EVM User's Guide: ADC3543EVM ADC3544EVM

ADC354x Evaluation Module

Description

The ADC354x evaluation module (EVM) is designed to evaluate the single channel variants of the ADC36xx family of high-speed analog-to-digital converters (ADCs), including the ADC3543 and the ADC3544. These ADCs have a configurable, serial or parallel, low-voltage CMOS (LVCMOS) data interface.

Get Started

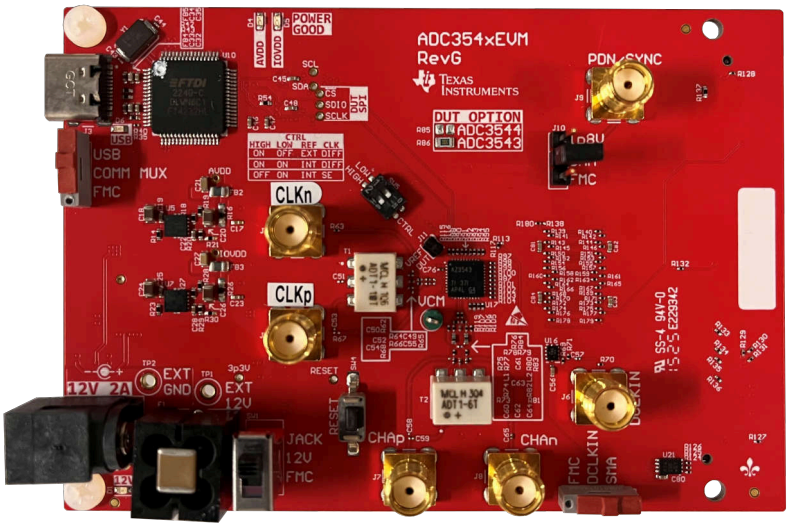
1. Order the ADC3543EVM or ADC3544EVM.
2. Download the latest revision of the data sheet.
3. Download the latest software.
4. Download the comprehensive reference design files from the tools page of the EVM.

Features

- Single-ended and differential options for AC-coupled analog input with onboard balun
- Single-ended and differential options for sampling clocking input
- Powered with an external 12V connection and onboard power regulation
- Flexible switch controlled ADC configuring thru USB-C connection or FMC connector
- FMC connector to interface with TI data capture card or third-party FPGA development kit

Applications

- Software defined radio
- Communications infrastructure
- Spectrum analyzer
- Medical and healthcare
- Control systems



ADC354xEVM

1 Evaluation Module Overview

1.1 Introduction

The ADC354xEVM is an evaluation board used to evaluate the single channel variants of the ADC36xx family of analog-to-digital converters (ADC) from Texas Instruments. The ADC36xx uses a serial LVCMOS interface to output the digital data. The ADC36xx can be operated in 'oversampling + decimating' mode using the internal decimation filter to improve the dynamic range.

By default, the EVM is configured to receive external inputs for the sampling clock and analog input via AC-coupled transformer (balun) inputs. The transformer performs the single-ended to differential conversion, and provides a low noise/distortion passive input.

This user’s guide describes the characteristics, operation, and use of the ADC354x evaluation module (EVM). This user's guide also discusses how to set up and configure the software and hardware.

1.2 Kit Contents

The following equipment is included in the EVM evaluation kit:

Table 1-1. Included equipment

Item	Description	Quantity
ADC354xEVM	PCB	1
DC Jack Power Cable	Cable	1
USB-C Cable	Cable	1
JTAG Dongle & Micro USB Cable	PCB and Cable	1

1.3 Device Information

There are two variants of the ADC354xEVM which cover the devices in this family with LVCMOS output interfaces: the ADC3543EVM, and the ADC3544EVM.

The following is a list of the devices that these EVM variants can be used to evaluate:

Table 1-2. Devices evaluated using the ADC3543EVM

ADC3543EVM			
Device	**Number of Channels**	**Resolution**	**Max Sample Rate**
ADC3543	1	14	65MHz
ADC3542	1	14	25MHz
ADC3541	1	14	10MHz

Table 1-3. Devices evaluated using the ADC3544EVM

ADC3544EVM			
Device	**Number of Channels**	**Resolution**	**Max Sample Rate**
ADC3544	1	14	125MHz

2 Hardware

This section details the required hardware tools and connections necessary to effectively use the ADC354xEVM, which covers the ADC3543 and ADC3544 variant EVMs.

2.1 Required Hardware

The following equipment is **not** included in the EVM evaluation kit, but is **required** for evaluation of this EVM:

- TSWDC155EVM data capture board and related items
- Three low-noise signal generators for the analog input, sample clock, and DCLKIN signals. (These signal generators must share the same reference frequency)
- Two bandpass filters for your desired sample clock frequency and analog input frequency.
- One power supply capable of supplying 12V, 1A
- PC running Microsoft® Windows® 10 or 11.

TI recommends the following low phase noise signal generators for analog inputs and clocking inputs:

- Rohde & Schwarz SMA100A
- Rohde & Schwarz SMA100B
- Keysight E8257D
- Hewlett Packard HP8644B
- Rohde & Schwarz SMHU
- Or other equivalents

A bandpass filter is required for all signal generators to remove spurious components and/or noise. The DCLKIN input does not require a bandpass filter. If bandpass filters are not used, then the true performance of the ADC is not always clearly seen, and is limited by the performance of the signal generators used.

The bandpass filter used is recommended to have:

- Greater than or equal to 60dB harmonic attenuation
- Less than or equal to 10% bandwidth
- Greater than 18dBm power
- Less than 5dB insertion loss

2.2 Hardware Setup

1. Connect the ADC354xEVM to the TSWDC155EVM using the FMC connectors.
2. Connect the USB-C connector to J3 on the ADC354xEVM to your PC using the included USB-C Cable.
3. Connect the USB-C connector to J8 on the TSWDC155EVM to your PC using the included USB C cable.
4. Connect the Micro USB Cable to the JTAG dongle and connect the JTAG dongle to the JTAG header J7 on the TSWDC155EVM. Then connect the Micro USB Cable to your PC.
5. Verify that the jumper J2 on the TSWDC155EVM is installed across pins 1-2 to power the board through the USB-C connector.

