

Precision Signal Injector EVM (PSIEVM)

This user's guide describes the characteristics, operation, and use of the *Precision Signal Injector* evaluation module (PSIEVM). The EVM facilitates the evaluation of single-ended, differential, and high-voltage SAR analog-to-digital converters (ADC) by generating a very low distortion, low-noise signal. This signal generator is powered by and controlled by the USB port. This user's guide provides a description of how to configure and control the hardware using the provided software GUI.



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

Device	Literature Number
ADS8900BEVM-PDK	SBAU269
ADS8881EVM-PDK	SBAU281
ADS8681EVM-PDK	SBAU252
DAC8411	SBAS439
MSP430F5503	SLAS645
OPA1612	SBOS450
OPA1662	SBOS489
OPA227	SBOS110
OPA827	SBOS376
PCM5142	SLAS759
THS4131	SLOS318

Table 1. Associated Devices

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1 Overview

The *Precision Signal Injector Evaluation Module* (PSIEVM, or PSI for short) is a platform for testing and evaluating the performance of successive approximation register (SAR) ADCs. The board is strictly designed to provide a low distortion, low-noise, 2-kHz input signal for driving the input of the ADC and pairs with most of TI's SAR ADC evaluation modules (EVMs). The board is powered over a USB cable which also provides a user interface connection to a PC.

The software platform that accompanies the PSIEVM allows for the user to adjust the PSIEVM output through the graphical user interface (GUI) that is downloaded to the computer.

Along with the PSIEVM, this evaluation kit includes an A-to-micro-B USB cable to connect to a computer via USB 3.0 or below, as well as 2 SMA to SMA coaxial cables for EVM connectivity.

1.1 PSIEVM Features

The PSIEVM includes the following features:

- Software suite with a graphical tool for controlling the amplitude, frequency, and offset of the AC signal
- Onboard filter for generating a very low distortion, low-noise, 2-kHz signal
- Jumper-selectable options for filtering and offset voltage or common-mode voltage
- Single-ended or true differential signal output options.
- Easy-to-use evaluation software for Microsoft[®] Windows[®] 7, Windows 8, and Windows 10 64-bit operating systems
- Powered over a single USB cable

2 PSIEVM Initial Setup

This section explains the initial hardware and software setup procedure required for the proper operation of the PSIEVM.

2.1 Default Jumper Settings

Jumper settings are used to enable or disable filter stages, enable or disable EEPROM write, select internal or external power supplies, select internal or external analog signals, and adjust offset or common-mode voltage for the outputs. Jumper settings are described in and initial jumper position is shown in .



PSIEVM Initial Setup

	Table	2.	Jumper	Position	Description
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Designator	Position	Setting
JP1 and JP3	Filter	Enables filter following the audio DAC. The filter is used to minimize distortion and noise. When the filter is enabled, the PSI should only output 2 kHz.
JP2	Not Installed	If installed, this jumper can be used to allow for an external analog input signal. This option is intended for debug purposes only and is not required for normal operation. Connector P1 must be installed for the source of the signal (see Section 6.3).
JP4	Ground	Sets the offset to 0 V for single-ended output. To add a voltage offset, move this jumper to the SE_VOS side (see Section 3.2).
JP5	Not Installed	If installed, this jumper can be used to select external power supplies. Also install header P7 for the source of the power supplies. For general operation, the USB power is sufficient and external power is not required (see section Section 6.1).
JP7	Open	EEPROM in <i>Write Protect Mode</i> . The EEPROM is programmed during manufacturing with correction coefficients. To reprogram the correction coefficients, short jumper JP7. Since the EEPROM is programed in the factory, it is not necessary to recalibrate the PSI.
JP8	Ground	Sets VCM to 0 volts for <i>Differential Output</i> . To add a common-mode voltage, move this jumper to the DIF_VCM side (see Section 3.2).



Figure 1. Initial Jumper Setting Illustration

2.2 EVM Graphical User Interface (GUI) Software Installation

Download the latest version of *ADS8900BEVM-PDK Precision Signal Injector (PSI) GUI Installer* from the Tools and Software folder of the PSIEVM and run the GUI installer to install the EVM GUI software on the user's computer.

NOTE: Manually disable any antivirus software running on the computer before downloading the EVM GUI installer onto the local hard disk. Otherwise, depending on the antivirus settings, an error message may appear or the installer.exe file may be deleted.

Accept the license agreements and follow the on-screen instructions to complete the installation.



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Do you accept this license? I accept the agreement I do not accept the agreement initialBuilder		InstalBuilder	
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Figure 2. PSIEVM Software Installation Prompts

As part of the PSI GUI installation, a prompt with a *Device Driver* Installation appears on the screen. Click the *Next* > button to proceed.

NOTE: A notice may appear on the screen stating that *Windows* cannot verify the publisher of this driver software. Select Install this driver software anyway.

Welcome to the Device Driver Installation Wizard! This wizard helps you install the software drivers that some computers devices need in order to work.		Completing the Installation Wiz The drivers were successfu You can now connect your came with instructions, plea	Device Driver and By installed on this computer. device to this computer. If your device see read them first.
		Driver Name V Texas Instruments (usi	Status bs Ready to use
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Figure 3. Device Driver Installation Wizard Prompts

The PSIEVM requires LabVIEW[™] Run-Time Engine and may prompt for the installation of this software, if not already installed.



PSIEVM Initial Setup

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Figure 4. LabVIEW[™] Run-Time Engine Installation

After these installations, verify that C:\Program Files (x86)\Texas Instruments\Precision Signal Injector is as shown in Figure 5.



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Documents	Precision Signal Injector.ini	2/7/2017 9:37 PM	Configuration sett	1 KB		
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Figure 5. PSIEVM Folder Post-Installation

3 PSIEVM Operation

The following instructions are a step-by-step guide to connecting the PSIEVM to the computer and operating it to apply precision signals to a TI SAR ADC EVM (referred to as device under test (DUT)):

- 1. Use the provided USB cable to connect the PSIEVM to the computer.
 - LED D3 lights up indicating that the PSIEVM is powered up.
- 2. Launch the Precision Signal Injector GUI (PSI GUI) software.
- Connect the PSIEVM to the desired DUT to connector P2 for single ended, or P4 and P5 for differential signal (see Table 3). Ensure a firm contact on these connectors for effective signal transmission.
- 4. Connect the DUT EVM to the computer. Launch the GUI for the DUT EVM.
- 5. Set the PSI GUI to have the desired output type (single ended or differential), peak-to-peak voltage, offset voltage or common-mode voltage, and frequency.
- 6. Enable to output for the PSIEVM.



Figure 6. PSIEVM Hardware With Labels

Table 3. Output Connectors Dea	scription
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Reference Designator	Signal	Description
P2	Single-ended output	Single-ended output
P4	Differential output (-)	Negative-differential output

3.1 Using the PSI GUI

Through the PSI GUI, the user is able to control the input signal amplitude, offset, frequency, and type (single ended or differential). The PSI GUI gives the user control over the signal being applied to the DUT.

Figure 7 shows the PSI GUI as it appears on the user's computer screen.

PSI GUI Operation:

- 1. Select either *Single Ended* or *Differential* to ensure the output from the PSIEVM is the type the DUT takes as an input. The plot on the GUI adjusts to match the output signal.
- 2. Adjust the signal amplitude, common mode, and frequency by either typing in the desired values or by using the up or down arrows next to the text boxes. Click the *Set* button next to the parameter to change the output.
- 3. Enable the output by clicking *Output Enable*. A green light appears on the PSI GUI showing the output is enabled.





