

ADC08351EVM

This user's guide describes the function and use of the ADC08351 evaluation module (EVM). Included in this document are a quick-start guide, instructions for optimizing evaluation results, jumper and connector descriptions, software description, and alternate hardware configurations.

Contents

1	Overview	2
	1.1 Required Hardware	2
	1.2 Required Software	2
	1.3 Evaluation Board Feature Identification Summary	3
	1.4 References	3
2	Quick-Start Guide	4
	2.1 Software Installation	4
	2.2 Hardware Setup Procedure	5
	2.3 Software Setup Procedure.....	6
	2.4 Quick-Start Troubleshooting.....	8
3	Optimizing Evaluation Results	9
	3.1 Clocking Optimization	9
	3.2 Coherent Input Source	9
	3.3 HSDC Pro Settings	9
4	Alternate Hardware Configurations	10
	4.1 Clocking Options	10
Appendix A	Jumper and Connector Descriptions.....	11

List of Figures

1	EVM Feature Locations	3
2	Quick-Start Test Setup	5
3	HSDC Pro GUI Main Panel.....	6
4	Data Capture Results From Quick-Start Procedure.....	7

List of Tables

1	Quick-Start Performance Measurements.....	7
2	Troubleshooting Tips	8
3	HSDC Pro Settings to Optimize Results.....	9
4	Jumper Descriptions and Default Settings	11
5	Connector Descriptions.....	11

Trademarks

Microsoft, Windows are registered trademarks of Microsoft Corporation.

1 Overview

The ADC08351EVM is an evaluation module (EVM) designed to evaluate the ADC08351. The EVM provides simple and minimal external components to minimize system cost and power consumption.

The following features apply to this EVM:

- 8-bit, low-cost, low-power, high-speed, CMOS interface ADC08351
- Onboard 40-MHz crystal oscillator for sample clocking, with an external clock option
- TPS7A47 user-programmable RF LDO voltage regulator
- CDCV304 high-performance, low-skew, PCI_X-compliant clock buffer

The ADC08351EVM is designed to work seamlessly with the TSW1400EVM, TI's CMOS and LVDS pattern generator and data capture board, through the High-Speed Data Converter Pro Graphic User Interface (HSDC Pro GUI) software tool for high-speed data converter evaluation.

1.1 Required Hardware

The following equipment is **included** in the EVM evaluation kit:

- ADC08351EVM
- Standard banana jack power supply cables

The following list of equipment are items that are **not included** in the EVM evaluation kit but are items required for evaluation of this product in order to achieve the best performance:

- *TSW1400EVM Data Capture Board*, +5 V DC cable connector and mini-USB cable
- Computer running Microsoft® Windows® 8, Windows 7, or Windows XP
- One low-noise signal generator. Recommendations:
 - RF generator, > +17 dBm, < -40 dBc harmonics, < 500 fsec jitter 20 kHz–20 MHz, 1-MHz to 2-GHz frequency range
 - Examples: TSW2170EVM, HP HP8644B, Rohde & Schwarz SMA100A
- DC power supply. Recommendations:
 - DC Power Supply, 0-6 VDC, > 3 A
 - Examples: Agilent E363A or equivalent
- Bandpass or lowpass filter for desired analog input. Recommendations:
 - Filter, ≥ 60-dB harmonic attenuation, ≤ 5% bandwidth, > +18-dBm power, < 5-dB insertion loss
 - Examples: Trilithic 5VH-series Tunable BPF, K&L BT-series Tunable BPF, TTE KC6 or KC7-series Fixed BPF
- Signal path cables, SMA or BNC with BNC-to-SMA adapters

1.2 Required Software

The following software is required to operate the TSW1400EVM and available online. See [References, Section 1.4](#) for links.

- High-Speed Data Converter Pro software

1.3 Evaluation Board Feature Identification Summary

The EVM features are labeled in Figure 1.