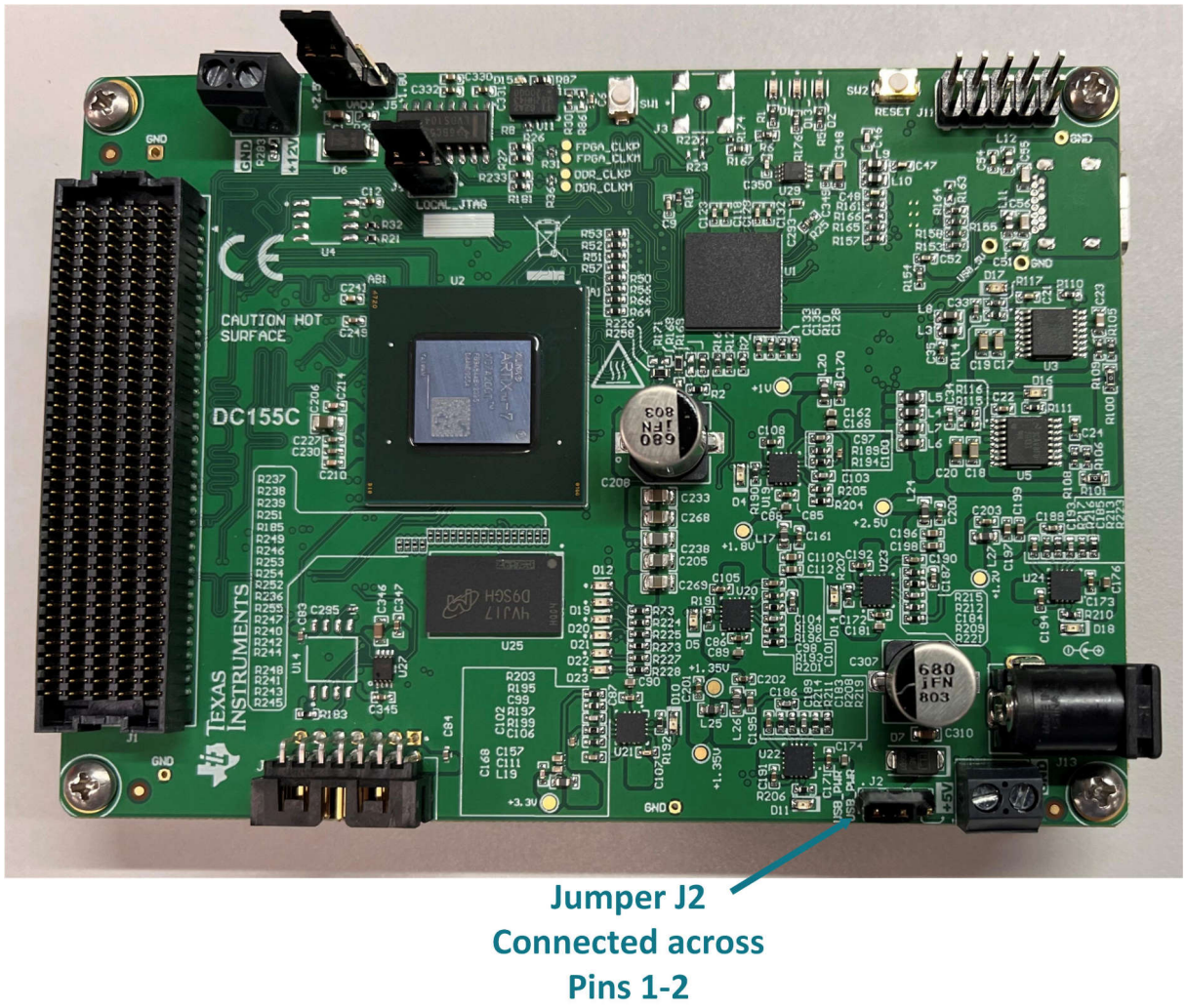


Figure 2-1. TSWDC155EVM Jumper J2

6. Verify that the following Switches and Jumpers are in the following configurations on the ADC354xEVM:
   a. Verify that the 12V Power Switch (SW1) is switched to Jack.
   b. Verify that the Comms Mux switch (SW2) is switched to USB.
   c. Verify that the DCLKIN switch (SW3) is switched to SMA.
   d. Verify that the both switches on the VREF CTRL Switch bank (SW5) are switched to ON.
   e. Verify that the VREF Jumper (J11) is populated.
   f. Verify that the PDN/SYNC Jumper (J10) is not connected.

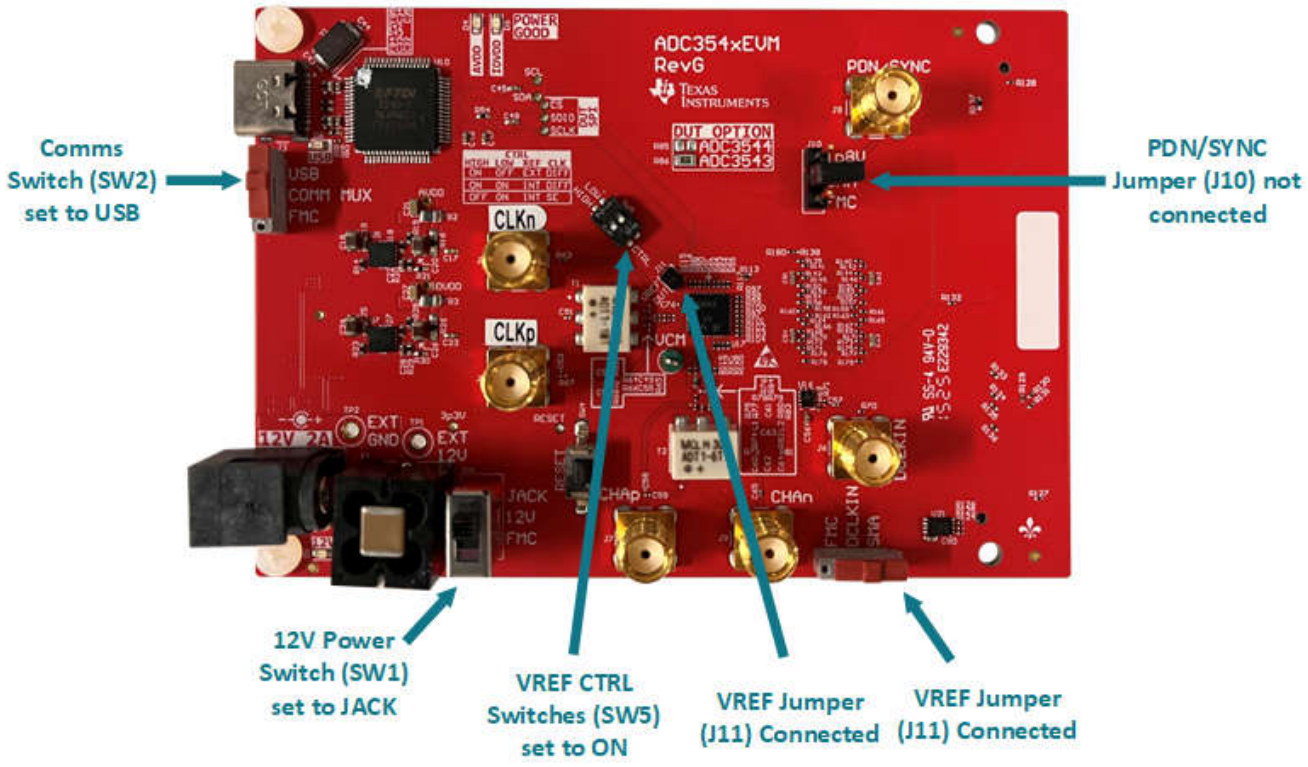


Figure 2-2. ADC354xEVM Switches and Jumpers

3 Software

This section details the required software tools and applications necessary to effectively use the ADC354xEVM, which covers the ADC3543 and ADC3544 variant EVMs.

3.1 Required Software

Below is a list of required software to evaluate the ADC354xEVM:

- ADC36xxEVM GUI
- Texas Instruments HSDC Pro Software
- Vivado Lab Solutions

3.2 Software Setup

1. Download and install the ADC36xxEVM LVDS GUI.
   a. While installing the ADC36xxEVM LVDS GUI, verify that the FX3 USB drivers are also installed.
2. Download and install HSDC Pro. This is used to view the captured data.
3. Download and install Vivado Lab Solutions from the AMD website. This is required to capture data from the FPGA.
4. Verify that the Vivado Lab bin folder is added to your PATH system environment variable:
   a. Search for "Edit the system environment variables" in the start menu
   b. Select on "Environment Variables…"
   c. Under "System variables", locate and select on the "Path" variable
   d. Select on "Edit…"
   e. Select on "New" to add a new path
   f. Add the path to your Vivado Lab installation, which is dependent on where you installed Vivado Lab and what version you installed. The path to the bin folder typically looks something like this: *C:\Xilinx\Vivado_Lab\2023.1.1\bin*

