

## **ADC31JB68 Evaluation Module**

This user's guide describes the characteristics, operation, and use of the ADC31JB68 evaluation module (EVM). This document also provides a quick start guide, evaluation procedures, a description of the software, some alternate hardware configurations, and descriptions of the jumpers, connectors, and LEDs.

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## 1 Overview

The ADC31JB68EVM is an evaluation board used to evaluate the ADC31JB68 analog-to-digital converter (ADC) from Texas Instruments. The ADC31JB68 is a single-channel 16-bit ADC capable of operating at sampling rates up to 500 Mega Samples Per Second (MSPS) with outputs featuring a standard JESD204B high speed serial interface.

This evaluation board also includes the following important features:

- Transformer-coupled signal input network allowing a single-ended signal source
- LMK04828 system clock generator that generates the FPGA reference clock for the high speed serial interface
- Default transformer-coupled clock input network to test the ADC performance with a very low-noise clock
- High speed serial data output over a standard FMC connector
- Device registers programming via USB connector and FTDI USB-to-SPI bus translator

The ADC31JB68EVM is designed to work seamlessly with the TSW14J56EVM, Texas Instruments' JESD204B data capture card and the High Speed Data Converter Pro (HSDCPro) software tool for high speed data converter evaluation. The ADC31JB68EVM is also compatible with many of the development kits from leading FPGA vendors that contain an FMC connector.

### 1.1 Required Hardware

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

- ADC31JB68EVM Evaluation Board (EVM)
- Power cable with barrel connector (for connection of EVM to +5-V bench power supply)
- Mini-USB cable

#### CAUTION

**Ensure that the power cable is connected to the bench power supply and EVM with the correct polarity.** Connecting the cable with an incorrect polarity may damage the EVM. Testing the voltage at the output of the power cable (at the barrel connector) is recommended before connecting the power cable to the EVM.

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.

- TSW14J56EVM Data Capture Board, power cable and Mini-USB cable
- Computer running Microsoft® Windows® 8, Windows 7, or Windows XP
- 2x (or dual-channel) bench power supply capable of +5 V, 2 A
- Two low-noise signal generators. Recommendations:
  - RF generator, > +17 dBm, < –40-dBc harmonics, < 500 fs jitter 20 kHz–20 MHz, 10 MHz–2 GHz frequency range
  - Examples: TSW2170EVM, HP HP8644B, Rohde & Schwarz SMA100A
- Bandpass filter for analog input (between 100–500 MHz). Recommendations:
  - Bandpass 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

- Bandpass filter for clock input (500 MHz). Recommendations:
  - Bandpass filter,  $\geq 60$ -dB harmonic attenuation,  $\leq 5\%$  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 and/or BNC with BNC-to-SMA adapters
- 6-dB, 50- $\Omega$  attenuator

## 1.2 Required Software

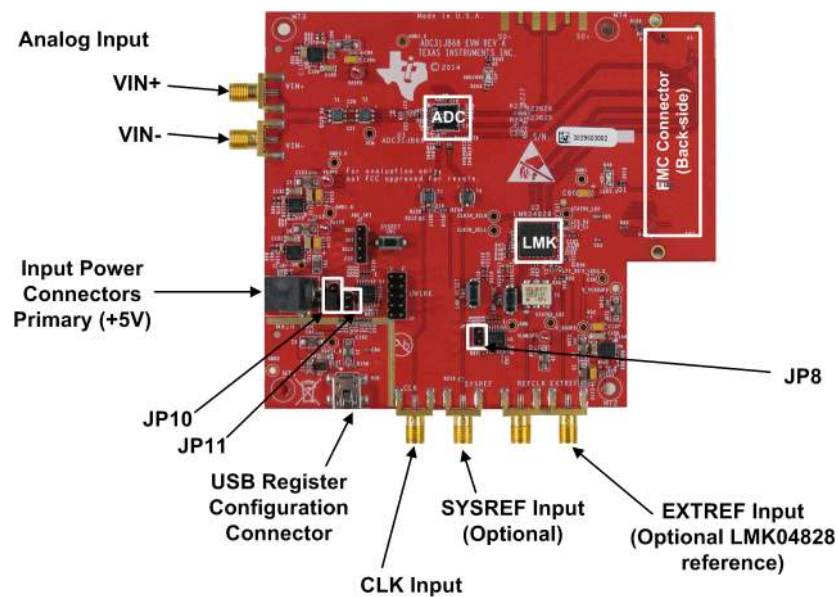
The following software is required to operate the ADC31JB68EVM and available online. See the [References](#) section for links.

