

# TPS22916 Load Switch Evaluation Module

The TPS22916EVM evaluation module (EVM) allows the user to connect power to and control the 4-pin YFP package load switch. Parameters such as the on-resistance, rise time and output pull-down resistance can be easily evaluated. [Table 1](#) lists a short description of the TPS22916 load switch performance specifications; for additional details on load switch performance, application notes, and the datasheet see [www.ti.com/loadswitch](http://www.ti.com/loadswitch).

**Table 1. TPS22916 Rise Time, Output Current Rating, Enable, and Output Discharge Characteristics**

EVM	Device	Rise Time Typical	VIN (V)	Maximum Continuous Current	Enable (ON Pin)	Quick Output Discharge
PSIL011-001	TPS22916C	1400 $\mu$ s	5.5	2A	Active High	Yes
	TPS22916B	105 $\mu$ s	5.5	2A	Active High	Yes
	TPS22916CL	1400 $\mu$ s	5.5	2A	Active Low	Yes
	TPS22916CN	1400 $\mu$ s	5.5	2A	Active High	No

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## 1 Introduction

### 1.1 Description

The TPS22916EVM is a two sided PCB containing the TPS22916C, TPS22916B, TPS22916CL, and TPS22916CN load switch devices. The VIN and VOUT connections to the device and the PCB layout routing are capable of handling high continuous currents and provide a low resistance pathway into and out of the device under test. Test point connections allow the EVM user to control the device with user defined test conditions and make accurate  $R_{ON}$  measurements.

### 1.2 Features

- VIN input voltage range: 1 V to 5.5 V.
- EVM allows access to the VIN, VOUT, GND, and ON pin of the *TPS22916 Load Switch Devices*.
- On board  $C_{IN}$  and  $C_{OUT}$  capacitors.
- 2-A maximum continuous current operation.
- This evaluation module comes with the TPS22916C, TPS22916B, TPS22916CL and TPS22916CN.

## 2 Electrical Performance

See the TPS22916 datasheet, [SLVSD05](#) for detailed electrical characteristics.