Figure 7. PSI GUI With Labels

3.2 Setting the Offset Voltage or Common-Mode Voltage

An offset voltage can be added to the single-ended output of the PSIEVM or a common-mode voltage can be added to the differential outputs. Table 4 shows the jumper combinations that are required to implement an offset or common-mode voltage. Once the jumpers are placed in the correct configuration, set the offset voltage or common-mode voltage through the GUI.

Table 4. Offset Voltage or Co	ommon-Mode Voltage	Jumper Settings
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Offset Voltage or Common-Mode Voltage Setting	JP4	JP8
VOS or VCM = 0 V	Ground	Ground
Single-ended offset	SE_VOS	Ground
Differential common-mode voltage	Ground	DIF_VCM



PSIEVM Operation

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Figure 8 shows an example of the GUI with single-ended output and an added offset voltage. The GUI does all of the calculations for the given inputs and shows the expected output on the plot.



Figure 8. Offset Voltage Example

Figure 9 shows an example of the GUI with differential output and an added common-mode voltage. The GUI does all of the calculations for the given inputs and shows the expected outputs on the plot.





3.3 AC versus DC Output

The PSIEVM is able to output a sine wave or a DC level. This change is made with the drop-down menu for *Output Mode*.

3.4 Amplitude Setting and Output Enable

The amplitudes selectable in the PSI GUI are available for AC single ended or differential as well as for DC output, see Table 5. Once all PSI GUI parameters have been selected, enabling the output allows for the selected signal to be produced from the PSIEVM. Disabling the output defaults the PSIEVM output to ground.

Table 5. Amplitude Range

Output Type	Minimum	Maximum
AC Single Ended or Differential	0 Vpp	11.88 Vpp
DC Single Ended or Differential	0 V	11.88 V

3.5 Frequency Selection

The eighth-order filter implemented on the PSIEVM and explained in Section 5.4, is optimized for a 2-kHz signal. The PSIEVM can create signals at other frequencies to effectively use a signal frequency other than 2 kHz, the filter must be bypassed by placing JP1 and JP3 into bypass mode. Note that the signal is not filtered when bypassing the eighth-order onboard filter, and consequently, THD and SNR are degraded. The PSI GUI allows input of any frequency, up to 20 kHz.

3.6 Typical Performance

Table 6 shows typical performance seen using the PSIEVM with the ADS8900BEVM with full scale signals.

Measurement	Value
SNR	101 dB
THD	–123 dB
SNR without filter	63.8 dB
THD without filter	–86.3 dB
DC resolution	36 codes = 0.34 mV

Table 6. Typical Performance

4 Examples Using PSIEVM to Drive TI Data Converter EVMs

In this section the PSIEVM is used to drive three different examples of SAR ADC evaluation modules. This includes both single-ended and differential cases.

4.1 Example of Single-Ended Operation With ADS8881EVM

To explain the single-ended output mode of operation, an example using the ADS8881EVM follows. The hardware setup is shown in Table 7 and Figure 10. First, download the ADS8881EVM GUI to use the ADC to acquire the PSIEVM output signals. Then, connect the PSIEVM to the ADS8881EVM by having P2 on the PSIEVM attached to J1 on the ADS8881EVM, also tie JP2 to ground on the ADS8881EVM and have no jumper installed on JP3. Next, select the output parameters as shown in Table 8. Lastly, enable the output on the PSI GUI and use the ADS8881EVM to acquire the signal. Figure 11 and Figure 12 show the two GUIs for this test. Table 9 shows the expected results for this test setup.

PSIEVM Operation



Reference Designator	Position or Connection	
ADS8881EVM J1	PSIEVM P2	
ADS8881EVM JP-2	Ground	
ADS8881EVM JP-3	Open	
PSIEVM P2	ADS8881EVM J1	
PSIEVM JP1, JP3	Filter	
PSIEVM JP4	Ground	





Figure 10. ADS8881EVM Connected to PSIEVM

Parameter	Value	
ADS8881EVM input type	Single ended	
PSI GUI output type	Single ended	
ADS8881EVM maximum input range	(-VREF to VREF) -4.5 V to 4.5 V	
PSI GUI amplitude	8.8 Vpp	
PSI GUI common mode	0 V	
PSI GUI frequency	2 kHz	

Table 8. ADS8881EVM Example Parameters



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Serial Numbers 504A0B510A002700	7
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3-	Amplitude (Vpp) 8.8000 🚔 Set
€ 1 = 0-Offset (0.00)	Offset (V) 0.00 Set
-1- -2- -3- Min (-4.39)	Frequency (KHz) 2
-4- -5- 0 0.0001 0.0002 0.0003 0.0004 0.0005 Time (Secs) Output_P	Output Mode Sine wave 💌 Output Enable 💿 🥥
enable filter. Please configure JP4 as VCM, JP8 as GND to enable Offset. Output : Single ended output at P2.	Output type Single Ended Olfferential

Figure 11. PSI GUI Setup for ADS8881EVM



Examples Using PSIEVM to Drive TI Data Converter EVMs

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Figure 12. ADS8881EVM GUI Spectral Analysis for PSIEVM Input

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Measurement	Value
SNR	97.7 dB
THD	–116.2 dB



4.2 Example of Differential Operation With ADS8900BEVM

To explain the differential output mode of operation, an example using the ADS8900BEVM follows. First, download the ADS8900BEVM GUI to use the ADC to acquire the PSIEVM output signals. Then, connect the PSIEVM to the ADS8900BEVM by having P4 and P5 on the PSIEVM attached to J7 and J3, respectively, on the ADS8900BEVM, using equal length cables, as shown in Table 10 and Figure 13. Next, the output parameters should be selected as shown in Table 11. Lastly, enable the output on the PSI GUI and use the ADS8900BEVM to acquire the signal. Figure 14 and Figure 15 show the two GUIs for this test. Table 12 shows expected results for this test setup.

Reference Designator	Position or Connection
ADS8900BEVM J3	PSIEVM P5
ADS8900BEVM J7	PSIEVM P4
PSIEVM P5	ADS8900BEVM J3
PSIEVM P4	ADS8900BEVM J7
PSIEVM JP1, JP3	Filter
PSIEVM JP8	Ground

Table 10. Example 2 Hardware Setup





Table	11.	ADS8900BEVM	Examples	Parameters
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Parameter	Value	
ADS8900BEVM input type	Differential	
PSI GUI output type	Differential	
ADS8900BEVM maximum input range	(-VREF to +VREF) -5 V to 5 V	
PSI GUI amplitude	9.8 Vpp	
PSI GUI common mode	0 V	
PSI GUI frequency	2 kHz	





Figure 14. PSI GUI Setup for ADS8900BEVM

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Figure 15. ADS8900BEVM GUI Spectral Analysis for PSIEVM Input

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L	able	12.		- 2	resuits

Measurement	Value
SNR	100.8 dB
THD	–123.5 dB



4.3 Example of Single-Ended, High-Voltage Operation With ADS8681EVM

To explain the single-ended output mode of operation with a high-voltage SAR ADC, an example using the ADS8681EVM follows. First, download the ADS8681EVM GUI to use the ADC to acquire the PSIEVM output signals. Then, connect the PSIEVM to the ADS8681EVM by having P2 on the PSIEVM attached to J1 on the ADS8681EVM as shown in Table 13 and Figure 16. Next, select the output parameters as Table 14 shows. Lastly, enable the output on the PSI GUI and use the ADS8681EVM to acquire the signal. Figure 17 and Figure 18 show the two GUIs for this test. The output range of the PSIEVM is limited to 11.88 V peak to peak. To test SAR ADC at higher voltages than ±5.93 V, use the common-mode offset. To implement an offset in single-ended mode, JP4 on the PSIEVM must be moved to SE_VOS, see Section 3.2. Table 15 shows the expected results for this test setup.