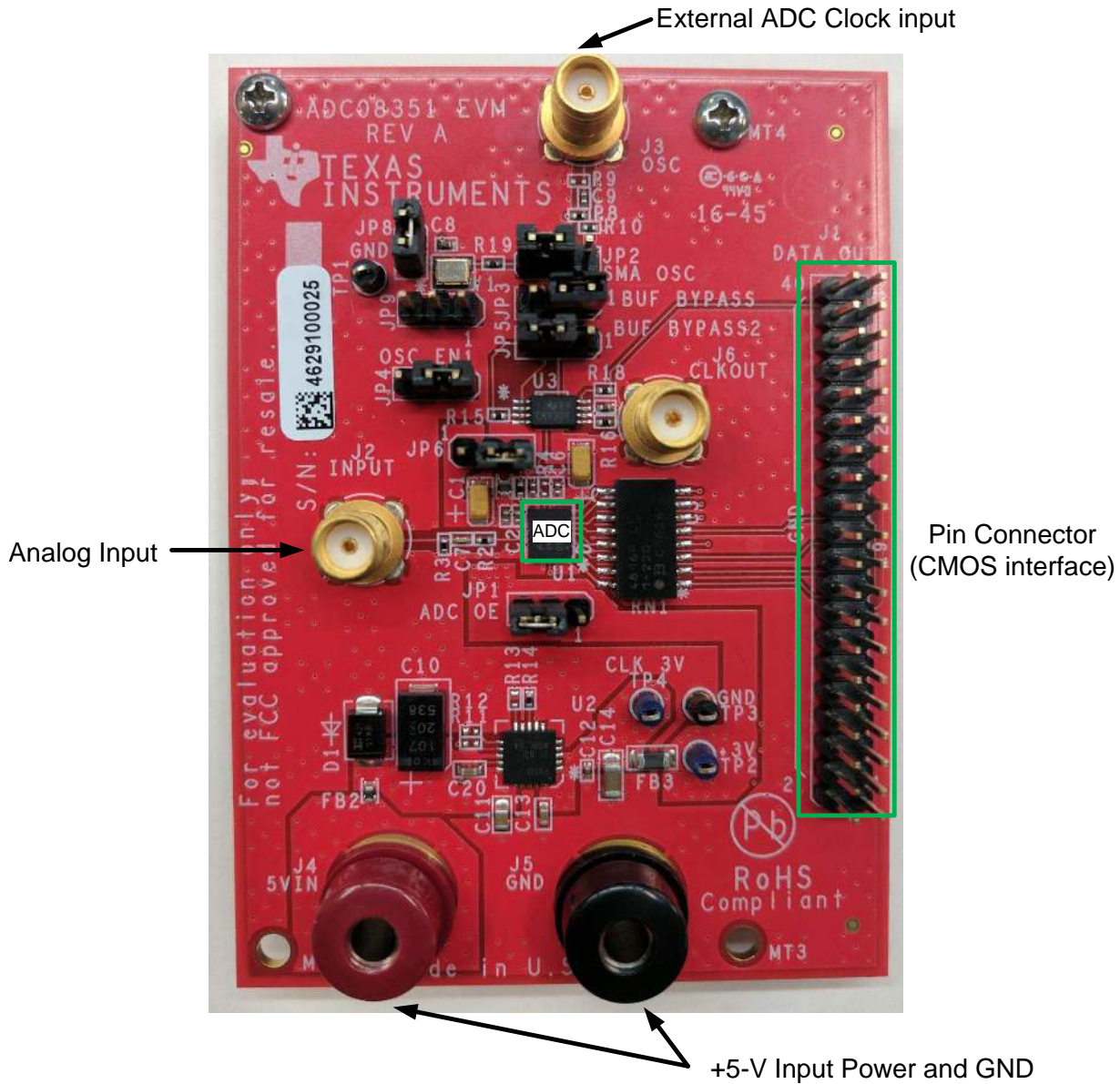


Figure 1. EVM Feature Locations

Copyright © 2017, Texas Instruments Incorporated

1.4 References

- ADC08351 data sheet (SNAS026), available at www.ti.com/product/adc08351
- TSW1400EVM User's Guide (SLWU079), available at www.ti.com/tool/TSW1400EVM
- High-Speed Data Converter Pro software (SLWC107) and User's Guide (SLWU087), available at www.ti.com/tool/dataconverterpro-sw

NOTE: Schematics, layout, and BOM are available on the [ADC08351EVM](http://www.ti.com) product page on www.ti.com.