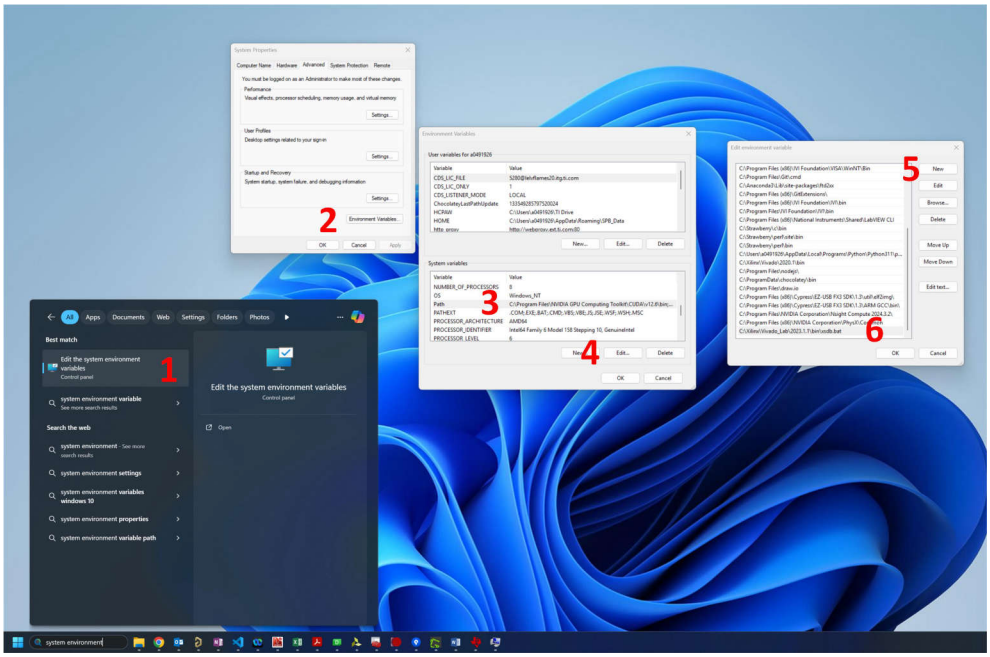


Figure 3-1. Environment Variable Setup

4 Setup Procedure

The following setup procedures detail how to setup and use the hardware and software required for evaluation of both variants of the ADC354xEVM.

4.1 Setting up the ADC3543EVM

1. Verify that the software is set up according to the Software Setup section.
2. Verify that the hardware is set up according to the Hardware Setup section.
3. To provide the CLK signal:
   a. Using an SMA cable and an inline 65MHz band pass filter, connect the signal generator to the CLKp SMA connector (J5) on the ADC3543EVM.
   b. Set the signal generator's output signal frequency to 65MHz and the signal amplitude to +10dBm.
4. By default, the EVM is configured to take a single ended input, so analog inputs must be applied to connectors CHAp (J7) for Channel A .To provide an analog input:
   a. Using an SMA cable and an inline 5MHz band pass filter, connect the signal generator to analog input channel A.
   b. Set the signal generator's output signal frequency to 5.135MHz (prime number) and 0dBm.
5. To provide a DCLK signal:
   a. Using an SMA cable, connect the signal generator to the DCLKIN SMA connector (J6).
   b. Set the signal generator's output frequency to 227.5MHz (14-bit, 2-wire, DDC bypass) and the signal amplitude to +2dBm.
6. Verify that all signal generators for clock, analog input and DCLK are referenced locked using the 10MHz REF on the back of the signal generators. For an example of this, please see figure below.

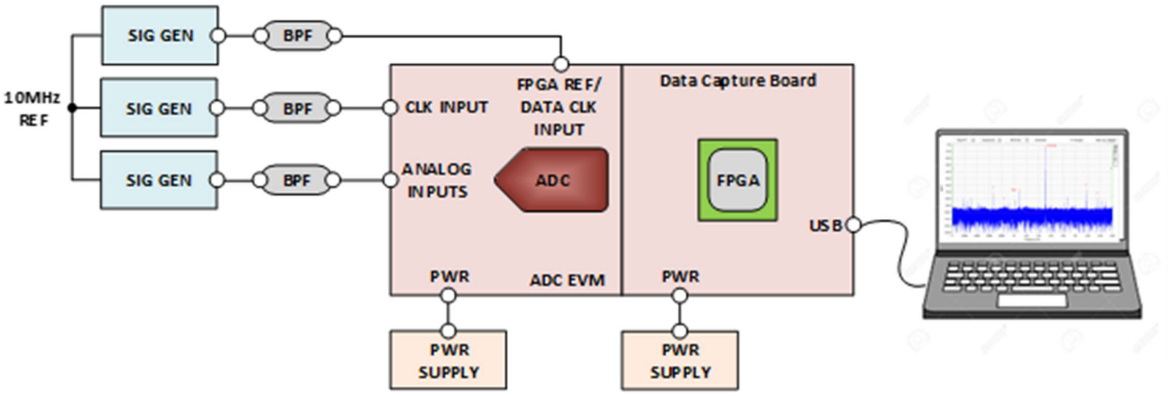


Figure 4-1. Basic Test Measurement Setup

7. Your setup now looks like the following:

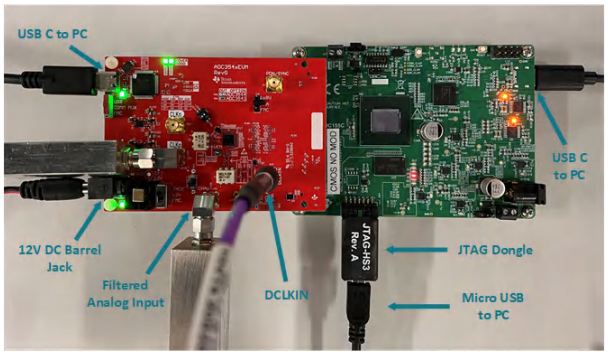


Figure 4-2. ADC3543EVM Hardware Setup

8. Open HSDC Pro. Always Verify that HSDC Pro is open **before** opening the ADC36xxEVM GUI.
9. Select on cancel when prompted to connect to a board. The GUI handles all of the other HSDC Pro capture and configuration related operations.

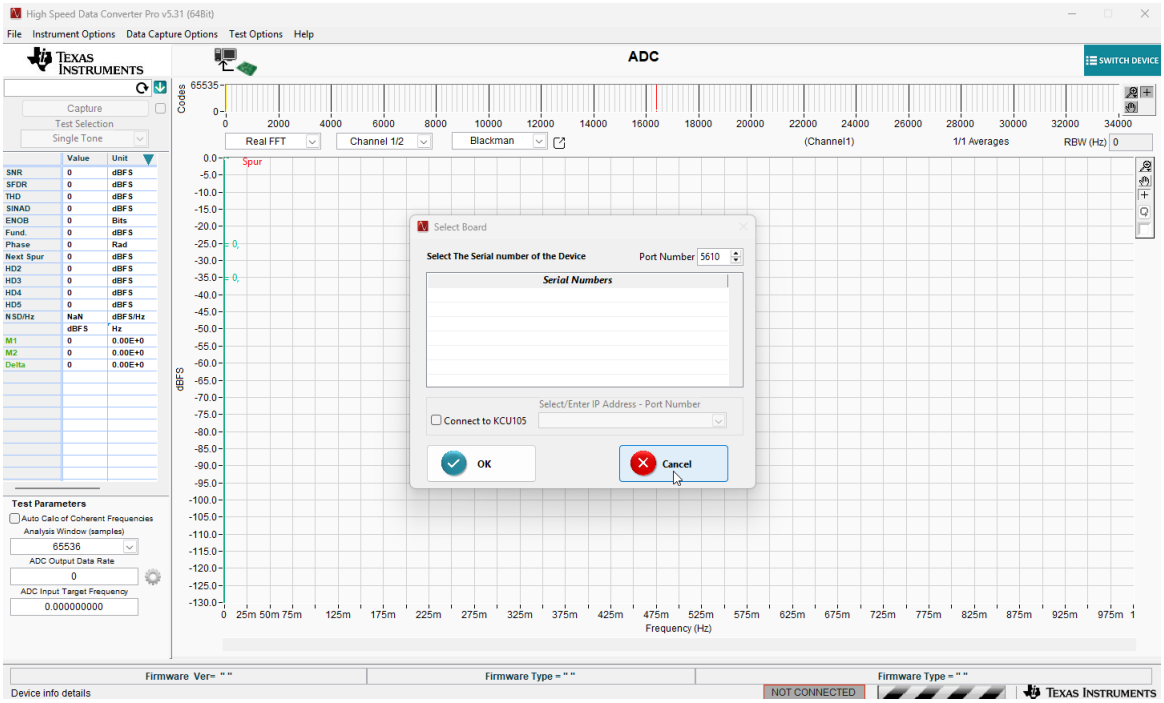


Figure 4-3. HSDC Pro

10. Open the ADC36xxEVM GUI. Allow a few seconds for the GUI to connect to the TSWDC155EVM FPGA Capture board. The TSWDC155EVM powers on, and several LEDs become illuminated, as shown below.