NOTE: To make the ADS8681EVM function properly using the PSIEVM, remove capacitor C1 on the ADS8681EVM. This is because the PSIEVM does not function properly when driving a capacitive load, see Section 7.1.

Reference Designator	Position or Connection
ADS8681EVM J1	PSIEVM P2
PSIEVM P2	ADS8681EVM J1
PSIEVM JP1, JP3	Filter
PSIEVM JP4	Ground

Table 13. Example 3 Hardware Setup



Figure 16. ADS8681EVM Connected to the PSIEVM

Examples Using PSIEVM to Drive TI Data Converter EVMs

Table 14. ADS8681EVM Example Parameters

Parameter	Value
ADS8681EVM input type	Single ended
PSI GUI output type	Single ended
ADS8681EVM maximum input range	$-3 \times VREF$ to $3 \times VREF = -12 V$ to $12 V$
PSI GUI amplitude	11.88 Vpp (maximum setting)
PSI GUI common mode	0 V
PSI GUI frequency	2 kHz
PSIEVM connectors	P3



Figure 17. PSI GUI Setup for ADS8681EVM



PSIEVM Design Overview

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Figure 18. ADS8681EVM GUI Spectral Analysis for PSIEVM Input

Table 15. Example 3 Results

Measurement	Value
SNR	86.4 dB
THD	–109.6 dB

5 **PSIEVM Design Overview**

5.1 Analog Interface

The evaluation board uses a variety of amplifiers in different configurations to compose the output signal based on the user inputs through the GUI. The signal path is explained fully in Section 5.4.

5.2 Digital Interface

The EVM communicates with the computer over USB. There are two devices on the EVM that communicate to the computer: the MSP430F5503 and the electrically erasable programmable read-only memory (EEPROM). The EEPROM comes pre-programmed with calibration coefficients and is ready to use out-of-the-box.



5.3 Connectors for Signal Output

The PSIEVM is designed to be easily interfaced with a TI SAR ADC EVM via a subminiature version A (SMA) connector. P2, P4, and P5 are SMA connectors that allow analog output connectivity through coaxial cables.

5.4 Signal Path

The PSIEVM takes user inputs from the GUI and transforms them into a highly-precise output signal. This process starts with the MSP430F5503 taking the user inputs and sending them to an audio digital-to-analog converter (DAC). The output of the audio DAC is then driven through a non-inverting topology op amp with a set gain of 2 volts-per-volt. The resulting signal is then placed through an eighth-order filter and this is the single-ended output signal. For the differential output, the single-ended output is driven into a fully differential amplifier.

The offset or common-mode voltage is controlled by a DAC, which takes input from the MSP430 and produces a voltage that drives into the filter to add single-ended offset and into the fully differential amplifier to add differential output common mode. Figure 19 helps visualize the explained signal path.



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Figure 19. Signal Path Illustration

5.5 Power Supplies

The USB supply is used to provide power to the analog power rail, digital power rail, positive amplifier supply, and negative amplifier supply. The power tree is shown in Table 16 and in Figure 20. External power supplies are not required but are an available option, see Section 6.1.

	le 16. Power Supplies	ies
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Power Rail	Voltage	Test Point
USB supply	4.75 V to 5.25 V	V_USB – TP3
Analog 3.3 (AV 3.3)	3.3 V	A3.3 – TP4
Digital 3.3 (DV 3.3)	3.3 V	D3.3 – TP5
Positive supply from switching regulator (POS SUP)	13.5 V	POS – TP1
Negative supply from switching regulator (NEG SUP)	–13.5 V	NEG – TP2
Positive supply from linear regulator (V_12)	12 V	P12 – TP6
Negative supply from linear regulator (VM_12)	–12 V	M12 – TP7



Optional Features

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Figure 20. Power Tree

6 **Optional Features**

In this section the options that are not installed on the PSIEVM are explained.

6.1 Using External Power Supplies

External power supplies are not required as the USB provides sufficient power for normal operation. This feature is included for debug. To use external power, install jumper JP5 and header P7. Place JP5 in external mode. Connect a 15-VDC supply and a -15-VDC supply to terminal block P7. The voltage input at header P7 is directly applied to the linear regulators.

CAUTION

Ensure the connected power supply is at a maximum of 15 V. Fluctuating above 15 V could result in component damage.

The PSIEVM must still be connected to the computer via the USB cable but this is only used for data from the GUI and not power.

6.2 Using an External Clock

The audio DAC, PCM5142, runs off the 20-MHz clock produced by the onboard crystal. Future developments may allow for an external clock input. Currently this hardware is not populated (P6).

6.3 Using an External Input Signal

The PSIEVM generates an output signal without requiring an analog input signal. An external analog input connection is available for debug purposes. This connection (P1) is not populated, and is not required for normal operation.

7 Other Considerations

7.1 Output Impedance

The output for the single ended and differential both have the option to populate output resistance. This feature can be used to help the PSI drive a capacitive load or to help minimize reflections through the coaxial cabling. Typically, a 50- Ω resistor for the output resistance will improve stability for driving a capacitive load and matches the impedance of the coaxial cabling. Note that by adding output resistance, there will be a voltage divider from the output resistance of the PSI and the input resistance of the DUT. The PSIEVM is fully calibrated with R53, R59, and R100 as 0- Ω resistors.

7.2 Cable Selection

It is best practice to minimize the length of the cabling used between the PSI and the DUT. It is also best to ensure a properly tightened connection between the SMA and the coaxial cable. A loose connection can lead to a low-quality signal transmission. The use of a torque wrench can help to ensure consistent tightness.

8 Bill of Materials, PCB Layout, and Schematics

This section contains the PSIEVM bill of materials, PCB layout, and the EVM schematics.

