This user’s guide describes the operation of the TSW2170 signal generator evaluation module (EVM). The EVM is a low-cost tool used to verify the functionality of various TI analog-to-digital converters (ADCs). This document has setup instructions, block diagrams and screen captures from actual experiments using the TSW2170EVM. The TSW2170EVM product folder on the TI web site contains the EVM schematic, bill of materials, and layout files.

Figure 1. TSW2170EVM Board

1 Introduction

The TI TSW2170EVM (EVM) helps designers evaluate the functionality of their ADC devices. This product eliminates the expense of using a signal generator to create an input signal.

The board is powered off a bench power supply or the 5-V output which is found on the TSW2200EVM. An external clock generator is required to provide a sampling clock for the ADC board to capture correctly. For the captures conducted in this document, a 245.76-MHz clocking signal from the TSW4806EVM was used.

Figure 2. Block Diagram for Testing
The EVM has a default setup expecting an input voltage of 5 V. With this voltage applied, a crystal oscillator (XO) generates a HCMOS waveform at 70 MHz. Using amplification, attenuation and filtering, a 70-MHz signal is generated with low harmonic distortion output. The output waveform is set to ≥ 10 dBm (2 Vpp), which is used as the input to an ADC board. External attenuation may be needed. The block diagram of the TSW2170EVM is shown in Figure 3.

For information on the 70MHz bandpass filter, contact PDI at www.pdixtal.com.

2 Evaluation with the TSW2170

This chapter details the evaluation process and features of the EVM. An external supply voltage must be connected to the voltage in and ground banana jacks (J1 and J6, respectively). An LED illuminates when power is supplied. An SMA to SMA cable must be connected from the output SMA connector to the input channel of the ADC EVM.

The board accepts a supply voltage of 5 V (default) or 3.3 V. Different jumper configurations are necessary for these two options. If the board is supplied with 5 V, the charge pump is bypassed and the LDO 3.3-V regulator is implemented. If 3.3 V is supplied, the regulator is bypassed and the charge pump is used. At 5 V, the board draws approximately 150 mA while at 3.3 V, the board draws approximately 230 mA. The necessary configurations for each method are shown in Table 1. Improper jumpers will not damage the parts on the board; however, the system will not create the desired waveform for accurate testing.

Table 1. Jumper Configurations

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<td>5 V (default)</td>
<td>Short 1-2</td>
<td>Opened</td>
<td>Shorted</td>
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<tr>
<td>3.3 V</td>
<td>Short 2-3</td>
<td>Shorted</td>
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3 Measurements

The output waveform measured on the SMA connector should have $\geq 10$ dBm of power. The best way to get an accurate reading is when measured on a signal analyzer with a 50-Ω load termination. The testing for this user’s guide was done on a spectrum analyzer.

On many signal analyzers, the EVM output signal overdrives the machine in their default settings. RF attenuation must be set to account for this. The data taken in Figure 4 had the RF attenuation set to 50 dB.

![Figure 4. Output Waveform At 70 MHz](image)
The spectrum analyzer has the attenuation set to 10 dB in Figure 5 and the TSW2170EVM output is filtered with an external 70-MHz rejection filter to keep from distorting the analyzer. Figure 5 shows the performance of the EVM at the second and third harmonics.

Figure 5. Waveform 2\textsuperscript{nd} and 3\textsuperscript{rd} Harmonics After Filtering
3.1 **TSW1400 Data Capture**

Figure 6 shows the captured data of the ADS4249EVM using the TSW2170 as the input signal source.

The data captured meets datasheet-type performance for the **ADS4249EVM**.
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3.1 **United States**

3.1.1 **Notice applicable to EVMs not FCC-Approved:**

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**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**

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FCC Interference Statement for Class B EVM devices

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- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210

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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.

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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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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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