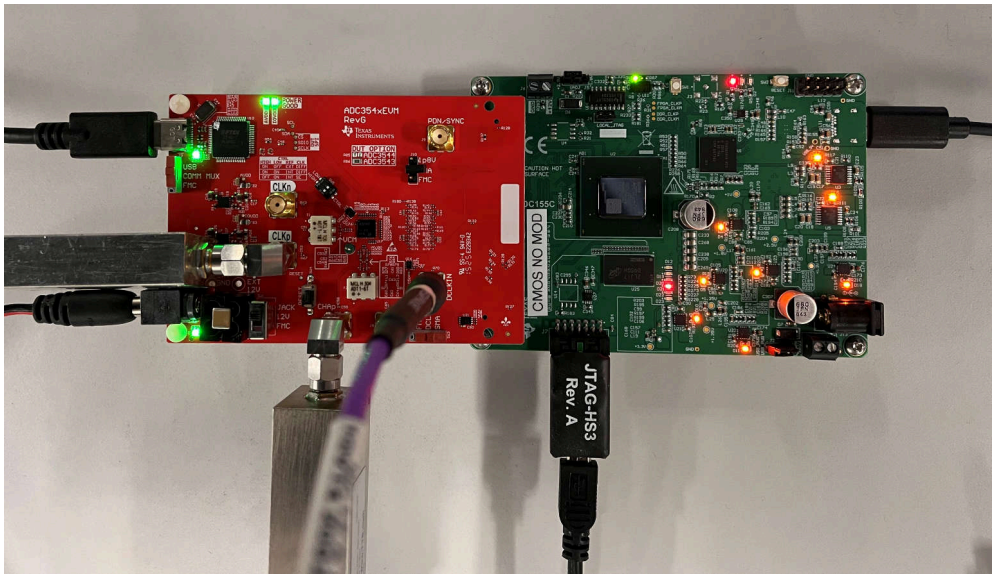


Figure 4-4. TSWDC155EVM powered on

11. Once the GUI has opened, verify the ADC configuration is correct, enter 65MHz in the "Sample frequency" entry and click on the “Calculate” button to calculate the necessary DCLK. For this mode, the DCLK must be 227.5MHz. Verify that this signal is provided to the DCLK input on the hardware setup.

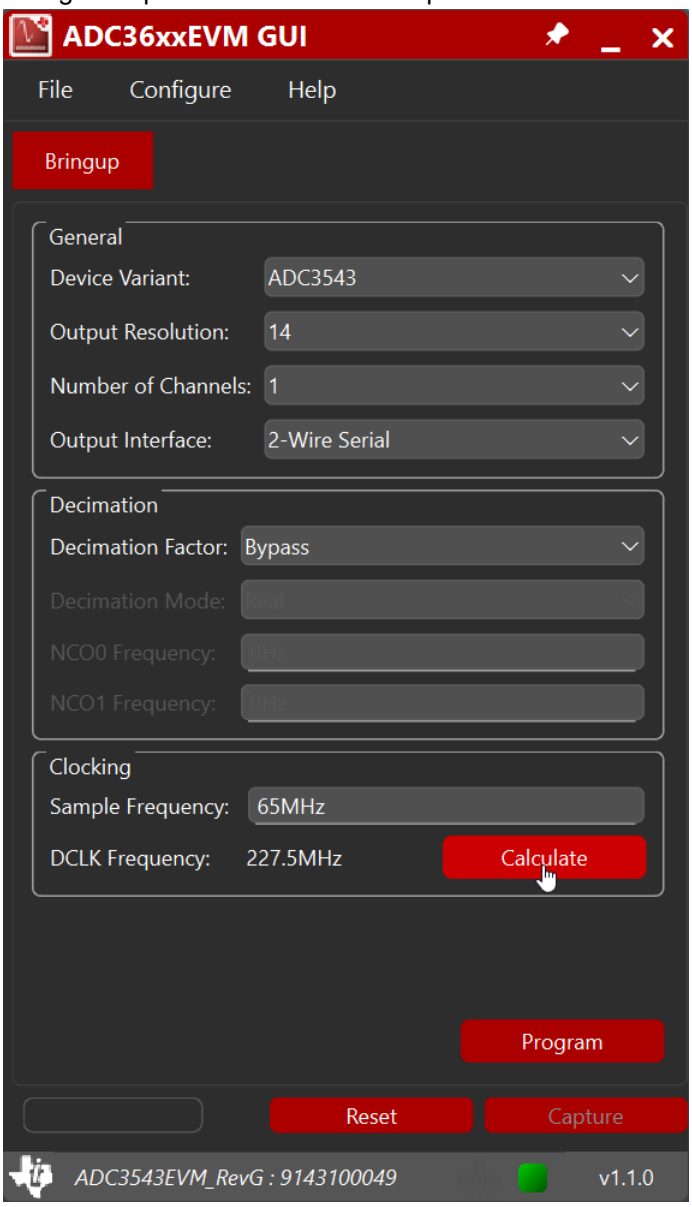


Figure 4-5. Calculating DCLK Frequency for ADC3543

12. Select the “Program” button. Allow a few seconds to program the ADC, program the FPGA, and configure the FPGA firmware.

