

BOOSTXL-ADS1219 BoosterPack™ User's Guide

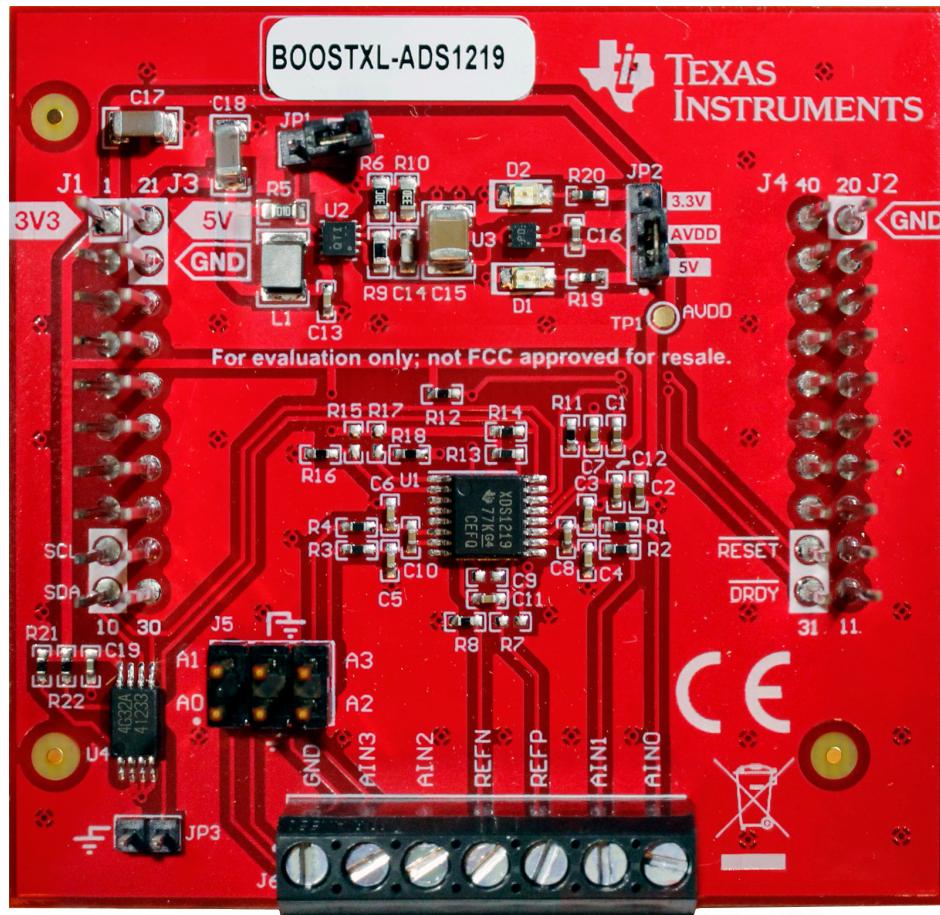


Figure 1. ADS1219 Evaluation Module (BOOSTXL-ADS1219)

The ADS1219 BoosterPack™ plug-in module (BOOSTXL-ADS1219) allows users to evaluate the functionality of the ADS1219. The ADS1219 is a 24-bit, delta-sigma, analog-to-digital converter (ADC) that can be configured as four single-ended inputs or as two differential input pairs. Data rates range from 20 SPS up to 1000 SPS. Processors can communicate to the ADS1219 through an I²C interface.

This user's guide includes a detailed description of the hardware (HW), bill of materials (BOM), schematic, and software GUI when using the LaunchPad™ MSP-EXP432E401Y.

Table 1. Related Documentation

Device	Literature Number
ADS1219	SBAS924
MSP-EXP432E401Y	SLAU748

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Trademarks

BoosterPack, LaunchPad are trademarks of Texas Instruments.
Windows is a registered trademark of Microsoft.

1 Introduction

The BOOSTXL-ADS1219 is a fully-assembled evaluation platform designed to highlight the [ADS1219](#) device features and its various modes of operation.

The BOOSTXL-ADS1219 interfaces to LaunchPad™ development platforms using the XL connector format. However, to use the ADS1219 BoosterPack™ GUI a specific LaunchPad™ (the MSP-EXP432E401Y) must be used. The LaunchPad™ communicates to the ADS1219 through its I²C interface and also acts as a USB-to-PC GUI communication bridge.

NOTE: The BOOSTXL-ADS1219 requires an external master controller to evaluate the ADS1219.

The MSP-EXP432E401Y LaunchPad™ is controlled by commands received from the ADS1219 BoosterPack™ GUI. The LaunchPad™ sends data to the GUI for display and analysis. If a LaunchPad™ is not used, the BoosterPack™ plug-in module format allows an alternate external host to communicate with the ADS1219 using the LaunchPad™ connectors.

The BOOSTXL-ADS1219 EVM incorporates circuitry and components with the following features:

- The 24-bit ADS1219 delta-sigma ADC with four single-ended input channels (or two differential), 2.048-V reference, and I²C interface.
- External reference and analog inputs can be connected either through a header or screw terminal block.
- 3.3-V or 5-V selectable analog power supply.
- LEDs to indicate active power supplies.
- I²C interface for the ADS1219 device configuration and communication.

[Figure 2](#) shows the BOOSTXL-ADS1219 EVM architecture along with key components and blocks listed in the features.

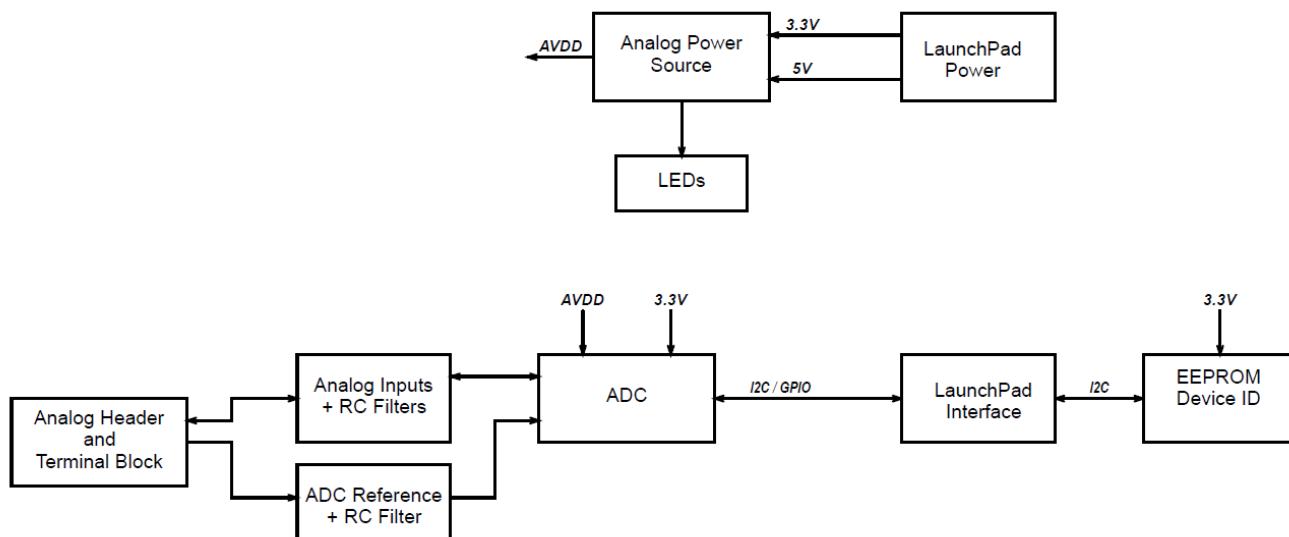


Figure 2. Block Diagram

2 Quick Start

The quick start in [Figure 3](#) shows a minimalist view of the startup procedure to get the system up and running. Details regarding these steps can be found in [Section 4](#).

