

ADS62PXXEVM

User's Guide



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ADS62PXXEVM

1 Overview

This user's guide gives a general overview of the evaluation module (EVM) and provides a general description of the features and functions to be considered while using this module. This manual is applicable to the ADS62P42/43/44/45/48/49, ADS62P22/23/24/25/28/29 and ADS62C15/17 analog to digital converters (ADC), which will be collectively referred to as ADS62PXX. This document should be used in combination with respective ADC data sheet. The ADS62PXX EVM provides a platform for evaluating the analog-to-digital converter (ADC) under various signal, clock, reference and power supply conditions.

1.1 EVM Block Diagram

Please refer to [Figure 1](#) below for EVM block diagram and configuration.

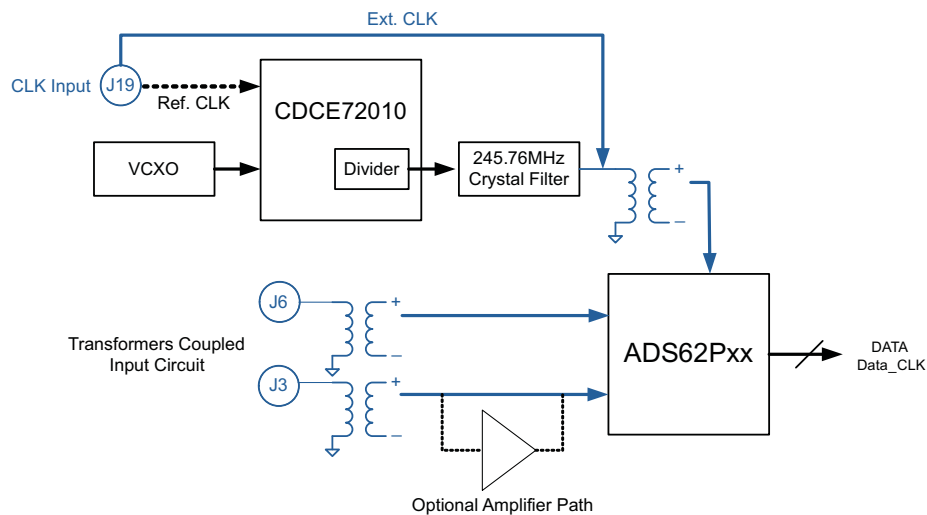


Figure 1. EVM Block Diagram

1.2 ADS62Pxx EVM Quick-Start Procedure

The ADS62PXXEVM provides numerous options for providing clock, input frequency and power to the ADC under evaluation. The quick start procedure describes how to quickly get initial results using the default configuration of the EVM as it was shipped. The EVM can be put back to default configuration by setting all jumpers to the default positions as described in [Table 1](#). The default configuration of the EVM is for the Input Frequency (IF) and the clock input, each to be a single ended input that is transformer-coupled to the ADC. The default configuration for the power supply is to provide a single 5V supply to the red banana jack J10, PWR IN. The default configuration for the EVM is to control the modes of operation by jumper settings for parallel input control pins rather than serial SPI control of the register space. The other modes of operation of the EVM are described in the latter sections of this document. If users modify the default jumper settings, this procedure does not apply.

A quick-setup procedure for the default configuration of the ADS62PXX follows:

1. Verify all the jumper settings against the schematic jumper list in [Table 1](#).
2. Connect the 5V supply between J10 (PWR IN) and J12(GND). If you are using the TSW1200 for capture, it also can be used to source 5V for the EVM. To use the 5V output power of the TSW1200, configure JP8 to short 1-2, J22 to short 1-2, and jumper over 5V from the banana jacks on the TSW1200 to J10 on the ADC EVM. Do not connect a voltage source greater than 5.5V.
3. Switch on power supplies.
4. Using a function generator with 50Ω output impedance, generate a 0V offset, 1.5V_{pp} sine-wave clock into J19. The frequency of the clock must be within the specification for the device speed grade.
5. Use a frequency generator with a 50Ω output impedance, generate a 0V offset, –1 dBFS-amplitude sine-wave signal into J6 (Channel A) or J3 (Channel B). This provides a transformer-coupled differential input signal to the ADC.
6. Connect the TSW1200 or suitable logic analyzer to J8 to capture the resulting digital data. If a TSW1200 is being used to capture data, follow the additional alphabetically labeled steps. For more details, see [Connecting to FPGA Platforms](#), located in this document.
 - (a) After installing the TSW1200 software and connecting the TSW1200 to the USB port, open the TSW1200 software.
 - (b) Depending on the ADC under evaluation, select from the TI ADC Selection pull-down menu.
 - (c) Change the ADC Sample rate and ADC Input frequency to match those of the signal generator.
 - (d) After selecting a Single Tone FFT test, press the Capture Data button.

Table 1. Jumper List

| Jumper | Function | Default Jumper Setting |
|---|--|------------------------|
| Interface Circuit Operational Amplifier THS4509 (Bypassed) | | |
| SJP1 | AMP_OUT+ | 1-2 |
| SJP2 | AMP_OUT- | 1-2 |
| JP3 | THS4509_PD | 2-3 |
| SJP5 | AMPIN- | 1-2 |
| SJP3 | AMPIN+ | No Shunt |
| ADC Circuit | | |
| JP11 | Parallel | 1-2 |
| JP9 | SDATA | 1-2 |
| JP10 | SEN | 1-2 |
| JP8 | SCLK | 1-2 |
| JP5 | CTRL3 | 1-2 |
| JP6 | CTRL2 | 1-2 |
| JP7 | CTRL1 | 1-2 |
| JP12 | MODE (Internal or External reference and Gain selection) | 1-2 |
| JP13 | | No Shunt |
| JP14 | DFS (Data Format and LVDS/CMOS output interface) | 3-4 |

Table 1. Jumper List (continued)

| Jumper | Function | Default Jumper Setting |
|--------------------------------|------------------------------|------------------------|
| JP22 | SDOUT/SPI-MISO Selection | No Shunt |
| Clock Interface Circuit | | |
| J18 | VCXO EN | No Shunt |
| SJP4 | CLOCKIN | 1-2 |
| SJP7 | CLOCK OPTION SELECT | 1-2 |
| SJP6 | CLOCK OPTION SELECT | 3-4 |
| SJP8 | PLL LOCK | 1-2 |
| J15 | RST (CDC Reset) | No Shunt |
| J14 | CDC_PWRDWN | 1-2 |
| JP20 | AUX SEL | 1-2 |
| JP21 | MODE_SEL | 1-2 |
| J22 | SPI Bus Access for CDCE72010 | |
| Power Supply | | |
| JP15 | ADC VA | 1-2 |
| JP18 | ADC VD | 1-2 |
| JP16 | TPS7A4501 INPUT SELECT | 1-2 |
| JP19 | 5V_AUX | 1-2 |
| JP17 | TPS5420 INPUT SELECT | No Shunt |

2 Circuit Description

2.1 Schematic Diagram

The schematic and layout for this EVM can be found on the EVM Product Folder Page of TI web as a design package. Please see the schematic or relevant section of this user's guide before changing any jumpers.

2.2 ADC Circuit Function

Selection of various modes of operation of the ADS62PXX EVM is most often controlled by jumpers on the EVM, either by placing shunts on 0.025-inch square jumper posts or by installation of surface mount 0Ω resistors. In general, the use of 0Ω resistors as jumpers are used in the clock or signal path where signal integrity is critical, and jumper posts are used for static or low-speed control paths.

2.2.1 ADC Operational Mode

By default, the ADC is configured to operate in parallel-mode operation, since jumper (JP11) asserts a 3.3V state to the ADC reset pin. Consequently, the SW1 reset pushbutton must be pressed only when the device is configured in serial operation mode. Since the ADC is in parallel operation mode, voltages are used to set the ADC configuration modes. Users can use the information printed on the EVM silkscreen to set the operation modes.

