EVAL-ADXL35x-SDP User Guide

FEATURES

- Separates device under test (DUT) from controller for accurate environmental testing
- Data capture up to maximum device output data rate (ODR)
- Standard USB cable for power and communications
- PC-based, user friendly graphical user interface (GUI)
- Fast and easy installation
- Captures, visualizes, and saves the data

GENERAL DESCRIPTION

This user guide provides comprehensive instructions for configuring both the hardware and software required to utilize the EVAL-ADXL35x-SDP as a user friendly, PC-based solution for evaluating the ADXL355/ADXL357 (digital output only) microelectromechanical systems (MEMS) accelerometers. The EVAL-ADXL35x-SDP offers direct PC connectivity. Also, it allows linking the DUT and processor board to diverse platforms. The user friendly GUI simplifies data collection, operational configuration, and motion profile observation. This user guide gives an overview of using the EVAL-ADXL35x-SDP, detailing its functionality with provided examples where relevant.

Figure 1 shows the required hardware components. The EVAL-SDP-CB1Z is a system demonstration platform (SDP) controller board that provides a means of communication with the sensor from the PC. The EVAL-SDP-INTER4-Z is an SDP interface board that serves as an interposer between the SDP controller board and the evaluation board. The EVAL-ADXL35xZ is the DUT breakout board.

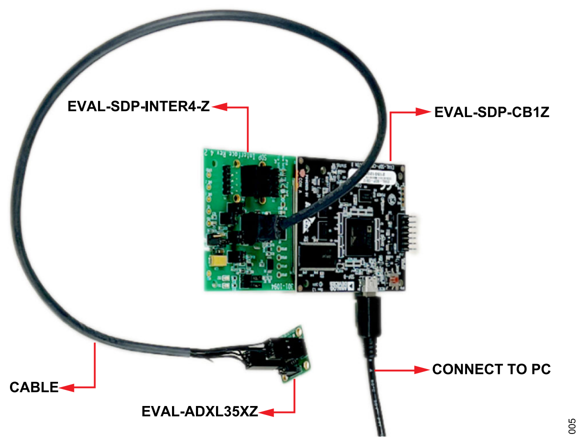

Figure 1. Required Hardware Components

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REVISION HISTORY

2/2024—Revision A: Initial Version

SETTING UP THE EVALUATION SYSTEM

The following steps describe the installation process for the ADXL357 evaluation system, as an example. Same steps apply to the ADXL355.

HARDWARE CONFIGURATION

To configure the hardware, follow these steps:

1. Connect the SDP interface board (EVAL-SDP-INTER4-Z) to the SDP controller board (EVAL-SDP-CB1Z) using the 120-pin small foot print connectors as shown in Figure 2.

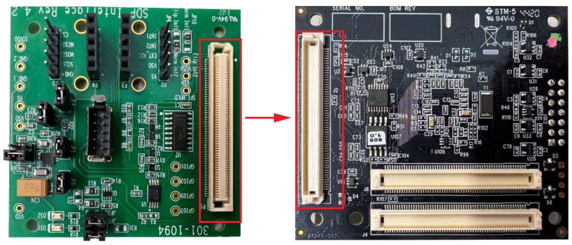


Figure 2. Connecting the Controller Board to the Interface Board

2. Connect the SDP interface board to the EVAL-ADXL35xZ using the provided cable.
    - One end of the cable features a Harwin connector designed to link with the SDP interface board, as illustrated in Figure 3.
    - The other end of the cable has two 3 × 2 pin header connectors, which are used for connecting to the EVAL-ADXL35xZ as shown in Figure 3.
    - For a visual guide on correctly aligning the cable on both the SDP interface side and the EVAL-ADXL35xZ side, check the red arrows in Figure 3 and Figure 4, respectively.