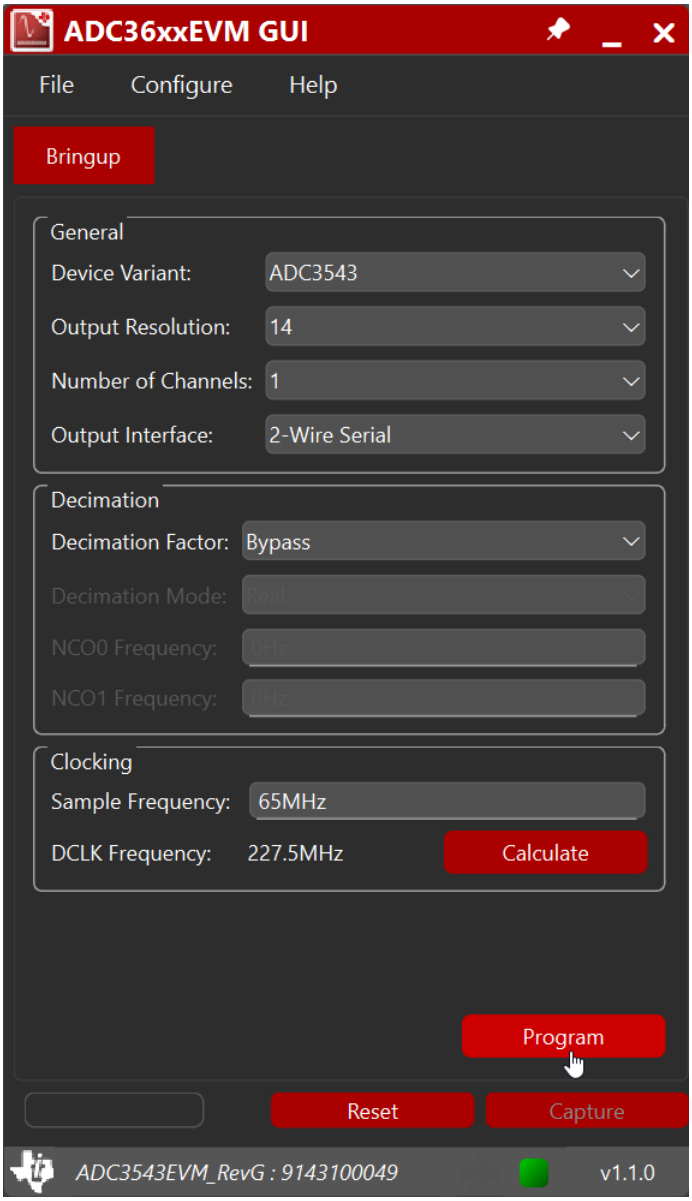


Figure 4-6. Programming the ADC3543EVM

13. Once programming is complete, select the "Capture" button to take an FFT data capture.

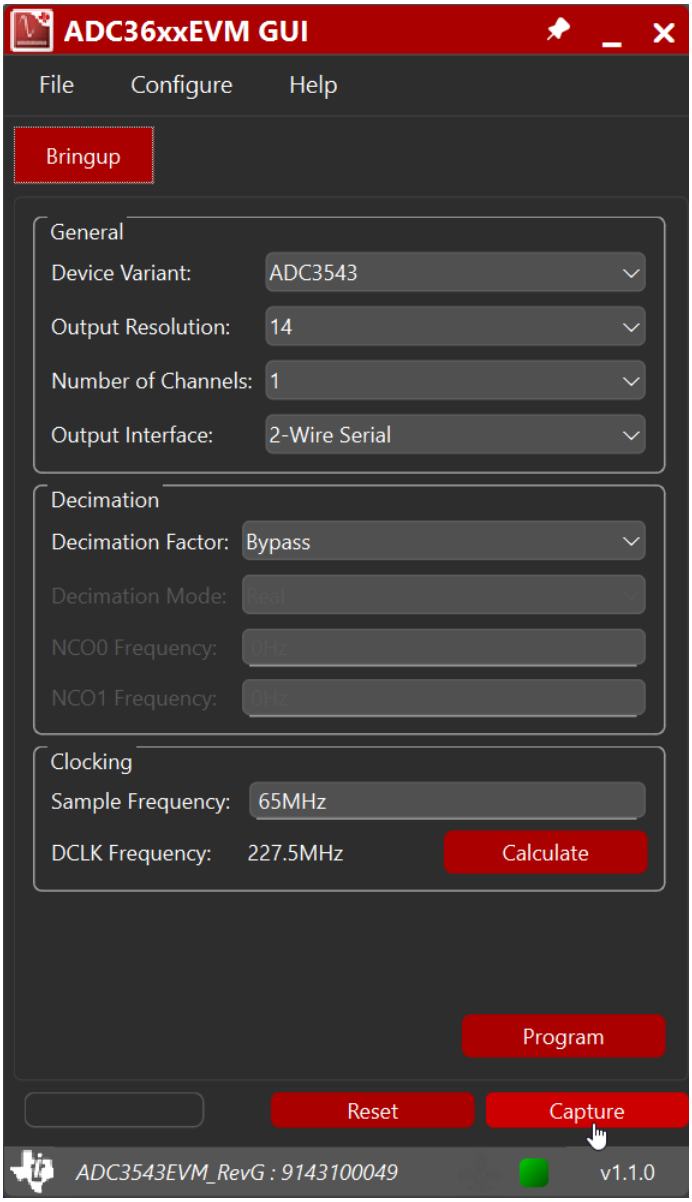


Figure 4-7. Capturing the FFT

14. After a few seconds, the captured data appears in the HSDC Pro window, where you can view the performance of the device. For more functions and features of HSDC Pro, see the HSDC Pro User Guide.

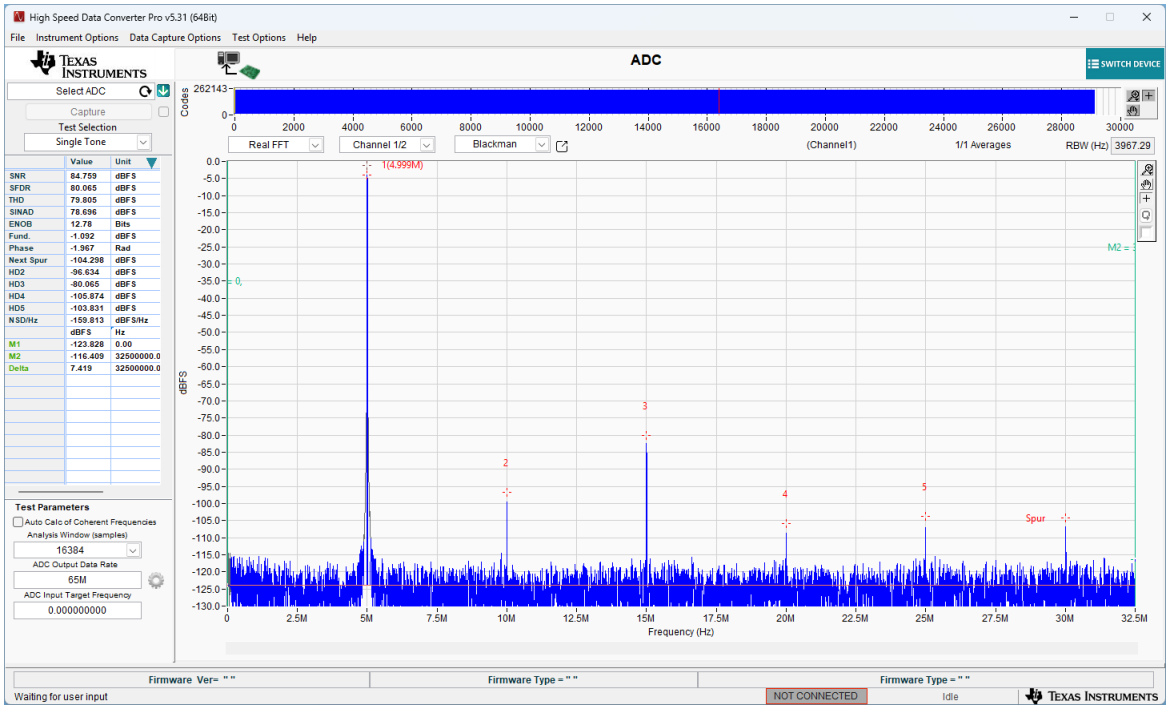


Figure 4-8. ADC3543EVM FFT Data Capture in HSDC Pro

15. If an error occurs when running the capture function, restart the GUI and follow steps 5-8 again.

4.2 Setting up the ADC3544EVM

1. Verify that the software is set up according to the Software Setup section.
2. Verify that the hardware is set up according to the Hardware Setup section
3. To provide the CLK signal:
   a. Using an SMA cable and an inline 125MHz band pass filter, connect the signal generator to the CLKp SMA connector (J5) on the ADC3544EVM.
   b. Set the signal generator's output signal frequency to 125MHz and the signal amplitude to +10dBm.
4. By default, the EVM is configured to take a single ended input, so analog inputs must be applied to connectors CHAp (J7) for Channel A. To provide an analog input:
   a. Using an SMA cable and an inline 5MHz band pass filter, connect the signal generator to analog input channel A.
   b. Set the signal generator's output signal frequency to 5.135MHz (prime number) and 0dBm.
5. To provide a DCLK signal:
   a. Using an SMA cable, connect the signal generator to the DCLKIN SMA connector (J6).
   b. Set the signal generator's output frequency to 437.5MHz (14-bit, 2-wire, DDC bypass) and the signal amplitude to +2dBm.