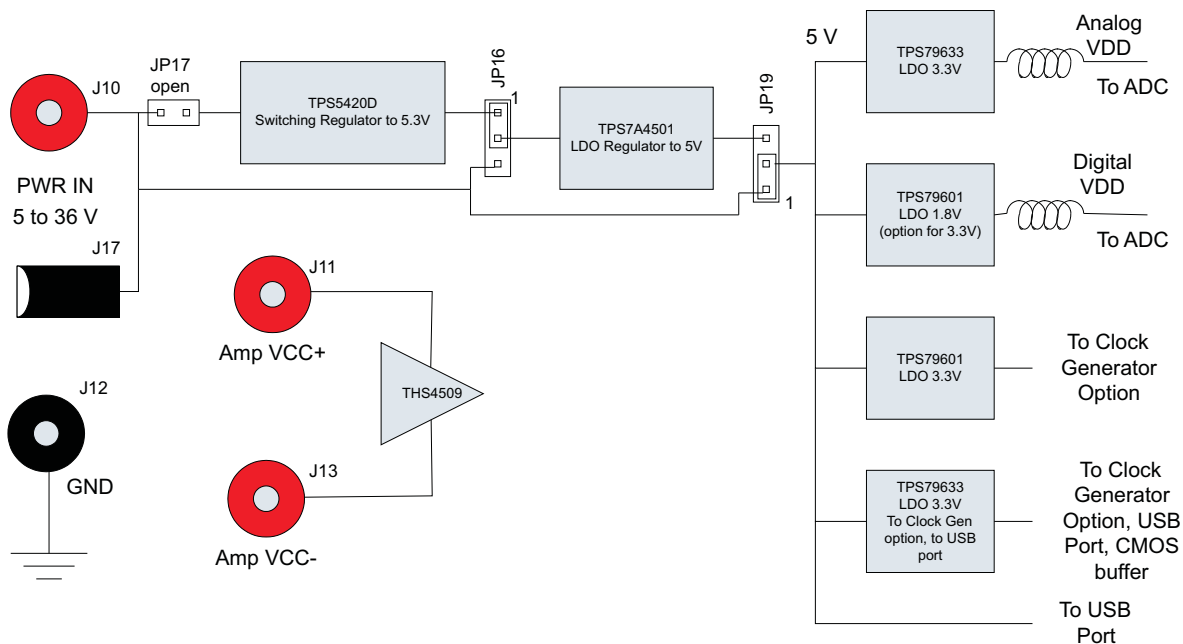


Figure 2. ADS62PXXEVM Power Distribution

2.2.2 EVM Power Connections

Power is supplied to the EVM through banana jacks. From this input power, several different ways of delivering power to the ADC and other EVM functions are available. [Figure 2](#) shows a simplified representation of the power options available for the ADS62PXXEVM. The default option is to provide 5V to J10 or J17, and from there, the EVM generates 3.3V for the analog supply to the ADC and the necessary digital supply voltage for the populated ADC. The EVM also generates the proper voltages for optional features of the EVM such as the Clock Generation circuitry, the USB circuitry, and the CMOS output buffer.

Some ADC devices that may be evaluated on the ADS62PXXEVM platform do not take 1.8V for the digital supply, but rather require 3.3V for the digital supply. For this reason, an adjustable voltage regulator was chosen for the digital supply; the output may be changed to 3.3V by changing the value of a resistor, R269 and capacitor C148. The resistor and capacitor need not to be changed in the field unless the ADC is being changed, because the EVM ships with the correct digital supply voltage for the ADC that is installed. For reference, ADS62P42/43/44/45, ADS62P22/23/24/25 and ADS62C15 use 3.3V as digital supply for the ADC whereas ADS62P48/49, ADS62P28/29 and ADS62C17 use 1.8V as digital supply for the ADC.

Power for the optional THS4509 operational amplifier is supplied by banana jacks J11 and J13. If the amplifier is being evaluated in AC coupled configuration, 5V is supplied to J11, and J13 is connected to ground. In DC-coupled configuration, 4V is supplied to J11 and -1V is supplied to J13. Otherwise, these inputs may be left unconnected.

Although various power options are available on this EVM, care must be taken while applying power on J10 or J17 as different options have different voltage ranges specified. [Table 2](#) displays the general jumper setting information; [Table 3](#) displays the various power option settings. Prior to making any jumper settings, see the schematics located in the design package.

CAUTION

Voltage limits: Exceeding the maximum input voltages can damage EVM components. Undervoltage can cause improper operation of some or all of the EVM components.

Table 2. EVM Power Supply Jumper Description

| EVM Jumper | Description | Jumper |
|------------------------|--------------------|--|
| J10 | Power Supply Input | Default 5V Supply Input 6V to 36V Supply Input for Power Supply Option 2 |
| J17 (same node as J10) | Power Supply Jack | Default 5V Supply Input 6V to 36V Supply Input for Power Supply Option 2 |
| JP16 | U14 Input Select | 1-2 → Connects U11 Output to Input of U14 2-3 → Connects Supply Voltage at J10 or J17 to Input of U14 |
| JP19 | 5V_AUX | 1-2 → Connects Supply Voltage at J10 or J17 to 5V_AUX 2-3 → Connects TPS7A4501 Output to 5V_AUX |
| JP17 | U11 Enable | Shunt → J10 or J17 connected to U11 |

Table 3. EVM Power Supply Options

| EVM Option | Evaluation Goal | Jumper Changes Required | Voltage on J10 | Comments |
|------------|---|---|--------------------|--|
| 1 | Evaluate ADC performance using a LDO based solution | JP17 → No Shunt JP16 → 1-2 JP19 → 1-2 JP15 → 1-2 JP18 → 1-2 | 5.0V to 5.5V | Maximum ADC performance |
| 2 | Evaluate ADC performance using a cascaded switching power supply (U11) and LDO (U14) solution | JP17 → 1-2 JP16 → 1-2 JP19 → 2-3 JP15 → 1-2 JP18 → 1-2 | 6V to 36V | Maximum ADC performance and power supply efficiency |
| 3 | Evaluate ADC performance using an isolated ADC AVDD and DVDD for current consumption measurements | JP17 → No Shunt JP16 → No Shunt JP19 → No Shunt JP15 → AVDD to pin 2 JP18 → DVDD to pin 2 | Do not apply power | Isolated power supply for current consumption measurements |

2.2.2.1 Power Supply Option 1

Option 1 supplies power to the ADC using the LDOs TPS79633DCQ and TPS79601DCQ. The LDOs take a maximum input of 5.5V. When using this option, take care powering up the EVM, because higher voltage or reverse polarity can damage it. This is the default power-supply configuration for the ADS62PXXEVM.

2.2.2.2 Power Supply Option 2

Option 2 supplies the power to the ADC using cascaded topology of the TPS5420D switching power regulator and the TPS7A4501 Low Drop-Out regulator. The TPS5420 is a step-down converter which works with the input voltage in the range 6V to 36V. The switching supply increases efficiency for higher input voltages but does create noise on the voltage supplies. To reduce the noise, a low-noise, high-PSSR LDO TPS7A4501 is used to clean the power supply. The TPS5420D is designed for 5.3V output, which acts as a supply for the TPS7A4501. The TPS7A4501 is designed to output 5V. This voltage rail is input to the LDO TPS79633, which outputs 3.3V, used for the ADC. A separate TPS79633 is designed to output 3.3V for the CDCE72010 supply rail. This solution adds two features to the EVM: one is to increase the range of the power supply on jumper J10 from 6V to 36V, allowing the user to choose any power supply source in the specified range without causing significant power dissipation. The other feature is that the output-voltage rail has a much lower ripple, allowing better performance of the part even when the power source is fluctuating.