- ADC31JB68\_GUI\_Installer.zip

The following software is required to operate the TSW14J56EVM and available online. See the [References](#) section for links.

- High Speed Data Converter Pro software

## 1.3 Evaluation Board Feature Identification Summary



**Figure 1. EVM Feature Locations**

## 1.4 References

- ADC31JB68EVM GUI software, schematics, layout, BOM, available at: [www.ti.com/tool/ADC31JB68EVM](http://www.ti.com/tool/ADC31JB68EVM)
- ADC31JB68 datasheet, available at [www.ti.com/product/ADC31JB68](http://www.ti.com/product/ADC31JB68)
- LMK04828 datasheet, available at [www.ti.com/product/lmk04828](http://www.ti.com/product/lmk04828)
- TSW14J56EVM User's Guide, available at [www.ti.com/tool/TSW14J56EVM](http://www.ti.com/tool/TSW14J56EVM)
- High Speed Data Converter Pro User's Guide, available at [www.ti.com/tool/dataconverterpro-sw](http://www.ti.com/tool/dataconverterpro-sw)

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**NOTE:** Schematics, layout, and BOM are available on the ADC31JB68EVM product page on [www.ti.com](http://www.ti.com).

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## 2 Quick Start Guide

This section guides the user through the EVM test procedure to obtain a valid data capture from the ADC31JB68EVM using the TSW14J56EVM 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.

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**NOTE:** The software must be installed before connecting the ADC31JB68EVM and TSW14J56EVM to the computer for the first time.

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#### 2.1.1 ADC31JB68 GUI Installation

The ADC31JB68 GUI is used to control the ADC31JB68EVM. It must be used to properly configured the devices on the EVM.

1. Download the GUI from the TI website. The [References](#) section of this document contains a 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.

#### 2.1.2 High Speed Data Converter Pro GUI Installation

High Speed Data Converter Pro (HSDC Pro) is used to control the TSW14J56EVM and analyze the captured data. Please see the HSDC Pro user's guide 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 ADC31JB68EVM and TSW14J56EVM is shown in Figure 2. This is the test setup that will be used for the quick start procedure. The rest of this section describes the hardware setup steps.