6. Verify that all signal generators for clock, analog input and DCLK are referenced locked using the 10MHz REF on the back of the signal generators. For an example of this, please see figure below.

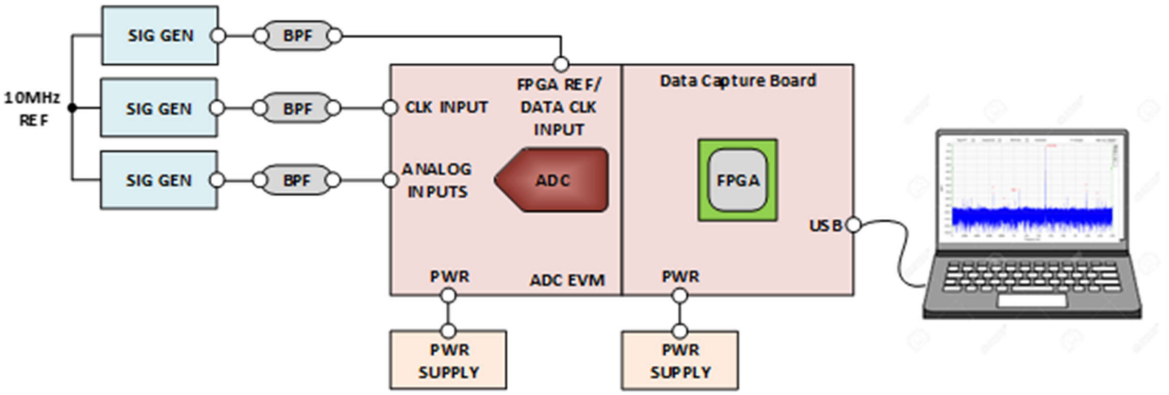


Figure 4-9. Basic Test Measurement Setup

7. Your setup now looks like the following:

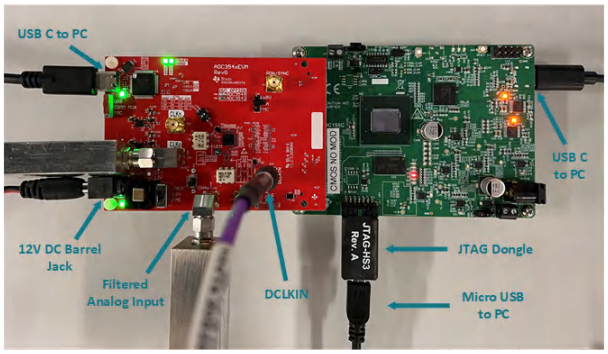


Figure 4-10. ADC3544EVM Hardware Setup

8. Open HSDC Pro. Always Verify that HSDC Pro is open **before** opening the ADC36xxEVM GUI.

9. Select on cancel when prompted to connect to a board. The GUI handles all of the other HSDC Pro capture and configuration related operations.

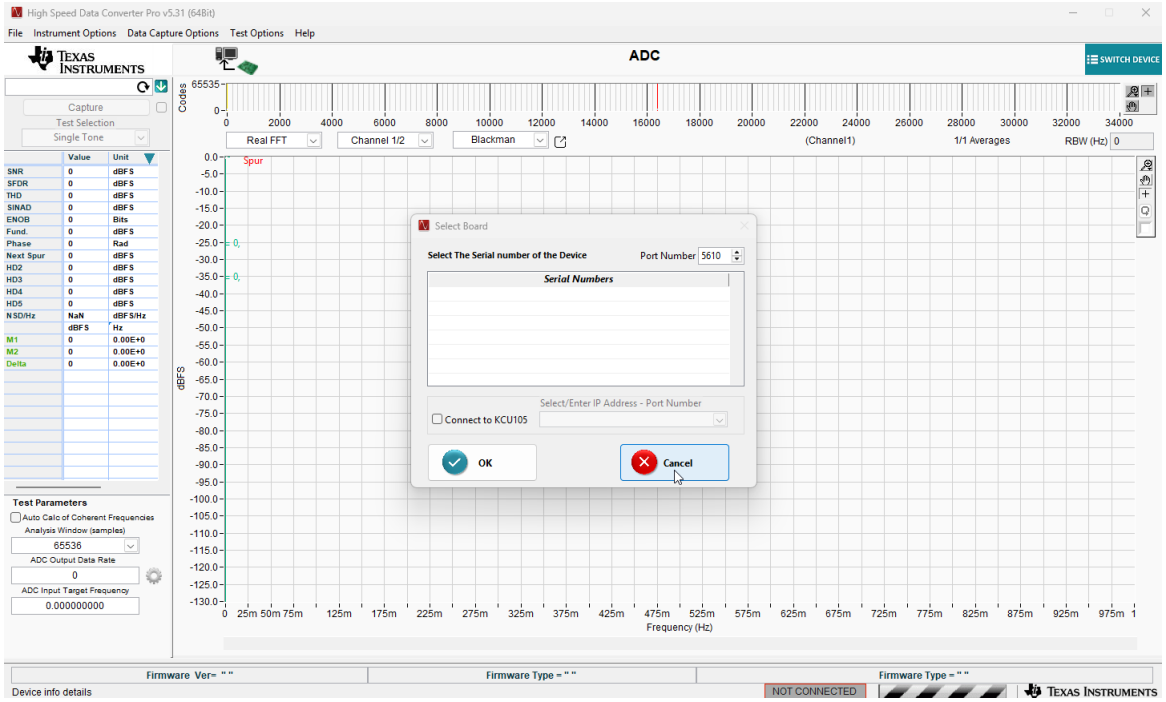


Figure 4-11. HSDC Pro

10. Open the ADC36xxEVM GUI. Allow a few seconds for the GUI to connect to the TSWDC155EVM FPGA Capture board. The TSWDC155EVM powers on, and several LEDs illuminates, as shown below.

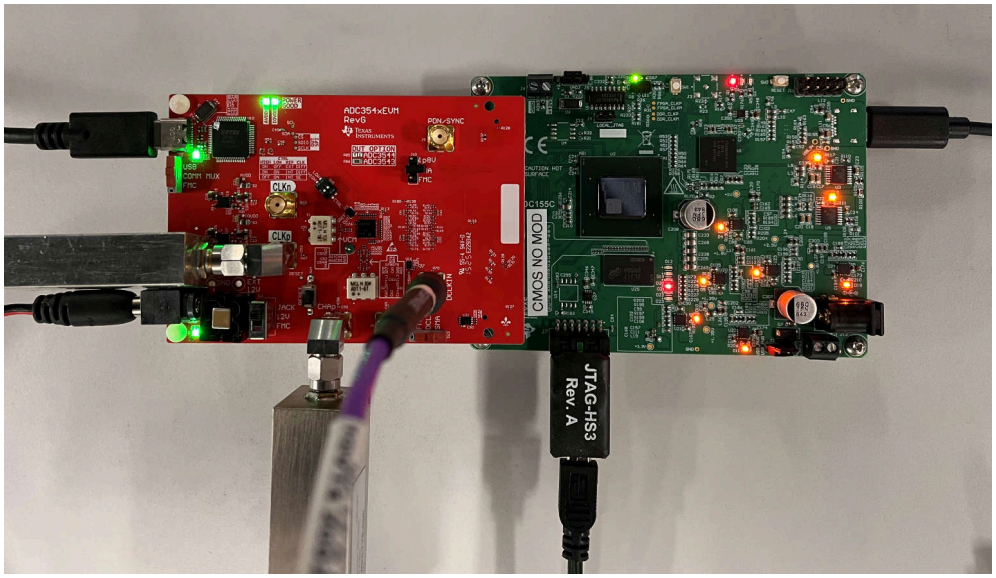


Figure 4-12. TSWDC155EVM powered on

11. Once the GUI has opened, verify the ADC configuration is correct, enter 125MHz in the "Sample frequency" entry and click on the “Calculate” button to calculate the necessary DCLK. For this mode, the DCLK must be 437.5MHz. Verify that this signal is provided to the DCLK input on the hardware setup.