2.2.2.3 Power Supply Option 3

Option 3 is used to evaluate ADC performance using an isolated AVDD and DVDD power supply for current-consumption measurements. This option must be used with caution, because reversing the power

supply or connecting to the wrong connector can damage the EVM. One common use of this option is to measure the separate current consumption of the relative supplies under particular operating conditions. For this option, the shunts on jumpers JP18 and JP15 are removed and the input power is supplied to the center post of the jumper. For convenience, a ground post is provided next to the center post for header connections that contain power and ground on 0.1" centers.

2.2.3 ADC Analog Inputs

The EVM can be configured to use either a transformer-coupled input or a THS4509 amplifier input, both from a single-ended source. The SMA connector J6 (for Channel A) and J3 (for Channel B) provide the single-ended analog input to the transformer-coupled input circuit to the ADC. The SMA connector J7 and J9 are not installed by default, but can be used to bring a differential input to the transformer-coupled input or to bring a single ended input to the THS4509 input circuit. To use the transformer for one of these options, the EVM must be configured for one of the options listed in [Table 5](#). See the schematic located in the design package prior to making any jumper changes.

Table 4. Analog Input Jumper description

| EVM Jumper | Description | Jumper Setting |
|------------|--|---|
| J6 | Analog Input single-ended | |
| J3 | Analog Input single-ended | |
| J7 | Analog input, can be used with J6 for differential input | Not populated |
| J9 | Analog input, can be used with J3 for differential input | Not populated |
| SJP1 | AMPOUT+, +ve terminal of T4 | 2-3 → AMPOUT+ is selected as source of input to ADC 1-2 → Use analog input from J3 as signal source to ADC (use with appropriate SJP5 setting) |
| SJP2 | AMPOUT-, -ve terminal of T4 | 2-3 → AMPOUT- is selected as source of input to ADC 1-2 → Use analog input from J9 as signal source to ADC (use with appropriate SJP3 setting) |
| SJP5 | INPUT -ve select | 1-2 → J3 supplies the analog signal to ADC 2-3 → -ve input to amplifier |
| SJP3 | INPUT +ve select | 1-2 → J9 supplies the analog signal to ADC 2-3 → +ve input to amplifier (DEFAULT is no shunt) |
| JP3 | Power down for amplifier THS4509 | 1-2 → Pulls up the pin (Normal operation or amplifier is ON) 2-3 → Grounds the pin (Low-power mode or amplifier is off) |

Table 5. EVM Analog Input Options

| EVM Option | Evaluation Goal | Jumper Changes Required | Voltage on J11 and J13 | Analog signal to ADC | Comments |
|------------|--|--|------------------------|---|---|
| 1 | Evaluate ADC performance using direct input to ADC | SJP1 → 1-2 SJP2 → 1-2 SJP3 → No shunt SJP5 → 1-2 JP3 → 2-3 | Do not connect | From J6 (Channel A) or J3 (Channel B) | Default |
| 2 | Evaluate ADC performance using input through THS4509 | SJP1 → 2-3 SJP2 → 2-3 SJP3 → 2-3 SJP5 → 2-3 JP3 → 1-2 Install J9 Remove R63 Install R62 | J11 → 5V J13 → GND | Signal from J3 and J9 is amplified by THS4509 | Used if input signal requires amplification |

2.2.3.1 Analog Input Option 1

Option 1 supplies the transformer-coupled input from J6 or J3 to the ADC. This configuration is the default on the EVM. The test result using this option is shown in [Figure 9](#). A double-transformer input circuit is used to provide better differential to single-ended conversion than a single transformer can provide. The transformers used are both of a 1:1 turns ratio, so termination of the 50Ω input signal path after the transformers can be two 25Ω resistors terminated to the Common Mode Voltage (VCM) provided by the ADC.

Following the transformer coupling, surface mount pads are provided for several input circuits. By default, the input circuit is configured as shown in the ADS62PXX data sheet under the recommended input circuit for high-bandwidth (>100 MHz IF) inputs. However, the recommended low-bandwidth input circuit for the ADS62PXX can be implemented on the surface mount pads provided.

2.2.3.2 Analog Input Option 2

Option 2 allows the use of an amplifier to provide input to the ADC. TI has a range of wideband operational amplifiers such as THS4508/09/11/13/20. On this EVM, THS4509 is used as an example to amplify the input from J3 or J9. The THS4509 is powered up by applying 5 V to J11 and GND to J13 (for AC coupled configuration). A differential power supply (4V applied to J11 and -1V applied to J13) may also be used to power up the amplifier if common-mode biasing is an issue for DC-coupled applications. See the THS4509 data sheet ([SLOS547](#)). The output of the THS4509 is filtered through a band-pass filter before ADC input. The band-pass filter can be designed depending on the end application. By default, the band-pass filter components are not populated because the filter design depends on the end application. A key point when designing a filter is to design it for proper load termination. Care must be taken when supplying the input to the board; the source impedance must be 50 Ω. Results can vary due to mismatching of the various source and termination impedances.

2.2.4 ADC Clock Input

The clock can be supplied to the ADC in one of several ways. The default clocking option is to supply a single ended clock directly to the SMA connector J19 directly, and this clock is converted to differential and AC coupled to the ADC by transformer coupling. The clock input must be from a clean, low-jitter source and is commonly filtered by a narrow bandpass filter. The clock amplitude is commonly set to about 1.5V peak to peak, and the amplitude offset is not an issue due to the AC coupling of the clock input. The clock source is commonly synchronized with the input frequency signal generator to keep the clock and IF coherent for meaningful FFT analysis.

Alternatively, the clock may be supplied by an onboard VCXO and CDCE72010 clock buffer. The CDCE72010 Clock Buffer has been factory programmed to output a clock to the ADC that is 1/4 the rate of the on-board VCXO. While using this clock option, a separate 20MHz reference clock must be supplied to the CDCE72010 by way of the Clock Input SMA connector J19 (Surface jumper SJP4 should be shorted to position 2-3 for this case). The user may also custom program the CDCE72010 with an external SPI bus by accessing the J22 connector. From the CDCE72010 two clocking options to the ADC are possible. A differential LVPECL clock output may be connected to the ADC clock input or a single-ended CMOS clock from the CDCE72010 may be routed to the ADC transformer-coupled clock input through an on-board crystal filter. For better performance, selecting the CMOS clock through a crystal output is recommended. Prior to making any jumper settings, see the schematic in the design package. [Table 6](#) displays the various clock option settings. The VCXO and crystal filter do not come populated on the EVM by default, although the CDCE72010 Clock buffer is installed.

Table 6. Clock Input Jumper Description

| EVM Jumper | Description | Jumper Setting |
|------------|------------------------------|--|
| J18 | ENABLE VCXO | 1-2 → VCXO enabled 2-3 → VCXO disabled |
| J19 | Clock Input | |
| J14 | CDCE72010 power down | 1-2 → powered down Open → powered on |
| J15 | CDCE72010 Reset | 1-2 → Reset Open → Normal operation |
| SJP4 | Input Clock Options | See Table 7 |
| SJP7 | Input Clock Options | See Table 7 |
| SJP6 | Input Clock Options | See Table 7 |
| JP21 | Mode select for CDCE72010 | 1-2 → High (Default) 2-3 → Low |
| SJP8 | PLLLOCK LED | 1-2 → Connects to D3 LED 2-3 → Connects to 10nF capacitor |
| JP20 | AUX Select pin for CDCE72010 | 1-2 → High 2-3 → Low |
| J22 | SPI Bus Access for CDCE72010 | see schematic |

