AFBR-S50MV85G

Evaluation Kit Quick Start Guide

User Guide

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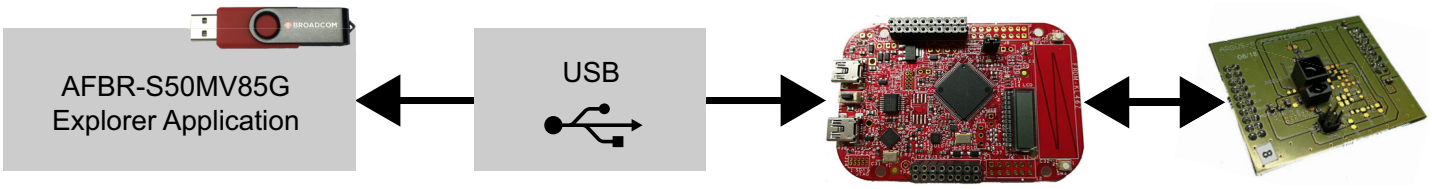
Chapter 1: Getting Started

1.1 Evaluation Kit Overview

The AFBR-S50MV85G evaluation kit is composed of the following main components:

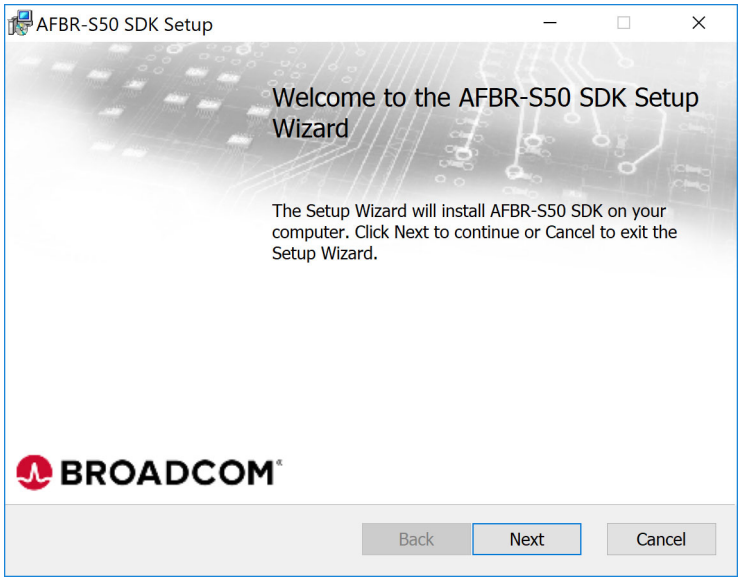
- NXP FRDM-KL46Z evaluation board: Embedded microcontroller platform (ARM Cortex-M0+) used to read out the AFBR-S50MV85G ToF sensor's data and exchange with the PC.
- AFBR-S50MV85G adapter board: The circuit board on which the AFBR-S50MV85G ToF sensor is mounted. It delivers out-of-box connection between the sensor and a microcontroller board without the need for soldering (just plug and play).
- USB-mini cable: Required to establish a communication between the AFBR-S50MV85G and your system environment (for example, PC, embedded application system).
- USB memory stick: Contains the software installer and factory configuration files.