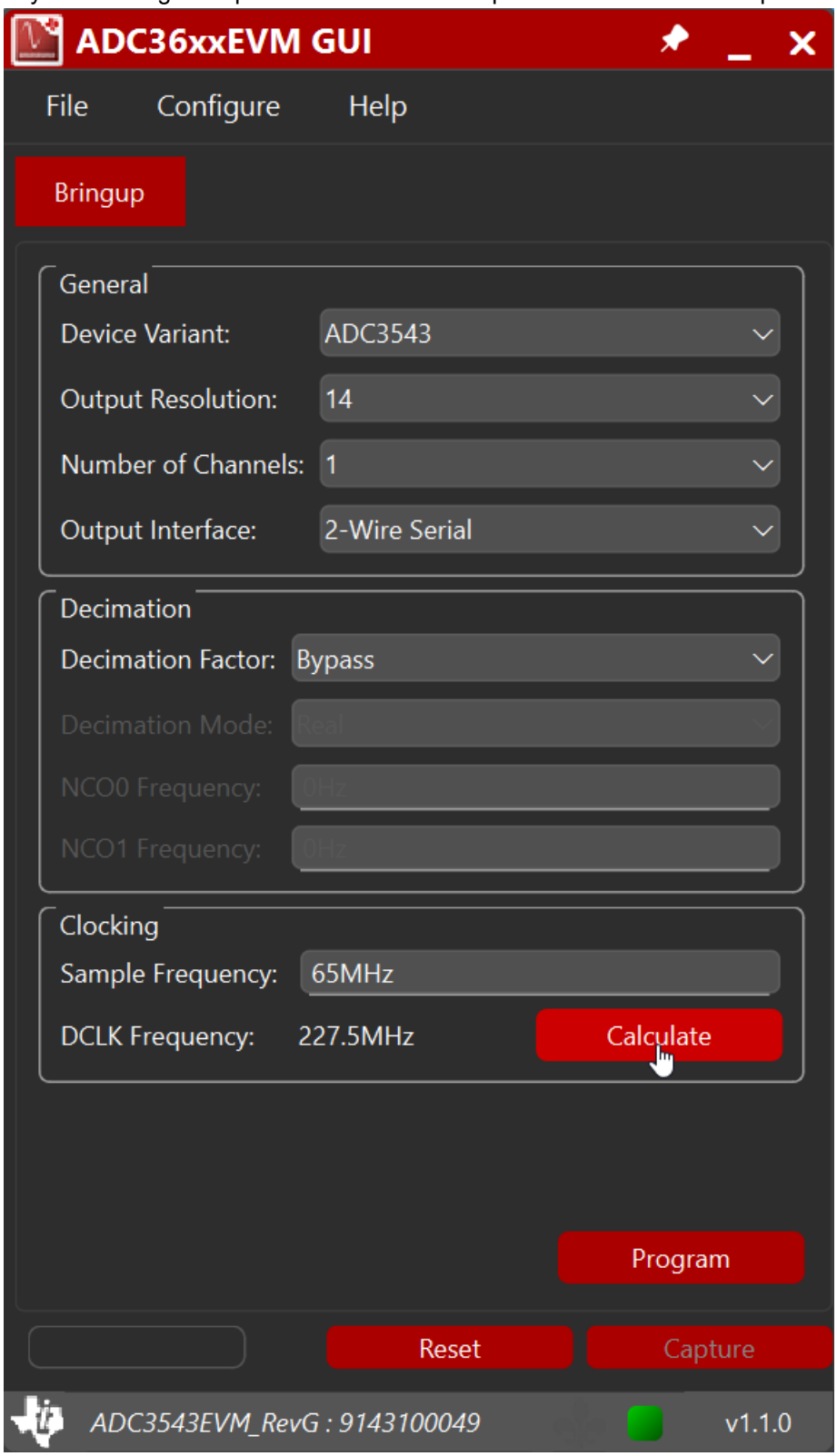


Figure 4-13. Calculating DCLK Frequency for ADC3544

12. Select the “Program” button. Allow a few seconds to program the ADC, program the FPGA, and configure the FPGA firmware.