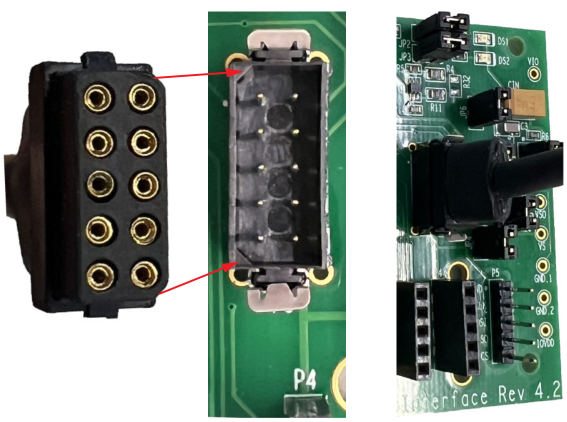


Figure 3. Connecting the SDP Interface to the EVAL-ADXL35xZ: SDP Interface Side

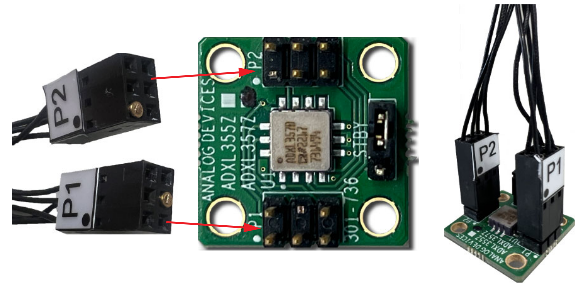


Figure 4. Connecting the SDP Interface to the EVAL-ADXL35xZ: EVAL-ADXL35xZ Side

3. Connect one end of the mini-B USB cable to the SDP-B controller board, and plug the other end of the cable into the PC. Figure 1 shows an overview of the complete setup and connections.

SOFTWARE INSTALLATION

1. Download the software installer on the PC by clicking the EVAL-ADXL355-SDP Software for the EVAL-ADXL355-SDP or the EVAL-ADXL357-SDP Software for the EVAL-ADXL357-SDP on the EVAL-ADXL35x-SDP website.
2. Once downloaded, extract the files to the desired local drive.
3. Double click on **EVAL-ADXL357-SDP_install** to start the installation process (see Figure 5).

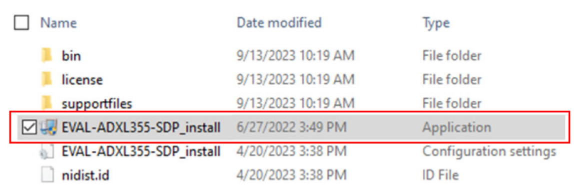


Figure 5. Start Installation

4. Simply follow the on-screen instructions, including choosing the preferred installation path and accepting the license agreement, until the evaluation platform and SDP driver installation are complete, as shown in Figure 6.

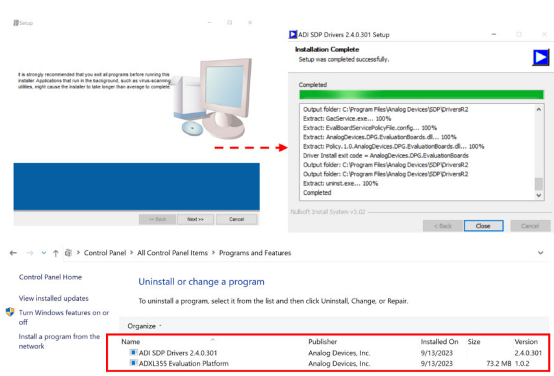


Figure 6. Installation Process

SETTING UP THE EVALUATION SYSTEM

SOFTWARE STARTUP

1. After the installation is complete, the software can be run through the installation directory by launching **EVAL-ADXL357-SDP.exe** (see Figure 7), or the user can simply type **EVAL-ADXL357-SDP** in the Windows search bar and press the enter key on the keyboard to start the software.