8.1 Bill of Materials

Table 17. PSIEVM Bill of Materials

Item #	Designator	Quantity	Value	Part Number	Manufacturer	Description	Package Reference
1	!PCB1	1		PA045	Any	Printed Circuit Board for PrecisionSignalEVM	
2	C1, C2, C7, C8, C9, C15, C34, C35, C76, C77	10	0.1uF	06033C104JAT2A	AVX	CAP, CERM, 0.1 μF, 25 V, ±5%, X7R, 0603	0603
3	C3, C4, C5, C6, C10, C11, C12, C13	8	0.1uF	C3216NP01H104J160AA	ТДК	CAP, CERM, 0.1 µF, 50 V, ±5%, C0G/NP0, 1206_190	1206_190
4	C14, C70, C71	3	10uF	GRM32ER7YA106KA12L	Murata	CAP, CERM, 10uF, 35V, ±10%, X7R, 1210	1210
5	C16, C18, C28, C30, C31, C32, C72, C82	8	0.1uF	GRM155R61A104KA01D	Murata	CAP, CERM, 0.1 µF, 10 V, ±10%, X5R, 0402	0402
6	C17, C19	2	10pF	GRM1555C1H100FA01D	Murata	CAP, CERM, 10 pF, 50 V, ±1%, C0G/NP0, 0402	0402
7	C20	1	0.1uF	GRM155R61E104KA87D	Murata	CAP, CERM, 0.1 µF, 25 V, ±10%, X5R, 0402	0402
8	C21, C22, C23, C46, C53, C54, C56, C63	8	4.7uF	GRM188R61A475MAAJ	Murata	CAP, CERM, 4.7 µF, 10 V, ±20%, X5R, 0603	0603
9	C24, C25	2	47pF	GRM1555C1H470JA01D	Murata	CAP, CERM, 47 pF, 50 V, ±5%, C0G/NP0, 0402	0402
10	C26	1	0.1uF	GRM188R70J104KA01D	Murata	CAP CER 0.1UF 16V 5% X7R 0603	0603
11	C27, C29	2	0.22uF	GRM155R71C224KA12D	Murata	CAP CER 0.22UF 16V 10% X7R 0402	0402
12	C38, C39, C41, C78	4	0.1uF	C0603C104J4RACTU	Kemet	CAP, CERM, 0.1 µF, 16 V, ±5%, X7R, 0603	0603
13	C40, C45	2	2.2uF	GRM188R61C225KE15D	Murata	CAP, CERM, 2.2 µF, 16 V, ±10%, X5R, 0603	0603
14	C42	1	2200pF	GRM1885C1H222JA01D	Murata	CAP, CERM, 2200 pF, 50 V, ±5%, C0G/NP0, 0603	0603
15	C43, C44, C75	3	10uF	GRM219R60J106KE19D	Murata	CAP CER 10UF 10V 10% X5R 0805	0805
16	C47, C58	2	10uF	C2012X5R1E106K125AB	TDK	CAP, CERM, 10 µF, 25 V, ±10%, X5R, 0805	0805
17	C48, C57, C61	3	0.1uF	GCM188R71H104KA57D	Murata	CAP, CERM, 0.1 µF, 50 V, ±10%, X7R, 0603	0603
18	C49, C59, C64, C67	4	10uF	GRM188R61C106MAALD	Murata	CAP, CERM, 10 µF, 16 V, ±20%, X5R, 0603	0603
19	C50, C68	2	22uF	C2012X5R1C226K125AC	TDK	CAP, CERM, 22 µF, 16 V, ±10%, X5R, 0805	0805
20	C51, C69, C73	3	1uF	0805YD105KAT2A	AVX	CAP, CERM, 1 µF, 16 V, ±10%, X5R, 0805	0805
21	C52	1	0.01uF	GRM188R71E103KA01D	Murata	CAP, CERM, 0.01 µF, 25 V, ±10%, X7R, 0603	0603
22	C55	1	0.22uF	GRM21BR71H224KA01L	Murata	CAP, CERM, 0.22 μF, 50 V, ±10%, X7R, 0805	0805
23	C60	1	0.01uF	06031C103JAT2A	AVX	CAP, CERM, 0.01 µF, 100 V, ±5%, X7R, 0603	0603
24	C62, C66	2	0.01uF	GRM188R71H103KA01D	Murata	CAP, CERM, 0.01 µF, 50 V, ±10%, X7R, 0603	0603
25	C65	1	0.047uF	06033C473JAT2A	AVX	CAP, CERM, 0.047 µF, 25 V, ±5%, X7R, 0603	0603
26	C74	1	200pF	GRM1555C1H201JA01D	Murata	CAP, CERM, 200 pF, 50 V, ±5%, C0G/NP0, 0402	0402
27	C79, C81	2	10uF	GRM21BZ71E106KE15L	Murata	CAP, CERM, 10 µF, 25 V, ±10%, X7R, 0805	0805
28	C80	1	1uF	EMK105BJ105KVHF	Taiyo Yuden	CAP, CERM, 1 µF, 16 V, ±10%, X5R, 0402	0402
29	C83, C84	2	0.1uF	08053C104KAT2A	AVX	CAP, CERM, 0.1 µF, 25 V, ±10%, X7R, 0805	0805
30	C85, C86	2	100uF	TPSV107K025R0100	AVX	CAP, TA, 100 µF, 25 V, ±10%, 0.1 ohm, SMD	7361-38
31	D1	1	15V	LSM115JE3/TR13	Microsemi	Diode, Schottky, 15 V, 1 A, DO-214BA	DO-214BA

Table 17. PSIEVM Bill of Materials (continued)