Figure 1: Evaluation Kit Components



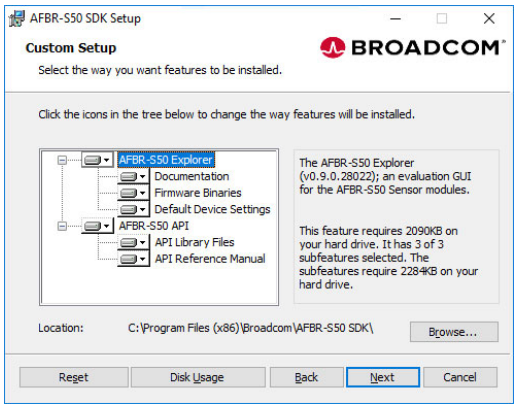
1.2 Hardware and Software Setup

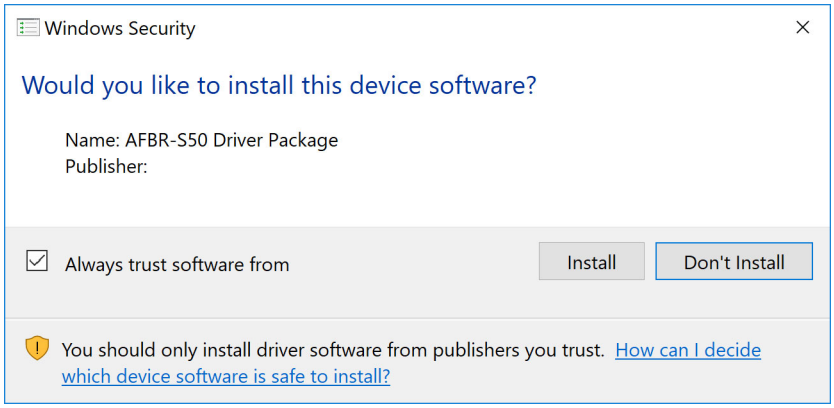
1. Install the main application and all necessary drivers by using the AFBR-S50 SDK setup wizard provided on the USB memory stick. The initial setup wizard window displays as follows:



2. Install the main driver and all additional modules to enable the full performance of the device:

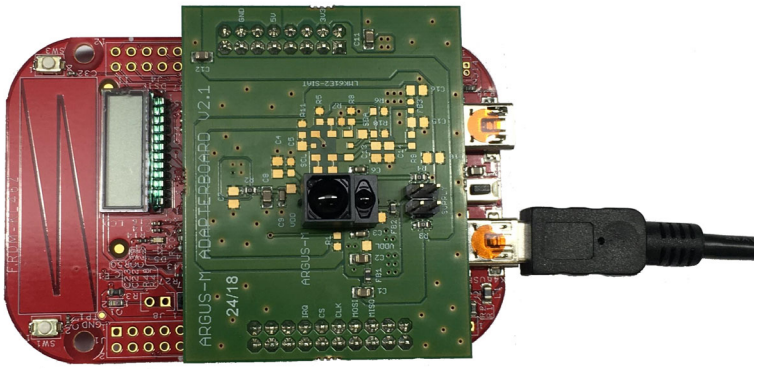
   Selecting either **Next** or **Install**. Ensure you are using the correct installer for your system. An installer for 32-bit (x86) and 64-bit (x64) is supplied.





3. Plug in the USB cable.

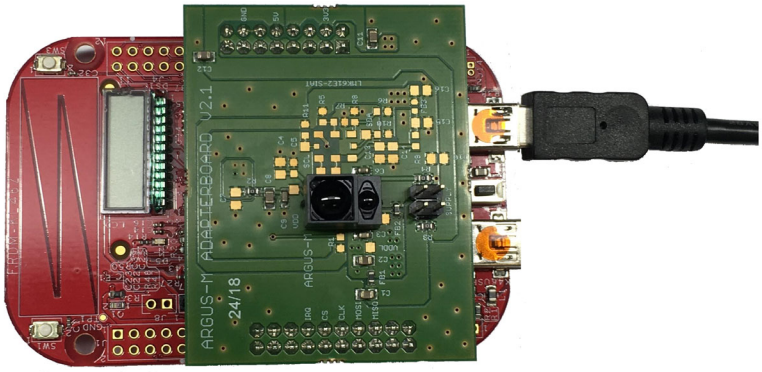
CAUTION! The correct USB port for this step is not labeled OpenSDA on the bottom side of the NXP board.