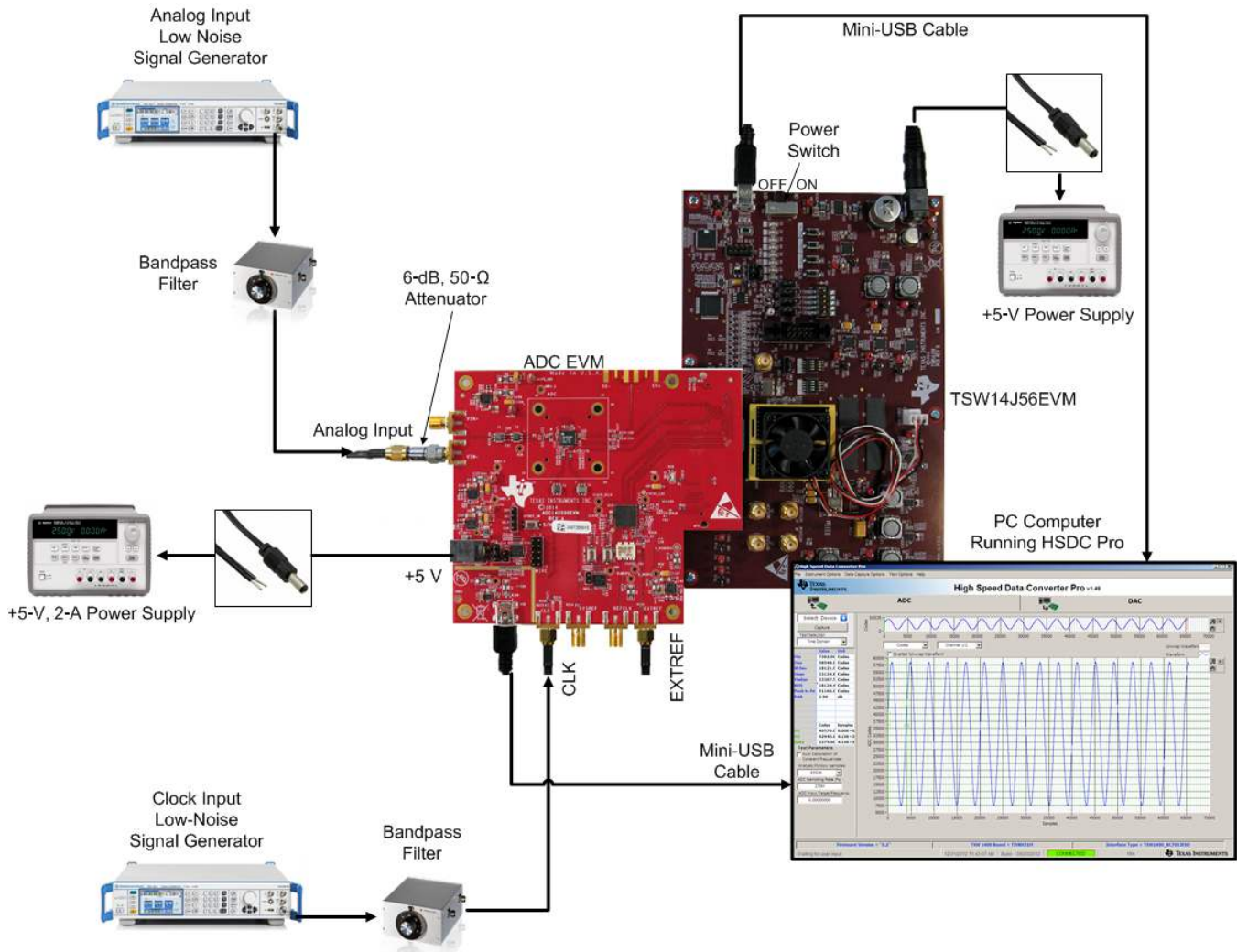


Figure 2. Quick Start Test Setup

### 2.2.1 TSW14J56EVM Setup

First, setup the TSW14J56EVM using the following steps:

1. Connect the ADC31JB68EVM to the TSW14J56EVM via the FMC connectors
2. Connect the included power cable for the TSW14J56EVM to the bench power supply
3. Test the voltage at the output of the power cable to verify correct polarity. The center core of the barrel connector must have +5V relative to the outside ground shield.
4. Connect the power cable to connector J11 (+5V IN) of the TSW14J56EVM
5. Connect the included mini-USB cable to the USB connector (J9) of the TSW14J56EVM
6. Flip the power switch (SW6) of the TSW14J56EVM to the ON position

### 2.2.2 ADC31JB68EVM Setup

Next, setup the ADC31JB68EVM using the following:

#### CAUTION

**Ensure that the power cable is connected to the bench power supply and EVM with the correct polarity.** Connecting the cable with an incorrect polarity may damage the EVM. Testing the voltage at the output of the power cable (at the barrel connector) is recommended before connecting the power cable to the EVM.

1. Connect the flying leads of the power cable to the +5V bench power supply
2. Test the voltage at the output of the power cable to verify correct polarity. The center core of the barrel connector must have +5V relative to the outside ground shield.
3. Connect the included power cable to connector MAIN PWR connector of the EVM
4. Connect the included mini-USB cable to the USB connector
5. Connect the 6-dB, 50- $\Omega$  attenuator to the VIN– input
6. Set the analog input signal generator for 70 MHz, +10 dBm
7. Connect the Signal generator to the VIN– input. Place the bandpass filter between the analog signal generator and the attenuator input to remove noise and harmonics from the signal generator.
8. Set the analog input signal generator for 500 MHz, +12 dBm
9. Connect the Signal generator to the CLK input. Place the bandpass filter between the clock signal generator and the CLK input to remove noise and harmonics from the signal generator.