32 D2 1 5.42 D025VASF-7 Diodes Inc. Diodes Zener, 5.42 X00 mW, SDD-323F SDD-323F 33 D3 1 Green LG L29K-62J1-24.2 OSRAM LED, Green, SMD 1.7x065x0.8mm 34 D4 D5 2 30V BATAB/FLM STMcreatectronics Diode, Schothy, 30 V, 0.35 A, SDD-323 SDD-323 35 D6, D7, D10, D11 4 40V 1N8419HW-7-F Diodes Inc. Diode, Schothy, 40 V, 1A, SDD-123 SDD-123 36 D8, D9 2 2.7V MMS24711-V Vishay-Semiconductor Diode, Zaner, 27V, 500mW, SDD-123 SOD-123 37 H1, H2, H3, H4 4 NY PMS 440 0025 PH BE Fastener Supply Machine Strew, Round, 84-40 x 14/, Nylon, Philips panhead Screw 38 H5, H6, H7, H8 4 191 10103592-0001LF FCI Receptade, USB 20, Micro B, 5 Position, RA, SMT Resensition, RA, SMT Resensition, RA, SMT Resensition, SML Header, 100mil, 3x1, Gold, TH Header, 100mil, 3x1, TH 41 JP7 1 HTSW-102/07-G-S Samtec Head
33 D3 1 Green LG L28/K 621/24-Z OSRM LED, Green, SMD 1.7x0 65x0 8mm 34 D4, D5 2 30'V BAT48,FILM STMicroelectronics Diode, Schottky, 30 V, 0.58 A, SOD-323 SOD-123 35 D6, D7, D10, D11 4 40'V INS819H/V-7-F Diodes Inc. Diode, Schottky, 40 V, 1A, SOD-123 SOD-123 36 D6, D9 2 27'V MMS24711-V Viahay-Semiconductor Diode, Schottky, 40 V, 1A, SOD-123 SOD-123 37 H1, H2, H3, H4 4 NY PMS 440 0025 PH BEF Fasterer Stupply Matchine Screw, Round, 84-40, Alminum, 14' 14 linch Alminum Hox Sia 38 H5, H6, H7, H8 4 1891 Kystene Hex Standoff, 44-40, Alminum, 14' Hich Alminum Hox Sia 40 JP1, JP3, JP4, JP8 4 HTSW-102-07-G-S Samtec Header, 100mil, 3x1, Cold, TH Header, 100mil, 3x1, TH 41 JP7 1 HTSW-102-07-G-S Samtec Header, 100mil, 2x1, Cold, TH Header, 100mil, 3x1, TH 42 L1, L2 2 4.70H T4403004
34 Dt, D5 2 30V BAT48,B/LM STMIcroslectronics Diode, Schottky, 30 V, 0.35 A, SOD-233 SOD-323 35 D6, D7, D10, D11 4 40V INSB splex Diodes, Enc. Diode, Schottky, 40 V, 1 A, SOD-123 SOD-123 36 D6, D9 2 27V MMS24711-V Vishay-Semiconductor Diode, Schottky, 40 V, 1 A, SOD-123 SOD-123 37 H1, H2, H3, H4 4 NY PMS 440 0025 PH B&F Fastener Supply Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead Screw 38 H5, H6, H7, H8 4 1831 Keystone Hax Standoff, #4-40, Auminum, 1/4" 1/4 inch Auminum Hex Stat 39 J1 1 10103592-001LF FCI Receptade, USB 20, Micro B, 5 Position, R/A, SMT Respectade, USB 20, Micro B, 5 Position, R/A, SMT Respectade, USB 20, Micro B, 5 Position, R/A, SMT Header, 100mil, 31, TH 40 JP1, 72, JP4, JP8 4 HTSW-103-07-6-S Samteo Header, 100mil, 31, Gid, TH Header, 100mil, 21, Gid, TH Header, 100mil, 21, Gid, TH Header, 100mil, 21, Gid, TH 41 JP7 1 N2514-6002-RB
35 D6, D7, D10, D11 4 40V IN8819HW-7-F Diodes Inc. Diode, Schottly, 40 V, 1 A, SOD-123 SOD-123 36 D6, D9 2 27V MMS24711-V Vishay-Semiconductor Diode, Zener, 27V, S00MW, SOD-123 SOD-123 37 H1, H2, H3, H4 4 NY PMS 400025 PH B&F Fastener Supply Machine Screw, Round, 44-0x 14, Mylon, Philips panhead Screw 38 H5, H6, H7, H8 4 1891 Keystone Hex Standoff, #4-40, Aluminum, 1/4" 1/4 inch Aluminum Hex Sta 39 J1 1 10103592-0001LF FCI Receptade, USB 2.0, Micro B, 5 Position, RA, SMT Receptade, USB 2.0, Micro B, 5 Position, RA, SMT Receptade, USB 2.0, Micro B, 5 Position, RA, SMT Receptade, USB 2.0, Micro B, 5 Position, RA, SMT Receptade, USB 2.0, Micro B, 5 Position, RA, SMT Receptade, USB 2.0, Micro B, 5 Position, RA, SMT Receptade, USB 2.0, Micro B, 5 Position, RA, SMT Receptade, USB 2.0, Micro B, 5 Position, RA, SMT Receptade, USB 2.0, Micro B, 5 Position, RA, SMT Receptade, USB 2.0, Micro B, 5 Position, RA, SMT Receptade, USB 2.0, Micro B, 5 Position, RA, SMT Receptade, USB 2.0, Micro B, 5 Position, RA, SMT Receptade, USB 2.0, Micro B, 5 Position, RA, SMT Receptade, USD, SMT Micro A, 1 M Micro A, 1 M Micr
36 D8, D9 2 27V MMS24711-V Vishay-Semiconductor Diode, Zener, 27V, 500mW, SOD-123 SOD-123 37 H1, H2, H3, H4 4 NY PMS 440 0025 PH B&F Fastener Supply Machine Screw, Round, #4-40 x1/4, Nylon, Philips panhead Screw 38 H5, H5, H7, H8 4 1891 Keystone Hex Standoff, #4-40, Xuminum, 1/4" 14 inch Aluminum Hax Sia 39 J1 10103592-0001LF FCI Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Posi
37 H1, H2, H3, H4 4 NY PMS 440 0025 PH B&F Fastener Supply Machine Screw, Round, #4-40 x 1/4, Nyton, Philips panhead Screw 38 H5, H6, H7, H8 4 1891 Keystone Hex Standoff, #4-40, Autinum, 1/4* 1/4 inch Aluminum Hex Sta 39 J1 1 10103592-0001LF FCI Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, 15 200 Nather ALD 20011E Ketacle, 100mil, 2x1, Tdi Header, 10
38 H5, H6, H7, H8 4 1891 Keystone Hex Standoff, #4-40, Aluminum, 1/4" 1/4 inch Aluminum Hex Sta 39 J1 1 1 10103592-0001LF FCI Receptade, USB 2.0, Micro B, 5 Position, R/A, SMT Receptade, USB 2.0, Micro B, 5 Position, R/A, SMT Receptade, USB 2.0, Micro B, 5 Position, R/A, SMT Receptade, USB 2.0, Micro B, 5 Position, R/A, SMT Receptade, USB 2.0, Micro B, 5 Position, R/A, SMT Receptade, USB 2.0, Micro B, 5 Position, R/A, SMT Receptade, USB 2.0, Micro B, 5 Position, R/A, SMT Receptade, USB 2.0, Micro B, 5 Position, R/A, SMT Receptade, USB 2.0, Micro B, 5 Position, R/A, SMT Receptade, USB 2.0, Micro B, 5 Position, R/A, SMT Receptade, 100mil, 3x1, TH 40 JP1, JP3, JP4, JP8 4 HTSW-102-07-G-S Samtec Header, 100mil, 2x1, Gold, TH Header, 100mil, 2x1, Gold, TH Header, 100mil, 2x1, TH 41 JP2, P4, P5 3 142/0701-851 Emers Network Power Connector, End launch SMA, 50 ohm, SMT SMA End Launch 44 P3 1 N2514-6002-RB 3M Header (shrouded), 100mil, 7x2, Gold, TH 7x2 Header 45 P7 1 ED555/3DS On-Shore Technology Terninal Block, 3.5m Pitch, 341, TH 10.5&
39 J1 1 10103592-0001LF FCI Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT Header, 100mil, 3x1, TH 41 JP7 1 HTSW-102-07-G-S Samtec Header, 100mil, 2x1, Gold, TH Header, 100mil, 3x1, TH 42 L1, L2 2 4.7uH 744031004 Wurth Elektronik Inductor, Shielded Drum Core, Ferrite, 4.7 µH, 0.9 A, 0.09 ohm, SMD WE-TPC-S 43 P2, P4, P5 3 142-0701-851 Emerson Network Power Connector, End launch SMA, 50 dhm, SMT SMA End Launch 44 P3 1 N2514-6002-RB 3M Header (shrouded), 100mil, 72, Gold, TH 752 Header 46 O1 1 -20V S12323DS Vishay-Siliconix MOSFET, P-CH, -20 V, -3.7 A, SOT-23 SOT-23 47 R1, R4 2 1.00k RP3/D2B/HKOBTG TE Connecivity RES, 10.0 k, 0.1%, 0.25 W, AE
40 JP1, JP3, JP4, JP8 4 HTSW-103-07-G-S Samec Header, 100mil, 3x1, Gold, TH Header, 100mil, 3x1, TH 41 JP7 1 HTSW-102-07-G-S Samtec Header, 100mil, 2x1, Gold, TH Header, 100mil, 2x1, Gold, TH Header, 100mil, 2x1, Gold, TH 42 L1, L2 2 4.7uH 744031004 Wurth Elektronik Inductor, Shelded Drum Core, Ferrite, 4.7 µH, 0.9 A, 0.09 ohm, SMD WE-TPC-S 43 P2, P4, P5 3 142-0701-851 Emerson Network Power Connector, End launch SAM, 50 ohm, SMT SMA End Launch 44 P3 1 N2514-6002-RB 3M Header (shrouded), 100mil, 72, Gold, TH 7x2 Header 45 P7 1 ED555/3DS On-Shore Technology Terminal Block, 3.5mm Pitch, 3x1, TH 10.5x8.2x6.5mm 46 Q1 1 -20V SI232DS Vishay-Siliconix MOSFET, P.CH, -20 V, -3.7 A, SOT-23 SOT-23 47 R1, R4 2 1.00k RP73DB1K0BTG TE Connectivity RES, 10.0 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 48 R2 1
41 JP7 1 HTSW-102-07-G-S Samtec Header, 100mil, 2x1, Gold, TH Header, 100mil, 2x1, TH 42 L1, L2 2 4.7uH 744031004 Wurth Elektronik Inductor, Shielded Drum Core, Ferrite, 4.7 µH, 0.9 A, 0.09 ohm, SMD WE-TPC-S 43 P2, P4, P5 3 142-0701-851 Emerson Network Power Connector, End launch SMA, 50 ohm, SMT SMA End Launch 44 P3 1 N2514-6002-RB 3M Header (shrouded), 100mil, 7x2, Gold, TH 7x2 Header 45 P7 1 ED555/3DS On-Shore Technology Terminal Block, 3.5mm Pitch, 3x1, TH 10.58.2x6.5mm 47 R1, R4 2 1.00k RP73D2B1K0BTG TE Connectivity RES, 10.0 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 48 R2 1 6.34k ERA-8APB3321V Panasonic RES, 3.3 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 50 R5 1 3.16k ERA-8APB161V Panasonic RES, 3.3 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 51 R6 1 1.65k ERA-
42 L1, L2 2 4.7uH 744031004 Wurth Elektronik Inductor, Shielded Drum Core, Ferrite, 4.7 µH, 0.9 A, 0.09 ohm, SMD WE-TPC-S 43 P2, P4, P5 3 1 142-0701-851 Emerson Network Power Connector, End Iaunch SMA, 50 ohm, SMT SMA End Launch 44 P3 1 N2514-6002-RB 3M Header (shrouded), 100mil, 7x2, Gold, TH 7x2 Header 45 P7 1 ED55/3DS On-Shore Technology Terminal Block, 3.5mm Pitch, 3x1, TH 10.5x8.2x6.5mm 46 Q1 1 -20V SI232DS Vishay-Siliconix MOSFET, P-CH, -20 V, -3.7 A, SOT-23 SOT-23 47 R1, R4 2 1.00k RP3D2B1K0BTG TE Connectivity RES, 6.34 k, 0.1%, 0.25 W, AEC-0200 Grade 0, 1206 1206 48 R2 1 6.34k ERA-8APB6341V Panasonic RES, 3.32 k, 0.1%, 0.25 W, AEC-0200 Grade 0, 1206 1206 49 R3 1 3.36k ERA-8APB6311V Panasonic RES, 3.16 k, 0.1%, 0.25 W, AEC-0200 Grade 0, 1206 1206 50 R5 1
43 P2, P4, P5 3 142-0701-851 Emerson Network Power Connector, End launch SMA, 50 ohm, SMT SMA End Launch 44 P3 1 N2514-6002-RB 3M Header (shrouded), 100mil, 7x2, Gold, TH 7x2 Header 45 P7 1 ED555/3DS On-Shore Technology Terminal Block, 3.5mm Pitch, 3x1, TH 10.5x8.2x6.5mm 46 Q1 1 -20V Sl232DS Vishay-Siliconix MOSFET, P-CH, -20 V, -37 A, SOT-23 SOT-23 47 R1, R4 2 1.00k RP73D2B1K0BTG TE Connectivity RES, 1.00k, 0.1%, 0.25 W, 1206 1206 48 R2 1 6.34k ERA-8APB6341V Panasonic RES, 3.32 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 49 R3 1 3.16k ERA-8APB3161V Panasonic RES, 3.32 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 50 R5 1 3.16k ERA-8APB1651V Panasonic RES, 1.65 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 51 R6 1 1.65k ERA-8APB1331V Panaso