2 Quick-Start Guide

This section guides the user through the EVM test procedure to obtain a valid data capture from the ADC08351EVM using the TSW1400EVM capture card. This should be the starting point for all evaluations.

2.1 Software Installation

The proper software must be installed before beginning evaluation. See [Section 1.2](#) for a list of the required software. The [References](#) section of this document contains links to find the software on the TI website.

Important: The software must be installed before connecting the ADC08351EVM and TSW1400EVM to the computer for the first time.

2.1.1 High-Speed Data Converter Pro GUI Installation

The *High-Speed Data Converter Pro* (HSDC Pro) is used to control the TSW1400EVM and analyze the captured data. See the HSDC Pro user's guide ([SLWU087](#)) for more information.

1. Download HSDC Pro from the TI website. The [References](#) section of this document contains the link to find the software on the TI website.
2. Extract the files from the zip file.
3. Run *setup.exe* and follow the installation prompts.

2.2 Hardware Setup Procedure

A typical test setup using the ADC08351EVM and TSW1400EVM is shown in Figure 2. This is the test setup used for the quick-start procedure. The rest of this section describes the hardware setup steps.

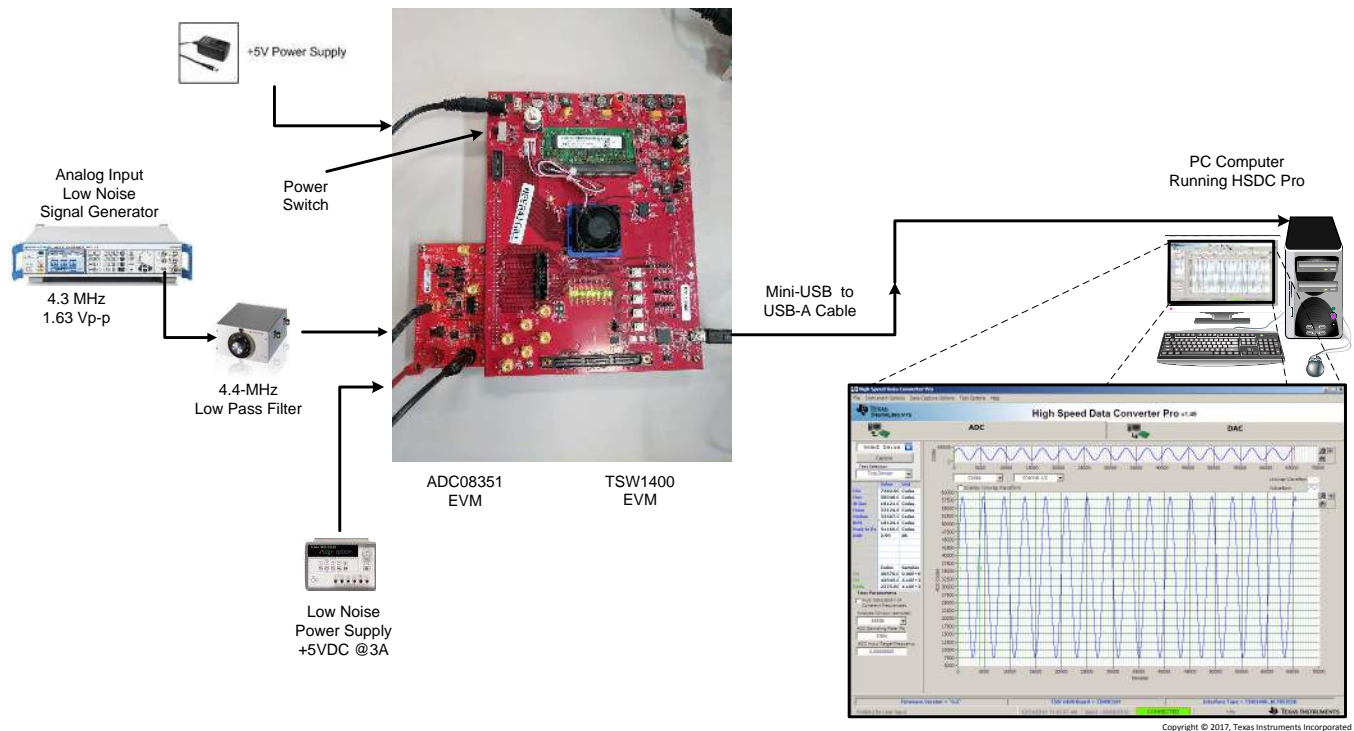


Figure 2. Quick-Start Test Setup

2.2.1 TSW1400EVM Setup

First, setup the TSW1400EVM using the following steps:

1. Connect the ADC08351EVM to the TSW1400EVM by connecting pin 1 of the CMOS_INTERFACE (J1) to pin 1 of the ADC08351EVM output data (J1).
2. Connect the power cable to connector J12 (+5 V IN) to the TSW1400EVM.
3. Connect the mini-USB cable to the USB connector (J5).
4. Turn on the power supply. Flip the power switch (SW7) to the *ON* position. The board should draw around 0.5 A after power up. This will increase to around 1.7 A when loaded with firmware.

2.2.2 ADC08351EVM Setup

Next, setup the ADC08351EVM using the following:

1. Connect the banana jack power supply cables to the EVM. Connect the red wire to +5 VDC ± 0.1 VDC of a power supply rated for at least 3 A to connector J4. Connect the black wire to J5 (GND) of the power supply.
2. Turn on the power supply. The power draw should be around 0.66 A.
3. Set the analog input signal generator for 4.3 MHz, 1.63 Vp-p.
4. Place a low-pass filter (4.4-MHz to 5-MHz) at the output of the analog signal generator to remove noise and harmonics from the signal generator.
5. Connect the analog input signal generator to the EVM through SMA connector INPUT (J2) and provide a 4.3-MHz signal.

2.3 Software Setup Procedure

The software can be opened and configured once the hardware is properly setup.

2.3.1 HSDC Pro GUI Configuration

1. Open High Speed Data Converter Pro by going to *Start Menu* \rightarrow *All Programs* \rightarrow *Texas Instruments* \rightarrow *High Speed Data Converter Pro*. The GUI main page looks as shown in [Figure 3](#).