### 3 Schematic

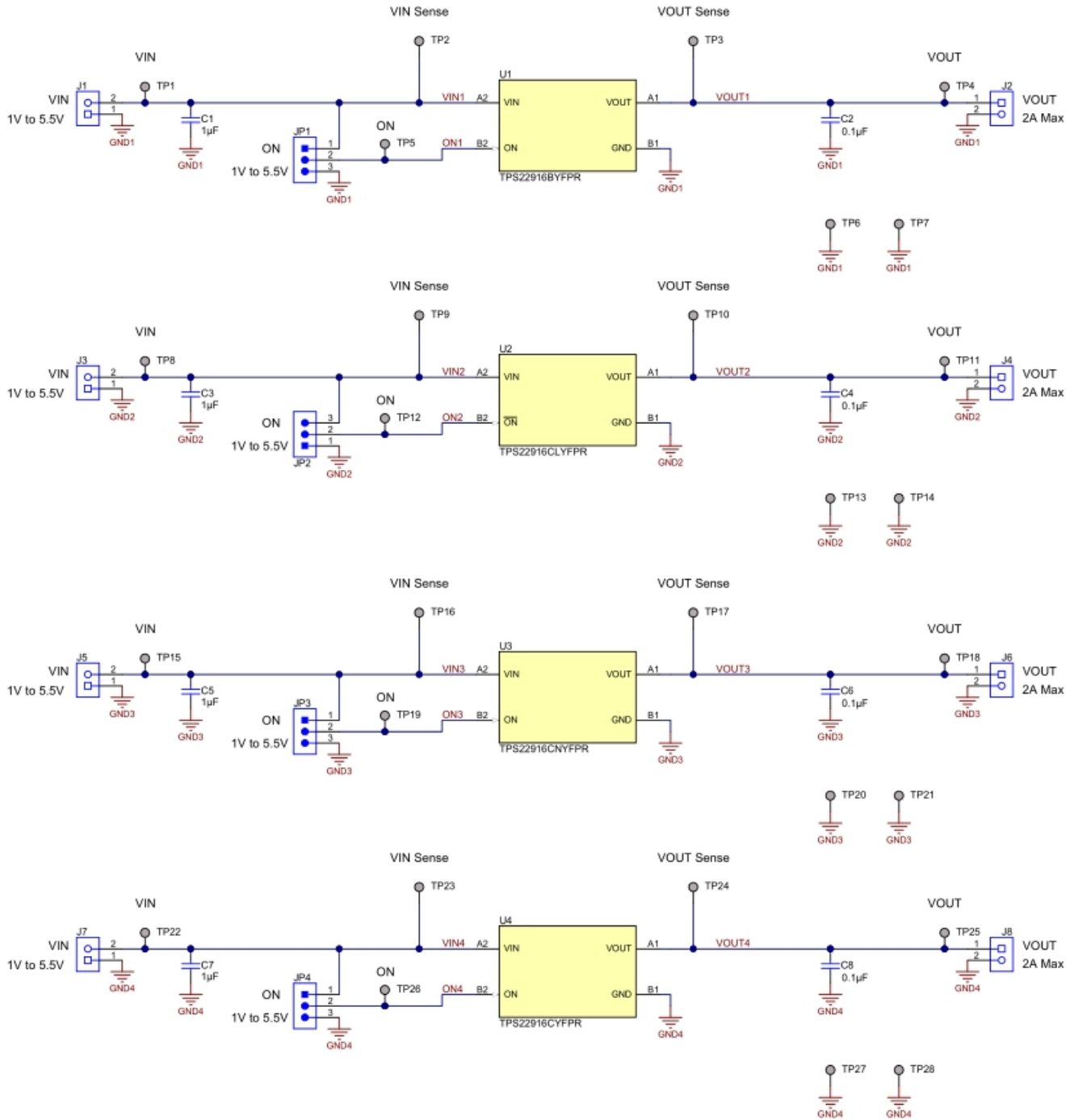


Figure 1. TPS22916EVM Schematic

4 Layout

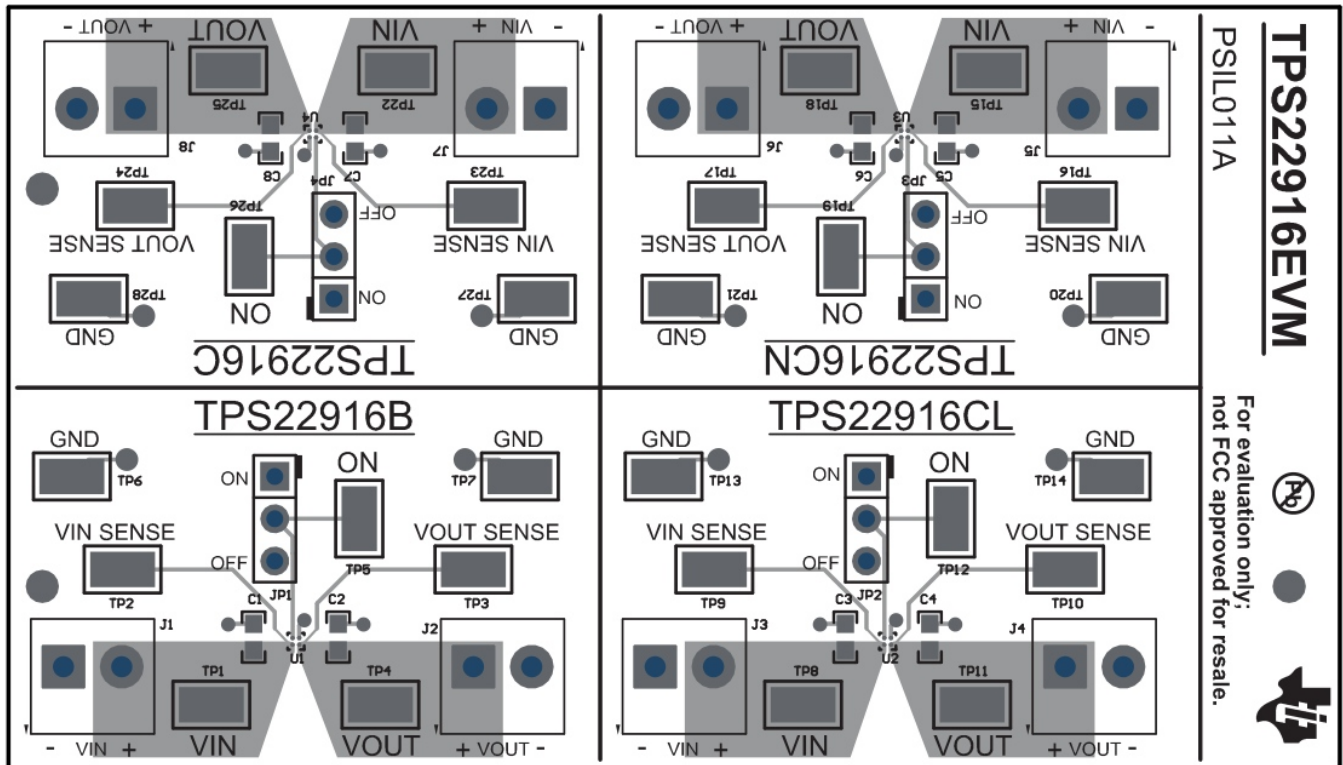


Figure 2. TPS22916EVM Top Layout

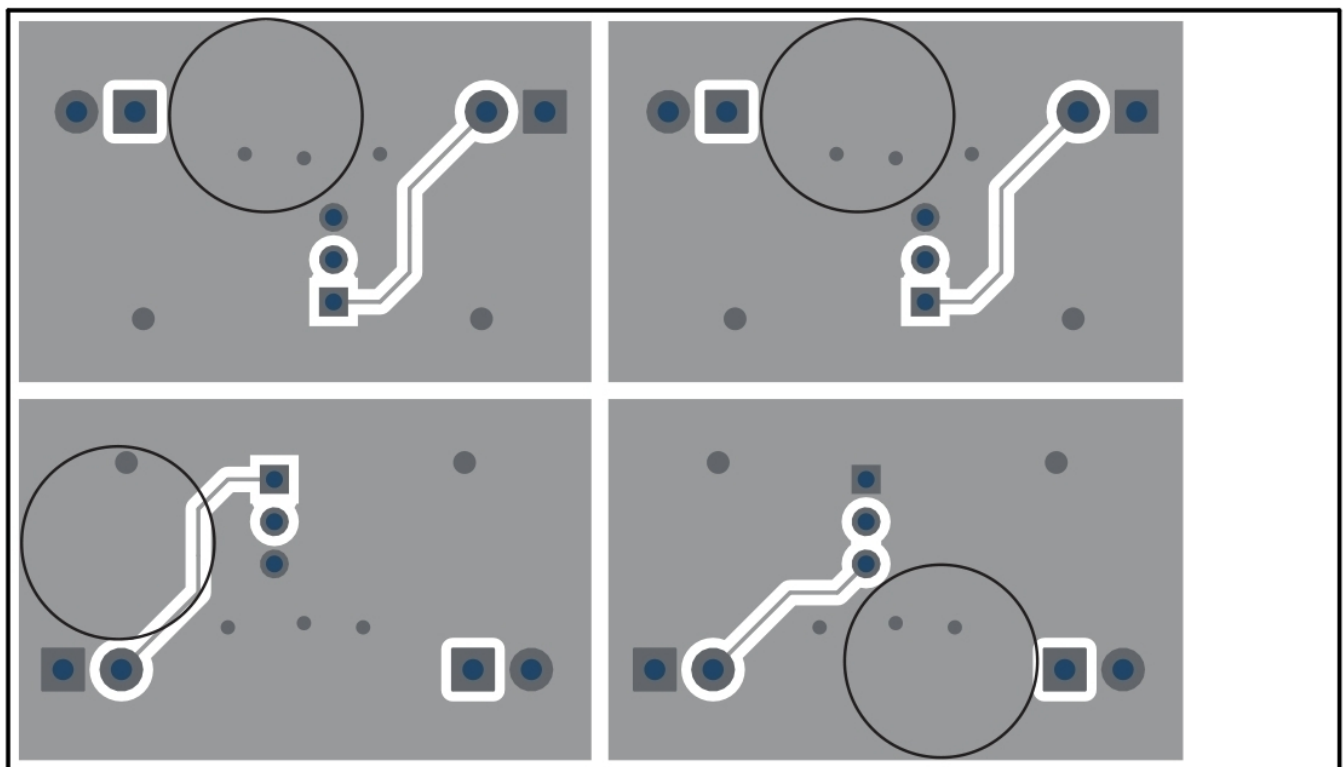


Figure 3. TPS22916EVM Bottom Layout

## 4.1 Setup

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

### 4.1.1 J1/J3/J5/J7 – Input Connection

This is the connection for the leads from the input source. Connect the positive lead to the J1/J3/J5/J7 "+" terminal and the negative lead to the "-" terminal (GND).

### 4.1.2 J2/J4/J6/J8 – Output Connection

This is the connection for the output of the EVM. Connect the positive lead to the J2/J4/J6/J8 "+" terminal and the negative lead to the "-" terminal (GND).