Table 7. EVM Clock Input Options

| EVM Option | Evaluation Goal | Jumper Changes Required | Frequency Input on J19 | CDC Configuration Description | Comments |
|------------|---|--|-------------------------------|---|---------------------------------------|
| 1 | Evaluate ADC performance using a sinusoid clock | SJP4 → 1-2 SJP7 → 1-2 SJP6 → 3-4 J14 → 1-2 J15 → No shunt | ADC's Sampling Frequency | NA | Default |
| 2 | Evaluate ADC performance using a crystal filtered LVCMOS clock derived from CDCE72010 | SJP4 → 2-3 SJP7 → 3-4 SJP6 → 5-6 J14 → No Shunt J15 → No Shunt | CDCE72010 PLL Reference Clock | Divide VCXO frequency by 4, output on Y0 | Maximum performance |
| 3 | Evaluate ADC performance using a differential LVPECL clock | SJP4 → 2-3 SJP7 → 5-6 SJP6 → 1-2 J14 → No Shunt J15 → No Shunt Install R123, R124, R14, R9 Remove T6 | CDCE72010 PLL Reference Clock | Divide VCXO frequency by 4, differential LVPECL Clock output on Y1P and Y1N | Not recommended for most applications |

2.2.4.1 Clock Option 1

The Clock Option 1 provides a clock to ADC directly from an external source. For the direct supply of the clock to the ADC, a single-ended square or sinusoidal clock input must be applied to J19. The clock frequency must be within the maximum frequency specified for the ADC. The clock input is converted to a differential signal by a Mini-Circuits™ ADT4-1WT, which has an impedance ratio of 4, implying that voltage applied on J19 is stepped up by a factor of 2. ADC performance in this case depends on the clock source quality. This option is also the default configuration on the EVM, when it is shipped from the factory. The test result using this option is shown in [Figure 9](#).

2.2.4.2 Clock Option 2

Option 2 uses the onboard VCXO and CDCE72010 to provide a clock to the ADC. The CDCE72010 is used in SPI mode which uses the internal EEPROM to configure the CDCE72010. The EEPROM is programmed in the factory for a divide-by-4 configuration. The EEPROM configuration is shown in [Figure 3](#). The clock at J19 is the reference clock for CDCE72010. The VCXO frequency can be calculated as $F_{vcxo} = F_{out} \times 4$ (F_{out} is the frequency output U0 and U1). The reference clock for CDCE72010 is calculated from Ref Clock = $(F_{vcxo} \times 125) / (48 \times 128)$. This is the clock-to-M divider. When VCXO of frequency 983.04 MHz is used, the calculation results in a reference clock of 20 MHz; the clock output on Y0 pin of CDCE72010 is 245.76 MHz. This clock is filtered using the crystal filter with center frequency of 245.76 MHz. By default, the VCXO and the crystal filter are not populated on the EVM, so that the user can populate the components depending on the end application and sampling rate. This configuration is recommended for applications requiring an onboard clock generation scheme. The test result using this option is shown in [Figure 10](#).

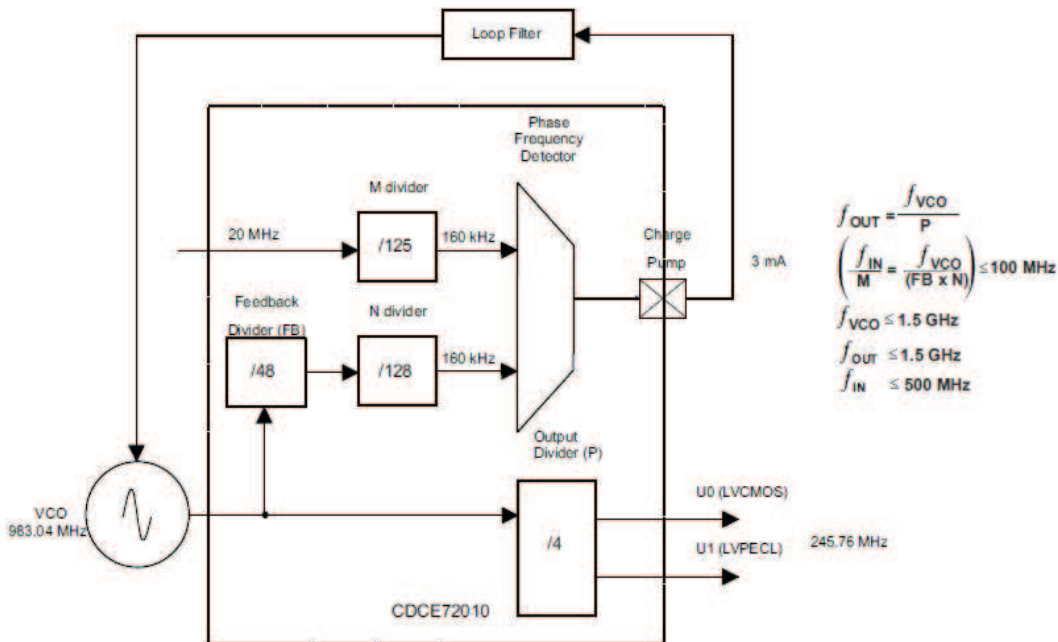


Figure 3. CDCE72010 EEPROM Configuration Block Diagram

2.2.4.3 Clock Option 3

Option 3 is used for a differential LVPECL clock. This configuration eliminates the need for a crystal filter. It uses the same EEPROM configuration as Option 2, but in this case, the ADC clock pins are connected to Y1N and Y1P. The jumper setting uses the clock output Y1P and Y1N from CDCE72010, to clock ADC. This configuration is not recommended for SNR critical applications. Notice that the clock frequency does not change. The frequency remains the same as in Clock Option 2. The test result using this option is shown in [Figure 11](#).

2.2.5 ADC Digital Outputs

The LVDS digital outputs can be accessed through the J8 output connector. A parallel 100-Ω termination resistor must be placed at the receiver to properly terminate each LVDS data pair. These resistors are required if the user wants to analyze the signals on an oscilloscope or a logic analyzer. The ADC performance also can be quickly evaluated using the TSW1200 boards as explained in the next section. The TSW1200 will automatically terminate the LVDS outputs once the TSW1200 is connected to J8.

The ADS62PXX and most other ADCs that may be evaluated on this EVM also have an option to output the digitized parallel data in the form of single-ended CMOS. If single-ended CMOS is desired, header post connectors J1 and J2 are provided for the CMOS output. In order to use the header J1, a CMOS buffer U12 must be installed in place of a bank of 0-ohm resistors that by default steer the outputs to the LVDS connector J8. And in order to use the header J2, a CMOS buffer U13 must be installed in place of a bank of 0-ohm resistors that by default steer the outputs to the LVDS connector J8.

2.2.6 LEDs on the EVM

There are four LEDs on the EVM. LED D4 is named as ADC VD; this LED illuminates when the 3.3V digital supply is available to the ADC by setting jumper JP18 to position 1-2. Similarly, LED D5 (ADC VA) illuminates when the 3.3V analog supply is available to the ADC by setting jumper JP15 to position 1-2. LED D6 is 3.3V AUX, which illuminates when the 3.3V auxiliary supply is available from TPS79633. LED D3 is the PLL LOCK LED. This LED illuminates when the CDCE72010 PLL is locked.

3 TI ADC SPI Control Interface

This section describes the software features of the EVM kit. The TI ADC SPI control software provides full control of the SPI interface, allowing users to write to any of the ADC registers found in the data sheet. For most ADS62PXX performance evaluations, users do not need to use the TI SPI control software. Users only need to use the ADC SPI control software when the desired feature is inaccessible through the ADC parallel interface mode.

3.1 Installing the ADC SPI Control Software

The ADC SPI control software can be installed on a personal computer by running the setup.exe file located on the CD. This file installs the graphical user interface (GUI) along with the USB drivers needed to communicate to the USB port that resides on the EVM. When prompted, users should allow the Windows® operating system to search for device drivers by checking "Yes, this time only", as seen in Figure 4. It will find the TI ADC SPI interface drivers automatically. After the software is installed, insert the USB cable to the EVM to finish the installation. The "Found New Hardware" wizard will start, and you must acknowledge that the TI ADC SPI Interface has not passed the Windows® Logo testing as shown in Figure 5. After completion, the TI ADC SPI Interface should show up in the Hardware Device Manager. Figure 6 shows the SPI interface in the Hardware Manager which indicates that it is ready for use.