Quick Start Guide: BOOSTXL-ADS1219

Evaluation Module

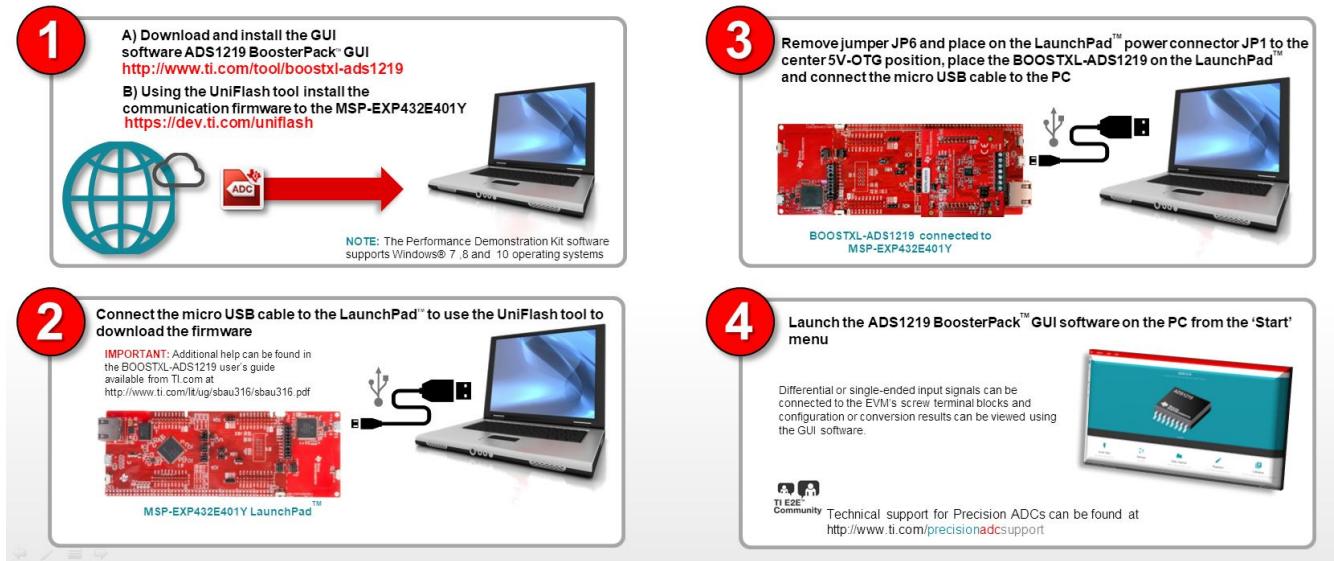


Figure 3. Quick Start

2.1 Step 1

Download and install the GUI software from the [BOOSTXL-ADS1219](#) tools folder. This software install also includes the firmware file required for communication with the LaunchPad™. The firmware file can be installed to the LaunchPad™ by using the [UniFlash](#) cloud tool. A desktop version of UniFlash is also available for [download](#) if needed.

2.2 Step 2

Connect the LaunchPad™ to the PC and download the firmware to the LaunchPad™ using the micro USB cable provided with the LaunchPad™ kit.

2.2.1 Connect the LaunchPad™

Connect the USB cable from the PC to the micro USB connector on the top portion of the LaunchPad™ (XDS110 portion of the LaunchPad™). A green LED lights up indicating that the LaunchPad™ is powered.

2.2.2 Start the UniFlash Program and Choose the Correct LaunchPad™

Start the UniFlash program and begin a *New Configuration* ([Figure 7](#)) and select the LaunchPad™ MSP-EXP432E401Y.

The connection type is automatically chosen based on the LaunchPad™ being used. Verify that the *Texas Instruments XDS110 USB Debug Probe* is selected and press *Start*.

2.2.3 Choose the Firmware File and Flash the LaunchPad™

The firmware file is located in the folder *Program Files (x86)\Texas Instruments\ADS1219\firmware*. Use the *Browse* button to browse to folder containing the firmware binary file. The firmware file can also be dragged and dropped into the browse window provided in UniFlash.

When the desired firmware is selected, use the *Load Image* button to load the firmware into the LaunchPad™.

Verify that the firmware installed successfully by checking the *Console* portion of the UniFlash tool at the bottom of the GUI window.

2.3 Step 3

After the firmware file has successfully downloaded to the LaunchPad™, unplug the USB cable from the LaunchPad™. Further communication takes place using the USB connector located at the opposite end of the LaunchPad™. For proper power to be supplied to the BOOSTXL-ADS1219, remove the jumper from the middle of the LaunchPad™ at JP6 and place the jumper on the center pins of JP1 (see [Figure 12](#)). This jumper takes the available USB power from the bottom connector and applies the voltage to the remainder of the board.

Before plugging the USB cable to the bottom LaunchPad™ USB connector, properly align the connectors and attach the BOOSTXL-ADS1219 BoosterPack™ to the bottom set of connectors on the LaunchPad™ ([Figure 4](#)).

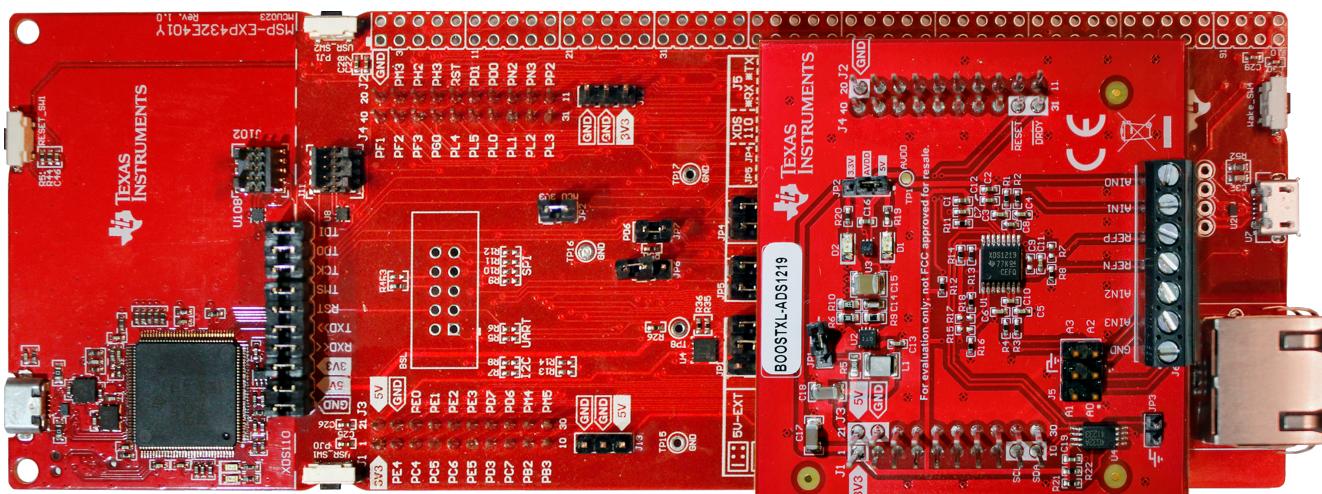


Figure 4. LaunchPad™ and BoosterPack™ Combo

When the BoosterPack™ is attached, plug the USB cable into the bottom connector of the LaunchPad™ and also to the PC. The LaunchPad™ communication to the PC is USB communications device class (CDC) using a virtual COM port. Windows® 10 automatically installs the required driver. Earlier versions of the operating system may require a manual driver installation. The required driver files can be found in the installation directory *Program Files (x86)/Texas Instruments/ADS1219/drivers*.

2.4 Step 4

From the Windows Start menu, go to the Texas Instruments folder and under ADS1219 start the GUI application. The communication should automatically connect. If the hardware does not connect, manually try to make the connection by clicking on the connect icon in the lower left portion of the GUI.

3 BOOSTXL-ADS1219 Hardware Overview

This section lists various onboard components that are used to interface analog inputs, analog reference, digital interface, and power to the BOOSTXL-ADS1219 EVM. [Figure 5](#) shows a top-level view of the board.

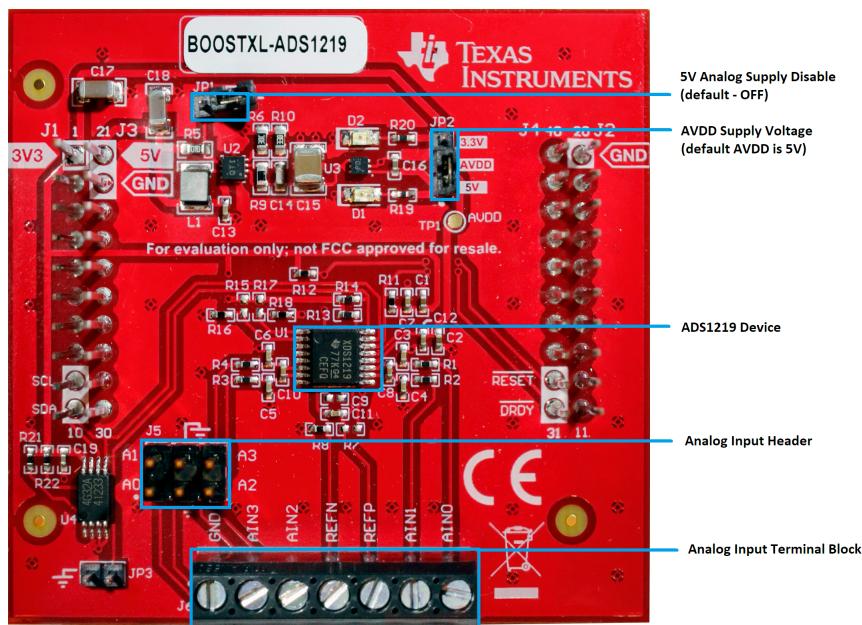


Figure 5. BOOSTXL-ADS1219 Overview

3.1 Connectors for the Analog Input

The BOOSTXL-ADS1219 EVM is designed for easy interface to analog sources through a 100-mil header (J5) or to a screw terminal block (J6). J6 also allows for an external reference input. [Table 2](#) shows the input configuration for J5 and [Table 3](#) shows the configuration for J6. Both connectors are clearly labeled on the PCB silkscreen for easy input connection identification.

