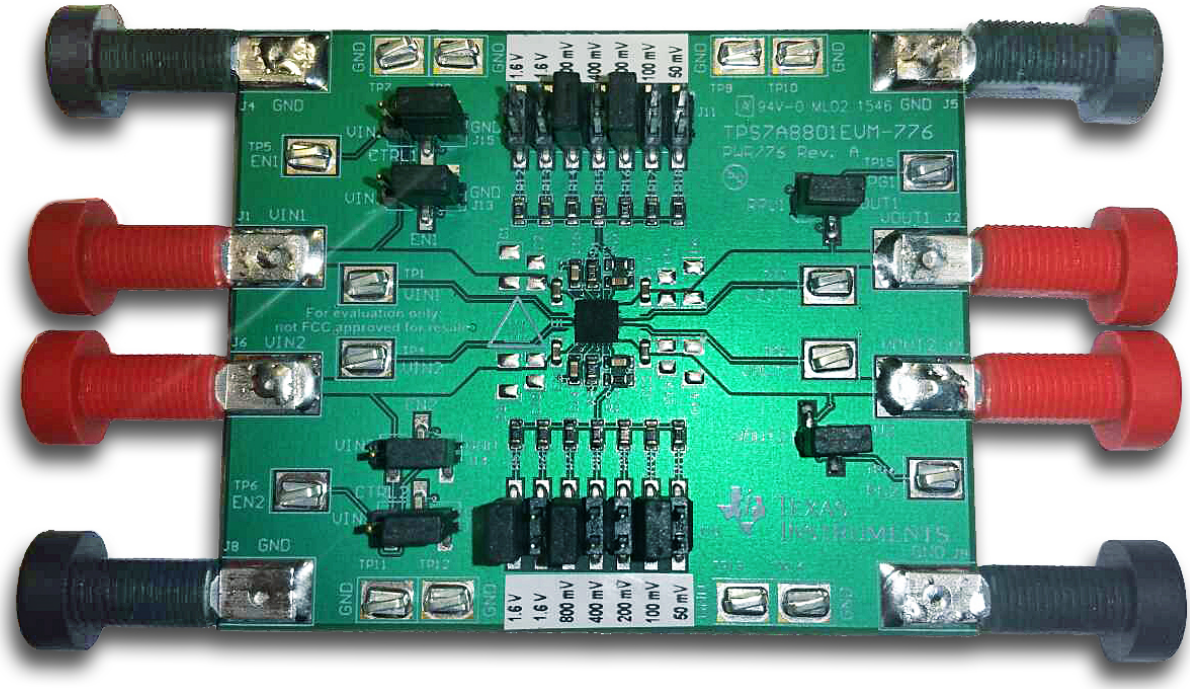
# TPS7A88 Evaluation Module




This user's guide describes the operational use of the TPS7A8801EVM-776 evaluation module (EVM) as a reference design for engineering demonstration and evaluation of the TPS7A8801RTJ, low-dropout linear regulator (LDO). Included in this user's guide are setup and operating instructions, thermal and 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, evaluation module are synonymous with the TPS7A8801EVM-776.

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

**Related Documentation**

| Device | Literature Number |
|---|---|
| TPS7A8801 | SBVS248 |

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# 1 Introduction

The Texas Instruments TPS7A8801EVM-776 EVM helps design engineers evaluate the operation and performance of the TPS7A88 family of linear regulators for possible use in their own circuit application. This particular EVM configuration contains a dual low-noise, high-PSRR linear regulator for high-speed communication systems. The regulator is capable of delivering up to 1 A per channel to each load with low VIN to VOUT dropout voltage. For stability, use a 10-µF input capacitor and 10-µF output capacitor per channel for the TPS7A8801.

# 2 EVM Setup

This section describes how to properly connect and setup the TPS7A8801EVM-776, including the jumpers and connectors on the EVM board.

## *2.1 Input/Output Connectors and Jumper Descriptions*

### 2.1.1 J1 – VIN1

Channel-1, input power-supply voltage connector. Twist together the positive input lead and ground return lead from the input power supply; keep the leads as short as possible to minimize input inductance. Add additional bulk capacitance between J1 and J4 (use the C1 footprint) if the supply leads are longer than six inches. For example, an additional 47-µF electrolytic capacitor connected from J1 to ground improves the transient response of the TPS7A8801, while eliminating unwanted ringing on the input because of long wire connections.

### 2.1.2 J2 – VOUT1

Channel-1, regulated, output voltage connector.