NOTE: Before plugging in the USB cable for the first time, install the TI ADC SPI software. The software installs the drivers necessary for USB communication.



Figure 4. Found New Hardware

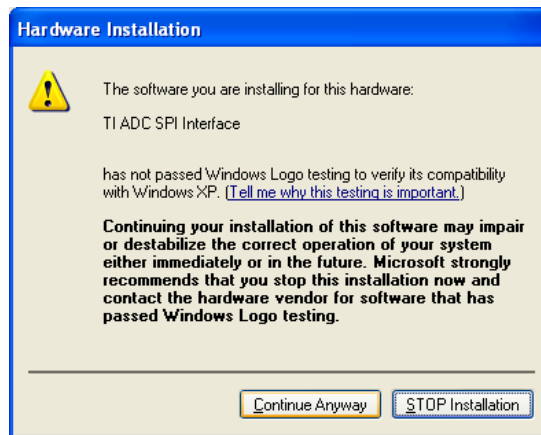


Figure 5. Window Logo Testing

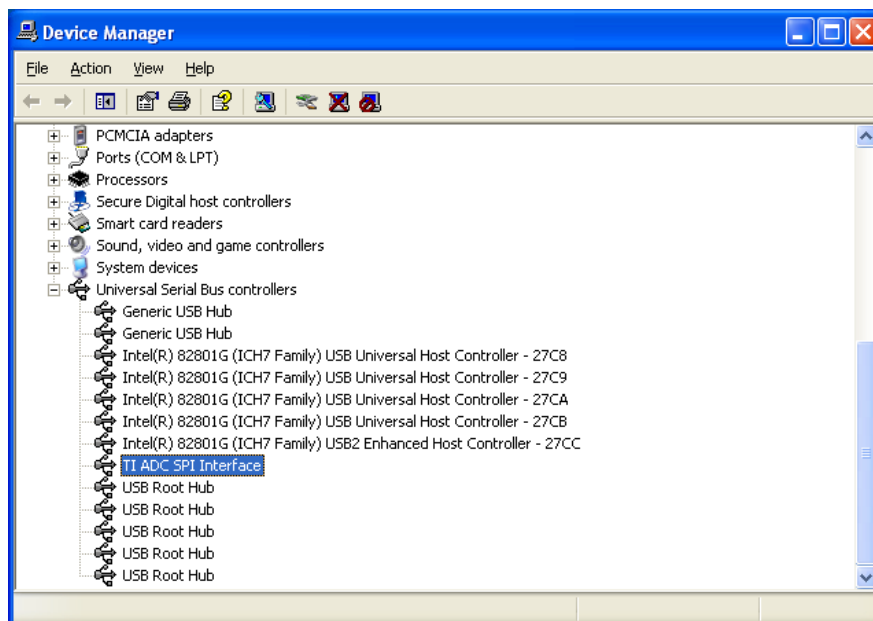


Figure 6. Hardware Device Manager

3.2 Setting Up the EVM for ADC SPI Control

By default, the EVM comes with the ADC configured in parallel mode. In order to use the SPI interface to control the ADC modes of operation, users must move several jumpers.

- Move jumper JP11 to short positions 2–3, which places the ADC into serial operation mode.
- Move jumper JP8 to short positions 2–3, which allows the USB circuit to control SCLK.
- Move jumper JP9 to short positions 2–3, which allows the USB circuit to control SDATA.
- Move jumper JP10 to short positions 2–3, which allows the USB circuit to control SEN.

3.3 Using the TI ADC SPI Interface Software

Once the software is installed and the USB cable is connected, three primary modes of operating the software are available: SPI Register Writes, SPI Register Write Using a Script File, and ADS62PXX Frequently Used Registers.

NOTE: Before beginning an ADC evaluation, users are required to reset the ADC. This can easily be done by pressing the ADS62PXX Reset button found on the ADS62PXX tab. For most ADS62PXX evaluations that make use of the SPI interface, users should also assert the Override Bit also found on the ADS62PXX tab. This will force the ADC to be configured by the SPI interface only and it will ignore any board-level settings that may have been set. Please consult the datasheet for a full list of available functions in SPI interface mode.

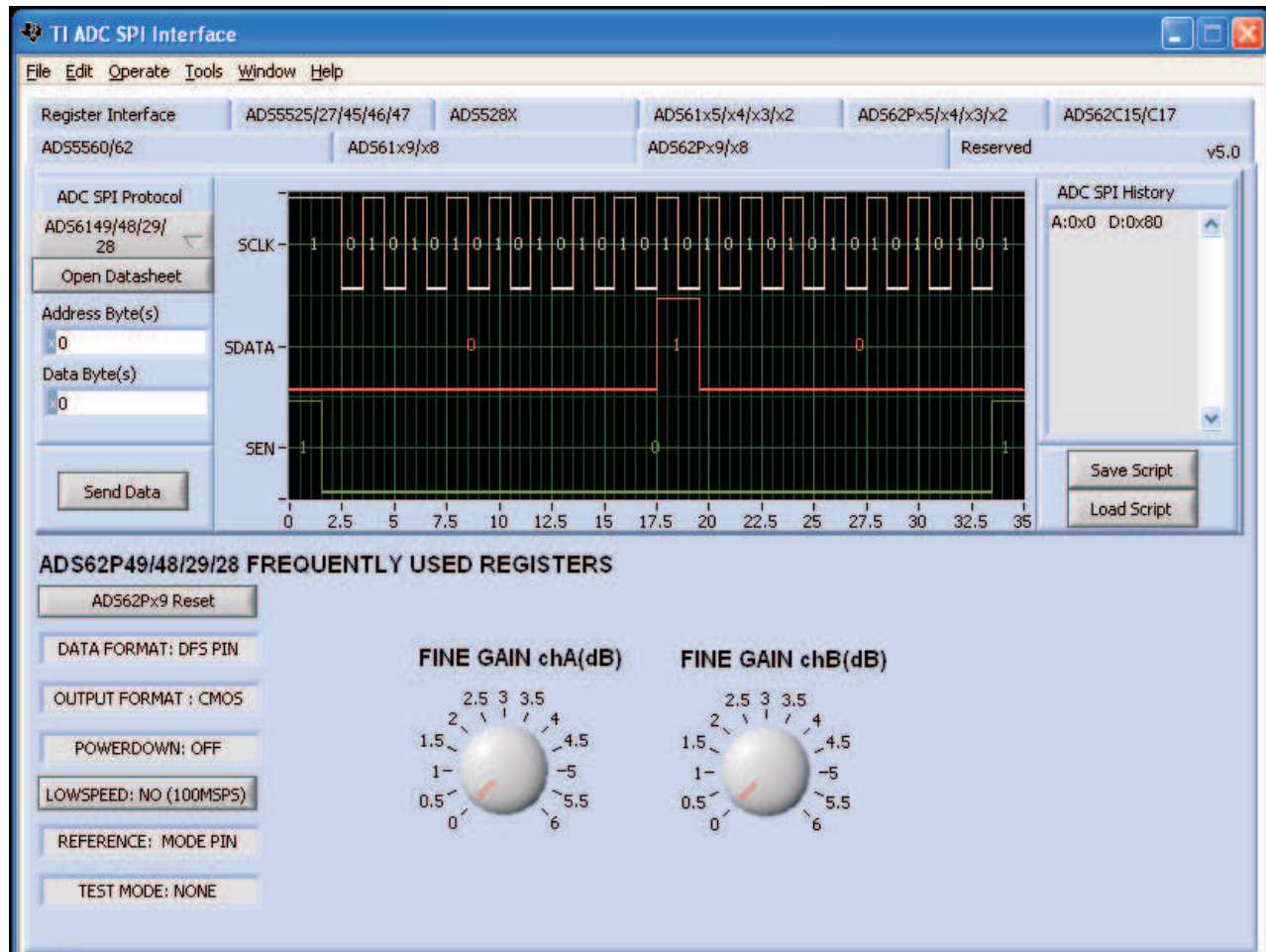


Figure 7. SPI Interface Screen

3.3.1 SPI Register Writes

The most basic mode of operation allows full control of writing to individual register addresses. From the tabs at the top of the interface screen (Figure 7), select the ADS62PXX ADC. Next, type the Address Bytes(s) in hexadecimal (hex) and Data Byte(s) in hex, which can be found in the device data sheet. When you are ready to send this command to the ADC, either press "Enter" on your keyboard or press the Send Data button. The graph indicator is updated with the patterns sent to the ADC. The default inputs to both the Address Byte(s) and Data Byte(s) fields are hex inputs as designated by the small x in the control. Users can change the default input style by clicking on the "x" to binary, decimal, octal, or hex. Multiple register writes can be written simply by changing the contents of the Address Byte(s) and Data Byte(s) field and pressing "Enter" or Send Data again. The ADC SPI History window will keep track of the register writes performed in a session.