44 P3 1 N2514-6002-RB 3M Header (shrouded), 100mil, 7x2, Gold, TH 7x2 Header 45 P7 1 ED555/3DS On-Shore Technology Terminal Block, 3.5mm Pitch, 3x1, TH 10.5x8.2x6.5mm 46 Q1 1 -20V Si2323DS Vishay-Siliconix MOSFET, P-CH, -20 V, -3.7 A, SOT-23 SOT-23 47 R1, R4 2 1.00k RP73D2B1K0BTG TE Connectivity RES, 1.00 k, 0.1%, 0.25 W, 1206 1206 48 R2 1 6.34k ERA-8APB6341V Panasonic RES, 6.34 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 49 R3 1 3.32k ERA-8APB3321V Panasonic RES, 3.32 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 50 R5 1 3.16k ERA-8APB161V Panasonic RES, 3.16 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 51 R6 1 1.65k ERA-8APB1651V Panasonic RES, 1.65 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 52 R7 1 1.33k ERA-8APB1331V <td< td=""></td<>
45 P7 1 ED555/3DS On-Shore Technology Terminal Block, 3.5mm Pitch, 3x1, TH 10.5x8.2x6.5mm 46 Q1 1 -20V SI2323DS Vishay-Siliconix MOSFET, P-CH, -20 V, -3.7 A, SOT-23 SOT-23 47 R1, R4 2 1.00k RP73D2B1K0BTG TE Connectivity RES, 1.00 k, 0.1%, 0.25 W, 1206 1206 48 R2 1 6.34k ERA-8APB6341V Panasonic RES, 6.34 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 49 R3 1 3.32k ERA-8APB3321V Panasonic RES, 3.32 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 50 R5 1 3.16k ERA-8APB3161V Panasonic RES, 3.16 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 51 R6 1 1.65k ERA-8APB1651V Panasonic RES, 1.65 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 52 R7 1 1.33k ERA-8APB1331V Panasonic RES, 1.05 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 53 R8 1 102 <t< td=""></t<>
46 Q1 1 -20V SI2323DS Vishay-Siliconix MOSFET, P-CH, -20 V, -3.7 A, SOT-23 SOT-23 47 R1, R4 2 1.00k RP73D2B1K0BTG TE Connectivity RES, 1.00 k, 0.1%, 0.25 W, 1206 1206 48 R2 1 6.34k ERA-8APB6341V Panasonic RES, 6.34 k, 0.1%, 0.25 W, AEC-0200 Grade 0, 1206 1206 49 R3 1 3.32k ERA-8APB3321V Panasonic RES, 3.32 k, 0.1%, 0.25 W, AEC-0200 Grade 0, 1206 1206 50 R5 1 3.16k ERA-8APB3321V Panasonic RES, 3.16 k, 0.1%, 0.25 W, AEC-0200 Grade 0, 1206 1206 51 R6 1 1.65k ERA-8APB1651V Panasonic RES, 1.65 k, 0.1%, 0.25 W, AEC-0200 Grade 0, 1206 1206 52 R7 1 1.33k ERA-8APB1331V Panasonic RES, 1.33 k, 0.1%, 0.25 W, AEC-0200 Grade 0, 1206 1206 53 R8 1 102 RT1206BRC07102RL Yageo America RES, 102, 0.1%, 0.25 W, 1206 1206 54 R9 1 215
47 R1, R4 2 1.00k RP73D2B1K0BTG TE Connectivity RES, 1.00 k, 0.1%, 0.25 W, 1206 1206 48 R2 1 6.34k ERA-8APB6341V Panasonic RES, 6.34 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 49 R3 1 3.32k ERA-8APB3321V Panasonic RES, 3.32 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 50 R5 1 3.16k ERA-8APB3161V Panasonic RES, 3.32 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 51 R6 1 1.65k ERA-8APB1651V Panasonic RES, 1.65 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 52 R7 1 1.33k ERA-8APB1651V Panasonic RES, 1.33 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 53 R8 1 102 RT1206BRC07102RL Yageo America RES, 215, 0.1%, 0.25 W, 1206 1206 54 R9 1 215 RT1206BRC07215RL Yageo America RES, 215, 0.1%, 0.25 W, 1206 1206 55 R11 1 5.49k
48 R2 1 6.34k ERA-8APB6341V Panasonic RES, 6.34 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 49 R3 1 3.32k ERA-8APB3321V Panasonic RES, 3.32 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 50 R5 1 3.16k ERA-8APB3161V Panasonic RES, 3.16 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 51 R6 1 1.65k ERA-8APB1651V Panasonic RES, 1.65 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 52 R7 1 1.33k ERA-8APB1331V Panasonic RES, 1.33 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 53 R8 1 102 RT1206BRC07102RL Yageo America RES, 102, 0.1%, 0.25 W, 1206 1206 54 R9 1 215 RT1206BRC07215RL Yageo America RES, 5.49 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 55 R11 1 5.49k ERA-8APB5491V Panasonic RES, 5.49 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 56 R12 1
49 R3 1 3.32k ERA-8APB3321V Panasonic RES, 3.32 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 50 R5 1 3.16k ERA-8APB3161V Panasonic RES, 3.16 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 51 R6 1 1.65k ERA-8APB1651V Panasonic RES, 1.65 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 52 R7 1 1.33k ERA-8APB1651V Panasonic RES, 1.33 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 53 R8 1 1.02 RT1206BRC07102RL Yageo America RES, 102, 0.1%, 0.25 W, 1206 1206 54 R9 1 215 RT1206BRC07215RL Yageo America RES, 215, 0.1%, 0.25 W, 1206 1206 55 R11 1 5.49k ERA-8APB5491V Panasonic RES, 5.49 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 56 R12 1 8.25k ERA-8APB8251V Panasonic RES, 8.25 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206
50 R5 1 3.16k ERA-8APB3161V Panasonic RES, 3.16 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 51 R6 1 1.65k ERA-8APB1651V Panasonic RES, 1.65 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 52 R7 1 1.33k ERA-8APB1331V Panasonic RES, 1.33 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 53 R8 1 102 RT1206BRC07102RL Yageo America RES, 102, 0.1%, 0.25 W, 1206 1206 54 R9 1 215 RT1206BRC07215RL Yageo America RES, 215, 0.1%, 0.25 W, 1206 1206 55 R11 1 5.49k ERA-8APB5491V Panasonic RES, 5.49 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 56 R12 1 8.25k ERA-8APB8251V Panasonic RES, 8.25 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206
51 R6 1 1.65k ERA-8APB1651V Panasonic RES, 1.65 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 52 R7 1 1.33k ERA-8APB1331V Panasonic RES, 1.33 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 53 R8 1 102 RT1206BRC07102RL Yageo America RES, 102, 0.1%, 0.25 W, 1206 1206 54 R9 1 215 RT1206BRC07215RL Yageo America RES, 215, 0.1%, 0.25 W, 1206 1206 55 R11 1 5.49k ERA-8APB5491V Panasonic RES, 5.49k k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 56 R12 1 8.25k ERA-8APB8251V Panasonic RES, 8.25 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206
52 R7 1 1.33k ERA-8APB1331V Panasonic RES, 1.33 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 53 R8 1 102 RT1206BRC07102RL Yageo America RES, 102, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 54 R9 1 215 RT1206BRC0715RL Yageo America RES, 215, 0.1%, 0.25 W, 1206 1206 55 R11 1 5.49k ERA-8APB5491V Panasonic RES, 5.49k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 56 R12 1 8.25k ERA-8APB5251V Panasonic RES, 8.25 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206
53 R8 1 102 RT1206BRC07102RL Yageo America RES, 102, 0.1%, 0.25 W, 1206 1206 54 R9 1 215 RT1206BRC0715RL Yageo America RES, 215, 0.1%, 0.25 W, 1206 1206 55 R11 1 5.49k ERA-8APB5491V Panasonic RES, 5.49 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 56 R12 1 8.25k ERA-8APB8251V Panasonic RES, 8.25 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206
54 R9 1 215 RT1206BRC07215RL Yageo America RES, 215, 0.1%, 0.25 W, 1206 1206 55 R11 1 5.49k ERA-8APB5491V Panasonic RES, 5.49 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 56 R12 1 8.25k ERA-8APB8251V Panasonic RES, 8.25 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206
55 R11 1 5.49k ERA-8APB5491V Panasonic RES, 5.49 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206 56 R12 1 8.25k ERA-8APB8251V Panasonic RES, 8.25 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206
56 R12 1 8.25k ERA-8APB8251V Panasonic RES, 8.25 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206
57 R13 1 2.05k ERA-8APB2051V Panasonic RES, 2.05 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206
58 R14 1 121 RT1206BRC07121RL Yageo America RES, 121, 0.1%, 0.25 W, 1206 1206
59 R15 1 80.6 ERA-8AEB80R6V Panasonic RES, 80.6, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206 1206
60 R16, R30, R31, R32, R33, R45, R63, R64, R65, R66, R67, R68, R69, R70, R72, R73, R86, R97 19 10.0k CRCW040210K0FKED Vishay-Dale RES, 10.0 k, 1%, 0.063 W, 0402 0.402 60 R45, R63, R64, R65, R66, R67, R68, R69, R70, R72, R73, R86, R97 19 10.0k CRCW040210K0FKED Vishay-Dale RES, 10.0 k, 1%, 0.063 W, 0402 0402
61 R17, R20 2 27.4 CRCW040227R4FKED Vishay-Dale RES, 27.4, 1%, 0.063 W, 0402 0402
62 R18 1 1.37k RT0603BRD071K37L Yageo America RES, 1.37 k, 0.1%, 0.1 W, 0603 0603
63 R21, R46, R48, R49, R50, R78, R99 7 0 CRCW04020000Z0ED Vishay-Dale RES, 0, 5%, 0.063 W, 0402 0402
64 R23, R24 2 100k CRCW0402100KJNED Vishay-Dale RES, 100 k, 5%, 0.063 W, 0402 0402
65 R25, R26 2 150k CRCW0402150KJNED Vishay-Dale RES, 150 k, 5%, 0.063 W, 0402 0402
66 R29, R34, R36, R38, R40, R42, R43, R71 8 51.1 CRCW040251R1FKED Vishay-Dale RES, 51.1, 1%, 0.063 W, 0402 0402
67 R35, R37, R39, R41 4 33 CRCW040233R0JNED Vishay-Dale RES, 33, 5%, 0.063 W, 0402 0402