Table 2. Header Input (J5)

J5 Connector Pin	Description
J5:1	Analog input for A0 of the ADC
J5:2	Analog input for A1 of the ADC
J5:3 and J5:4	BoosterPack™ plug-in module ground
J5:5	Analog input for A2 of the ADC
J5:6	Analog input for A3 of the ADC

Table 3. Terminal Block Input (J6)

J6 Terminal Block Inputs	Description
J6:1	BoosterPack™ plug-in module ground
J6:2	Analog input for A3 of the ADC
J6:3	Analog input for A2 of the ADC
J6:4	Analog reference input REFN
J6:5	Analog reference input REFP
J6:6	Analog input for A1 of the ADC
J6:7	Analog input for A0 of the ADC

The analog inputs can range from GND up to AVDD, which is the analog supply voltage. A maximum of four single-ended inputs, or two differential inputs may be applied to the ADS1219. The user can configure the input channels through the ADS1219 BoosterPack™ GUI. Each of the analog inputs have a series 1-kΩ resistor with a 100-nF differential capacitor between inputs and a 10-nF common-mode capacitor to GND for filtering noise and aliasing. [Figure 23](#) provides a schematic that details the input filtering.

3.2 Voltage Reference

The ADS1219 contains an internal 2.048-V reference and no external reference is required. The analog supply can also be used as reference input by installing a 0-Ω resistor at R7. An external reference can be applied to the terminal block REFP and REFN connections available on J6 (see the analog input terminal block in [Figure 5](#)). The external reference input is limited by a minimum of 0.75 V and a maximum of the analog supply voltage (AVDD). The REFN input is connected to the board ground by default through the 0-Ω resistor R8.

3.3 Digital Interface

The BOOSTXL-ADS1219 interfaces to the MSP-EXP432E401Y LaunchPad™, which in turn communicates with the computer through USB. The two devices are on the BoosterPack™ and they both communicate using I²C. U4 is an EEPROM used to hold device and board manufacturing information. The EEPROM information is not currently available to the GUI. U1 is the ADS1219 and communication from the GUI allows for register read and write as well as ADC conversion data collection.

3.4 BOOSTXL-ADS1219 Digital I/O

The BOOSTXL-ADS1219 EVM supports the I²C digital interface and functional modes as described in the ADS1219 datasheet. The LaunchPad™ operates at a 3.3-V logic and I/O level. The ADS1219 has both DVDD and AVDD. DVDD is the digital supply and is fixed to the same voltage level as the LaunchPad™ processor so no level shifting is required. The I²C communication is through LaunchPad™ ports PN5 (SCL) and PN4 (SDA). GPIO pin control for the *Reset* pin of the ADS1219 is controlled by port PK6. The *Reset* control pin defaults high (not in reset). GPIO port PK7 is an input port pin used to interrupt the processor when a new conversion result is ready to be read from the ADS1219. [Table 4](#) lists the port to connector pin interface.

Table 4. MSP432E401Y Port to BoosterPack™ Interface

MSP-EXP432E401Y GPIO Port	BOOSTXL-ADS1219 Connector Pin
SCL (PN5 - Output)	J1:9
SDA (PN4 - Input/Output)	J1:10
RESET (PK6 - Output)	J4:32
DRDY (PK7 - Input)	J4:31

3.5 Power Supply

Both the LaunchPad™ 3.3-V and 5-V supplies are used for the BOOSTXL-ADS1219. The digital supply is 3.3 V and supplies the ADS1219 DVDD supply input. AVDD is the ADS1219 analog supply and can accommodate either 3.3-V or 5-V operation. The choice of analog supply voltage is selected by jumper JP2. JP2:1-2 selects the 5-V supply source and JP2:2-3 selects the 3.3-V source, as shown in [Figure 6](#).

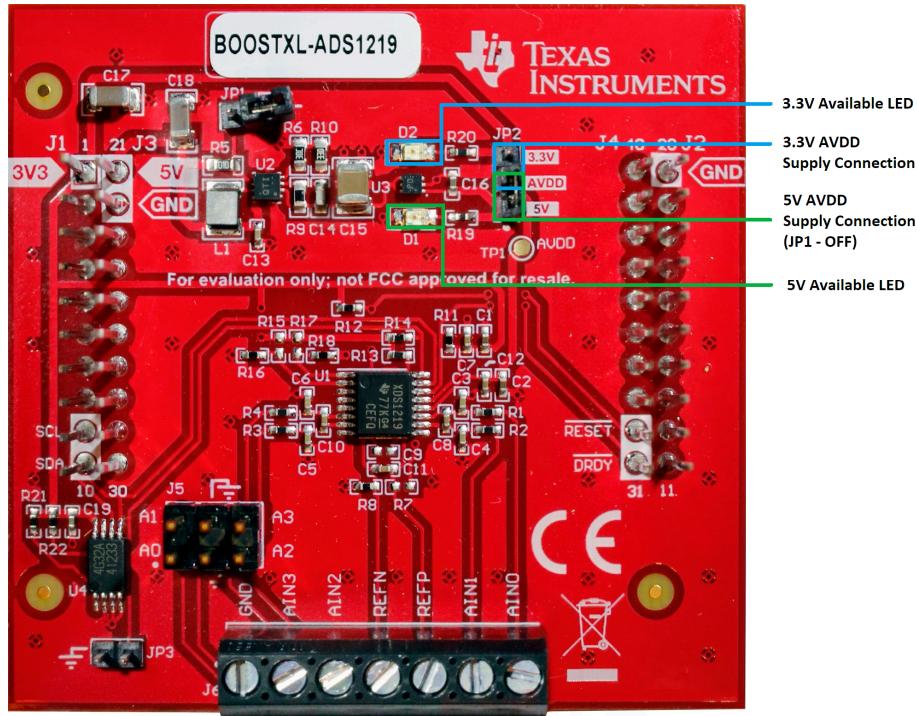


Figure 6. Analog Supply Jumper

The 3.3-V source comes directly from the LaunchPad™ and when available on the BOOSTXL-ADS1219 the D2 LED lights up indicating that the supply is active. The LaunchPad™ 5-V source is often less than 5 V. To achieve a stable voltage when operating at 5-V AVDD, U3 is used to charge pump the LaunchPad™ 5-V source and regulate for a fixed 5-V output. U3 can be disabled by installing jumper JP1, but by default this jumper is not installed. When U3 is active, then LED D1 lights up indicating the supply is available. TP1 can be used to monitor the AVDD supply voltage. Jumper placement and LEDs are shown in [Figure 6](#).

4 Setup Details

Getting the BOOSTXL-ADS1219 and MSP-EXP432E401Y LaunchPad™ combination to communicate with the PC requires firmware to be installed in the LaunchPad™ (see [Section 4.2.1](#)). This firmware is made available as part of the ADS1219 BoosterPack™ GUI software installation. Depending on which operating system is being used, there may also be a need for driver installation. The drivers are also included as a part of the GUI software installation.

4.1 ADS1219 BoosterPack™ GUI Installation

Download and install the GUI from the [BOOSTXL-ADS1219](#) tools folder. The license agreements must be accepted or the software will not install. Follow all remaining on-screen instructions to complete the installation.

4.2 Using the UniFlash Tool to Program the LaunchPad™

The UniFlash program can be accessed via the [cloud](#) or by [download](#). When using the cloud version for the first time the TI cloud agent must be installed. Follow all instructions by downloading and installing the correct cloud version for the operating system being used.

4.2.1 Flashing the Firmware

When the UniFlash program is accessed, either by cloud or download, start the process by first plugging in the LaunchPad™ to the XDS110 programming connector at the top of the LaunchPad™. A green LED lights up indicating that power is available and the cloud agent driver recognizes and installs the appropriate drivers for the LaunchPad™. For any issues with the installation or operation of the UniFlash program, click on the Help icon in the UniFlash menu bar.

1. In the UniFlash program start a *New Configuration* by selecting the MSP-EXP432E401Y LaunchPad™ from the drop down list as shown in [Figure 7](#).