### 2.1.3 J3 – VPU1

Channel-1, pullup-voltage selector for PG1. This EVM is designed so that PG1 can be pulled up to either VOUT1 by shorting J3, or pulled up to another voltage by applying an external voltage to the RPU1 post.

### 2.1.4 J4 – GND

Return connector for the channel-1, input power supply.

### 2.1.5 J5 – GND

Channel-1, output, ground return connector.

### 2.1.6 J6 – VIN2

Channel-2, input, power-supply voltage connector. Twist together the positive input lead and ground return lead from the input power supply; keep the leads as short as possible to minimize input inductance. Add additional bulk capacitance between J6 and J8 (use the C9 footprint) if the supply leads are longer than six inches. For example, an additional 47-µF electrolytic capacitor connected from J6 to ground improves the transient response of the TPS7A8801, while eliminating unwanted ringing on the input because of long wire connections.

### 2.1.7 J7 – VOUT2

Channel-2, regulated, output voltage connector.

### 2.1.8 J8 – GND

Return connector for the channel-2, input power supply.

### 2.1.9 J9 – GND

Channel-2, output, ground return connector.

### 2.1.10 J10 – ANYOUT2

The channel-2 output voltage of the TPS7A8801 is selectable in accordance with the names given to the output voltage setting pins: 50 mV, 100 mV, 200 mV, 400 mV, 800 mV, 1.6 V, and 1.6 V. For each pin connected to the ground, the output voltage setting increases by the value associated with that pin name, starting from the value of the reference voltage of 0.8 V; floating the pins has no effect on the output voltage.

### 2.1.11 J11 – ANYOUT1

The channel-1 output voltage of the TPS7A8801 is selectable in accordance with the names given to the output voltage setting pins: 50 mV, 100 mV, 200 mV, 400 mV, 800 mV, 1.6 V, and 1.6 V. For each pin connected to the ground, the output voltage setting increases by the value associated with that pin name, starting from the value of the reference voltage of 0.8 V; floating the pins has no effect on the output voltage.

### 2.1.12 J12 – VPU2

Channel-2 pullup voltage selector for PG2. This EVM is designed so that PG2 can be pulled up to either VOUT1 by shorting J3, or pulled up to another voltage by applying an external voltage to the RPU1 post.

### 2.1.13 J13 – EN1

Channel-1 output enable. To enable the output for channel 1, connect a jumper to short VIN1 to EN1. To disable the output, connect a jumper to short EN1 to GND.

### 2.1.14 J14 – EN2

Channel-2 output enable. To enable the output for channel 2, connect a jumper to short VIN2 to EN2. To disable the output, connect a jumper to short EN2 to GND.

### 2.1.15 J15 – CTRL1

Channel-1, soft-start control. Connect a jumper to short VIN1 to CTRL1 for a fast charge time. Connect a jumper to short CTRL1 to GND for a slower startup.

### 2.1.16 J16 – CTRL2

Channel-2, soft-start control. Connect a jumper to short VIN2 to CTRL2 for a fast charge time. Connect a jumper to short CTRL2 to GND for a slower startup.

### 2.1.17 TP1 – VIN1

Channel-1, input, sense test point.

### 2.1.18 J2 – VOUT1

Channel-1. output, sense test point.

### 2.1.19 TP3 – VOUT2

Channel-2, output, sense test point.

### 2.1.20 TP4 – VIN2

Channel-2, input, sense test point.

#### 2.1.21 TP5 – EN1

Channel-1, enable, sense test point.

#### 2.1.22 TP6 – EN2

Channel-2, enable, sense test point.

#### 2.1.23 TP7 – GND

Ground.

#### 2.1.24 TP8 – GND

Ground.

#### 2.1.25 TP9 – GND

Ground.

#### 2.1.26 TP10 – GND

Ground.

#### 2.1.27 TP11 – GND

Ground.

#### 2.1.28 TP12 – GND

Ground.

#### 2.1.29 TP13 – GND

Ground.

#### 2.1.30 TP14 – GND

Ground.

### 2.2 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.

### 2.3 Equipment Connection

1. Set the input power supplies for each channel to 6.5 V (max), and turn the power supplies off.
2. Connect the positive voltage lead from input power supply 1 to VIN1, at the J1 connector of the EVM.
3. Connect the ground lead from input power supply 1 to GND at the J2 connector of the EVM.
4. Connect the positive voltage lead from input power supply 2 to VIN2, at the J6 connector of the EVM.
5. Connect the ground lead from input power supply 2 to GND at the J7 connector of the EVM.
6. Connect a 0-A to 1-A load between OUT1 and GND.
7. Connect a 0-A to 1-A load between OUT2 and GND.
8. Disable the output for channel 1 by shorting EN1 to GND on J13.
9. Disable the output for channel 2 by shorting EN2 to GND on J14.