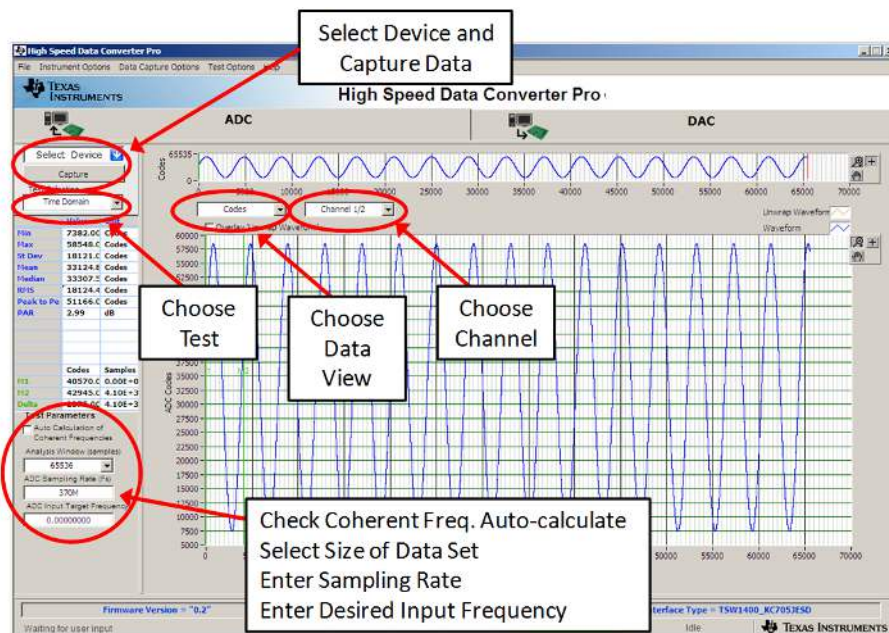
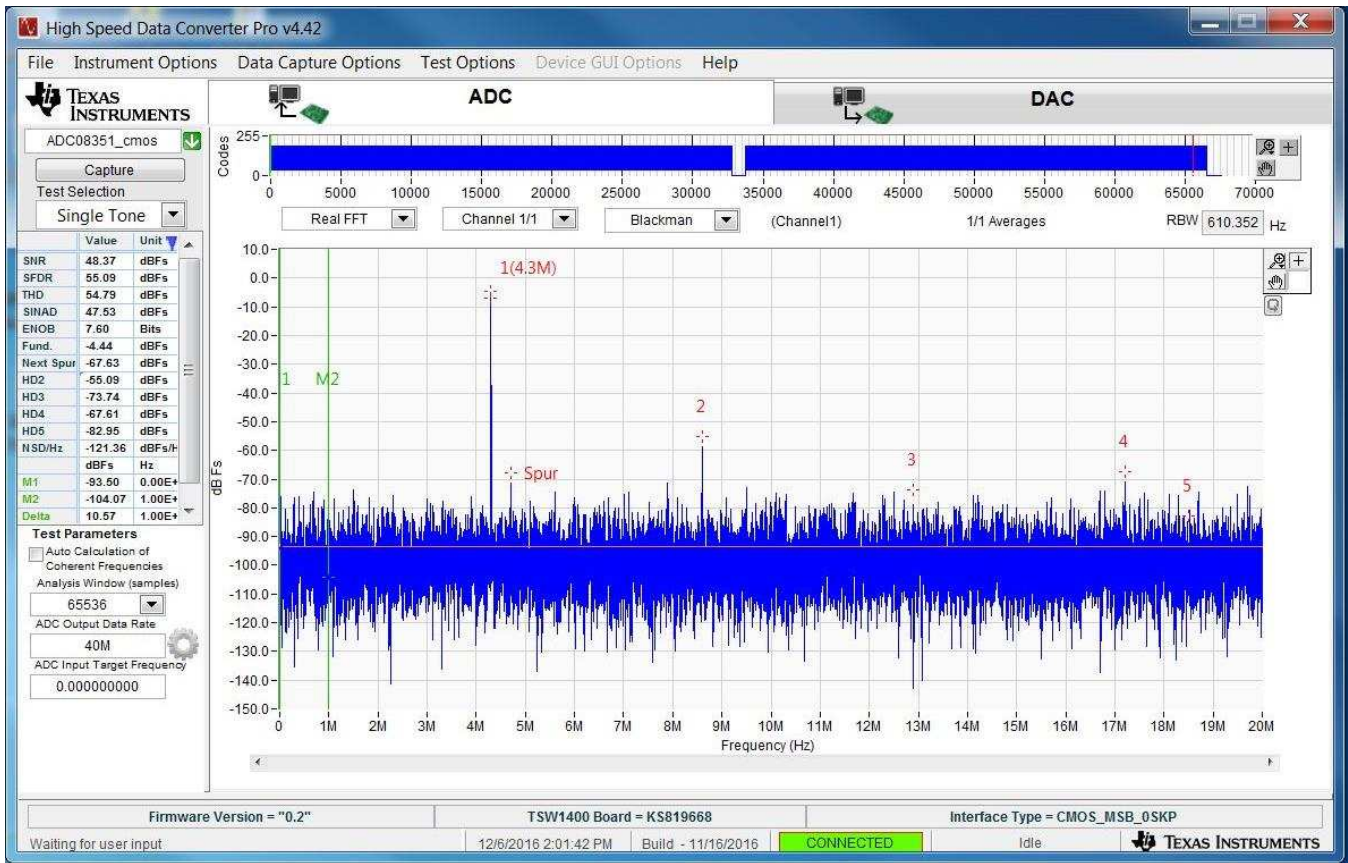


Figure 3. HSDC Pro GUI Main Panel

2. When prompted to select the capture board, select the TSW1400 whose serial number corresponds to the serial number on the TSW1400EVM and click *OK*. This popup can be accessed through the *Instrument Options* menu.
3. If no firmware is currently loaded, there is a message indicating this. Click on *OK*.
4. Verify the *ADC* tab at the top of the GUI is selected.
5. Use the *Select ADC* drop-down menu at the top left corner to select *ADC08351_cmos*.
6. When prompted to update the firmware for the ADC, click *Yes* and wait for the firmware to download to the TSW1400. This takes a couple of seconds.
7. Enter "40M" into the *ADC Output Data Rate* field at the bottom left corner then click outside this box or press return on the PC keyboard.
8. Click *Capture* in HSDC Pro to capture data from the ADC.

