EVM User's Guide: TPS3424EVM
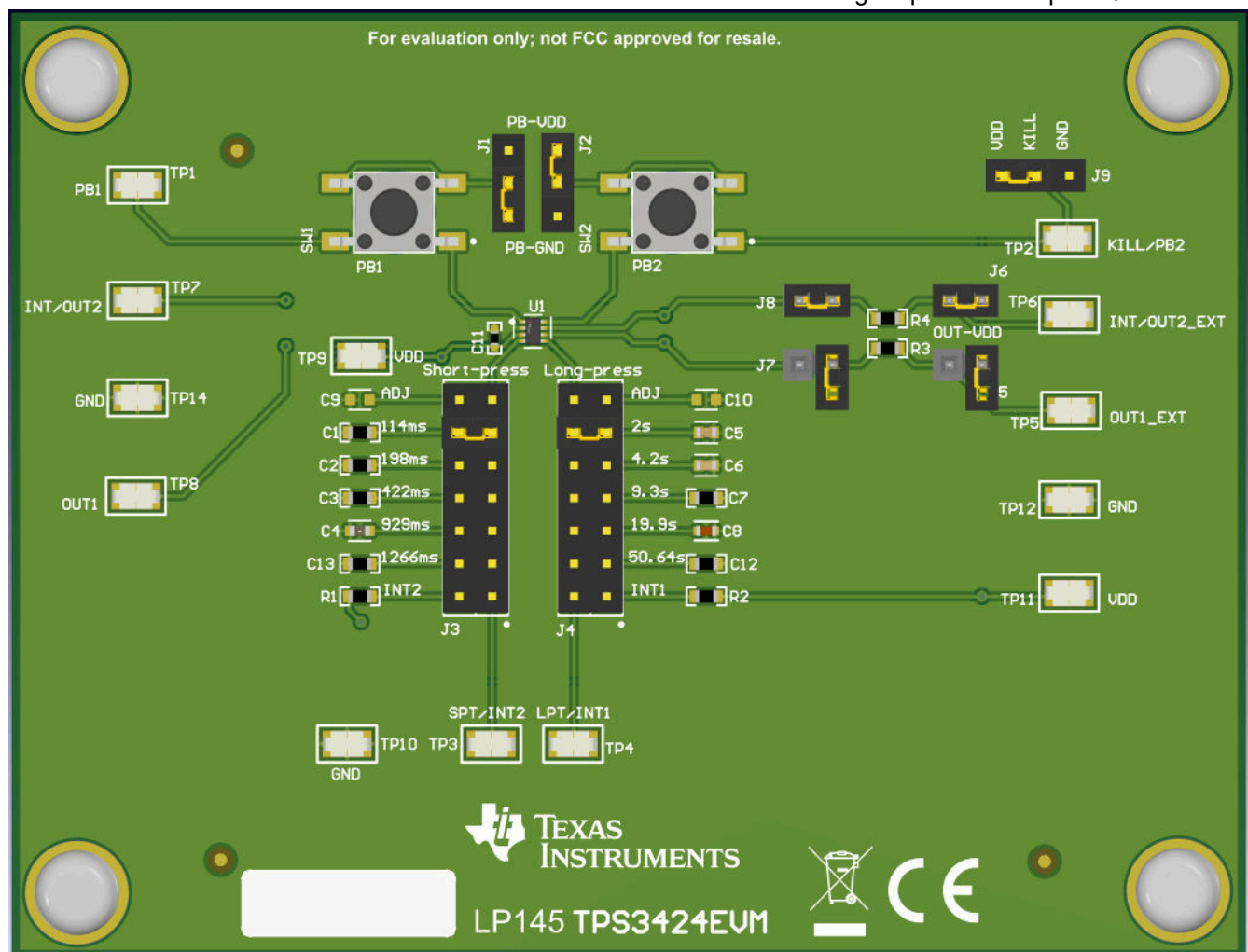# TPS3424 Evaluation Module

Description

The TPS3424EVM is an evaluation module for evaluating the TPS3424 and TPS3423 push button family. The purpose of this board is to provide a sample design and test point for all input and output pins of the TPS3424 and TPS3423 devices to capture measurements and behavioral data for the device.

Features

- Operating voltage range: 1V to 6V
- Configurable input and output to accommodate all the input and output topology of the TPS3424 and TPS3423
- Various selection of capacitors for timing configurations
- HBM ESD rating on push-button pin: 10kV

TPS3424EVM Board

1 Evaluation Module Overview

1.1 Introduction

The TPS3424EVM is an evaluation module (EVM) for the TPS3424 and TPS3423 push button devices. This family of pushbutton devices offers various orderable configurations such as:

- A wide selection of fixed timing as well as capacitor programmable timing for the short and long press.
- Latched or fixed reset delay
- Active-high or active-low input and output.
- Push-pull or open-drain output

The TPS3424EVM offers access to all input and output pins. Test points are provided to give the user access to an extra connection if needed for oscilloscope or multimeter measurements.

1.2 Kit Contents

The TPS3424EVM circuit board comes pre-installed with the TPS3424A11C13ADRL device for full functionality testing of the TPS3424 and TPS3423 family of devices. The TPS3424EVM circuit board comes packaged in a moisture barrier bag inside of antistatic foam layered cardboard box. Also contained in the box is the EVM literature disclaimer.