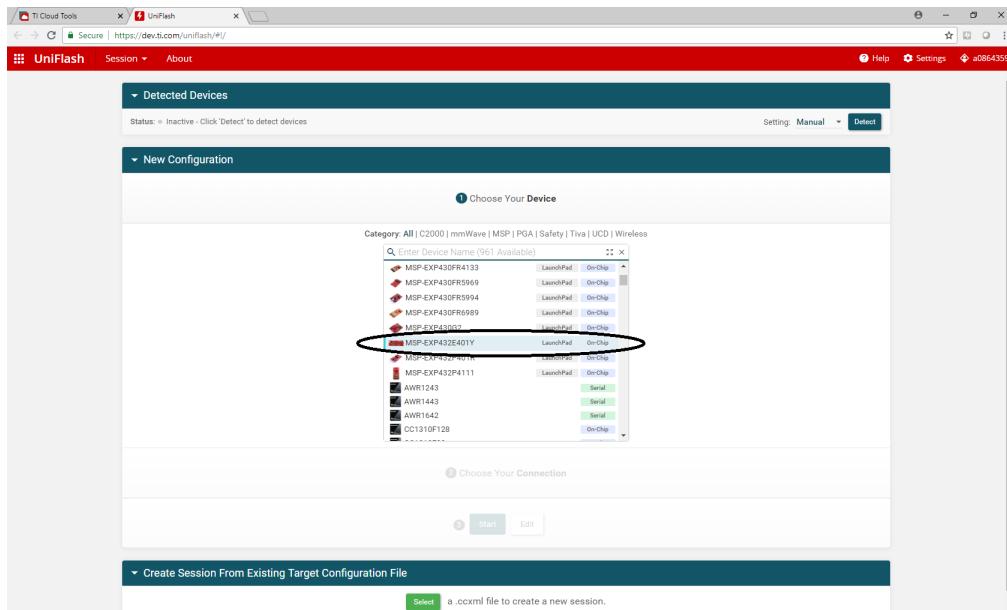


Figure 7. UniFlash: New Configuration

2. The *Selected Connection* happens automatically to *Texas Instruments XDS110 USB Debug Probe* as seen in [Figure 8](#), then press *Start*.

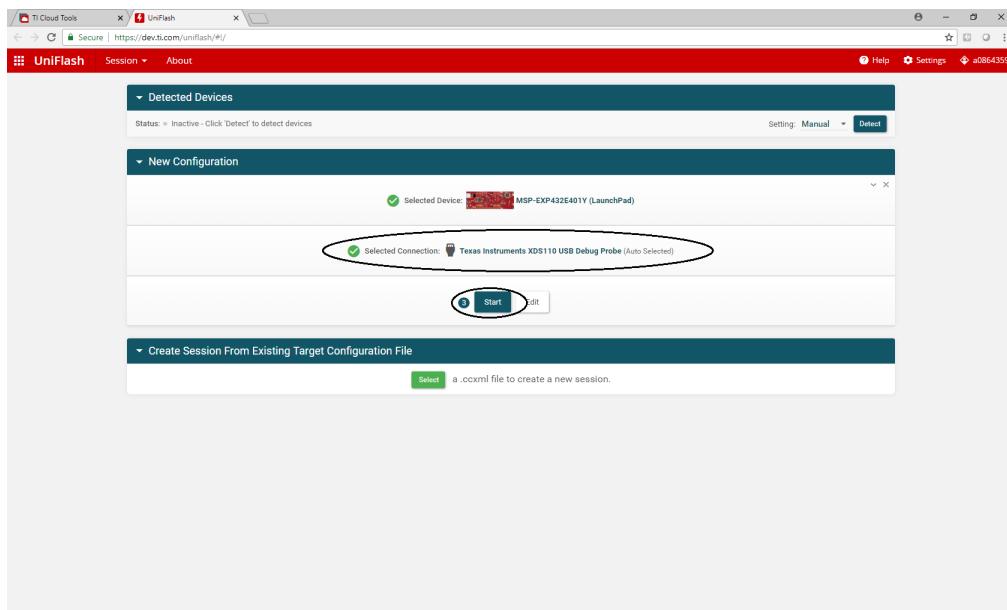


Figure 8. UniFlash: Choose Connection

3. From the *Program* tab, *Browse* to the *Flash Image* to be installed, as shown in [Figure 9](#). The flash binary file is found under the *Program Files (x86)\Texas Instruments\ADS1219\firmware* folder.

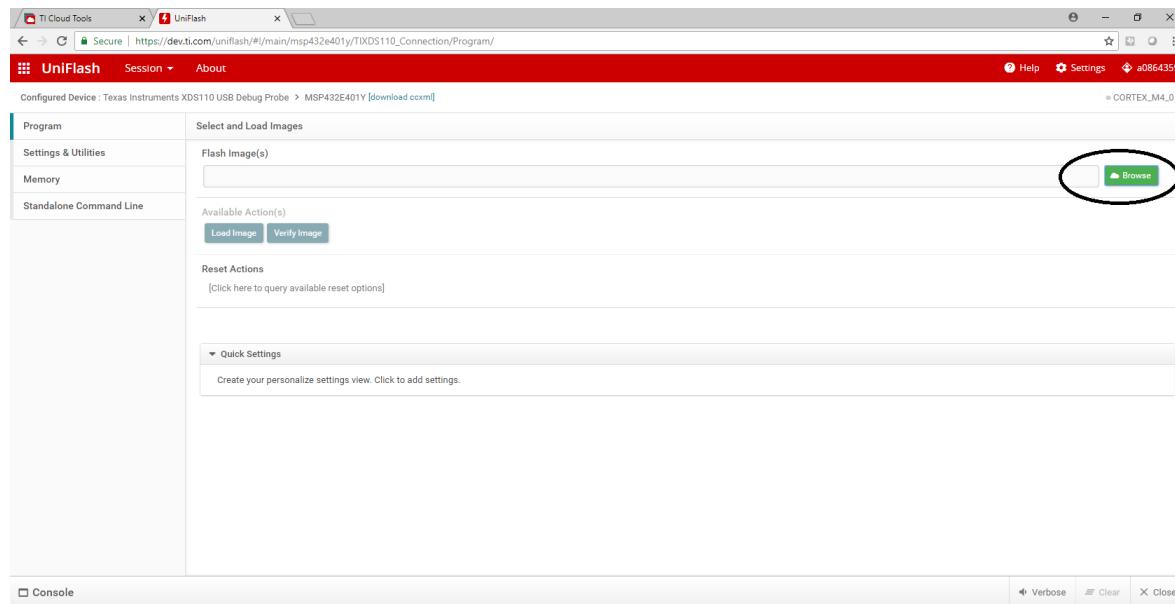


Figure 9. UniFlash: Browse to Firmware

4. When the flash binary image file is located, press the *Load Image* button to start the firmware download, as shown in [Figure 10](#).

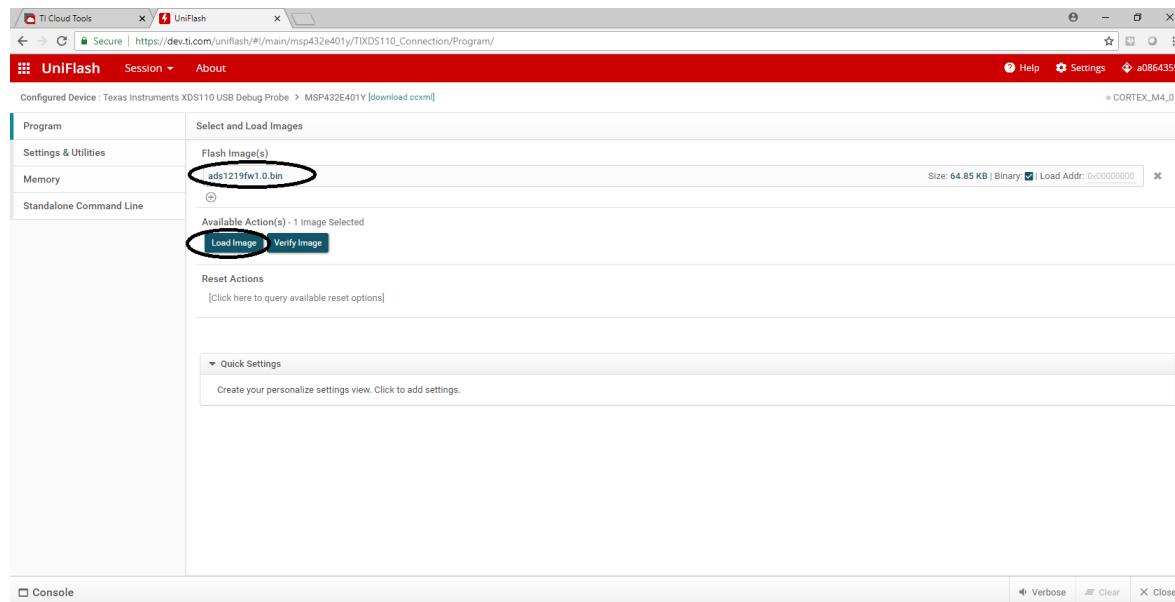


Figure 10. UniFlash: Load Image

5. The console at the bottom of the UniFlash window shows the result of the loading process. The correct response is **[SUCCESS] Program Load completed successfully**, as shown in [Figure 11](#). If this response is not shown or an error message is displayed try the *Load Image* button again. You may have to unplug and plug the USB cable to the LaunchPad™ again to reset communication.