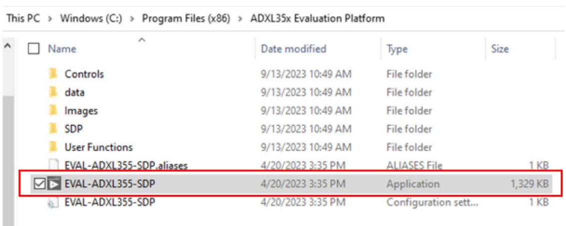


Figure 7. Run Software

2. When launching the software without connecting the evaluation board setup to the computer, the **Hardware Select** window appears as it searches for the connected hardware (see Figure 8).

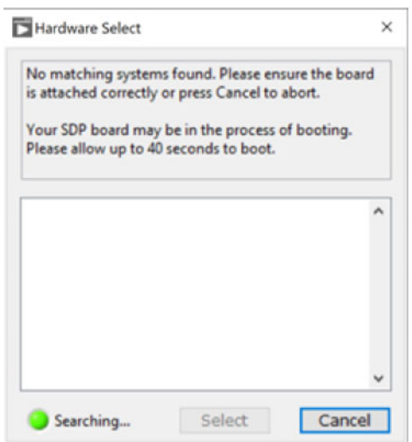


Figure 8. Hardware Select Window

- To use the board, connect the setup to the computer using a USB cable. Once connected, the software automatically detects the hardware, and user can select it for use (see Figure 9).

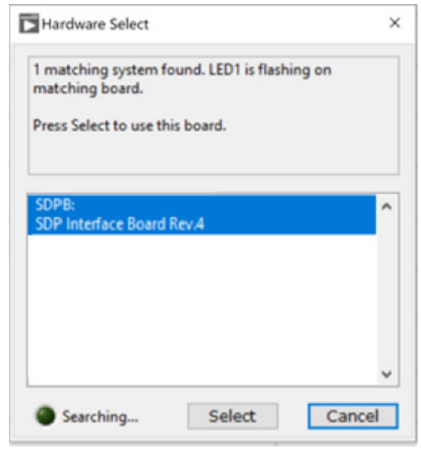
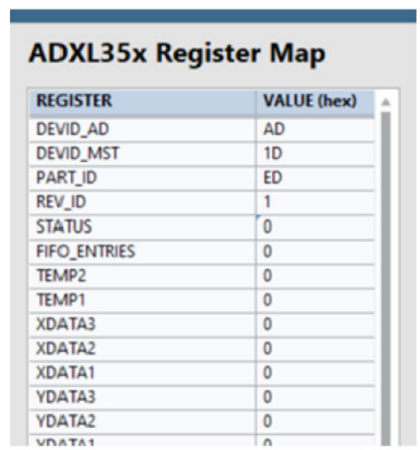


Figure 9. Hardware Detection

- Note that the name of the hardware recognized in the **Hardware Select** window matches the name of the interface board.
- If the evaluation board is already connected to the computer when the user runs the software, the **Hardware Select** window does not appear. In this case, if everything works as expected, the system reads the entire register map from the accelerometer and displays it on the **ADXL35x Register Map** section of the GUI, on the gray rectangle to the right instead (see Figure 10).



REGISTER	VALUE (hex)
DEVID_AD	AD
DEVID_MST	1D
PART_ID	ED
REV_ID	1
STATUS	0
FIFO_ENTRIES	0
TEMP2	0
TEMP1	0
XDATA3	0
XDATA2	0
XDATA1	0
YDATA3	0
YDATA2	0

Figure 10. Register Map

- One way to verify that the system is working properly is by checking that the **ADXL35x Register Map** fields read the expected values. For example, the **DEVID_AD** register must read **AD**.

3. If the hardware is not recognized in any of the ways mentioned, the user can resolve this issue by following these steps:

   a. Close the software completely.
   b. Reopen the software.
   c. If the hardware is still not recognized, attempt to disconnect then reconnect the evaluation board to the computer, ensuring a secure connection.

SETTING UP THE EVALUATION SYSTEM

d. Once the hardware is successfully connected and recognized, the user can access the register map as described in Step 2.