Table 1-1. Kit Contents

ITEM	QUANTITY
TPS3424EVM	1

1.3 Specification

		MIN	MAX	UNIT
Voltage	V_{DD}	1	6	V
Voltage	V_{PB}	0	V_{DD}	V
Voltage	V_{KILL}, $V_{\overline{INT}}$, V_{RESET}, $V_{\overline{RESET}}$	0	V_{DD}	V
Current	I_{RESET}, $I_{\overline{RESET}}$	0	5	mA
Temperature	Operating junction temperature, T_J	−40	125	°C

1.4 Device Information

The TPS3424EVM is shipped pre-installed with the TPS3424A11C13ADRL device, but can be used with any TPS3424 and TPS3423 variants.

2 Hardware

2.1 EVM Connectors

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

2.1.1 EVM Jumpers

Table 2-1 lists the default jumper connections and functional description for the device configuration.

Table 2-1. Pinout & Onboard Jumpers

PIN NUMBER / NAME	JUMPER CONNECTION	DEFAULT CONNECTION	DESCRIPTION
Pin1/PB1	J1	Closed(pin2, pin3)	Jumper J1 configures the input for PB1. Connecting pin 2 and pin 3 is for devices with input active LOW configuration. Connecting pin 1 and pin 3 is for devices with input active HIGH.
Pin8/ KILL/PB2	J2	Closed(pin1, pin2)	For TPS3423 devices, Jumper J2 configures the input for PB2. Connecting pin 2 and pin 3 is for devices with input active LOW configuration. Connecting pin 1 and pin 3 is for devices with input active HIGH. For TPS3424 devices, Jumper J2 can be left floating.
Pin4/SPT/INT2	J3	Closed(pin3, pin4)	For TPS3423 devices, Jumper J3 connects pin 4 to a 10kΩ pull-up to V_{DD} and the pin can be probed from TP3. For TPS3424 devices, Jumper J3 is to configure the short press timing with various capacitors available on the board.
Pin5/LPT/INT1	J4	Closed(pin2, pin3)	For TPS3423 devices, Jumper J4 connects pin 4 to a 10kΩ pull-up to V_{DD} and the pin can be probed from TP4. For TPS3424 devices, Jumper J4 is to configure the long press timing with various capacitors available on the board.
Pin6/OUT1/$\overline{OUT1}$	J7	Open(pin1)	Jumper J7 connects $\overline{RESET}$/RESET to a 10kΩ pull-up for devices with open-drain outputs. For push-pull output devices, set this jumper to floating.
Pin7/INT/OUT2/$\overline{OUT2}$	J8	Closed(pin1, pin2)	For TPS3423 Jumper J8 connects $\overline{RESET2}$/RESET2 to a 10kΩ pull-up for devices with open-drain outputs. For push-pull output devices, set this jumper to floating. For TPS3424 J8 connects INT to a 10kΩ pull-up.
Pin6/OUT1/$\overline{OUT1}$	J5	Open(pin1)	Jumper J5 connects R3 pull-up resistor to V_{DD}. If pull-up voltage for $\overline{RESET}$/RESET is not V_{DD}, leave J5 floating and input desired pull-up voltage to TP5
Pin7/INT/OUT2/$\overline{OUT2}$	J6	Closed(pin1, pin2)	Jumper J6 connects R4 pull-up resistor to V_{DD}. If pull-up voltage for $\overline{RESET}$/RESET for TPS3423 or INT for TPS3424 is not V_{DD}, leave J6 floating and input desired pull-up voltage to TP6
Pin8/KILL/PB2	J9	Closed(pin1, pin2)	**Important** Jumper J9 is floating for TPS3423 devices. For TPS3424, J9 configures the KILL functionality. For KILL enabled connect pin 1 and pin 2, connecting Pin 9 to V_{DD}. For KILL disabled, connect pin 2 and pin 3, connecting pin 9 to GND

2.1.2 EVM Test Points

Table 2-2 lists the test point connections and functional description for the device configuration. Test points are placed throughout the board to verify pin functionality.

Table 2-2. Test Points

PIN NUMBER / NAME	TEST POINT	DESCRIPTION
Pin1/PB1	TP1	Test point TP1 connects to PB1.
Pin8/KILL/PB2	TP2	Test point TP2 connects to PB2 for TPS3423 and KILL for TPS3424.
Pin4/SPT/INT2	TP3	Test point TP3 connects to INT2 for TPS3423 and SPT for TPS3424.
Pin5/LPT/INT1	TP4	Test point TP4 connects to INT1 for TPS3423 and LPT for TPS3424.
OUT1_EXT	TP5	Test point TP5 is an input if $\overline{RESET}$/RESET pull-up voltage is not V_{DD}.
INT/OUT2_EXT	TP6	Test point TP6 is an input if $\overline{RESET2}$/RESET2/INT pull-up voltage is not V_{DD}.
Pin7/INT/OUT2	TP7	Test point TP7 connects to $\overline{RESET2}$/RESET for TPS3423 and INT for TPS3424.
Pin6/OUT1	TP8	Test point TP8 connects to $\overline{RESET}$/RESET.
Pin3/V_{DD}	TP9/TP11	Test point TP9 and TP11connects to V_{DD}.
Pin2/GND	TP10/TP12/TP14	Test point TP10, TP12 and TP14 connects to GND.

2.2 EVM Setup and Operation

This section describes the functionality and operation of the TPS3424EVM. This EVM comes with the TPS3424A11C13ADRL device installed. Read the TPS3423/4 data sheet (SNVSCN9) for electrical characteristics of this device.