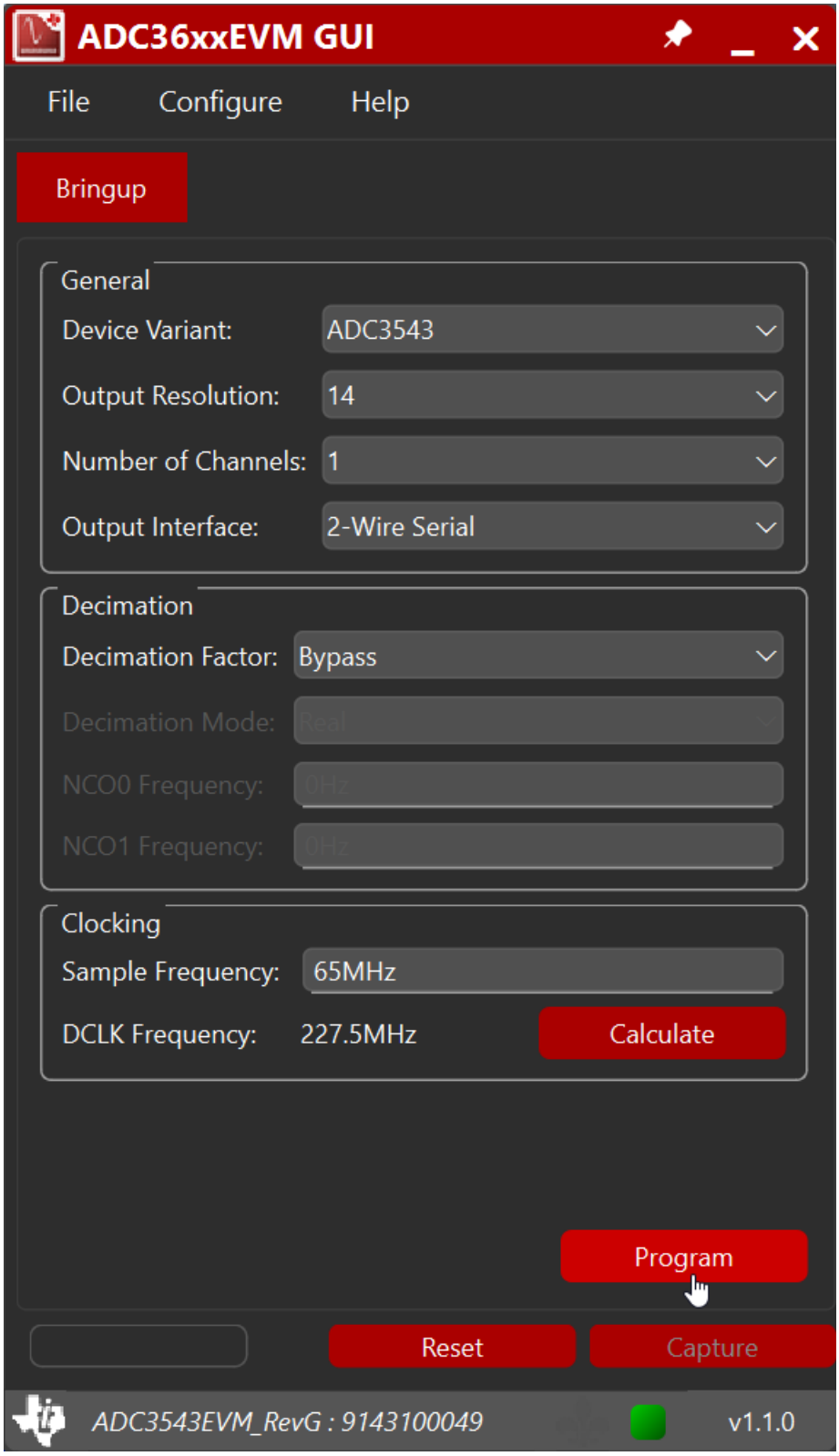


Figure 4-14. Programming the ADC3544EVM

13. Once programming is complete, select the "Capture" button to take an FFT data capture.

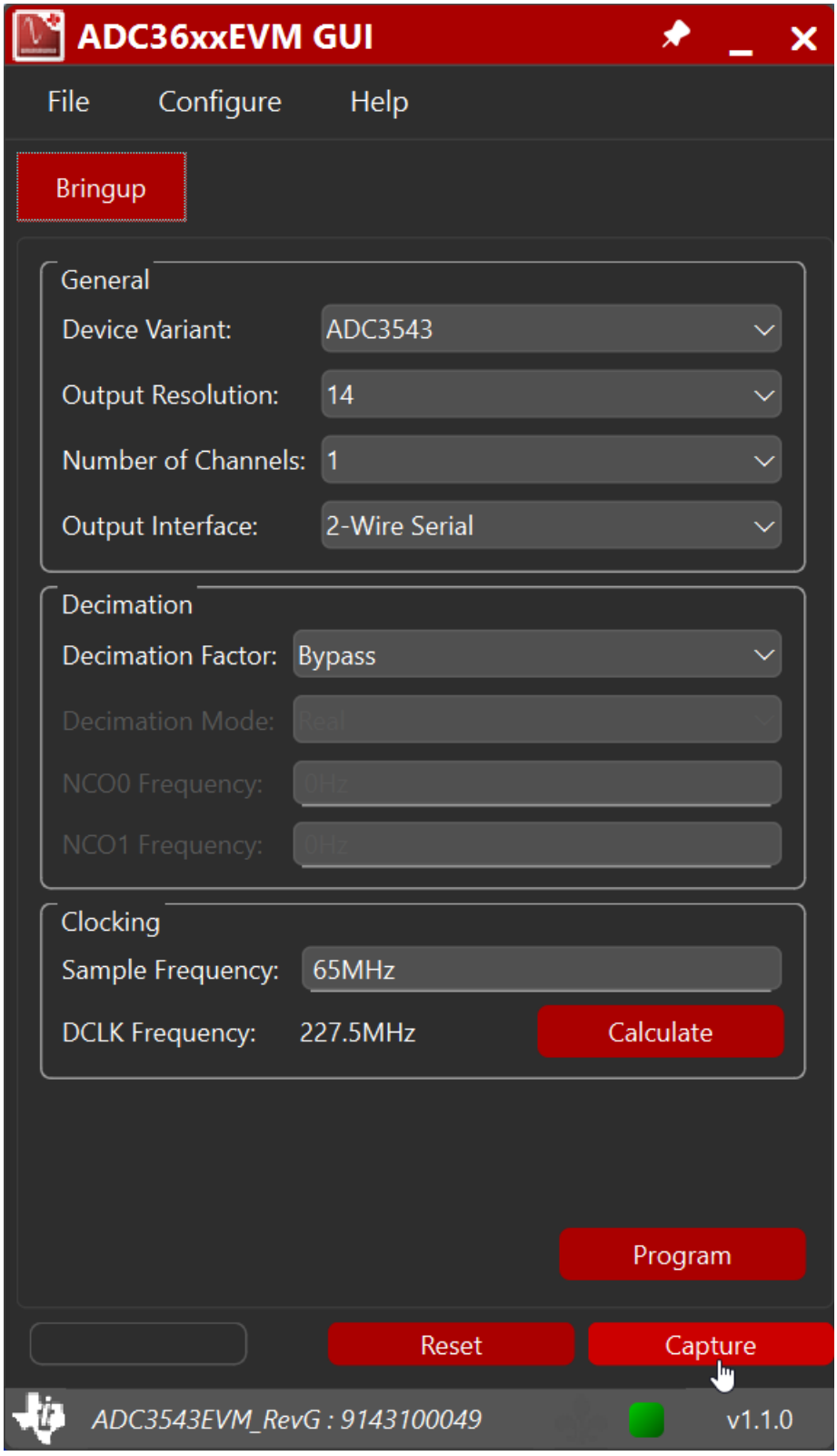


Figure 4-15. Capturing the FFT

14. After a few seconds, the captured data appears in the HSDC Pro window, where you can view the performance of the device. For more functions and features of HSDC Pro, see the HSDC Pro User Guide.

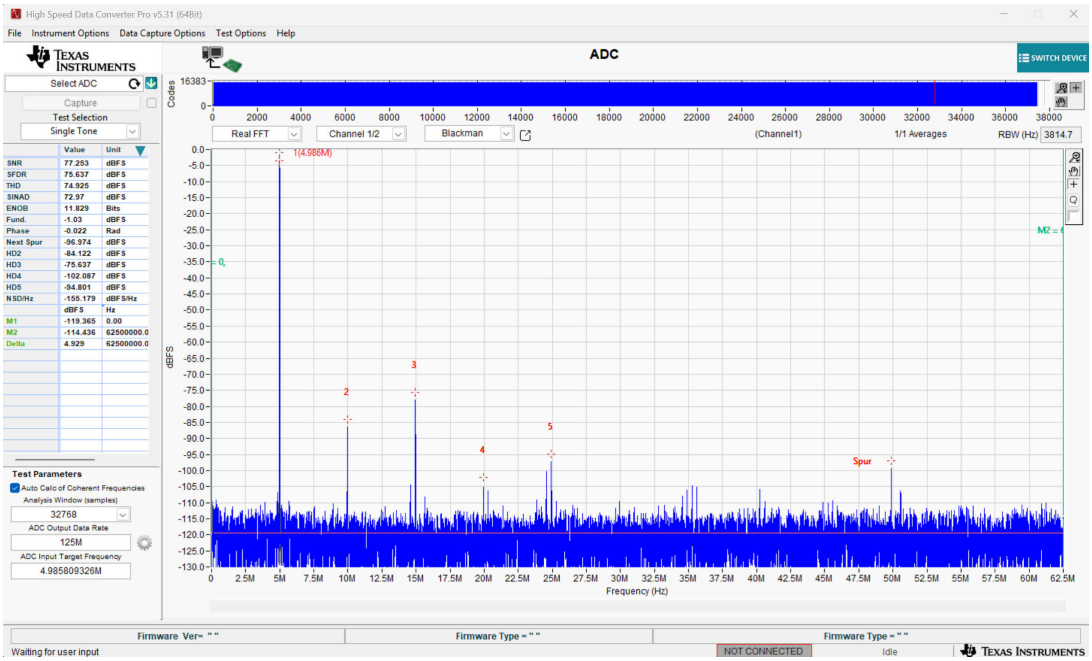


Figure 4-16. ADC3544EVM FFT Data Capture in HSDC Pro

15. If an error occurs when running the capture function, restart the GUI and follow steps 5-8 again.

5 Hardware Design Files

The design files (schematics, PCB layout, and bill of materials (BOM) are available on the product page: ADC3543EVM or ADC3544EVM.

6 Additional Information

6.1 Trademarks

All trademarks are the property of their respective owners.

7 References

- Texas Instruments, ADC3543EVM product page
- Texas Instruments, ADC3544EVM product page
- Texas Instruments, TSWDC155 Evaluation Module, user's guide
- Texas Instruments, High Speed Data Converter Pro GUI, user's guide
- Texas Instruments, ADC354x 14-bit, 10-MSPS to 65-MSPS, Low-noise, Ultra-low Power ADC, data sheet

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 semiconductors 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.

WARNING

Evaluation Kits 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 shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

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 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

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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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。

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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/lsds/ti_ja/general/eStore/notice_02.page

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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.

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