## 3 Operation

1. Turn on the power supplies.
2. Enable the channel 1 output by shorting the EN1 pin to VIN1 on J13.
3. Enable the channel 2 output by shorting the EN2 pin to VIN2 on J14.
4. 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.

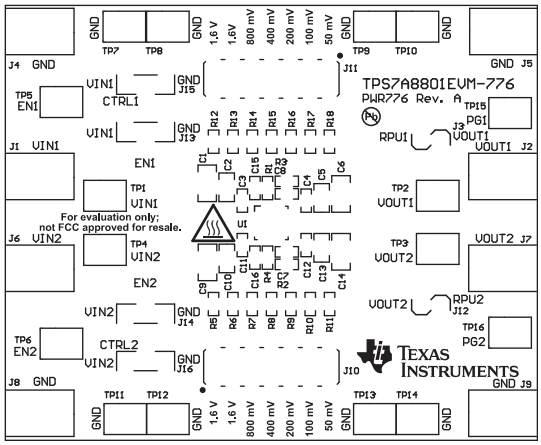


**Figure 1. Assembly Layer**

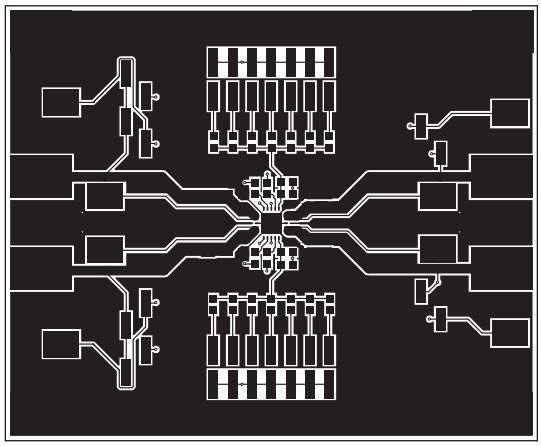

**Figure 2. Top Layer Routing**

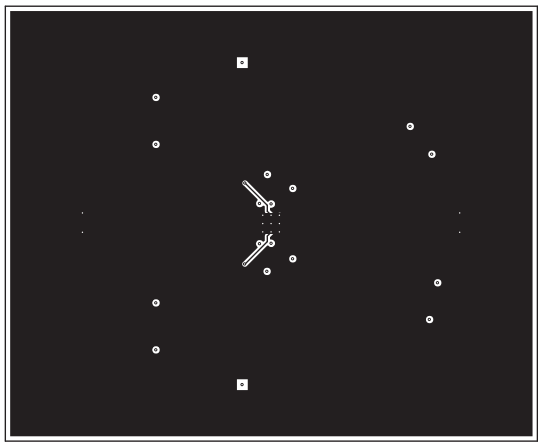

**Figure 3. Bottom Layer Routing**

# 5 Schematic

Figure 4 is the schematic for this EVM.