2.2.1 Input Power V_{DD}

The input supply voltage (V_{DD}) is connected through the TP9 on the board. The input supply voltage range is 1V to 6V a 0.1µF decoupling capacitor is placed at the input for reducing noise that can propagate through the device (included on the EVM board at C11). Please refer to the device data sheet for additional details.

2.2.2 Pushbutton input

The TPS3423 and TPS3424 push button family have various orderable options for input configuration. The TPS3424EVM is designed to accommodate any available input configuration for the TPS3423 and TPS3424 devices. Please refere to Table 2-1 for setting up desired configuration. Once configured to the proper input configuration, pressing PB1 or PB2 for the specified timing to oberser the output waveform.

3 Implementation Results

3.1 EVM Performance Results

The following measurements are taken using the default TPS3424EVM with the TPS3424A11C13ADRL device.
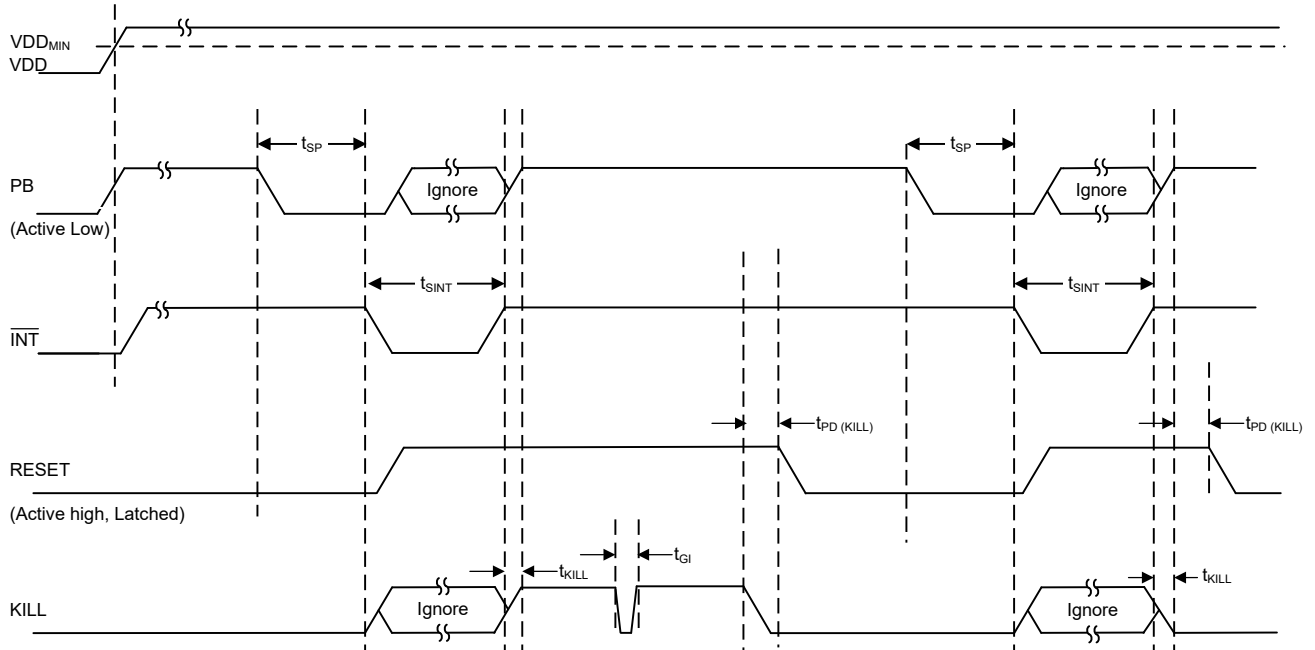
PB input is ignored if it is released and again pressed during
- Interrupt pulse
- KILL debounce

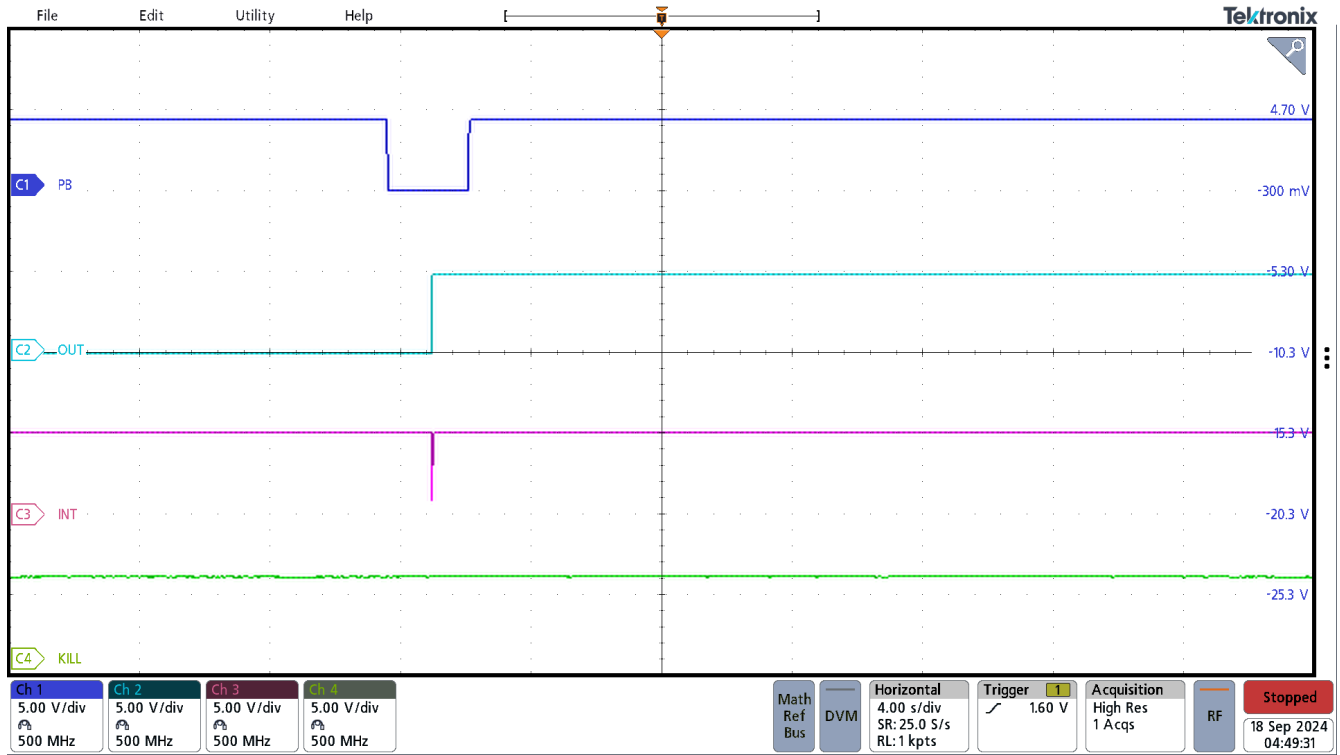**Figure 3-1. PB1 $\overline{\text{RESET}}$ Assertion**