3.3.2 SPI Register Write Using a Script File

After the ADC is configured to the desired usage, users can save time in future ADC configurations by saving a script file. By pressing the Save Script button, it dumps ADC SPI History window contents into a text file. Alternatively, users can edit the script file in a text editor. An example script file is located in the \\Install Directory\Script Files\ADS62PXX_LVDS_oBinary.txt which configures the ADC for use with the TSW1200. When ready to write the contents of the script file to the ADC, users can press the Load Script button and they will be prompted for the file location of their script file. The commands are sent to the ADC when the user acknowledges the selection of the file, however the graph indicator does not show multiple writes. The ADC SPI History will update to show the register writes executed in the script file.

3.3.2.1 ADS62PXX Frequently Used Registers

For ease of use, several buttons have been added that allow one-click register writes of commonly used features found in Table 8. These are found in the ADS62PXX tab (note that there is one tab for ADS62PX5/X4/X3/X2, one tab for ADS62Px9/X8 and one tab for ADS62C15/17, because these commands are specific to the ADS62PXX ADC only. The software writes to the ADC both the contents of the associated address and data when the button is clicked. When the ADS62PXX Reset button is pressed, it issues a software reset to the ADC, and it resets the button values to match the contents inside of the ADC. The graph indicator plots the SPI commands written to the ADC when a button has been pressed.

Table 8. ADS62PXX Frequently Used Registers

| Default Value | Alternate Value |
|----------------------|----------------------------|
| ADS62PXX Reset | |
| Over-ride bit: Off | Over-ride bit: On |
| 2s Complement | Straight Binary |
| CMOS | DDR LVDS |
| Powerdown: OFF | Multiple Powerdown Options |
| No Course Gain | 3.5-dB Course Gain |
| INT Reference | EXT Reference |
| Bit-Wise (LVDS Only) | Byte-Wise |
| Test Mode: None | Multiple Options |
| Fine Gain | Multiple Options |

4 Connecting to FPGA Platforms

The ADS62PXX EVM provides several connection options to use the EVM with various FPGA development platforms and FPGA-based capture boards. The ADC features two output options, a DDR LVDS which interfaces with a TSW1200 capture card, and a CMOS output which interfaces with a TSW1100 capture card.

4.1 TSW1200 Capture Board

The TSW1200 board can be used to analyze the performance of the EVM. The TSW1200EVM is a circuit board that assists designers in prototyping and evaluating the performance of high-speed ADCs that feature parallel or serialized LVDS outputs. The TSW1200 has the LVDS 100Ω termination resistor on the input interface for ADC outputs. To start the TSW1200 software, note the following points. Users should consult the TSW1200 documentation for configuration details.

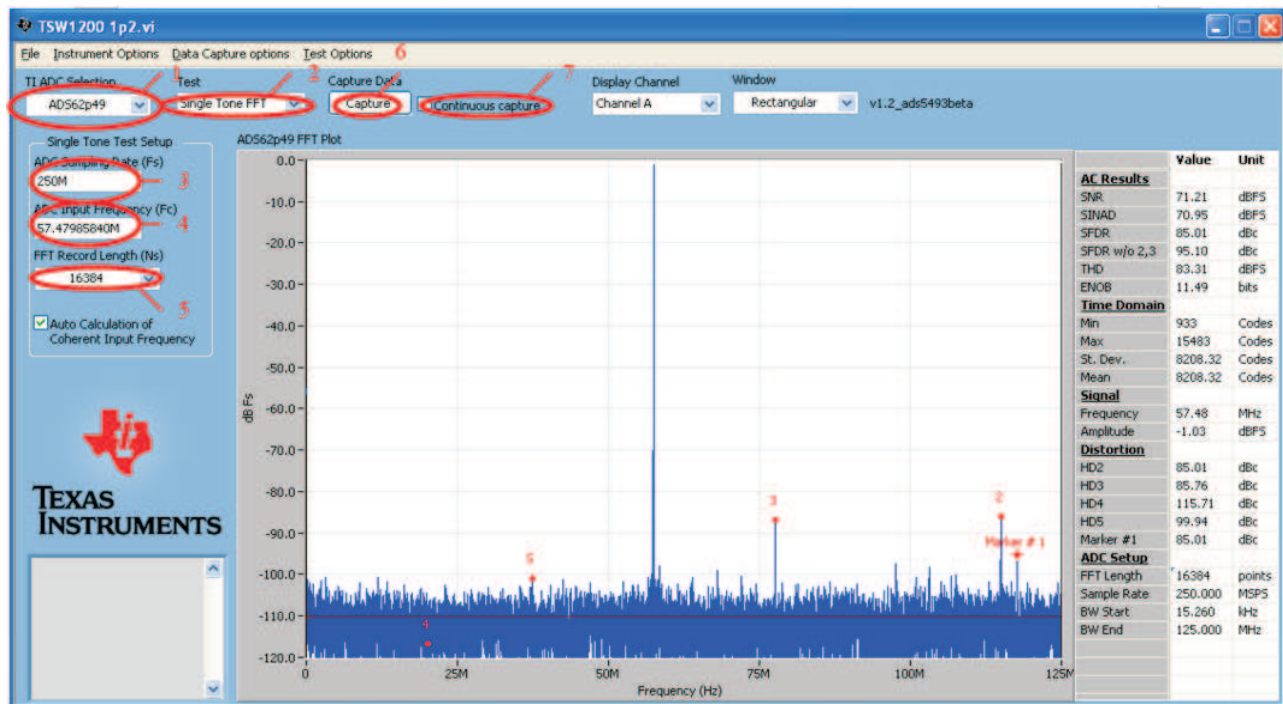


Figure 8. TSW1200 GUI Introduction

1. Select the ADC type to be used before capturing.
 2. For test, select Single Tone FFT plot.
 3. For the ADC Sampling Rate, type in the value.
 4. Type in the ADC Input Frequency. Auto calculation of the input frequency depends on the FFT record length. As soon as the number is entered, the software calculates the coherent input frequency corresponding to that FFT length. This frequency signal must be supplied through the signal generator.
 5. Select the FFT Record Length.
 6. Select Capture to obtain the plot
 7. The Continuous Capture option is used if the user wants to continuously capture the FFT.
- Adjust the input level signal to attain a dBFS value of approximately -1.

4.1.1 Quick-Test Results

The user can make the jumper setting as mentioned in [Table 1](#). In this configuration, the EVM uses an external clock source from J19 and a direct input signal J6 (Channel A) or J3 (Channel B) to the ADC. This setup uses Power Option 1 ([Table 3](#)), Analog Input Option 1 ([Table 5](#)), and Clock Option 1 ([Table 7](#)), which is the default on the EVM. [Figure 9](#) shows the ADC performance capture using TSW1200 with the input signal of a 57.6-MHz frequency and clock frequency of 250 MHz with ADS62PXX.