### 4.1.3 JP1/JP2/JP3/JP4 – ON

This is the enable input for the device. A shorting jumper must be installed on JP1/JP2/JP3/JP4 in either the ON or OFF position. The TPS22916C/B/CN is active high, and the TPS22916CL is active low. ON must not be left floating. An external enable source can be applied to the EVM by removing the shunt and connecting a signal to TP5/TP12/TP19/TP26. Refer to the datasheet for proper ON and OFF voltage level settings. A switching signal may also be used and connected at this point.

### 4.1.4 TP2/TP9/TP16/TP23 - VIN Sense, TP3/TP10/TP17/TP24 - VOUT Sense

These two connections are used when very accurate measurements of the input or output are required. RON measurements must be made using these sense connections when measuring the voltage drop from VIN to VOUT to calculate the resistance.

### 4.1.5 TP6/TP7/TP13/TP14/TP20/TP21/TP27/TP28 – GND

These are connections to GND.

## 5 Operation

Connect the positive input of the VIN power supply to VIN at the positive terminal of J1/J3/J5/J7. Connect the negative lead of the power supply to GND at the negative terminal of J1/J3/J5/J7. The input voltage range of the TPS22916EVM is 1 V to 5.5 V.

External output loads can be applied to the switch by using J2/J4/J6/J8. The TPS22916EVM is rated for a maximum continuous current of 2 A. Configure JP1/JP2/JP3/JP4 as required. A shunt must be installed for proper operation. When the ON pin is asserted to the ON state of the jumper, the output of the TPS22916 is enabled.

## 6 Test Configurations

### 6.1 On-Resistance ( $R_{ON}$ ) Test Setup

Figure 4 shows a typical setup for measuring On-Resistance. The voltage drop across the switch is measured using the sense connections then divided by the current into the load yielding the  $R_{ON}$  resistance.