Table 17. PSIEVM Bill of Materials (continued)

Item #	Designator	Quantity	Value	Part Number	Manufacturer	Description	Package Reference
68	R44	1	1.1Meg	CRCW04021M10JNED	Vishay-Dale	RES, 1.1 M, 5%, 0.063 W, 0402	0402
69	R52, R54, R57, R60	4	665	ERA-8APB6650V	Panasonic	RES, 665, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206	1206
70	R53, R59, R100	3	0	RCA12060000ZSEA	Vishay-Dale	RES, 0, 5%, 0.25 W, AEC-Q200 Grade 0, 1206	1206
71	R55, R56, R61, R89	4	0	ERJ-3GEY0R00V	Panasonic	RES, 0, 5%, 0.1 W, 0603	0603
72	R74, R84	2	100k	RC0603FR-07100KL	Yageo America	RES, 100 k, 1%, 0.1 W, 0603	0603
73	R75	1	86.6k	RG1608P-8662-B-T5	Susumu Co Ltd	RES, 86.6 k, 0.1%, 0.1 W, 0603	0603
74	R76	1	887k	CRCW0402887KFKED	Vishay-Dale	RES, 887 k, 1%, 0.063 W, 0402	0402
75	R77, R80, R85	3	1.00k	ERA-2APB102X	Panasonic	RES, 1.00 k, 0.1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402
76	R81	1	2.21Meg	CRCW04022M21FKED	Vishay-Dale	RES, 2.21 M, 1%, 0.063 W, 0402	0402
77	R82	1	1.00Meg	CRCW04021M00FKED	Vishay-Dale	RES, 1.00 M, 1%, 0.063 W, 0402	0402
78	R83	1	86.6k	ERA-2AEB8662X	Panasonic	RES, 86.6 k, 0.1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402
79	R87	1	93.1k	CRCW040293K1FKED	Vishay-Dale	RES, 93.1 k, 1%, 0.063 W, 0402	0402
80	R90, R91	2	0	MCR50JZHJ000	Rohm	RES, 0, 5%, 0.5 W, AEC-Q200 Grade 0, 2010	2010
81	R92, R93, R94, R95	4	1.0	CRCW08051R00JNEA	Vishay-Dale	RES, 1.0, 5%, 0.125 W, 0805	0805
82	R98	1	470	ERJ-2RKF4700X	Panasonic	RES, 470, 1%, 0.1 W, AEC-Q200 Grade 0, 0402	0402
83	S1	1		B3U-1100P	Omron Electronic Components	Switch, SPST-NO, Off-Mom, 12 V, SMD	SMD, 3-Leads, Body 3x2.5mm
84	SH-J1, SH-J2, SH-J3, SH-J4	4		881545-2	TE Connectivity	Shunt, 100mil, Gold plated, Black	Shunt 2 pos. 100 mil
85	TP9, TP10, TP11	3		5000	Keystone	Test Point, Miniature, Red, TH	Red Miniature Testpoint
86	TP12, TP13, TP14, TP15, TP16	5		5006	Keystone	Test Point, Compact, Black, TH	Black Compact Testpoint
87	U1	1		OPA227U	Texas Instruments	High Precision, Low Noise Operational Amplifier, 5 to 36 V, -55 to 125 degC, 8-pin SOIC (D0008A), Green (RoHS & no Sb/Br)	D0008A
88	U2	1		OPA1662AID	Texas Instruments	Sound Plus Low-Power, Low-Noise and Distortion, Audio Operational Amplifier, 3 to 36 V, -40 to 85 degC, 8-pin SOIC (D0008A), Green (RoHS & no Sb/Br)	D0008A
89	U3	1		OPA1612AID	Texas Instruments	High-Performance, Bipolar-Input Audio Operational Amplifier, D0008A	D0008A
90	U4	1		TPD2E001DRL	Texas Instruments	Low-Capacitance 2-Channel ±15-kV ESD-Protection Array For High-Speed Data Interfaces, DRL0005A	DRL0005A
91	U5	1		LMV761MFX/NOPB	Texas Instruments	Low-Voltage, Precision Comparator With Push-Pull Output, DBV0006A (SOT-23-6)	DBV0006A
92	U6	1		MSP430F5503IRGZT	Texas Instruments	25 MHz Mixed Signal Microcontroller with 32 KB Flash, 4096 B SRAM and 31 GPIOs, -40 to 85 degC, 48-pin QFN (RGZ), Green (RoHS & no Sb/Br)	RGZ0048A
93	U7	1		THS4131IDGNR	Texas Instruments	HIGH-SPEED, LOW-NOISE, FULLY-DIFFERENTIAL I/O AMPLIFIER, DGN008D	DGN0008D
94	U8	1		PCM5142PWR	Texas Instruments	2VRMS DirectPath, 112/106dB Audio Stereo DAC with 32-bit, 384kHz PCM Interface, PW0028A	PW0028A
95	U9	1		TPS7A4700RGWR	Texas Instruments	36-V, 1-A, 4.17-uVRMS, RF LDO Voltage Regulator, RGW0020A	RGW0020A
96	U10	1		TPS65130RGER	Texas Instruments	Postive and Negative Output DC-DC Converter, 2.7 to 5.5 V, -40 to 85 degC, 24-pin QFN (RGE24), Green (RoHS & no Sb/Br)	RGE0024B
97	U11	1		TPS7A3001DGNR	Texas Instruments	Single Output High PSRR LDO, 200 mA, Adjustable -1.18 to -33 V Output, -3 to -36 V Input, with Ultra-Low Noise, 8-pin MSOP (DGN), -40 to 125 degC, Green (RoHS & no Sb/Br)	DGN0008D
98	U12	1		TPS7A4700RGWR	Texas Instruments	36-V, 1-A, 4.17-uVRMS, RF LDO Voltage Regulator, RGW0020A (VQFN-20)	RGW0020A
99	U13, U14, U16	3	100kHz to 1GHz	BNX024H01L	Murata	FLTR EMI 15A 50V 100KHZ-1GHZ SMD	12.1x3.1x9.1