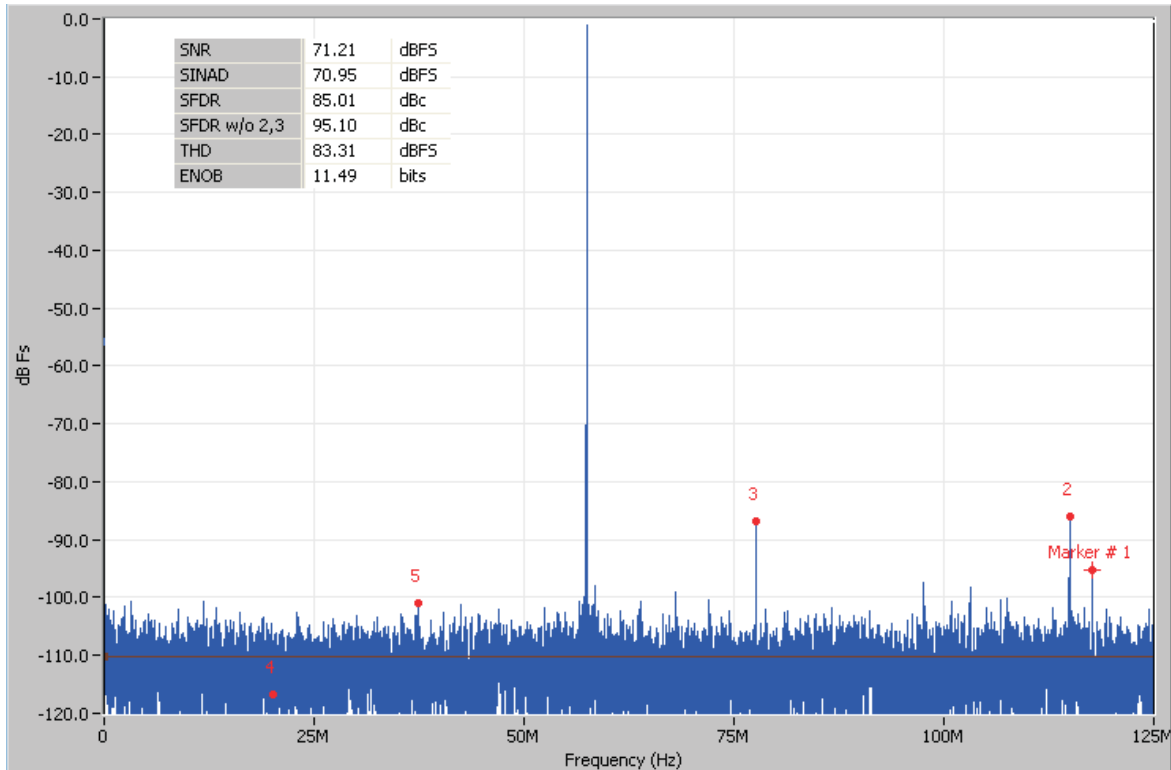


Figure 9. Quick-Setup Test Result

4.1.2 Test Result With Onboard VCXO and Clock Through Crystal Filter

This test uses the VCXO of frequency 983.04 MHz. This setup uses the Power Option 1 (Table 3), Analog Input Option 1 (Table 5), and Clock Option 2 (Table 7). For this test, the CDCE72010 crystal filter path was chosen to provide the clock to the ADC. The CDCE72010 provides a single-ended clock through output Y0 (Table 7), which is passed through a crystal filter of center frequency 245.76 MHz. This was the example setup; the VCXO and the crystal filter are not populated on the EVM because the values depend on the end application sampling rate. The capture result for ADS62PXX is as shown in Figure 10.

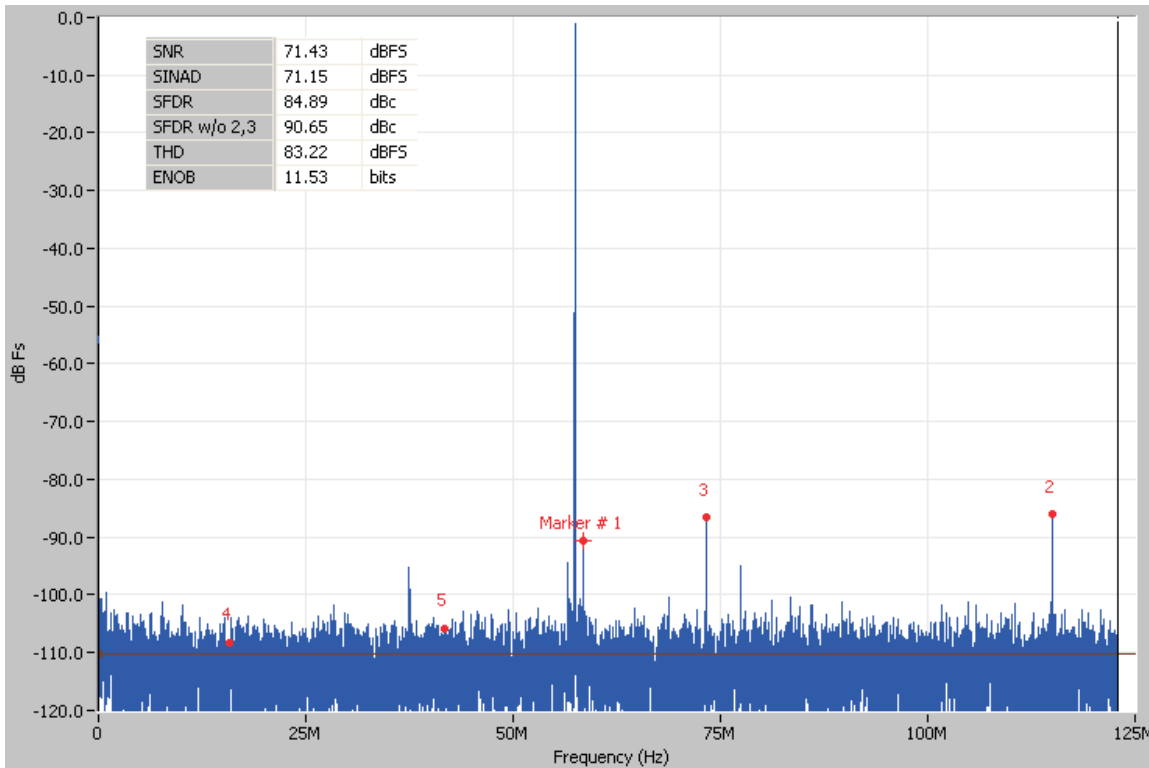


Figure 10. ADC Performance With Clock Through Onboard VCXO, CDCE72010 and Crystal Filter

4.1.3 Test Result With Onboard VCXO and Differential LVPECL Clock

For the same setup as explained in the previous section, when Clock Option 3 (Table 7) was used, the FFT was captured as shown in Figure 11. The test results with Clock Option 2 are better than with Clock Option 3. That is why Option 2 (clock with crystal filter) is recommended over the differential LVPECL output.