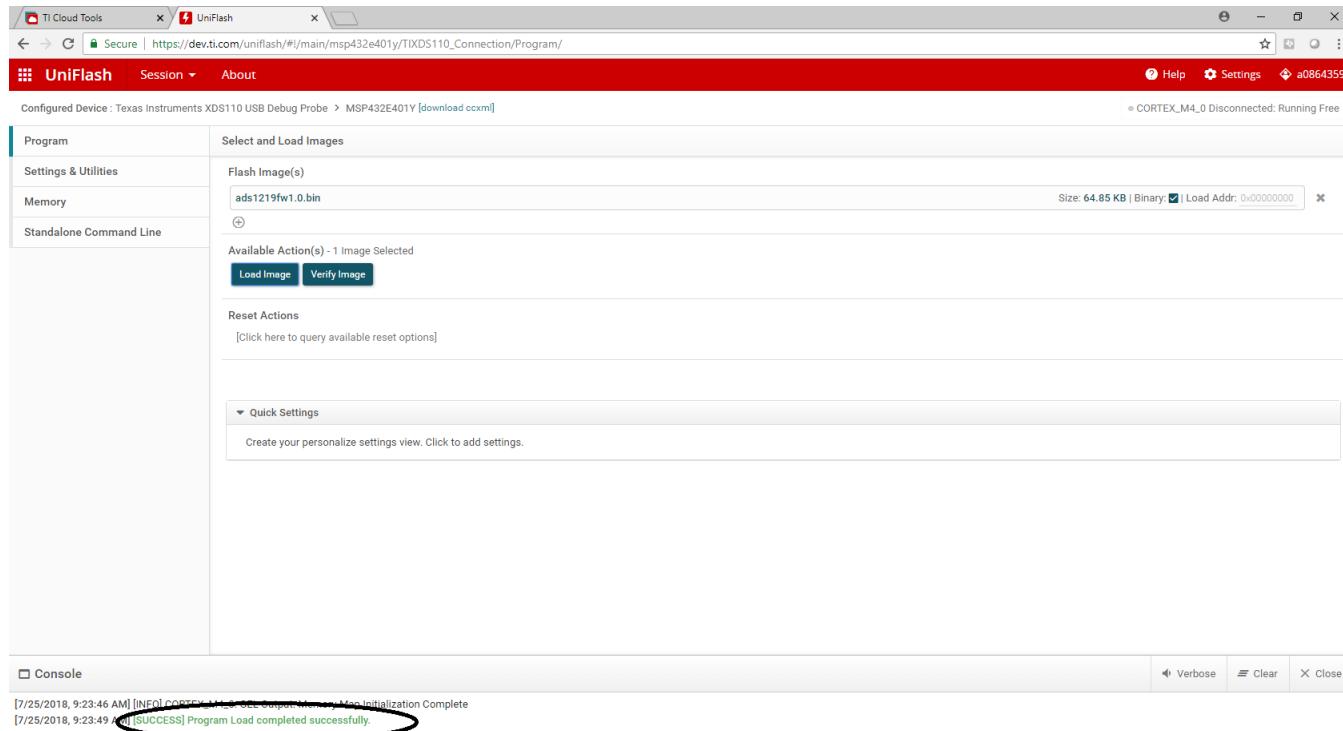


Figure 11. UniFlash: Successful Download

4.2.2 LaunchPad™ Power Configuration

To reduce the number of cables required to communicate and power the BOOSTXL-ADS1219, the USB connection at U7 can be used as the supply source for the LaunchPad™ as well as the communication connection for the CDC virtual COM port to the GUI. To route the power correctly, use the jumper installed on JP6 and connect to JP1 at the 5V-OTG (center) position as shown in [Figure 12](#). There should now be two jumpers on JP1.

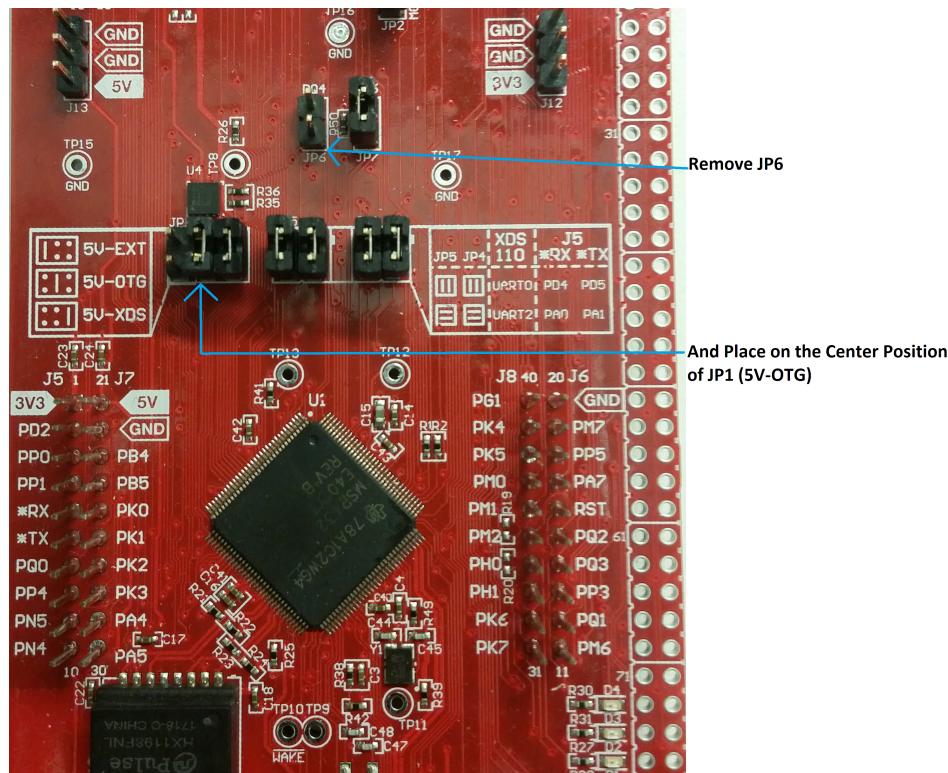


Figure 12. Power Jumper Change

4.3 Driver Installation (If Required)

For Windows 10, the enumeration of a CDC device automatically installs the required driver on enumeration. For earlier versions of the operating system a communication device class driver (CDC) may need to be installed. If the driver shows as *unknown*, manually install the driver from *Program Files (x86)/Texas Instruments/ADS1219/drivers*. Go to the *Control Panel* and select *Device Manager*. Right click on the unknown device and select *Update driver*. Choose the selection *Browse my computer for driver software*. Browse to the driver folder location and choose *Next* to locate the correct driver.

5 ADS1219 BoosterPack™ GUI Operation

[Figure 13](#) illustrates the home page of the ADS1219 BoosterPack™ GUI. This page provides a high-level overview of the ADS1219 device. Starting at the upper left portion of the GUI are various icons that refer to particular pages within the GUI application. Along with the home page is the quick start, setup, chart, register, and collateral pages. Each page can be selected by clicking on the appropriate icon. When the MSP-EXP432E401Y LaunchPad™ is combined with the BOOSTXL-ADS1219 BoosterPack™ and connected to the PC with the micro USB cable, the board is detected and connected. The connection status is shown at the lower left corner of the GUI.

5.1 Home Page

The *Home* page is the starting point of the GUI application. The five other pages can be selected from the bottom portion of the page, or from the icons along the left-hand side of the window. By clicking on *Learn more*, the ADS1219 features and functional diagram will be displayed in place of the page control tabs. When clicking on *Show Less* the page control tabs are once again displayed.