- The results from the captured data of Channel 1 should look like [Figure 4](#) and the performance should be similar to [Table 1](#). If this result is not achieved, then see the [Quick Start Troubleshooting](#) section of this document.



Copyright © 2017, Texas Instruments Incorporated

Figure 4. Data Capture Results From Quick-Start Procedure

Table 1. Quick-Start Performance Measurements

Result	Measured Value	Units
SNR	48	dBFS
SFDR	55	dBFS

2.4 Quick-Start Troubleshooting

Use [Table 2](#) to assist with problems that may have occurred during the quick-start procedure.

Table 2. Troubleshooting Tips

Issue	Troubleshooting Tips
General problems	Verify the test setup shown in Section 2 and repeat the setup procedure as described in this document.
	Check power supplies to the EVMs. Verify that the power switches are in the ON position and supplies are drawing the appropriate current.
	Check signal and clock connections to the EVM.
	Check that all boards are properly connected together.
	Try power-cycling the external power supply to the EVM and reprogram the ADC devices.
TSW1400 LEDs are not correct: D2 – D9 OFF	Verify the settings of the configuration switches on the TSW1400EVM.
	Verify that the EVM configuration GUI is communicating with the USB and that the configuration procedure has been followed.
	Try capturing data in HSDC Pro to force an LED status update.
HSDC Pro software is not capturing good data or analysis results are incorrect.	Verify that the TSW1400EVM is properly connected to the PC with a mini-USB cable and that the board serial number is properly identified by the HSDC Pro software.
	Check that the proper ADC device is selected. In default conditions, ADC08351_cmos should be selected.
	Check that the analysis parameters are properly configured.
	Check that the fundamental power is no larger than –1 dBFs.
HSDC Pro software gives a time-out error when capturing data	Restart HSDC Pro and reload the firmware.
	Verify that the ADC sampling rate is correct in the HSDC Pro software.
Sub-optimal measured performance	Measure test points to verify operating voltage ranges.
	Verify jumper configurations are in default locations.
	Verify that filters are used in the clock and input signal paths and that low-noise signal sources are used.

3 Optimizing Evaluation Results

This section assists the user in optimizing the performance during evaluation of the product.

3.1 Clocking Optimization

The sampling clock provided to the ADC needs to have very low phase noise to achieve optimal results. The default EVM configuration uses a crystal oscillator to generate the sampling clock. Another option to improve the clock noise performance is bypassing the onboard clock in favor of an external clock. The clock must have very low noise and must use an external narrow pass-band filter to achieve optimal noise performance. The clock amplitude must be within the datasheet limits. See [Section 4](#) for more information regarding this setup.

3.2 Coherent Input Source

A *Rectangular* window function can be applied to the captured data when the sample rate and the input frequency are set precisely to capture an *integer* number of cycles of the input frequency (sometimes called coherent frequency). This may yield better SNR results. The clock and analog inputs must be frequency locked (such as through 10-MHz references) in order to achieve coherency.

3.3 HSDC Pro Settings

HSDC Pro has some settings that can help improve the performance measurements. These are highlighted in [Table 3](#).

Table 3. HSDC Pro Settings to Optimize Results

HSDC Pro Feature	Description
Analysis Window (samples)	Selects the number of samples to include in the selected test analysis. Collect more data to improve frequency resolution of Fast-Fourier Transform (FFT) analysis. If more than 65,536 samples are required, increase the setting in the <i>Data Capture Options</i> to match this value.
Data Windowing Function	Select the desired windowing function applied to the data for FFT analysis. Select <i>Blackman</i> when sampling a non-coherent input signal or <i>Rectangle</i> when sampling a coherent input signal.
Test Options → Notch Frequency Bins	Select bins to be removed from the spectrum and back-filled with the average noise level. May also customize which Harmonics and Spurs are considered in SNR and THD calculations and select the method for calculating spur power.
Test Options → Bandwidth Integration Markers	Enable markers to narrow the <i>Single-Tone FFT</i> test analysis to a specific bandwidth.
Data Capture Options → Capture Options	Configure the number of contiguous samples per capture (capture depth). May also enable <i>Continuous Capture</i> and <i>FFT Averaging</i> .