### 2.3 Software Setup Procedure

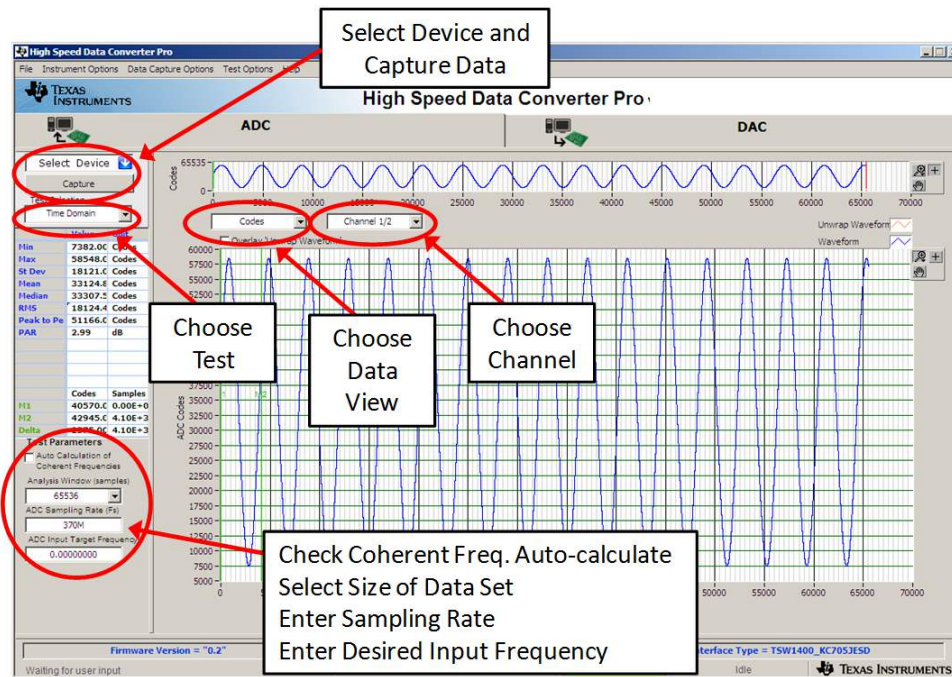
The software can be opened and configured once the hardware is properly setup.

#### 2.3.1 ADC31JB68 GUI Configuration

1. Open the ADC31JB68 GUI by going to *Start Menu* → *All Programs* → *Texas Instruments ADCs* → *ADC31JB68 GUI*
2. Verify that the green *USB Status* indicator is lit in the top right corner of the GUI
3. Press the *Program LMK04828* button
4. Press the *Calibrate ADC31JB68* button

### 2.3.2 HSDC Pro GUI Configuration

1. Open High Speed Data Converter Pro by going to *Start Menu* → *All Programs* → *Texas Instruments* → *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 TSW14J56EVM whose serial number corresponds to the serial number on the TSW14J56EVM and click *OK*. This popup can be accessed through the *Instrument Options* menu.
3. Select the *ADC* tab at the top of the GUI
4. Use the *Select ADC* drop-down menu at the top left corner to select **ADC31JB68EVM**
5. When prompted to update the firmware for the ADC, click *Yes* and wait for the firmware to download to the TSW14J56EVM
6. Enter "500M" into the *ADC Output Data Rate* field at the bottom left corner
7. Click *Capture* in HSDC Pro to capture data from the ADC

