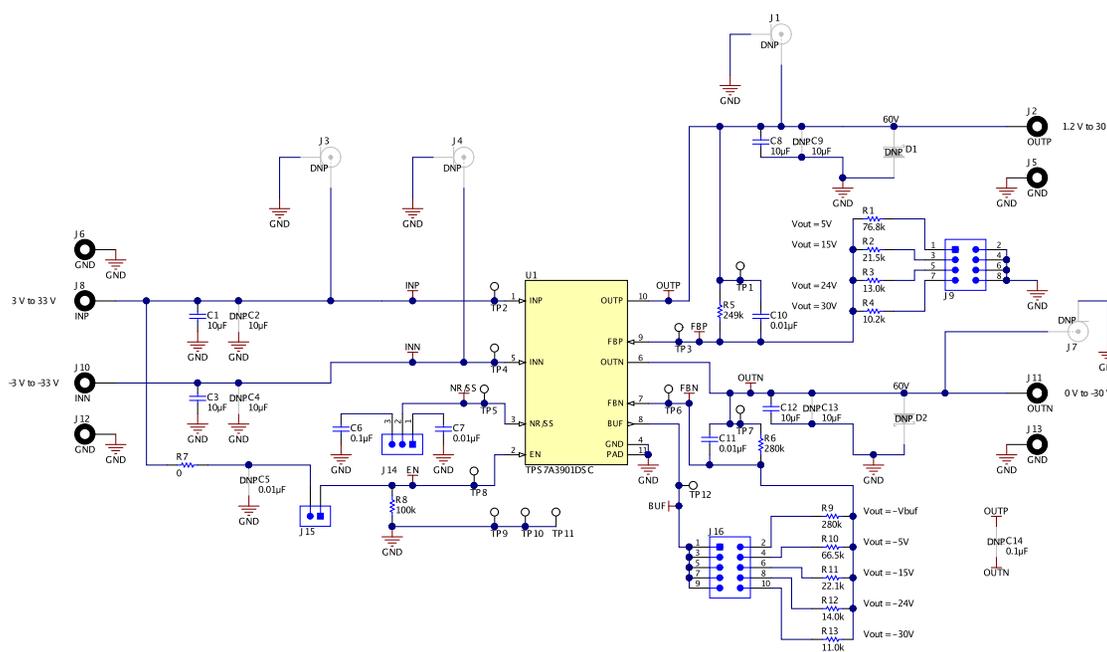
4 PCB Layout

Figure 1 to Figure 3 illustrate the PCB layout for this EVM.



5 Schematic

Figure 4 is the schematic for this EVM.



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Figure 4. TPS7A39EVM-865 Schematic

6 Bill of Materials

The BOM for this EVM is shown in [Table 1](#).