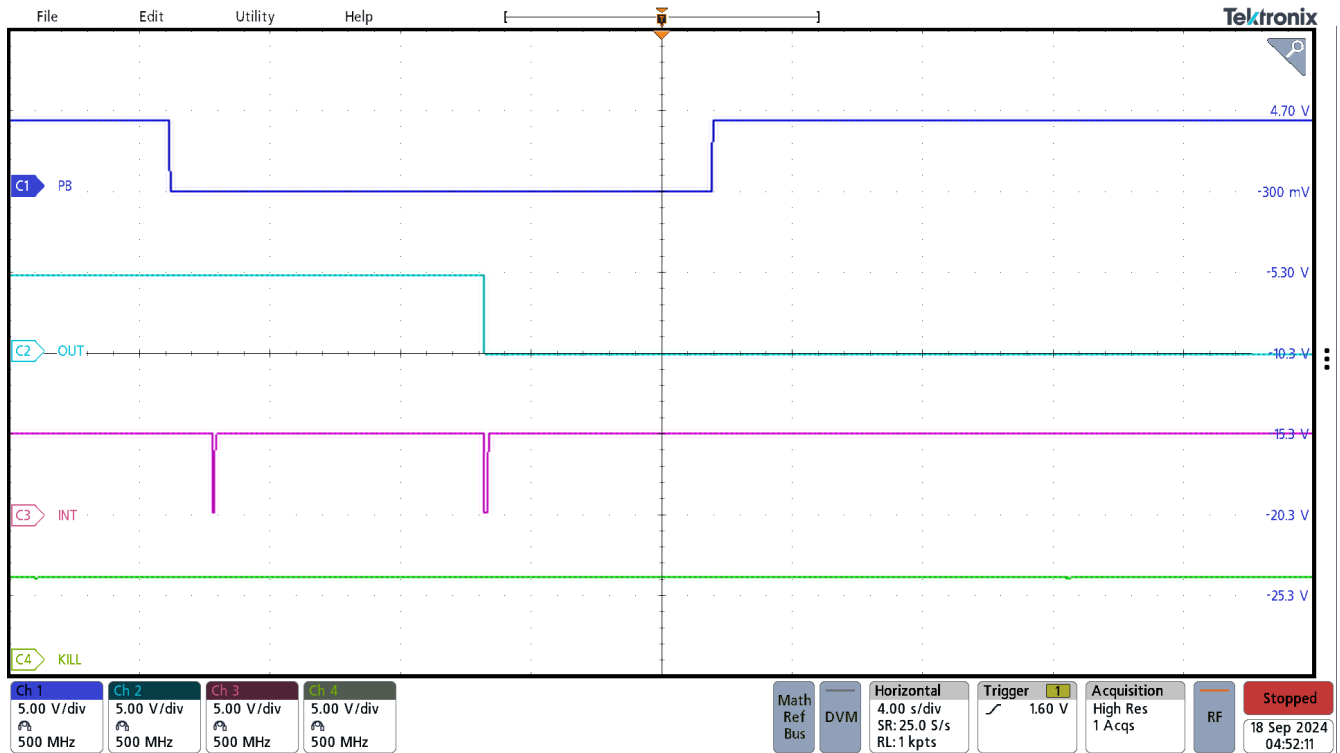**Figure 3-2. PB1 Short Press $\overline{\text{RESET}}$ Assertion With KILL HIGH**