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

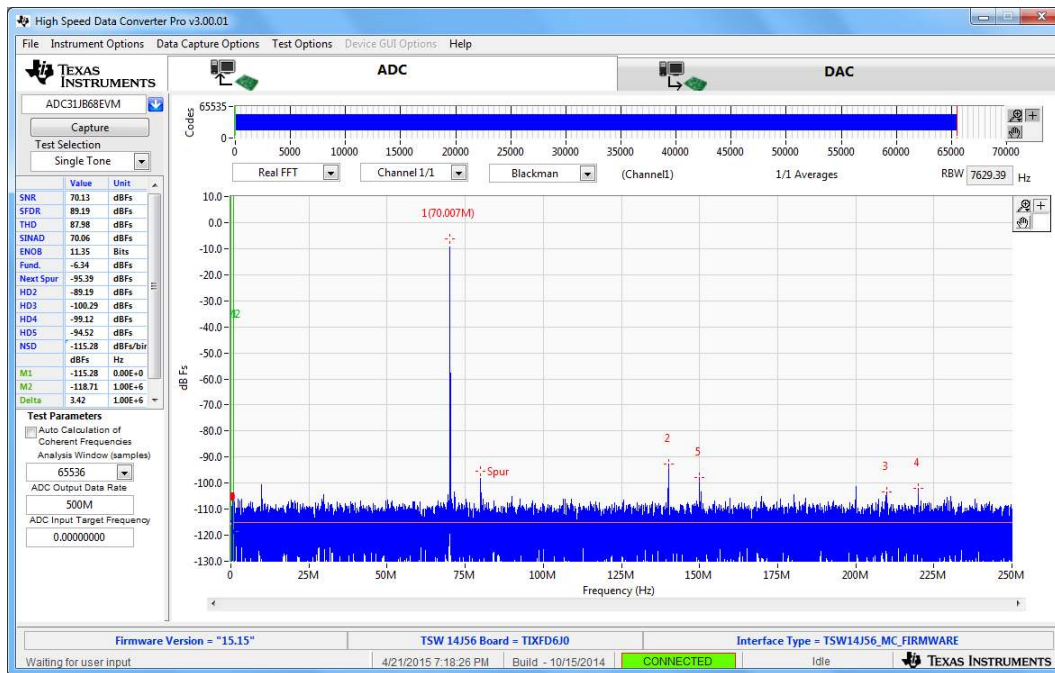


Figure 4. Data Capture Results From Quick Start Procedure

Table 1. Quick Start Performance Measurements

Result	Measured Value	Units
SNR	> 68	dBFS
SFDR	> 80	dBFS



## 2.4 Quick Start Trouble Shooting

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

**Table 2. Troubleshooting Tips**

Issue	Troubleshooting Tips
<b>General Problems</b>	Verify the test setup shown in <a href="#">Figure 2</a> and repeat the setup procedure as described in this document
	Check power supplies to the EVM and TSW14J56EVM. Verify that the power switches are in the ON position
	Check signal and clock connections to EVM
	Check that all boards are properly connected together
	Try pressing the CPU_RESET button on the TSW14J56EVM
	Try power-cycling the external power supply to the EVM and re-program the LMK and ADC devices
<b>TSW14J56 LEDs are not correct: D1, D5 – N/A D2, D4 – <i>Blinking</i> D3, D6, D7 – <i>OFF</i> D8, D28 – <i>ON</i></b>	Verify the settings of the configuration switches on the TSW14J56EVM
	Verify that the EVM configuration GUI is communicating with the USB and that the configuration procedure has been followed
	(LEDs Not Blinking) Re-program the LMK device
	Try pressing the CPU_RESET button on the TSW14J56EVM
	Try capturing data in HSDC Pro to force an LED status update
<b>Device GUI is not working properly</b>	Verify that the USB cable is plugged into the EVM and the PC
	Check the computer's Device Manager and verify that a <i>USB Serial Device</i> is recognized when the EVM is connected to the PC
	Verify that the green <i>USB Status</i> LED light in the top right corner of the GUI is lit. If it is not lit, press the <i>Reconnect FTDI</i> button.
	Try restarting the configuration GUI
	Check default jumper connections as shown in <a href="#">Appendix A</a>
<b>HSDC Pro Software is not capturing good data or analysis results are incorrect</b>	Verify that the TSW14J56EVM 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, <i>ADC31JB68EVM</i> should be selected.
	Check that the analysis parameters are properly configured
<b>HSDC Pro Software gives a Time-Out error when capturing data</b>	Try to re-program the LMK device and reset the JESD204 link
	Verify that the ADC sampling rate is correct in the HSDC Pro software
<b>Sub-Optimal Measured Performance</b>	Try pressing the <i>Calibrate ADC</i> button on the INTRO tab of repeating the configuration GUI procedure for programming the EVM
	Check that the spectral analysis parameters are properly configured
	Verify that bandpass filters are used in the clock and input signal paths and that low-noise signal sources are used

### 3 Optimizing Evaluation Results

This section describes how to optimize the performance during evaluation of the product.