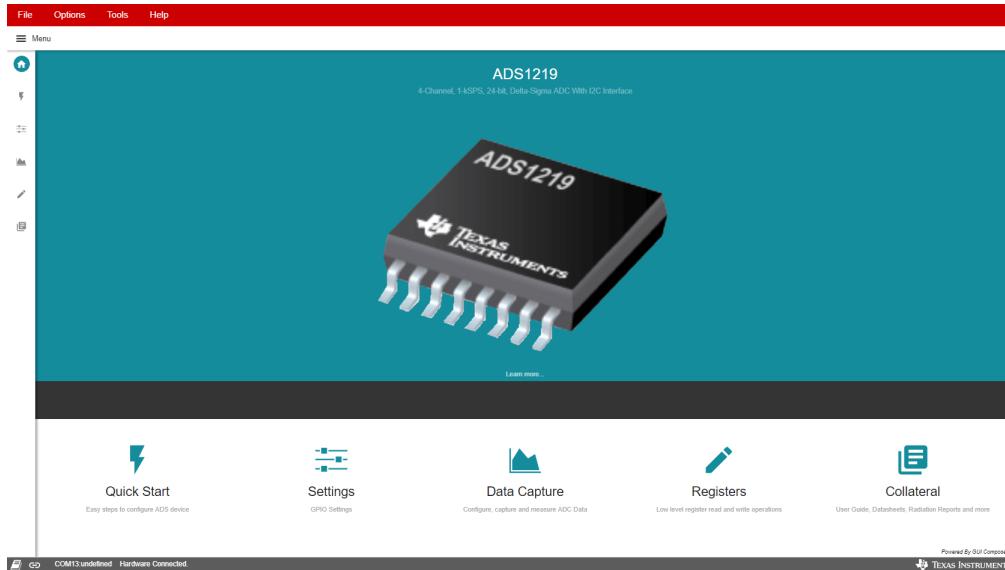


Figure 13. Home Page

5.2 Quick Start Page

The *Quick Start* page (Figure 14) shows a minimal view of the startup procedure to get the system up and running. For specific details see [Section 4](#).

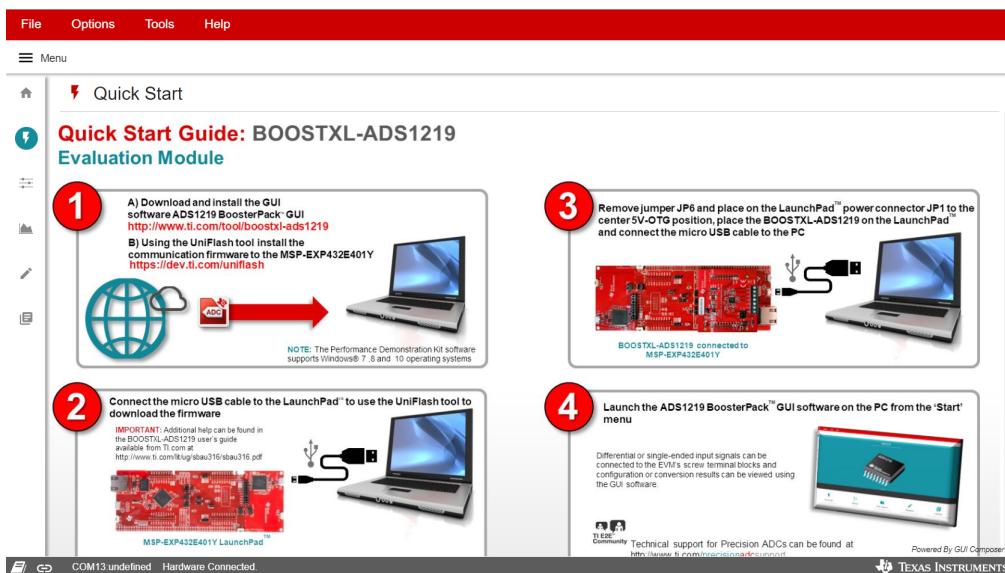


Figure 14. Quick Start Page

5.3 Settings Page

There is only one control setting on the *Settings* page (Figure 15). The control can be used to force a hardware reset to the ADS1219. Clicking the *Reset* button twice forces the reset pin low with the first click, and then returns the pin high with the second button click.

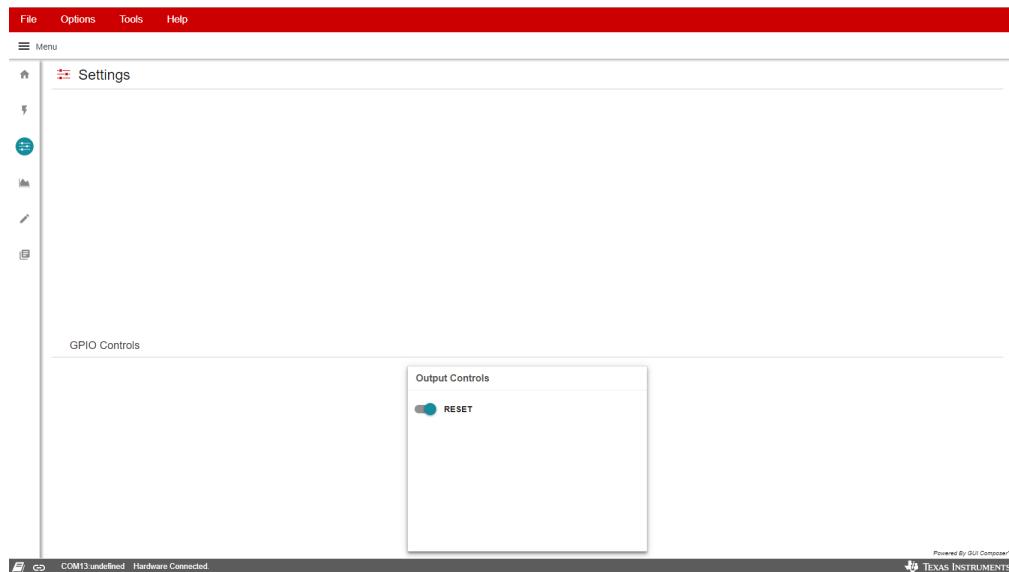


Figure 15. Settings Page

5.4 Chart Page

There is only one *Chart* page option available (Figure 16) and that is the Time Domain Analysis plot. For any data to be displayed in a continuous mode of operation requires that the *Conversion Mode* in the ADS1219 register setting be set to *Continuous*.

5.4.1 Time Domain Analysis

The plot begins when the START button is pressed. When the chart begins to display data, the START button changes to STOP. Data are displayed on the chart until the STOP button is pressed. There are two ways the data can be displayed. One option is to display by voltage and the second option displays by the number of codes. The voltage option is the default, and the voltage value displayed depends on the gain applied in the register setting and the reference voltage being used. The default reference voltage displayed is the internal reference voltage of the ADS1219. If another reference source is used, update the reference voltage box to accurately display the voltage value determined at the ADC input.



Figure 16. Chart Page

5.5 Register Map Page

The Register Map page ([Figure 17](#)) displays the contents of the ADS1219 registers. Only the first register can be written. The second register is a read-only register. Register settings can be changed using the drop-down lists and click boxes. Information regarding the selections and options can be displayed by using the cursor to hover over the various options.

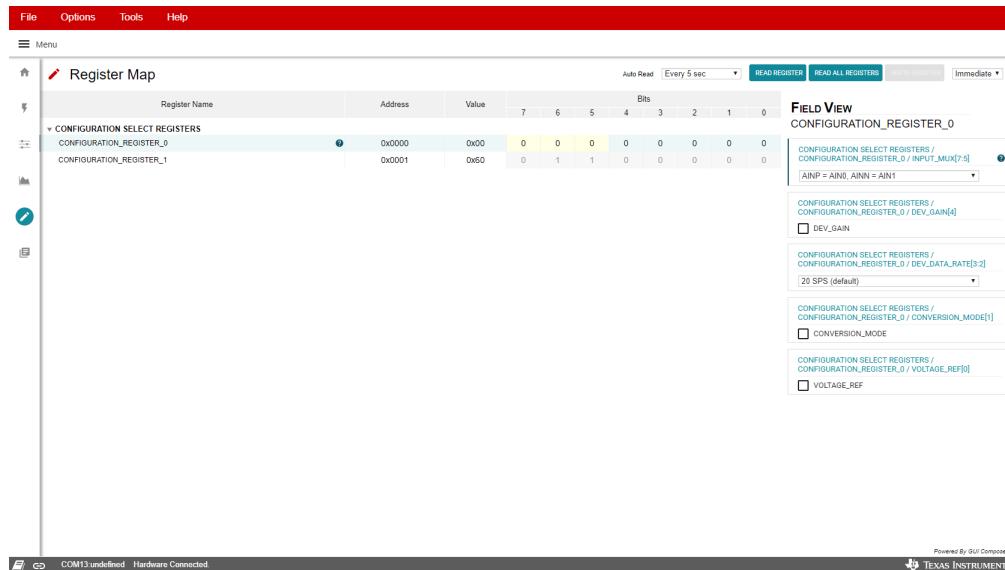


Figure 17. Register Map Page

5.6 Collateral Page

The Collateral page (Figure 18) provides information and links to various application notes and any other useful information as applicable to the GUI or the BOOSTXL-ADS1219.