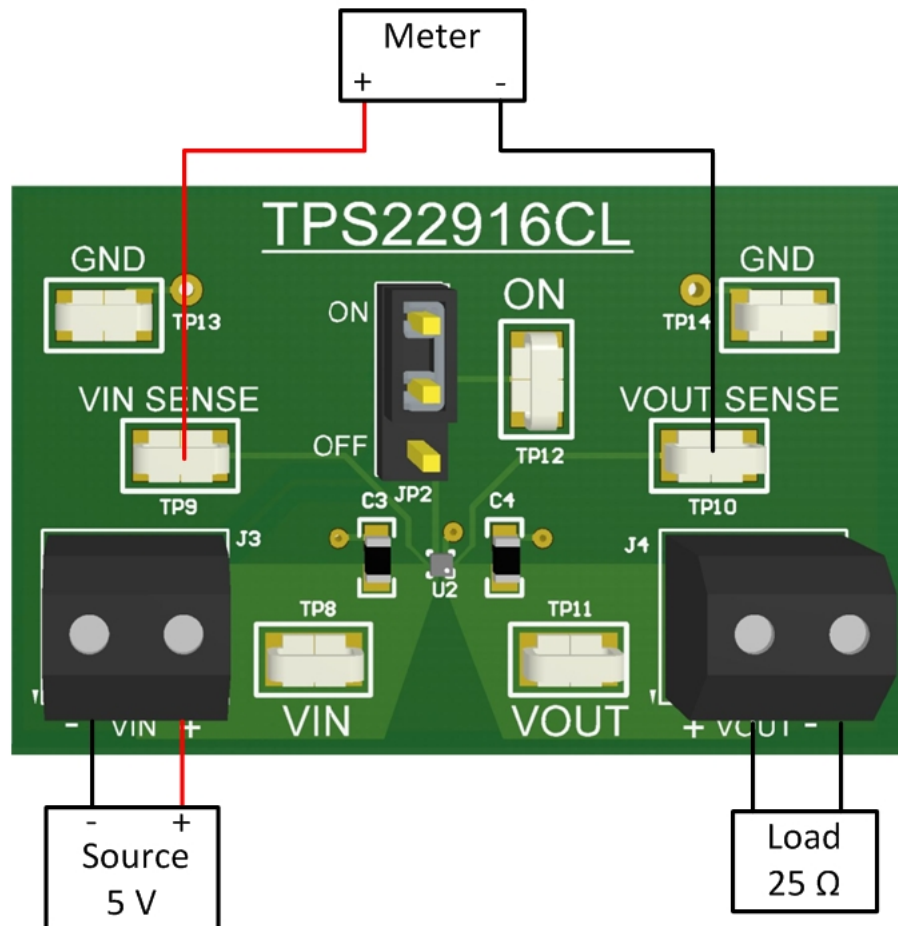


Figure 4.  $R_{ON}$  Setup

## 6.2 Slew Rate Test Setup

Figure 5 shows a test setup for measuring the Slew Rate of the Load Switch. Apply a square wave to the ON pin of the switch using a function generator and apply a voltage to the VIN terminal using a power supply. Observe the waveform at VOUT with a scope to measure the slew rate and rise time of the switch with a given input voltage.