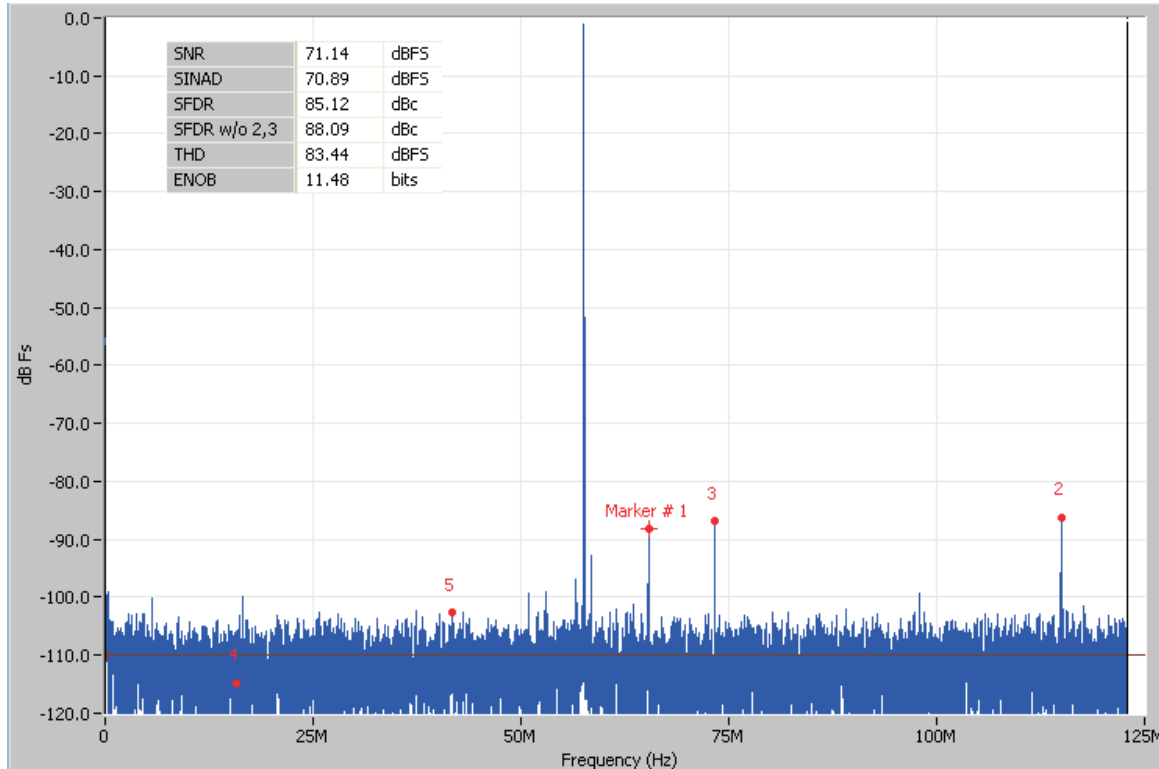


Figure 11. ADC Performance With Clock Through Onboard VCXO, CDCE72010 Configured for Differential LVPECL Output

4.2 TSW1100

When the ADS62PXX is configured in CMOS output mode users can use TI's [TSW1100](#) capture board. Several additional board configuration steps are required before using this option.

- Remove resistor packs with the following reference designators: RN7, RN8, RN9, RN10, RN11, RN12, RN13 and RN14.
- Install TI's SN74AVC16244 buffer into U12 and U13.
- If using the parallel interface mode (JP11=1-2), configure the ADC in CMOS output mode using the silkscreen on JP14.

5 ADC Evaluation

This section describes how to set up a typical ADC evaluation system that is similar to what TI uses to perform testing for data-sheet generation. Consequently, the information in this section is generic in nature and is applicable to all high-speed, high-resolution ADC evaluations. This section covers signal tone analysis, which yields ADC data sheet figures of merit such as signal-to-noise ratio (SNR) and spurious free dynamic range (SFDR).

5.1 Hardware Selection

To reveal the true performance of the ADC under evaluation, great care should be taken in selecting both the ADC signal source and ADC clocking source.

5.1.1 Analog Input Signal Generator

When choosing the quality of the ADC analog input source, consider both the harmonic distortion performance of the signal generator and the noise performance of the source.

In many cases, the harmonic distortion performance of the signal generator is inferior to that of the ADC, and additional filtering is needed if users expect to reproduce the ADC SFDR numbers found in the data sheet. Users can easily evaluate the harmonic distortion of the signal generator by connecting it directly to a spectrum analyzer, measuring the power of the output signal, and comparing that to the power of the integer multiples of the output signal frequency. If the harmonic distortion is worse than the ADC under evaluation, the ADC digitizes the performance of the signal generator and the true SFDR of the ADC is masked. To alleviate this, it is recommended that users provide additional LC filtering after the signal-generator output.

Another important metric when deciding on a signal generator is its noise performance. As with the distortion performance, if the noise performance is worse than that of the ADC under evaluation, the ADC digitizes the performance of the source. Noise can be broken into two components, broadband noise and close-in phase noise. Broadband noise can be improved by adding an LC filter to improve distortion performance; however, the close-in phase noise typically cannot be improved by additional filtering. Therefore, when selecting an analog signal source, it is important to review the manufacturer's phase noise plots and take care to choose a signal generator with the best phase-noise performance.

5.1.2 Clock Signal Generator

Equally important in the high-performance ADC evaluation setup is the selection of the clocking source. Most modern ADCs, the ADS62PXX included, accept either a sinusoidal or a square-wave clock input. The key metric in selecting a clocking source is selecting a source with the lowest jitter. This becomes increasingly important as the ADC input frequency (f_{in}) increases, because the ADC SNR evaluation setups can become jitter-limited (t_j) as shown by the following equation.

$$\text{SNR (dBc)} = 20 \log [2\pi \times f_{in} \times t_j(\text{rms})]$$

In theory, a square-wave source with femtosecond jitter would be ideal for an ADC evaluation setup. However, in practical terms, most commercially available square-wave generators offer jitter measured in picoseconds, which is too great for high-resolution ADC evaluation setups. Therefore, most evaluation setups rely on the ADC internal clock buffer to convert a sinusoidal input signal into a ultra-low-jitter square wave. When selecting a sinusoidal clocking source, it has been shown that phase noise has a direct impact on jitter performance. Consequently, great scrutiny should be applied to the phase-noise performance of the clocking signal generator. TI has found that high-Q monolithic crystal filters can improve the phase noise of the signal generator, and these filters become essential elements of the evaluation setup when high ADC input frequencies are being evaluated.

5.2 Coherent Input Frequency Selection

Typical ADC analysis requires users to collect the resulting time-domain data and perform a Fourier transform to analyze the data in the frequency domain. A stipulation of the Fourier transform is that the signal must be continuous-time; however, this is impractical when looking at a finite set of ADC samples, usually collected from a logic analyzer. Consequently, users typically apply a window function to minimize the time-domain discontinuities that arise when analyzing a finite set of samples. For ADC analysis, window functions have their own frequency signatures or lobes that distort both SNR and SFDR measurements of the ADC.

TI uses the concept of coherent sampling to work around the use of a window function. The central premise of coherent sampling entails that the input signal into the ADC is carefully chosen such that when a continuous-time signal is reconstructed from a finite sample set, no time-domain discontinuities exist. To achieve this, the input frequency must be an integer multiple of the ratio of the ADC sample rate (f_s) and the number of samples collected from the logic analyzer (N_s). The ratio of f_s to N_s is typically referred to as the fundamental frequency (f_f). Determining the ADC input frequency is a two-step process. First, select the frequency of interest for evaluating the ADC; then, divide this by the fundamental frequency. This typically yields a non-integer value, which should be rounded to the nearest odd, preferably prime, integer. Once that integer, or frequency bin (f_{bin}), has been determined, multiply this with the fundamental frequency to obtain a coherent frequency to program into their ADC input signal generator. The procedure is summarized as follows.

$$f_f = f_s / N_s$$

$$f_{bin} = \text{Odd_round}(f_{desired} / f_f)$$

$$\text{Coherent frequency} = f_f \times f_{bin}$$

6 Revision Changes

Changes from Revision C. to Revision D.

- Modified the layout of input and output decoupling path for the DC/DC power supply and LDO.
- Added power jack J17 to allow 5V power brick input.
- Changed LDO U14 to allow higher 5V input current.
- Modified the layout and jumper settings of the ADC input clock path from the external clock source or clock distribution chip (U10) output.
- Added external SPI connector J22 to allow external SPI control input to the clock distribution chip (U10).
- Changed USB-to-SPI Controller IC from U4 in Rev. C to U6 in Rev. D to minimize the physical size of the SPI controller.
- Changed USB connector from J5 in Rev. C to J16 in Rev. D to minimize the physical size of the USB connector.

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It is important to operate this EVM within the input voltage range of -0.3 V to 5.6 V and the output voltage range of -0.3 V to 5.6 V .

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

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