#### 3.1 Clocking Optimization

The sampling clock provided to the ADC must have very low noise to achieve optimal results. The ADC31JB68EVM is configured by default to require a device clock from an external signal source via the CLK SMA connector to allow for the best possible measured performance.

#### 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 options that can help improve the performance measurements. These are highlighted in [Table 3](#).

**Table 3. HSDC Pro Options for Optimal Analysis 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 FFT analysis.
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/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 Single-Tone FFT 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 Software Description

### 4.1 ADC31JB68EVM GUI

Figure 5 shows the front page of the ADC31JB68EVM GUI as it should be seen upon opening the GUI. Descriptions for each of the tabs of the GUI are shown in Table 6.

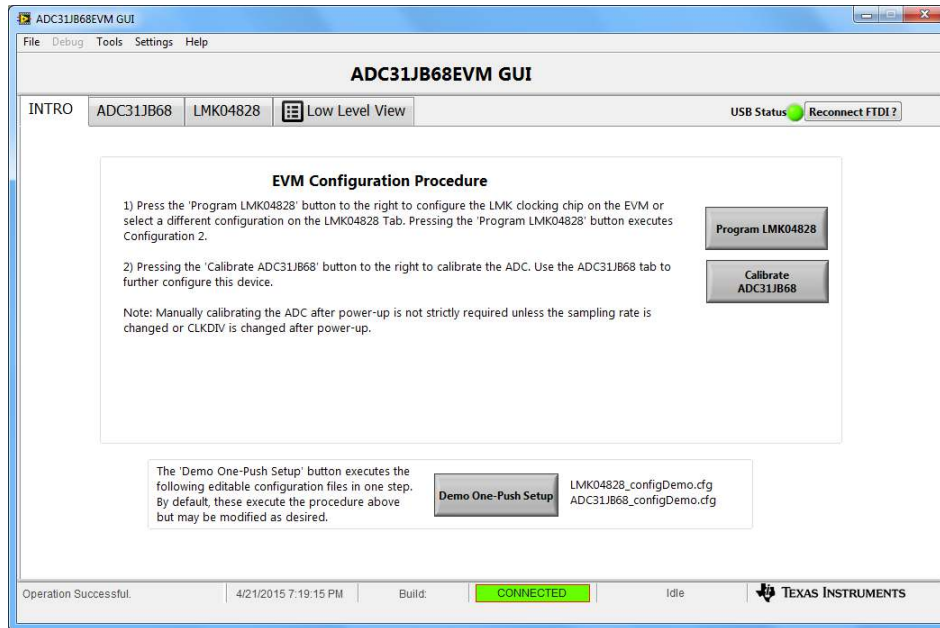


Figure 5. ADC31JB68EVM GUI

Table 4. ADC31JB68EVM GUI Tab Descriptions

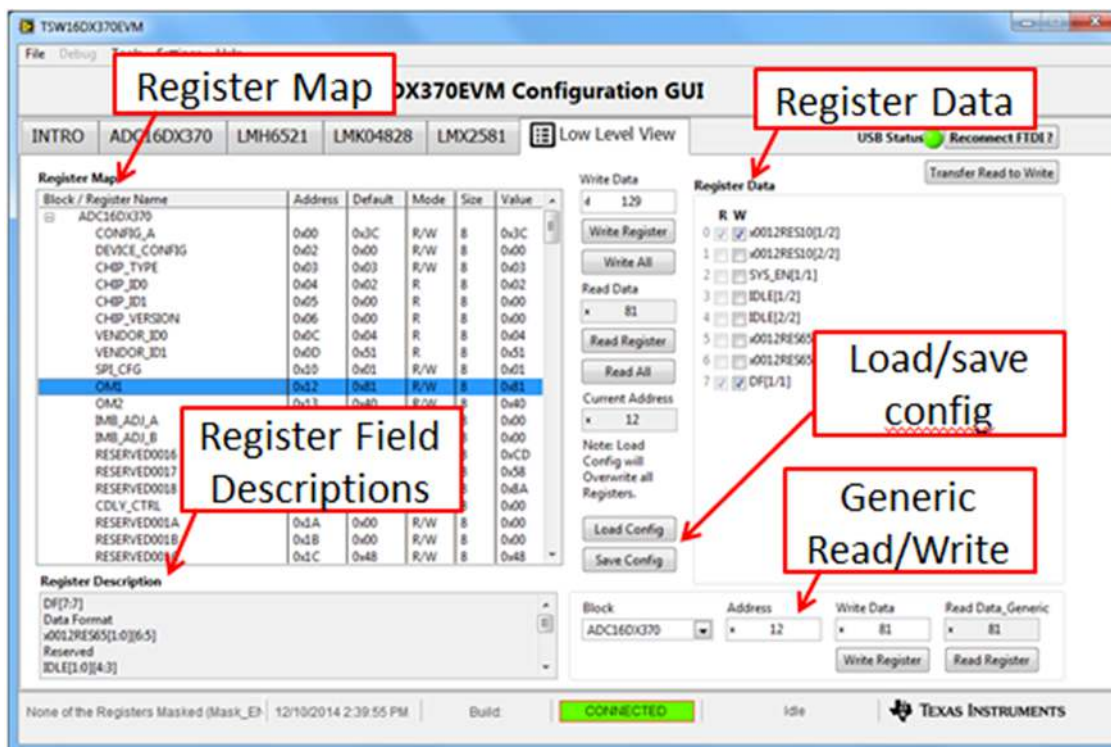
Tab	Description
INTRO	Configure the devices on the EVM for evaluation
ADC31JB68	Provides controls for ADC31JB68 features that can be used to customize evaluation
LMK04828	Provides controls for LMK04828 features that can be used to customize evaluation or setup more advanced clocking schemes
Low Level View	Allows write and read access to all device registers and bits, also allows loading and saving of configuration files. The device configurations can be saved from this tab for use in the user's system.

## 4.2 Low Level View

The Low Level View tab, shown in [Figure 6](#), allows configuration of the devices at the bit and field level. At any time, the controls described in [Table 5](#) may be used to configure or read from the device.

**Table 5. Low Level View Controls**

Control	Description