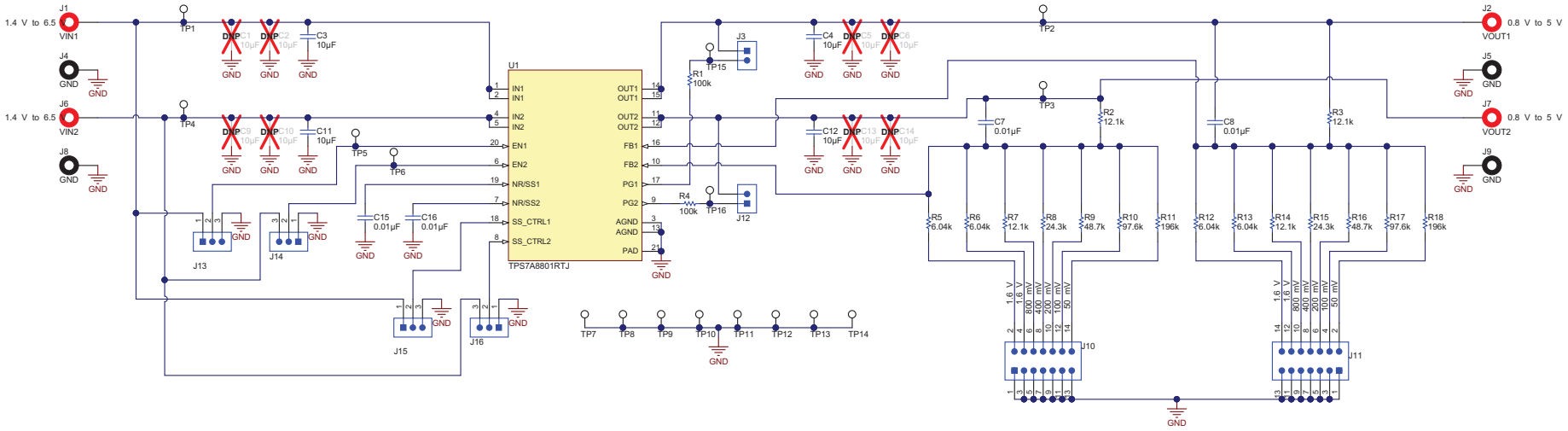


**Figure 4. Schematic**

## 6 Bill of Materials

The bill of materials (BOM) for this EVM is shown in Table 1

**Table 1. Bill of Materials[1][2][3]**

| RefDes | Value | Description | Size | Part Number | Manufacturer |
|---|---|---|---|---|---|
| C3, C4, C11, C12 | 10uF | CAP, CERM, 10 µF, 10 V, +/- 20%, X5R, 0603 | 0603 | GRM188R61A106ME69 | MuRata |
| C7, C8, C15, C16 | 0.01uF | CAP, CERM, 0.01 µF, 16 V, +/- 10%, X7R, 0603 | 0603 | GRM188R71C103KA01D | MuRata |
| J1, J2, J6, J7 | | Standard Banana Jack, Insulated, Red | | 6091 | Keystone |
| J3, J12 | | Header, 2.54 mm, 2x1, Gold, R/A, SMT | Header, 2.54 mm, 2x1, R/A, SMT | 87898-0204 | Molex |
| J4, J5, J8, J9 | | Standard Banana Jack, Insulated, Black | | 6092 | Keystone |
| J10, J11 | | Header, 100mil, 7x2, SMT | Header, 100 mil, 7x2, SMT | 0015912140 | Molex |
| J13, J14, J15, J16 | | Header, 100mil, 3x1, Gold, SMT | Samtec_TSM-103-01-X-SV | TSM-103-01-L-SV | Samtec |
| R1, R4 | 100k | RES, 100 k, 1%, 0.1 W, 0603 | 0603 | CRCW0603100KFKEA | Vishay-Dale |
| R2, R3, R7, R14 | 12.1k | RES, 12.1 k, 1%, 0.1 W, 0603 | 0603 | CRCW060312K1FKEA | Vishay-Dale |
| R5, R6, R12, R13 | 6.04k | RES, 6.04 k, 1%, 0.1 W, 0603 | 0603 | CRCW06036K04FKEA | Vishay-Dale |
| R8, R15 | 24.3k | RES, 24.3 k, 1%, 0.1 W, 0603 | 0603 | CRCW060324K3FKEA | Vishay-Dale |
| R9, R16 | 48.7k | RES, 48.7 k, 1%, 0.1 W, 0603 | 0603 | CRCW060348K7FKEA | Vishay-Dale |
| R10, R17 | 97.6k | RES, 97.6 k, 1%, 0.1 W, 0603 | 0603 | CRCW060397K6FKEA | Vishay-Dale |
| R11, R18 | 196k | RES, 196 k, 1%, 0.1 W, 0603 | 0603 | CRCW0603196KFKEA | Vishay-Dale |
| SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10, SH-J11 | | Shunt, 100mil, Gold plated, Black | Shunt | 969102-0000-DA | 3M |
| TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16 | | Test Point, Compact, SMT | Testpoint_Keystone_Compact | 5016 | Keystone |
| U1 | | Dual, 1-A, 6-µVRMS, RF, LDO Voltage Regulator, RTJ0020D | RTJ0020D | TPS7A8801RTJ | Texas Instruments |
| C1, C6, C9, C14 | 10uF | CAP, CERM, 10 µF, 10 V, +/- 10%, X5R, 1206 | 1206 | GRM31CR71A106KA01L | MuRata |
| C2, C5, C10, C13 | 10uF | CAP, CERM, 10 µF, 10 V, +/- 10%, X5R, 0805 | 0805 | GRM21BR61A106KE19L | MuRata |

(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.

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      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*

**Concerning EVMs Including Radio Transmitters:**

This device complies with Industry Canada license-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.

**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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If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

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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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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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.

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