ADXL35X GRAPHICAL USER INTERFACE

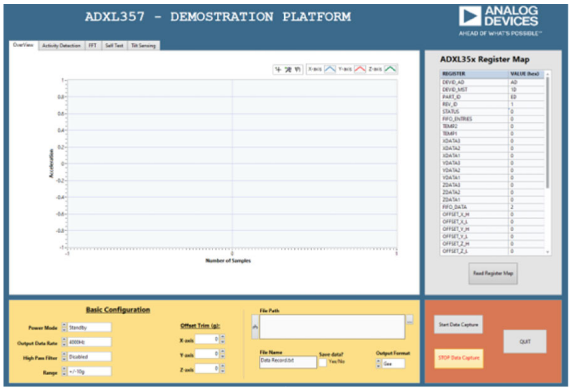


Figure 11. ADXL35x Evaluation Software Startup

GETTING STARTED

The ADXL355/ADXL357 demonstration platform provides a user friendly interface divided into separate tabs (see Figure 11), each tailored for common accelerometer measurements. This approach enables users to quickly capture data for various tests without the need for custom hardware or software development. For a quick overview of the functionality of each tab, refer to the information presented in Table 1.

Table 1. Evaluation Environment Overview

Tab	Functions
OverView	Views acceleration data in *g* units or least significant bit (LSB).
Activity Detection	Configures activity detection on each axis and visualizes the activity interrupt response real time.
FFT	Continuous FFT plotting, 1024 samples per loop.
Self Test	Demonstrates self test functionality.
Tilt Sensing	3D tilt sensing. Offset and sensitivity calibration.

SHARED COMMANDS BETWEEN TABS

The GUI provides options to configure the several features of the accelerometer, namely **Power Mode**, **Output Data Rate**, **High Pass Filter**, and **Range**, which are grouped in the **Basic Configuration** window. Other GUI functionalities like option to save the data to file and scaling of the accelerometer data to LSB or gee values are also available within this window.

- **Power Mode**. Ensure that the power mode is set to **Measure** when capturing data (see Figure 12).

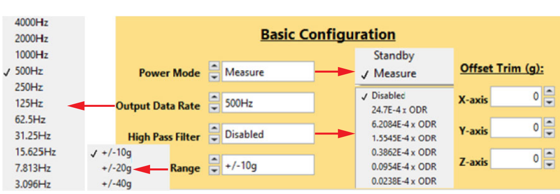


Figure 12. Basic Configuration

- **Output Data Rate**. ODR determines the rate at which data is sampled. The user has the flexibility to select the preferred ODR, ranging from 3.096 Hz to 4000 Hz, simply by accessing the **Output Data Rate** dropdown menu. Note that the bandwidth for the ADXL355/ADXL357 must be approximately 1/4 of the ODR.

  Figure 13 illustrates the impact of varying ODR settings on capturing the acceleration data when the sensor is shaked by hand. It shows that when data sampling rate is low (3.096 Hz), the captured data is not representing the actual hand shaking excitation as the sample rate is slower than the hand shake frequency (as shown in the top image of Figure 13). This slower rate may result in data loss. Conversely, when data is sampled at 500 Hz, it appears significantly faster and smoother and the captured data follows the hand shaking acceleration as demonstrated in the bottom image of Figure 13.