Register Map	Displays the devices on the EVM, the registers for those devices, and the states of the registers: <ul style="list-style-type: none"> <li>• Selecting a register field allows bit manipulation in the <i>Register Data</i> section.</li> <li>• The <i>Value</i> column shows the value of the register at the time the GUI was last updated due to a read or write event.</li> </ul>
Write Register Button	Write to the register highlighted in the <i>Register Map</i> with the value in the <i>Write Data</i> field. This button must be clicked after changing bits in the register data section.
Write All Button	Update all registers shown in the <i>Register Map</i> with the values shown in the <i>Register Map</i> summary
Read Register Button	Read from the register highlighted in the <i>Register Map</i> and display the results in the <i>Value</i> column
Read All Button	Read from all registers in the <i>Register Map</i> and display current state of hardware. Also updates the controls in the other tabs.
Load Config Button	Load a configuration file from disk and write the registers in the file
Save Config Button	Save a configuration file to disk that contains the current register configuration
Register Data Cluster	Manipulate individual accessible bits of the register highlighted in the <i>Register Map</i>
Generic Read/Write Register Buttons	Perform a generic read or write command to the device shown in the <i>Block</i> drop-down box using the <i>Address</i> and <i>Write Data</i> information



**Figure 6. Low Level View Tab**

## 5 Alternate Hardware Configurations

This section describes alternate hardware configurations that can be used for customized evaluation.

### 5.1 Clocking Options

By default, the ADC requires a clock source from an external signal generator. Optionally, the EVM may be configured such that the ADC is provided a clock signal by the LMK04828 in a variety of options. These options are described in the following sections.