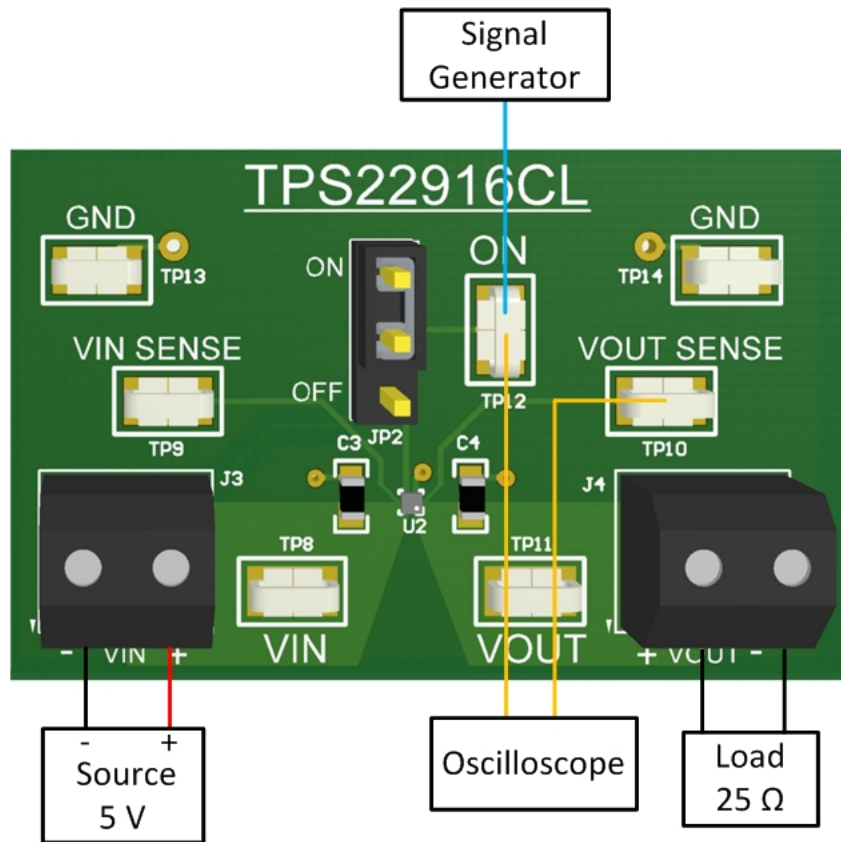


Figure 5. Slew Rate Setup

**7 Bill of Materials (BOM)**
**Table 2. Bill of Materials TPS22916xEVM**

Qty	Designator	Value	Description	Package Reference	Manufacturer	Part Number
1	IPCB		Printed Circuit Board		Any	PSIL011
4	C1, C3, C5, C7	1uF	CAP, CERM, 1 uF, 25 V, ±10%, X7R, 0603	0603	AVX	06033C105KAT2A
4	C2, C4, C6, C8	0.1uF	CAP, CERM, 0.1 μF, 16 V, ±5%, X7R, 0603	0603	AVX	0603YC104JAT2A
4	H9, H10, H11, H12		Bumpon, Hemisphere, 0.44 x 0.20, Clear	Transparent Bumpon	3M	SJ-5303 (CLEAR)
8	J1, J2, J3, J4, J5, J6, J7, J8		Terminal Block, 3.5-mm Pitch, 2×1, TH	7.0x8.2x6.5mm	On-Shore Technology	ED555/2DS
4	JP1, JP2, JP3, JP4		Header, 100 mil, 3×1, Gold, TH	3x1 Header	Samtec	TSW-103-07-G-S
4	SH-J1, SH-J2, SH-J3, SH-J4		Shunt, 2.54 mm, Gold, Black	Shunt, 2.54mm, Black	Würth Elektronik	60900213421
28	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21, TP22, TP23, TP24, TP25, TP26, TP27, TP28		Test Point, Miniature, SMT	Test Point, Miniature, SMT	Keystone	5019
1	U1		5.5-V, 2-A, 60-mΩ Low Leakage Load Switch With RCP, YFP0004ABAB (DSBGA-4)	YFP0004ABAB	Texas Instruments	TPS22916BYFP
1	U2		5.5-V, 2-A, 60-mΩ Low Leakage Load Switch With RCP, YFP0004ABAB (DSBGA-4)	YFP0004ABAB	Texas Instruments	TPS22916CLYFP
1	U3		5.5-V, 2-A, 60-mΩ Low Leakage Load Switch With RCP, YFP0004ABAB (DSBGA-4)	YFP0004ABAB	Texas Instruments	TPS22916CNYFP
1	U4		5.5-V, 2-A, 60-mΩ Low Leakage Load Switch With RCP, YFP0004ABAB (DSBGA-4)	YFP0004ABAB	Texas Instruments	TPS22916CYFP
0	FID1, FID2, FID3		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A



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    - 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**

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- 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.

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[http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_01.page](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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#### 3.4 *European Union*

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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.

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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.
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