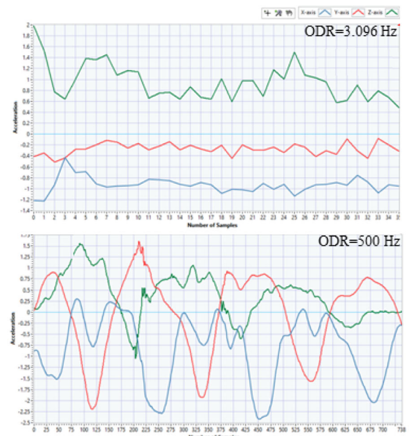


Figure 13. Output Data Rate Example

- **High Pass Filter**. The ADXL355/ADXL357 include an optional digital high-pass filter with a programmable corner frequency. The high-pass corner frequency, where the output is attenuated by 3 dB, is related to the ODR, and the HPF_CORNER setting in the filter register (Register 0x28, Bits[6:4]). The high-pass filter is disabled by default. Figure 13 shows the HPF settings, which are proportional to the ODR.
- **Range**. There are three user selectable ranges available for measuring acceleration. Users can adjust the range from ±2 *g* to ±8 *g* for the ADXL355 and from ±10 *g* to ±40 *g* for the ADXL357 (see Figure 12).
- **Offset Trim (g)**. The user has the option to set the offset value for each axis in the **Offset Trim (g)** section. This feature allows the user to eliminate offsets in any of the axes, providing the trimmed data as the resulting output (see Figure 12).
- **File Path**. All data can be saved with a custom name to a specified path in either gee or LSB format (see Figure 14). There are alternative methods for accessing data. When right click on the measurement window, various export options (such as to clipboard or to Excel) appear. Additionally, a screenshot of the window can be copied using the **Copy Data** option. Note that the export method is designed to capture the data currently displayed in the window, with a maximum of 10,000 samples

ADXL35X GRAPHICAL USER INTERFACE

(see Figure 15) while saving the data as a file in a specific path allows for saving all the data without the 10,000-sample limit.

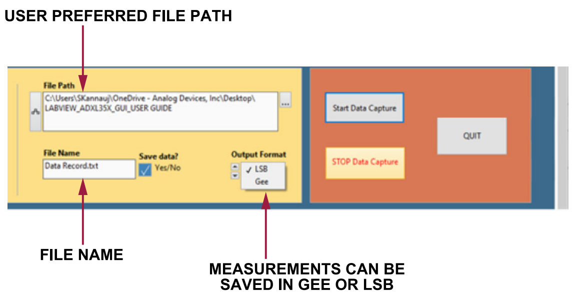


Figure 14. User Defined File Path and Name

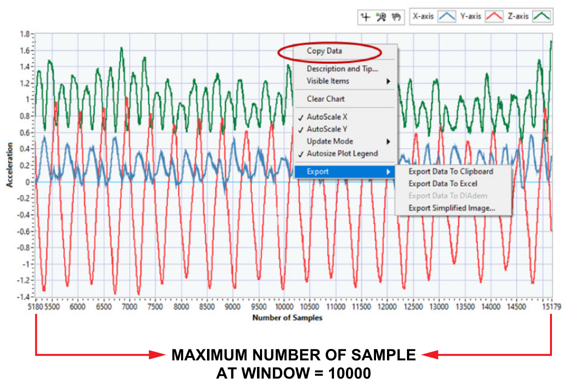


Figure 15. Data Export

- **Start Data Capture**/**Stop Data Capture** and **Quit**. These commands are universally accessible across all tabs. Clicking **Start Data Capture** initiates data collection on the current tab. Once activated, **Start Data Capture** is automatically grayed out and disabled until the user presses **Stop Data Capture**. **Quit** allows the user to exit the GUI (see Figure 14).

DEVICE OVERVIEW TAB

The **OverView** tab allows the user to capture acceleration data in three different axes based on the preconfigured settings. The real-time graphs in the main window display the acceleration data for each axis as a function of the number of samples collected (see Figure 16).