4 Alternate Hardware Configurations

This section describes alternate hardware configurations in order to achieve better results or to more closely mimic the system configuration.

4.1 Clocking Options

The default clocking mode uses a crystal clock oscillator to generate the ADC sampling clock and FPGA clocks. An alternative option is described in the following section.

4.1.1 External ADC Sampling Clock

An external clock can be used as the sampling clock for the ADC. For this option, the oscillator must be bypassed with a jumper (JP2) by changing its position to SHUNT 2–3. Provide a filtered, low-noise 40-MHz signal from an RF generator to the SMA connection on the EVM (J3).

Jumper and Connector Descriptions

A.1 Jumper Descriptions

The EVM jumpers are shown in [Table 4](#) as well as the default settings for the jumpers. Use this table to reset the EVM in the default configuration, in case of issues.

Table 4. Jumper Descriptions and Default Settings

Jumper	Description	Default Setting
JP1	Enable digital output to ADC08351 (active low)	Shunt pins 2-3
JP2	Selects either onboard or external sample clock (default is onboard)	Shunt pins 1-2
JP3	Option to bypass clock buffer (not bypassed by default)	Shunt pins 1-2
JP4	Enable outputs from clock buffer (active high)	Shunt pins 1-2
JP5	Option to bypass clock buffer (not bypassed by default)	Shunt pins 2-3
JP6	Powerdown mode for ADC08351 (default not in powerdown mode)	Shunt pins 2-3
JP8	Provides power to onboard clock (powered by default)	Shunt pins 1-2
JP9	INH function for onboard sample clock (active by default)	Open

A.1.1 Connector Descriptions

The EVM connectors and their function are described in [Table 5](#).

Table 5. Connector Descriptions

Connector	Description
J1	CMOS pin header connector
J2	Single-ended SMA analog input
J3	External ADC sample clock input
J4	+5-V DC banana jack connector
J5	GND banana jack connector
J6	Clock output for ADC sampling and FPGA

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (January 2017) to A Revision	Page
• Changed the wording and added the actual device as a feature to the EVM in the <i>Overview</i>	2
• Changed kit list in the <i>Required Hardware</i> section.	2
• Changed <i>10-MHz to 2-GHz</i> to <i>1-MHz to 2-GHz</i> in the required equipment list for the low-noise signal generator recommendations.....	2
• Changed both measured values in the <i>Quick-Start Performance Measurements</i> table.	7
• Deleted LED from the Appendix title.	11
• Changed part number on JP1 description in the <i>Jumper Descriptions and Default Settings</i> table.	11

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
 - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductor products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software
 - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. *Limited Warranty and Related Remedies/Disclaimers:*
 - 2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
 - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.
 - 2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.
3. *Regulatory Notices:*
 - 3.1 *United States*
 - 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

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.

3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lstds/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/lstds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿 6 丁目 2 4 番 1 号
西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lstds/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。 http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page

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.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the component(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

IMPORTANT NOTICE FOR TI DESIGN INFORMATION AND RESOURCES

Texas Instruments Incorporated ("TI") technical, application or other design advice, services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using any particular TI Resource in any way, you (individually or, if you are acting on behalf of a company, your company) agree to use it solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources.

You understand and agree that you remain responsible for using your independent analysis, evaluation and judgment in designing your applications and that you have full and exclusive responsibility to assure the safety of your applications and compliance of your applications (and of all TI products used in or for your applications) with all applicable regulations, laws and other applicable requirements. You represent that, with respect to your applications, you have all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. You agree that prior to using or distributing any applications that include TI products, you will thoroughly test such applications and the functionality of such TI products as used in such applications. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

You are authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING TI RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY YOU AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

You agree to fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of your non-compliance with the terms and provisions of this Notice.

This Notice applies to TI Resources. Additional terms apply to the use and purchase of certain types of materials, TI products and services. These include; without limitation, TI's standard terms for semiconductor products (<http://www.ti.com/sc/docs/stdterms.htm>), [evaluation modules](#), and [samples](http://www.ti.com/sc/docs/sampterm.htm) (<http://www.ti.com/sc/docs/sampterm.htm>).

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2017, Texas Instruments Incorporated