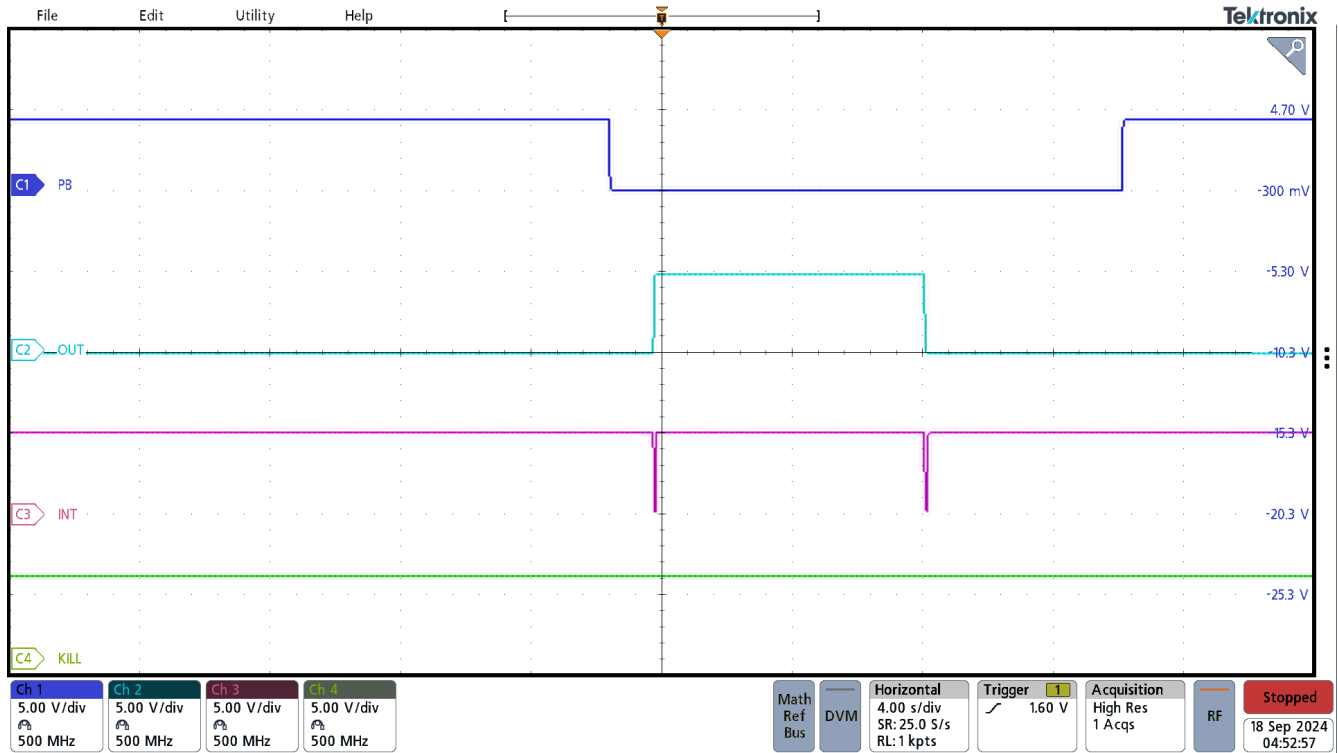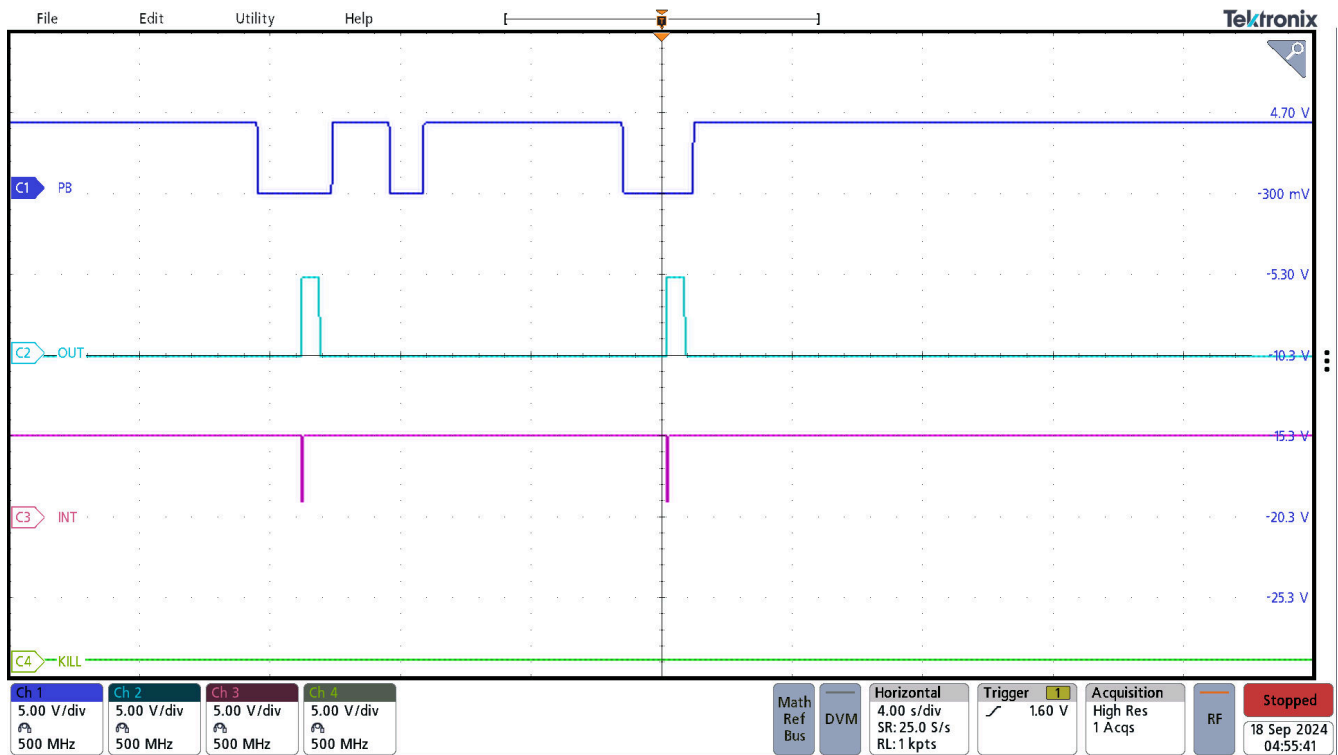**Figure 3-3. PB1 Long Press $\overline{\text{RESET}}$ De-assertion With KILL HIGH**