#### 5.1.1 Providing the ADC Sampling Clock From the LMK04828

The EVM may be reconfigured to route a clock from the LMK04828 to the ADC31JB68 to be used as the device clock. This configuration represents a more realistic system configuration but the data conversion noise performance is affected by the noise of the clock signal from the LMK device. The EVM must be changed from the default configuration in the following ways:

- Remove R40, R41
- Place R43 and R50 with 0402, 0-Ω resistors
- Remove R234
- Configure the LMK04828 to output an LVPECL clock on the DCLKout2 output

#### 5.1.2 Recommended LMK04828 Configurations

The LMK04828 can be used in a number of useful configurations to provide the necessary clocks for the ADC and JESD204B interface as described in [Table 6](#):

**Table 6. Recommended LMK04828 Configurations**

Mode	Description
Clock Distribution Mode	Input reference is distributed to clock outputs and the frequency is divided, if desired. Frequency multiplication not supported. Input reference must be provided to CLKin1 input via CLK SMA connector and R21 or via EXTREF SMA connector using an external signal generator.
Clock Multiplier Mode (PLL2 Only)	Input reference is locked to internal VCO, allowing frequency Integer-N multiplication from input to output. Reference must be provided at OSCin input via EXTREF SMA connector or on-board XO at Y3.
Jitter Cleaner and Clock Multiplier Mode (PLL1 + PLL2)	Input reference is cleaned with very low bandwidth PLL1 and then multiplied to the desired frequency using PLL2. Reference must be provided at CLKin1 input or on-board XO at Y1/Y2. On-board VCXO at Y3 is also required.

## ***Jumper, Connector, and LED Descriptions***

### **A.1 Jumper Descriptions**

The EVM jumpers are shown in [Table 7](#) 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 7. Jumper Descriptions and Default Settings**

<b>Jumper</b>	<b>Description</b>	<b>Default Setting</b>
JP8	LMK SPI bus level translator chip disable OPEN: enabled SHORTED: disabled	OPEN
JP10	ADC SPI bus level translator ADC-side logic level SHORT 1–2: 1.8-V logic SHORT 2–3: 3.3/3.0-V logic	SHORT 2–3
JP11	ADC SPI bus-level translator chip disable OPEN: enabled SHORTED: disabled	OPEN
SW3	LMK_SYNC push-button. Can be used to initiate the LMK04828 device SYNC function.	
SW2	LMK_RESET push-button. Can be used to reset the LMK04828 device.	
SW1	SYSREF_SW push-button. Can be used to generate a SYSREF signal edge at the ADC's SYSREF input. (Components on EVM are not fully populated for this function by default)	

### **A.2 Connector Descriptions**

The EVM connectors and their function are described in [Table 8](#).

**Table 8. Connector Descriptions**

<b>Connector</b>	<b>Description</b>
FMC	FMC connector that connects to data capture card
J6 (+5V IN)	+5-V power connector
USB	USB interface connector for device configuration
VIN+	VIN+ analog input to ADC via transformer network. Grounded by default.
VIN–	VIN– analog input to ADC via transformer network
CLK	Sampling clock input for ADC via transformer network
SYSREF	SYSREF input for ADC via transformer network
REFCLK	Optional reference output from LMK04828
EXTREF	Optional reference input to LMK04828 CLKin1 or OSCin inputs.

### A.3 LED Descriptions

The EVM LEDs are described [Table 9](#).

**Table 9. LED Descriptions**

LED	Description
LED3.3	Indicates status of JESD204B link: OFF: JESD204B link is not established ON: JESD204B link is established

### Revision History

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

Changes from Original (August 2016) to A Revision	Page
• +5-V power supply removed and replaced with cable with flying leads in <i>Required Hardware</i> section. ....	<a href="#">2</a>
• In the <i>Hardware Setup Procedure</i> section, updated the <i>Quick Start Test Setup</i> figure and the <i>TSW14J56EVM Setup</i> and <i>ADC31JB68EVM Setup</i> sections. ....	<a href="#">5</a>

## STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.
  - 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 and conditions 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 and conditions 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 any defects that are 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. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.
  - 2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, 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:*

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](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](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 by Radio Law of Japan to follow the instructions below with respect to EVMs:

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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#### 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.

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