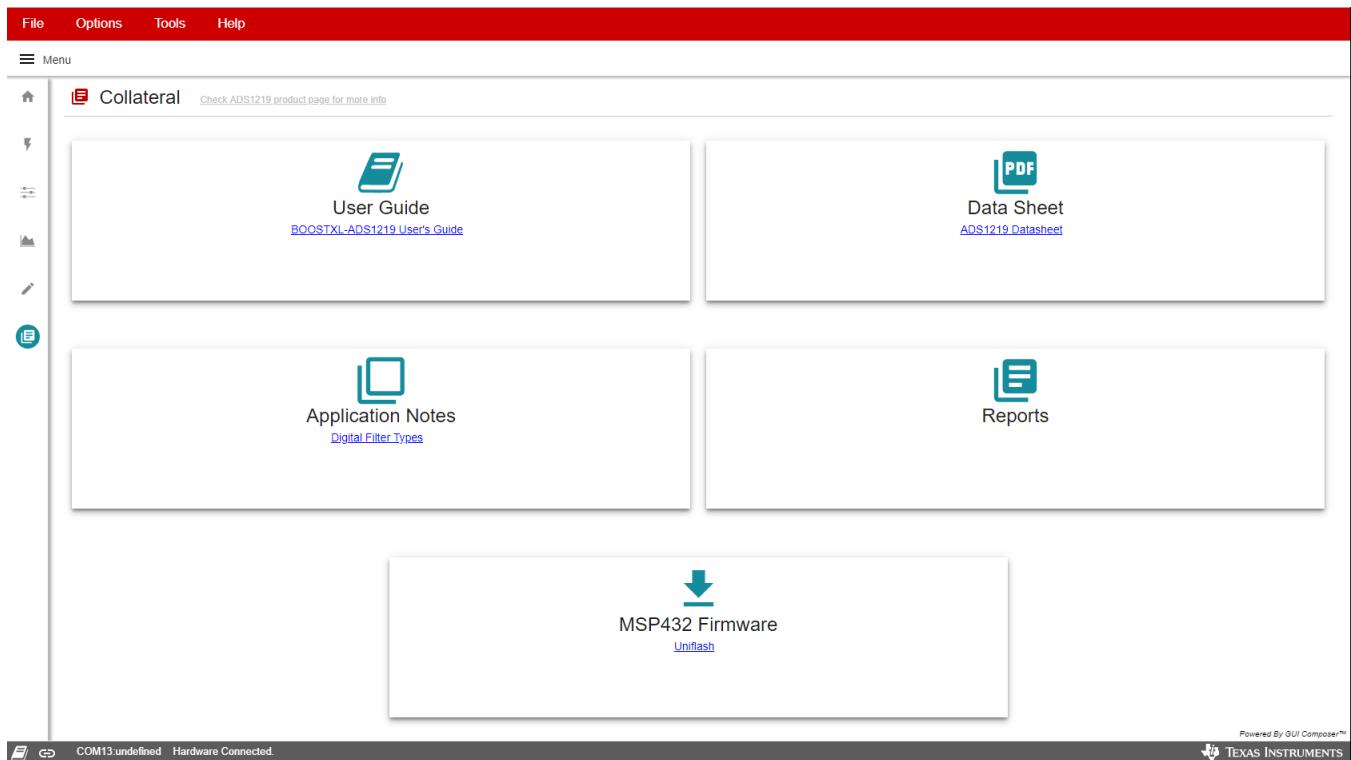


Figure 18. Collateral Page

6 Bill of Materials, PCB Layout, and Schematic

This section contains the BOOSTXL-ADS1219 EVM bill of materials (BOM), printed-circuit board (PCB) layout, and board schematic.

6.1 Bill of Materials

Table 5 lists the bill of materials (BOM) for the BOOSTXL-ADS1219 EVM.

Table 5. Bill of Materials

Designator	Quantity	Description	Manufacturer Part Number	Manufacturer
!PCB1	1	Printed Circuit Board	DC023	Any
C1, C2, C16	3	CAP, CERM, 1 uF, 10 V, +/- 10%, X7S, 0402	C1005X7S1A105K050BC	TDK
C3, C4, C5, C6	4	CAP, CERM, 0.01 uF, 10 V, +/- 10%, X7R, 0402	0402ZC103KAT2A	AVX
C7, C8, C10, C11, C12, C13, C19	7	CAP, CERM, 0.1 uF, 10 V, +/- 10%, X7R, 0402	GRM155R71A104KA01D	MuRata
C14	1	CAP, CERM, 100 pF, 25 V, +/- 10%, X7R, 0603	06033C101KAT2A	AVX
C15	1	CAP, CERM, 22 uF, 25 V, +/- 20%, X7R, 1210	TMK325B7226MM-TR	Taiyo Yuden
C17, C18	2	CAP, CERM, 10 uF, 16 V, +/- 10%, X5R, 1206	GRM319R61C106KE15D	MuRata

Table 5. Bill of Materials (continued)

D1, D2	2	LED, Green, SMD	LTST-C171GKT	Lite-On
J1/J3, J2/J4	2	Receptacle, 2.54mm, 10x2, Tin, TH	SSQ-110-03-T-D	Samtec
J5	1	Header, 100mil, 3x2, Gold, TH	TSW-103-07-G-D	Samtec
J6	1	Terminal Block, 3.5mm Pitch, 7x1, TH	ED555/7DS	On-Shore Technology
JP1, JP3	2	Header, 2mm, 2x1, Tin, TH	TMM-102-01-T-S	Samtec
JP2	1	Header, 2mm, 3x1, Tin, TH	TMM-103-01-T-S	Samtec
L1	1	Inductor, Wirewound, Ferrite, 1 uH, 2.05 A, 0.045 ohm, SMD	LQH32PN1R0NN0	MuRata
R1, R2, R3, R4, R13, R14	6	RES, 1.00 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04021K00FKED	Vishay-Dale
R5	1	RES, 100 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW0603100KFKEA	Vishay-Dale
R6	1	RES, 20.0 k, 1%, 0.1 W, 0603	RC0603FR-0720KL	Yageo
R8	1	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	ERJ-2GE0R00X	Panasonic
R9	1	RES, 768 k, 1%, 0.1 W, 0603	RC0603FR-07768KL	Yageo
R10	1	RES, 215 k, 1%, 0.1 W, 0603	RC0603FR-07215KL	Yageo
R11, R12, R16, R18, R21, R22	6	RES, 10 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	ERJ-2GEJ103X	Panasonic
R19	1	RES, 160, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW0402160RJNED	Vishay-Dale
R20	1	RES, 100, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW0402100RFKED	Vishay-Dale
SH-JP1, SH-JP2	2	Shunt, 2mm, Gold plated, Black	2SN-BK-G	Samtec
U1	1	24-Bit, 4-Channel, 1-kSPS, Delta-Sigma ADC with I2C Interface, PW0016A (TSSOP-16)	ADS1219IPWR	Texas Instruments
U2	1	3.5MHz, 1.5A, 92% Efficient Boost Converter with Adjustable Input Current Limit, DSG0008A (WSON-8)	TPS61252DSGR	Texas Instruments
U3	1	Single Output High PSRR LDO, 150 mA, Fixed 5 V Output, 2.5 to 6.5 V Input, with Low IQ, 6-pin WSON (DSE), -40 to 125 degC, Green (RoHS & no Sb/Br)	TPS71750DSER	Texas Instruments
U4	1	I2C BUS EEPROM (2-Wire), TSSOP-B8	BR24G32FVT-3AGE2	Rohm
C9	0	CAP, CERM, 0.1 uF, 10 V, +/- 10%, X7R, 0402	GRM155R71A104KA01D	MuRata
R7	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	ERJ-2GE0R00X	Panasonic
R15, R17	0	RES, 10 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	ERJ-2GEJ103X	Panasonic
SH-JP3	0	Shunt, 2mm, Gold plated, Black	2SN-BK-G	Samtec

6.2 PCB Layout

Figure 19 to Figure 22 depict the BOOSTXL-ADS1219EVM PCB layout.