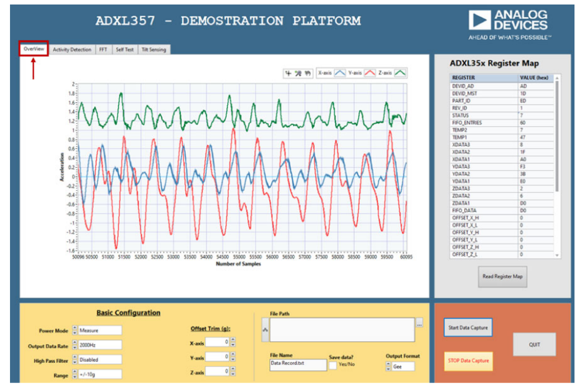


Figure 16. Device Overview Tab

ACTIVITY DETECTION TAB

The activity tab allows the user to evaluate the activity feature. The activity is set when the measured acceleration on any axis is above the activity threshold (**ACT_THRESH**) for specific consecutive measurements (**ACT_COUNT**). Figure 17 shows an example at which the activity box is checked for the **X-axis** and it shows the **ACT_EN** register is updated to only enable activity on the **X-axis**. It can be enabled for multiple axes as shown in Figure 18. The next settings are **Activity Threshold** and **Activity Counter**. The user can define the threshold for activity detection in the **Activity Threshold** dialog box. To trigger the activity interrupt, the measured acceleration must be above the threshold for at least the specified number of samples on the activity counter, which can be defined in the **Activity Counter** dialog box. For this example, **Activity Threshold** is set to 3 *g* and **Activity Counter** is set to 2. If there is any activity more than 3 *g* for at least 2 samples, the activity detects in the **X-axis** as shown in Figure 17. The bottom plot shows the activity bit going from low to high when the activity is detected.

Figure 17. Activity Detection for X-Axis

Activity detection can be activated for all three axes as shown in Figure 18.

ADXL35X GRAPHICAL USER INTERFACE

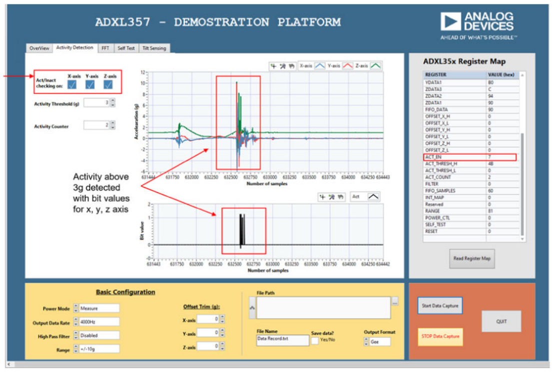


Figure 18. Activity Detection for All Axes

FFT TAB

The **FFT** tab provides the frequency analysis of the captured signal using the fast Fourier transform (FFT) method. It utilizes 1024 samples at the selected ODR to create a frequency domain plot. The FFT is configured for four samples RMS averaging and rectangular windowing. Figure 19 shows the FFT plot for a 1 *g* peak, 200 Hz sinewave excitation.

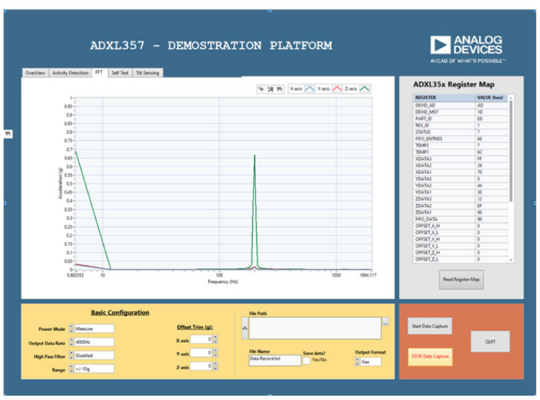


Figure 19. FFT Tab

SELF TEST TAB

The ADXL355/ADXL357 incorporate a self test feature that effectively tests its mechanical and electronic systems simultaneously. When the self test function is enabled, an electrostatic force is exerted on the mechanical sensor. The self test feature rejects externally applied acceleration and only responds to the self test force, which allows an accurate measurement of the self test, even in the presence of external mechanical noise.