Table 17. PSIEVM Bill of Materials (continued)

Item #	Designator	Quantity	Value	Part Number	Manufacturer	Description	Package Reference
100	U15	1		TLV70433DBVR	Texas Instruments	Single Output LDO, 150 mA, Fixed 3.3 V Output, 2.5 to 24 V Input, with Ultra-Low IQ, 5-pin SOT-23 (DBV), -40 to 125 degC, Green (RoHS & no Sb/Br)	DBV0005A
101	U17	1		DAC8411IDCKR	Texas Instruments	2.0V to 5.5V, 80uA, 16-Bit, Low-Power, Single-Channel, Digital-to-Analog Converter, DCK0006A	DCK0006A
102	U18	1		OPA827AIDR	Texas Instruments	Low-Noise, High-Precision, JFET-Input OPERATIONAL AMPLIFIER, D0008A (SOIC-8)	D0008A
103	U19	1		REF5050AID	Texas Instruments	Low Noise, Very Low Drift, Precision Voltage Reference, -40 to 125 degC, 8- pin SOIC (D), Green (RoHS & no Sb/Br)	D0008A
104	U20	1		BR24G32FVT-3AGE2	Rohm	I2C BUS EEPROM (2-Wire), TSSOP-B8	TSSOP-8
105	Y1	1		AS-4.000MAHK-B	TXC Corporation	Crystal, 4 MHz, TH	11.5x5mm
106	Y2	1		ASTX-H11-20.000MHZ-T	Abracon Corporation	Oscillators, 20 MHz, HCMOS, 3.3V, SMD	3.2x2.5mm
107	C33, C36	0	1000pF	12061A102FAT2A	AVX	CAP, CERM, 1000 pF, 100 V, ±1%, C0G/NP0, 1206	1206
108	C37	0	10uF	GRM219R60J106KE19D	Murata	CAP CER 10UF 10V 10% X5R 0805	0805
109	FID1, FID2, FID3	0		N/A	N/A	Fiducial mark. There is nothing to buy or mount.	Fiducial
110	JP2, JP5	0		HTSW-103-07-G-S	Samtec	Header, 100mil, 3x1, Gold, TH	Header, 100mil, 3x1, TH
111	P1, P6	0		142-0701-851	Emerson Network Power	Connector, End launch SMA, 50 ohm, SMT	SMA End Launch
112	R10	0	1.00Meg	CRCW12061M00FKEA	Vishay-Dale	RES, 1.00 M, 1%, 0.25 W, 1206	1206
113	R19, R22	0	1.1Meg	CRCW04021M10JNED	Vishay-Dale	RES, 1.1 M, 5%, 0.063 W, 0402	0402
114	R27, R28	0	10.0k	CRCW040210K0FKED	Vishay-Dale	RES, 10.0 k, 1%, 0.063 W, 0402	0402
115	R47, R51	0	0	CRCW04020000Z0ED	Vishay-Dale	RES, 0, 5%, 0.063 W, 0402	0402
116	R58, R62, R88	0	0	ERJ-3GEY0R00V	Panasonic	RES, 0, 5%, 0.1 W, 0603	0603
117	R79	0	33	CRCW040233R0JNED	Vishay-Dale	RES, 33, 5%, 0.063 W, 0402	0402
118	TP1, TP3, TP4, TP5, TP6, TP8	0		5000	Keystone	Test Point, Miniature, Red, TH	Red Miniature Testpoint
119	TP2	0		5004	Keystone	Test Point, Miniature, Yellow, TH	Yellow Miniature Testpoint
120	TP7	0		5009	Keystone	Test Point, Compact, Yellow, TH	Yellow Compact Testpoint



8.2 PCB Layers

Figure 21 through Figure 25 illustrate the EVM PCB layout.



Figure 21. PCB Layer 1: Top Layer





Figure 22. PCB Layer 2: Ground Layer





Figure 23. PCB Layer 3: Power Layer





Figure 24. PCB Layer 4: Bottom Layer





Figure 25. PCB: Top Silk Screen



8.3 Schematic

Figure 26 through Figure 32 illustrate the EVM schematics.



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Figure 27. Schematic Page 2





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Figure 28. Schematic Page 3





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Figure 29. Schematic Page 4







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Figure 30. Schematic Page 5





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Figure 31. Schematic Page 6



Bill of Materials, PCB Layout, and Schematics



SH-J1 SH-J2 SH-J3 SH-J4



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Figure 32. Schematic Page 7

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- 3 Regulatory Notices:

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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

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。 http://www.tij.co.jp/lsds/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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