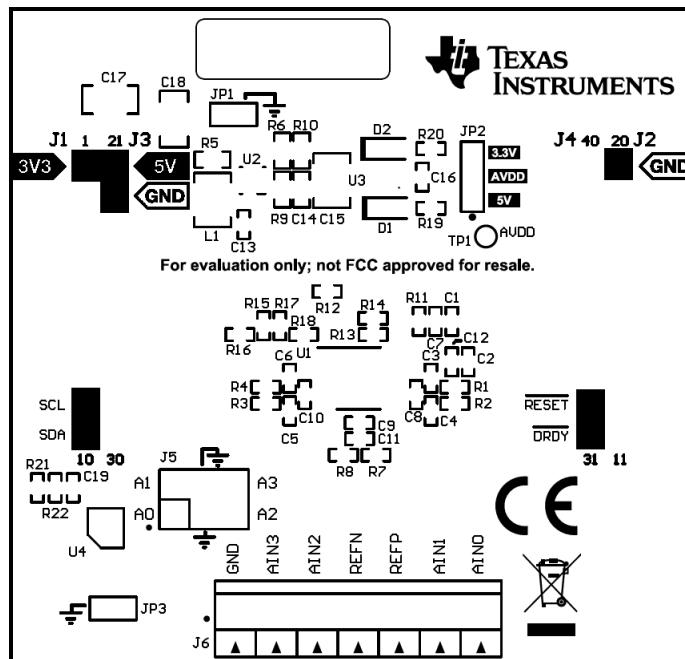


Figure 19. Top Silkscreen

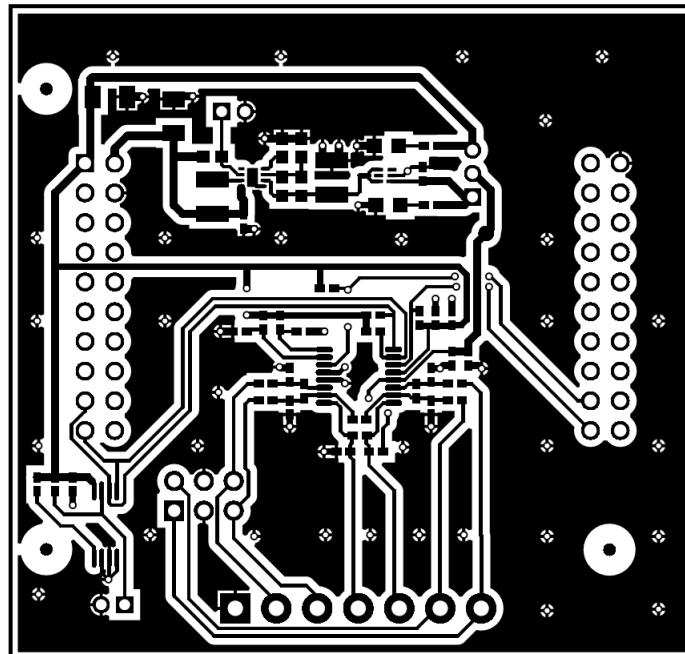


Figure 20. Top Layer

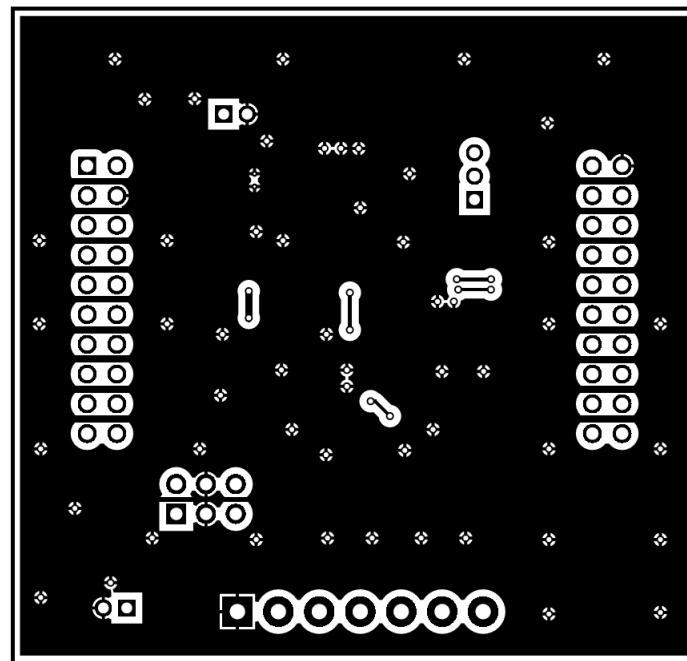


Figure 21. Bottom Layer

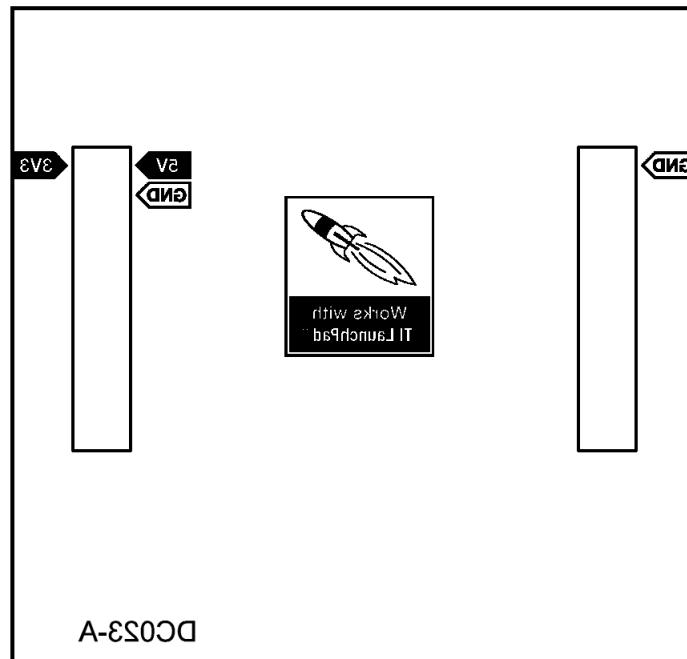


Figure 22. Bottom Silkscreen

6.3 Schematic

Figure 23 shows the BOOSTXL-ADS1219 schematic.

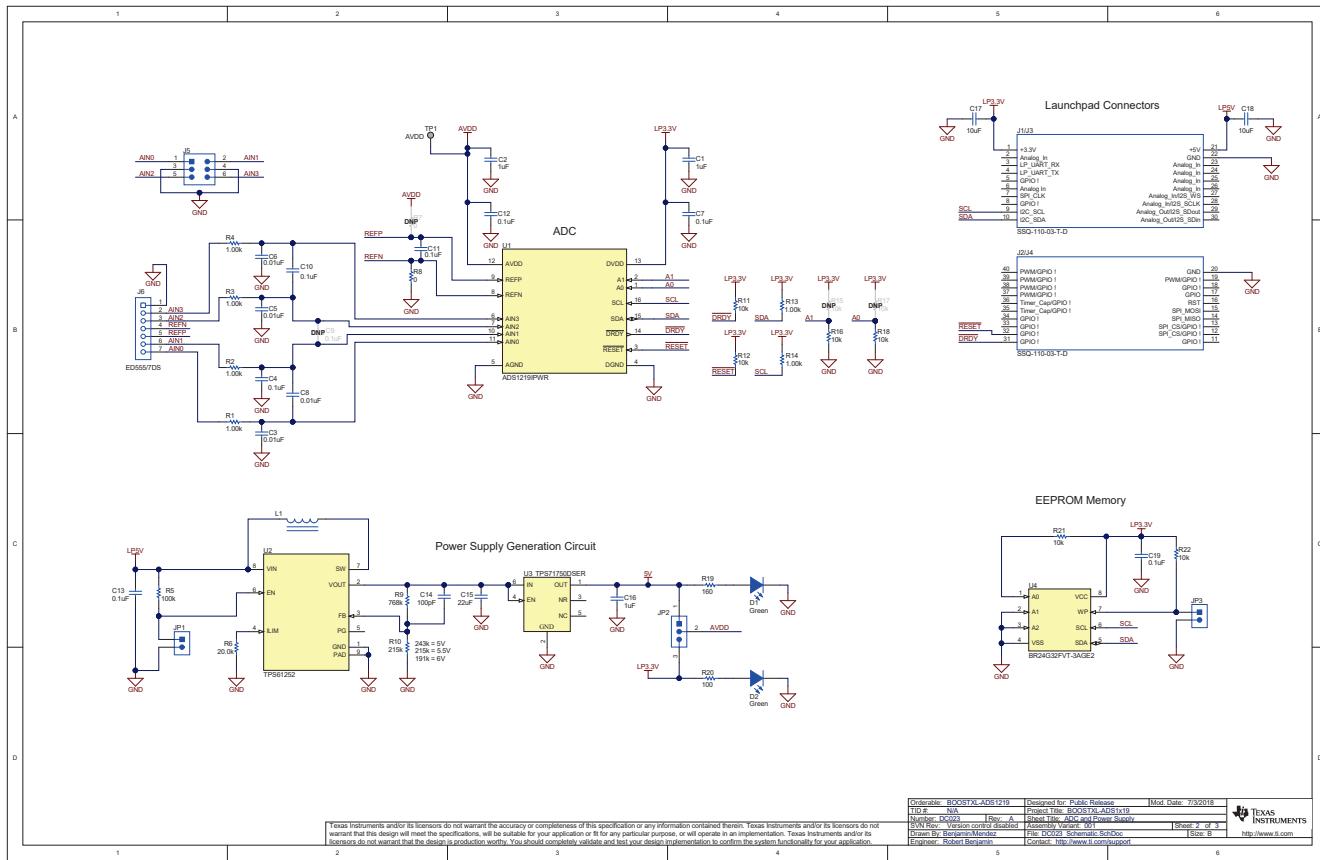


Figure 23. BOOSTXL-ADS1219 Schematic

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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.
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 - 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 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/lsts/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/lsts/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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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.

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- 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.
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