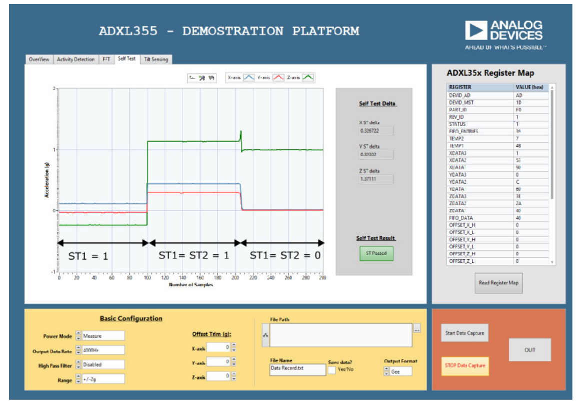


Figure 20. Self Test Tab

The **Self Test** tab demonstrates how this function operates for each axis. Once the **Start Data Capture** button is clicked, the software acquires one second of data from the ADXL355/ADXL357 at the user specified data rate. The **ST1** bit invokes self test mode. Enabling the **ST2** bit applies an electrostatic force to the mechanical sensor and induces a change in output in response to the force. The self test delta is the difference in output voltage in the **Z-axis** when **ST2** is high vs. **ST2** is low, while **ST1** is asserted. **ST1** and **ST2** can be accessed through the SELF_TEST register (Register 0x2E).

For example, as shown in Figure 20, for a specific data rate, the self test feature is disabled in default state for the first 109 samples. At the 109th sample, the self test bit is asserted, initiating the self test function. An electrostatic force is applied to the beam, causing the output to shift and remain in this state until the 210th sample. At this point, the self test bit is deasserted, and the device output returns to normal.

TILT SENSING TAB

In the **Tilt Sensing** tab, the user can measure the incline angle of the accelerometer in each direction. As illustrated in Figure 21, **θ** represents the inclination of the **X-axis**, **ψ** corresponds to the inclination of the **Y-axis**, and **Φ** denotes the inclination of the **Z-axis**. The reference point, which is shown as a circle, is highlighted with a dashed red circle in both Figure 21 and Figure 22.

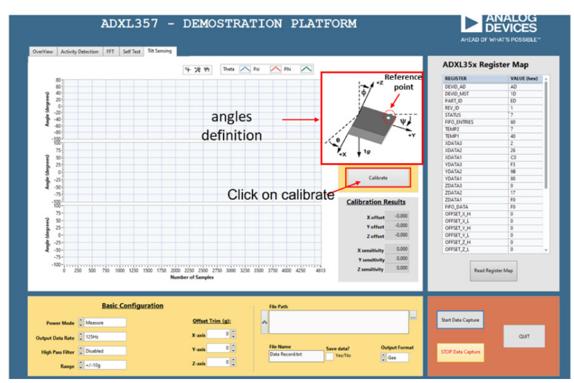


Figure 21. Tilt Measurement Tab

ADXL35X GRAPHICAL USER INTERFACE

To ensure precise results, the software provides a calibration option using gravity acceleration. Click the **Calibrate** button to initiate the process. Subsequently, six pop-up dialog boxes guide the user through specific orientations for the evaluation board to expose each axis to a ±1 *g* field. Figure 22 illustrates the first dialog box, providing instructions on how to position the part to expose the **X-axis** to a 1 *g* field.

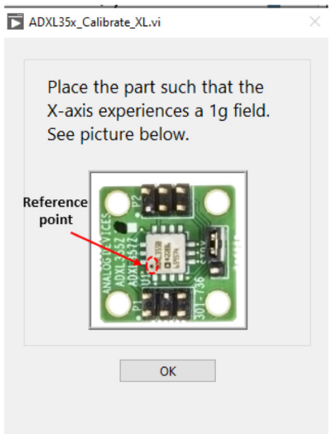


Figure 22. +1 g Calibration (Orientation for X-Axis)

Afterward, the software calculates the offset and sensitivity calibration coefficients for each axis in *g*s (see Figure 23).

Figure 23. Calibration Result

NOTES

ESD Caution
ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.