Figure 3-4. PB1 Long Press RESET Assertion With KILL HIGH

Figure 3-5. PB1 Short Press RESET Assertion With KILL LOW
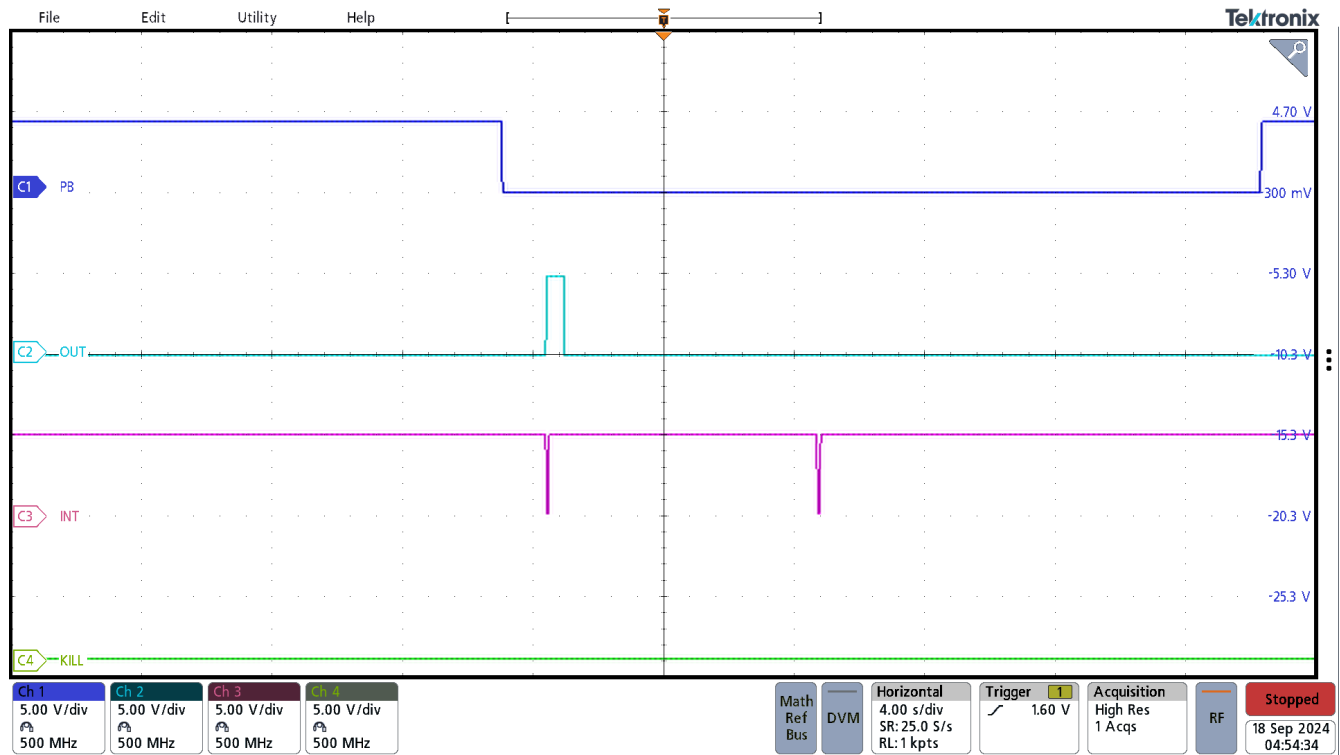
Figure 3-6. PB1 Long Press $\overline{\text{RESET}}$ Assertion With KILL LOW