Table 1. TPS7A39EVM-865 BOM⁽¹⁾⁽²⁾⁽³⁾⁽⁴⁾

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
!PCB1	1		Printed Circuit Board		PWR865	Any	-	-
C1, C3, C8, C12	4	10uF	CAP, CERM, 10 µF, 50 V, +/- 10%, X7 S, 1210	1210	C3225X7 S1 H106K250AB	TDK		
C6	1	0.1uF	CAP, CERM, 0.1 µF, 100 V, +/- 10%, X7 S, AEC-Q200 Grade 1, 0603	0603	CGA3E3X7 S2A104K080AB	TDK		
C7, C10, C11	3	0.01uF	CAP, CERM, 0.01 µF, 50 V, +/- 5%, C0 G/NP0, 0603	0603	C1608 NP01 H103 J080AA	TDK		
J2, J8	2		Standard Banana Jack, Insulated, Red	6091	6091	Keystone		
J5, J6, J12, J13	4		Standard Banana Jack, Insulated, Black	6092	6092	Keystone		
J9	1		Header, 2.54 mm, 4x2, Gold, SMT	Header, 2.54 mm, 4x2, SMT	TSM-104-01-L-DV	Samtec		
J10, J11	2		BANANA JACK, 15A, Insulated, Nylon, Yellow	940x438x438 mil	108-0907-001	Emerson Network Power		
J14	1		Header, 100 mil, 3x1, Gold, SMT	Samtec_TSM-103-01-X-SV	TSM-103-01-L-SV	Samtec		
J15	1		Header, 2.54 mm, 2x1, Gold, R/A, SMT	Header, 2.54 mm, 2x1, R/A, SMT	0878980204	Molex		
J16	1		Header, 2.54 mm, 5x2, Gold, SMT	Header, 2.54 mm, 5x2, SMT	TSM-105-01-L-DV	Samtec		
R1	1	76.8k	RES, 76.8 k, 1%, 0.1 W, 0603	0603	CRCW060376K8FKEA	Vishay-Dale		
R2	1	21.5k	RES, 21.5 k, 1%, 0.1 W, 0603	0603	CRCW060321K5FKEA	Vishay-Dale		
R3	1	13.0k	RES, 13.0 k, 1%, 0.1 W, 0603	0603	CRCW060313K0FKEA	Vishay-Dale		
R4	1	10.2k	RES, 10.2 k, 1%, 0.1 W, 0603	0603	CRCW060310K2FKEA	Vishay-Dale		
R5	1	249k	RES, 249 k, 1%, 0.1 W, 0603	0603	CRCW0603249KFKEA	Vishay-Dale		
R6, R9	2	280k	RES, 280 k, 1%, 0.1 W, 0603	0603	CRCW0603280KFKEA	Vishay-Dale		
R7	1	0	RES, 0, 5%, 0.1 W, 0603	0603	ERJ-3 GEY0R00 V	Panasonic		
R8	1	100k	RES, 100 k, 1%, 0.1 W, 0603	0603	CRCW0603100KFKEA	Vishay-Dale		
R10	1	66.5k	RES, 66.5 k, 1%, 0.1 W, 0603	0603	CRCW060366K5FKEA	Vishay-Dale		
R11	1	22.1k	RES, 22.1 k, 1%, 0.1 W, 0603	0603	CRCW060322K1FKEA	Vishay-Dale		
R12	1	14.0k	RES, 14.0 k, 1%, 0.1 W, 0603	0603	CRCW060314K0FKEA	Vishay-Dale		
R13	1	11.0k	RES, 11.0 k, 1%, 0.1 W, 0603	0603	CRCW060311K0FKEA	Vishay-Dale		
SH-J1, SH-J2, SH-J3	3	1x2	Shunt, 100 mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G	Samtec

- (1) These assemblies are ESD sensitive, observe ESD precautions.
- (2) These assemblies must be clean and free from flux and all contaminants. Use of no-clean flux is not acceptable.
- (3) These assemblies must comply with workmanship standards IPC-A-610 Class 2.
- (4) Unless otherwise noted in the Alternate Part Number or Alternate Manufacturer columns, all parts may be substituted with equivalents.

Table 1. TPS7A39EVM-865 BOM⁽¹⁾⁽²⁾⁽³⁾⁽⁴⁾ (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12	12		Test Point, Compact, SMT	Testpoint_Keystone_Compact	5016	Keystone		
U1	1		Wide-VIN (± 33 V), 150-mA, Split-Rail Output, Positive and Negative LDO Voltage Regulator with Startup Tracking, DSC0010 J	DSC0010 J	TPS7A3901DSC	Texas Instruments		
C2, C4, C9, C13	0	10uF	CAP, CERM, 10 μ F, 25 V, +/- 20%, X5R, 0603	0603	C1608X5R1E106M080AC	TDK		
C5	0	0.01uF	CAP, CERM, 0.01 μ F, 50 V, +/- 5%, C0 G/NP0, 0603	0603	C1608 NP01 H103 J080AA	TDK		
C14	0	0.1uF	CAP, CERM, 0.1 μ F, 100 V, +/- 10%, X7 S, AEC-Q200 Grade 1, 0603	0603	CGA3E3X7 S2A104K080AB	TDK		
D1, D2	0	60 V	Diode, Schottky, 60 V, 1 A, SOD-123	SOD-123	RB160M-60 TR	Rohm		
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		
J1, J3, J4, J7	0		Connector, SMA Jack, Vertical, Gold, SMD	SMA	142-0711-201	Emerson Network Power		

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 - 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/lstds/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。
http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page

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.

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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lstds/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。 http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page

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.

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