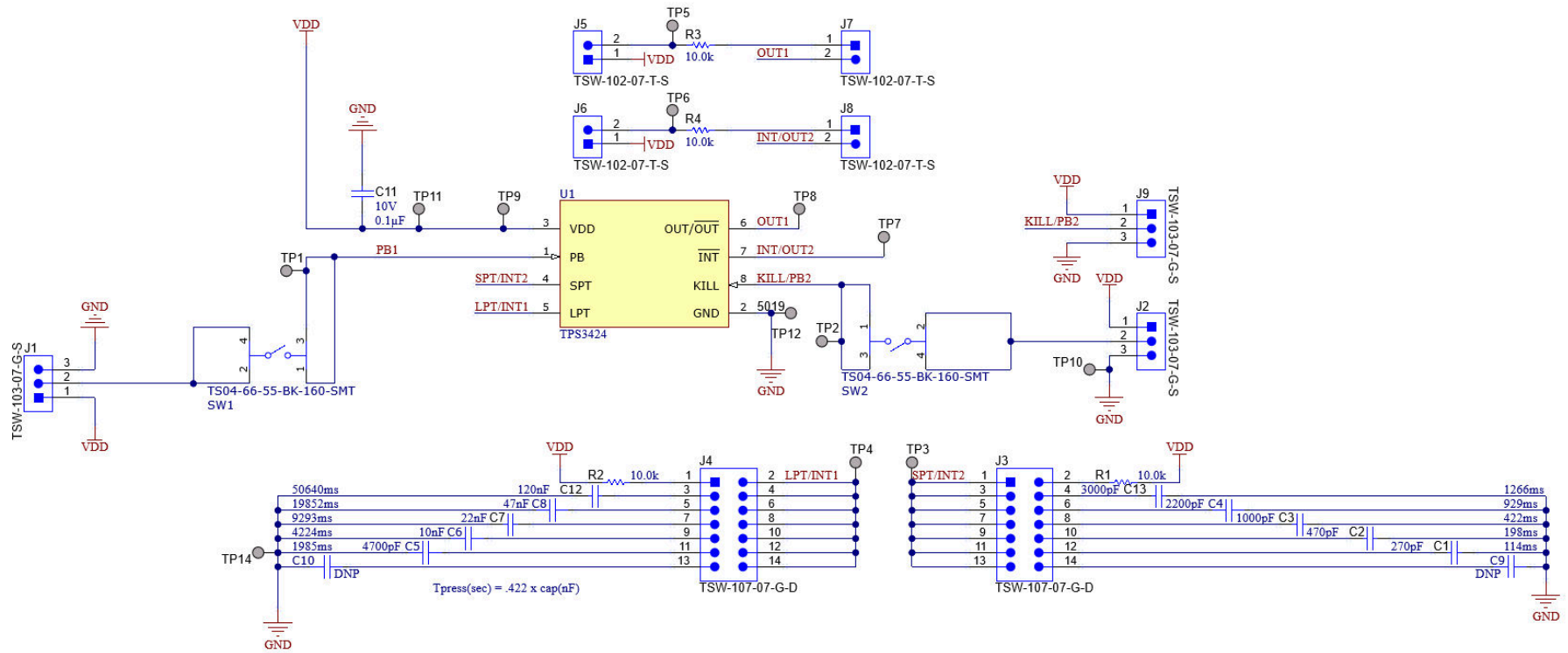# 4 Hardware Design Files

4.1 Schematics

Figure 4-1. TPS3424EVM Schematic

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4.2 PCB Layout

Figure 4-2 show the top assemblies of the printed circuit board (PCB) to display the component placement of the EVM.

Figure 4-3 show the top layouts, Figure 4-4 and Figure 4-5 show the top and bottom layers, and Figure 4-6 shows the top solder mask of the EVM.
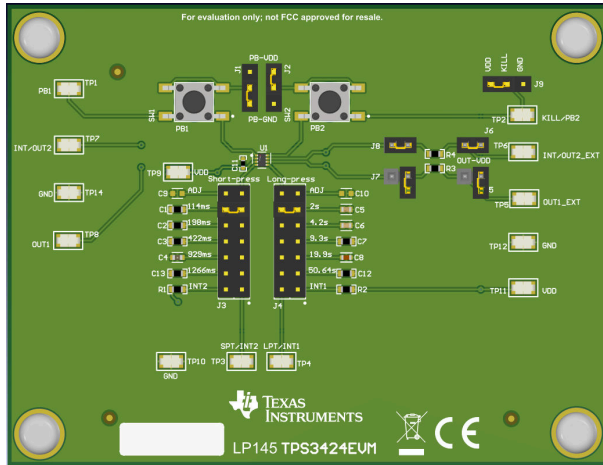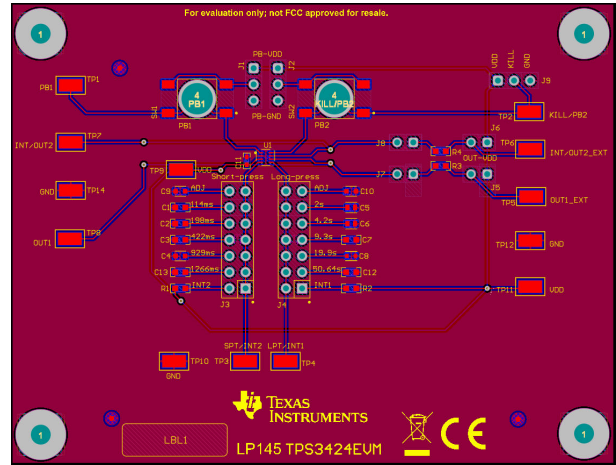

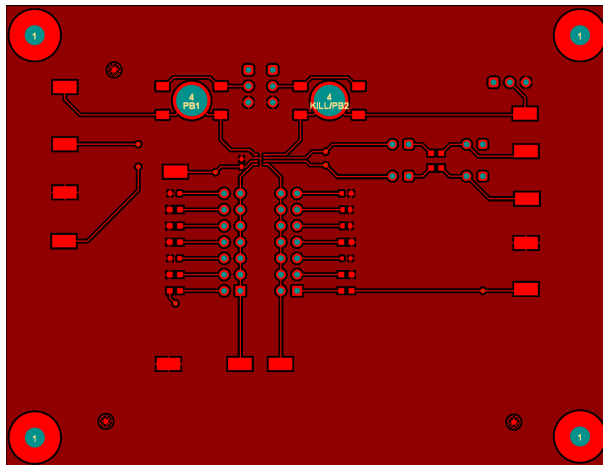**Figure 4-2. Component Placement - Top Assembly**

Figure 4-3. Layout - Top
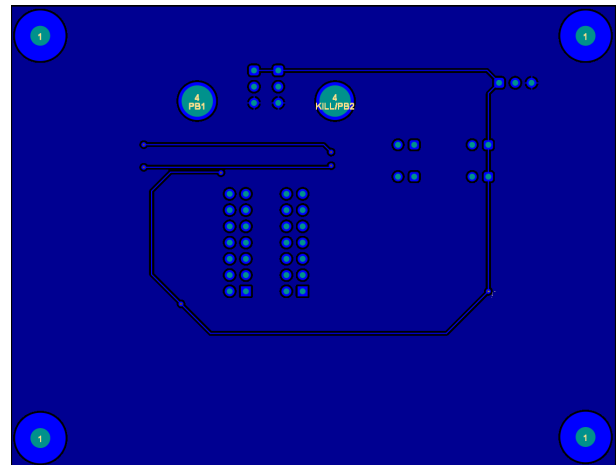

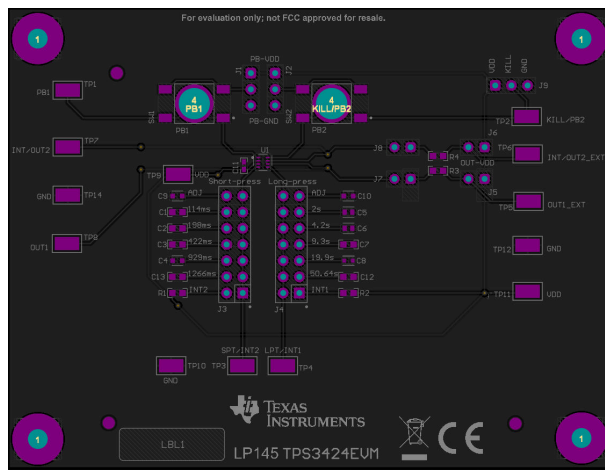**Figure 4-4. Top Layer**

Figure 4-5. Bottom Layer

Figure 4-6. Top Solder Mask

4.3 Bill of Materials

TPS3424EVM Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C1	1	270pF	CAP, CERM, 270pF, 50V, +/- 5%, C0G/NP0, 0603	0603	C0603C271J5GACTU	Kemet
C2	1	470pF	CAP, CERM, 470pF, 10V,+/- 5%, C0G/NP0, 0603	0603	8.85012E+11	Wurth Electronik
C3	1	1000pF	CAP, CERM, 1000pF, 25V,+/- 1%, C0G/NP0, 0603	0603	C0603C102F3GACTU	Kemet
C4	1	2200pF	2200pF ±1% 16V Ceramic Capacitor C0G, NP0 0603 (1608 Metric)	0603	VJ0603A222FXJCW1BC	Vishay
C9, C10	2	2200pF	2200pF ±1% 16V Ceramic Capacitor C0G, NP0 0603 (1608 Metric)	0603	VJ0603A222FXJCW1BC	Vishay
C5	1	4700pF	4700pF ±1% 25V Ceramic Capacitor C0G, NP0 0603 (1608 Metric)	0603	C0603C472F3GAC7867	Kemet
C6	1	10000pF	10000pF ±5% 50V Ceramic Capacitor X7R 0603 (1608 Metric)	0603	C0603C103J5RAC7867	Kemet
C7	1	22nF	CAP, CERM, 0.022uF, 16V, +/- 10%, X7R, 0603	603	GRM188R71C223KA01D	MuRata
C8	1	47nF	0.047µF ±10% 50V Ceramic Capacitor X7R 0603 (1608 Metric)	0603	GCJ188R71H473KA12D	MuRata
C11	1	100nF	CAP, CERM, 0.1µF, 10V,+/- 10%, X7R, 0402	402	C0402C104K8RACTU	Kemet
C12	1	120nF	CAP, CERM, 0.12uF, 25V, +/- 10%, X7R, 0603	0603	GRM188R71E124KA01D	MuRata
C13	1	3nF	CAP, CERM, 3000pF, 50V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H302JA01D	MuRata
H1, H2, H3, H4	4	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Philips panhead	NY PMS 440 0025 PH	B&F Fastener Supply
J1, J2, J9	3	Header, 100mil	Header, 100mil, 3x1, Gold, TH	3x1 Receptacle	TSW-103-07-G-S	Samtec
J3, J4	2	Header, 100mil	Header, 100mil, 7x2, Gold, TH	7x2 Receptacle	TSW-107-07-G-D	Samtec
J5, J6, J7, J8	4	Header, 2.54mm	Header, 2.54mm, 2x1, Tin, TH	2x1 Receptacle	TSW-102-07-T-S	Samtec

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
R1, R2, R3, R4	4	10.0kΩ	RES, 10.0k, 1%, 0.1W, 0603	0603	RC0603FR-0710KL	Yageo
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9	8	Shunt, 100mil	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
SW1, SW2	2	Switch Tactile OFF (ON) SPST Round Button Gull Wing 0.05A 12VDC 80000Cycles 1.6N SMD Bag	Switch Tactile OFF (ON) SPST Round Button Gull Wing 0.05A 12VDC 80000Cycles 1.6N SMD Bag	Button	TS04-66-55-BK-160-SMT	CUI Devices
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP14	13	Test Point, Miniature, SMT	Test Point, Miniature, SMT	Test point	5019	Keystone
U1	1	Nano-Power, Push-Button	Nano-Power, Push-Button	DRL	TPS3424A11C13ADRL	Texas Instruments

5 Additional Information

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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/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

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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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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.

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