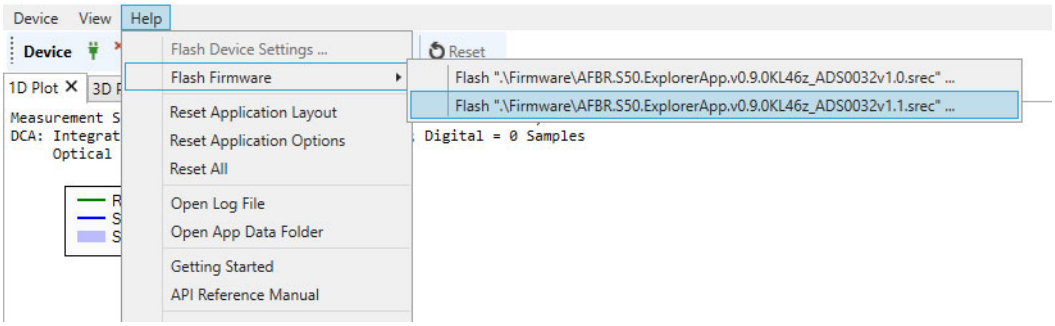
1.3 Updating the Firmware

A native USB connection has been made available for the Evaluation Kit since firmware version 0.9.0. To update the firmware, perform the following steps:

1. Install the desired firmware, as described in Hardware and Software Setup.
2. Connect the red AFBR-S50MV85G evaluation board via the OpenSDA interface to the PC. An additional driver is not required.

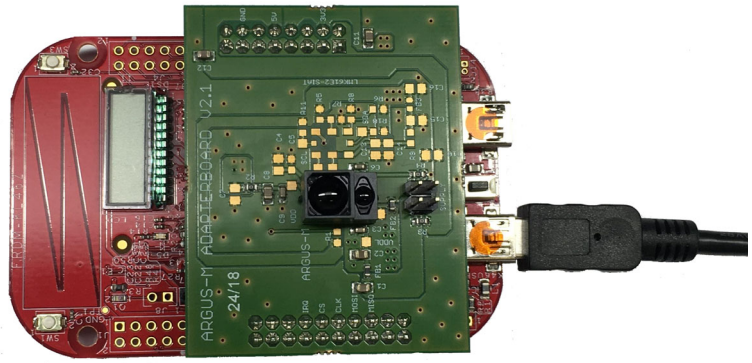


3. Select a menu option from **Help** > **Flash Firmware** > **Flash …. v.1.1** or greater and wait until the device is successfully flashed.



NOTE: There are different sensor versions v1.x available. If unsure of the sensor type, contact your Broadcom sales representative.

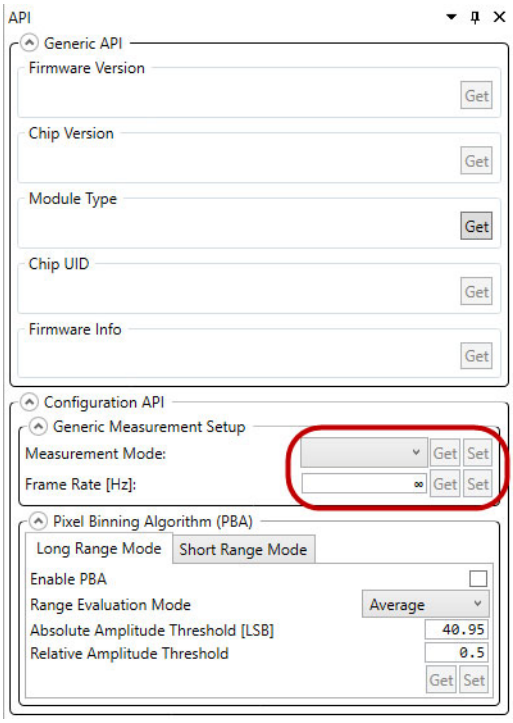
4. If flashed successfully, connect the device via the USB port not labeled OpenSDA and run it as described in the following section.



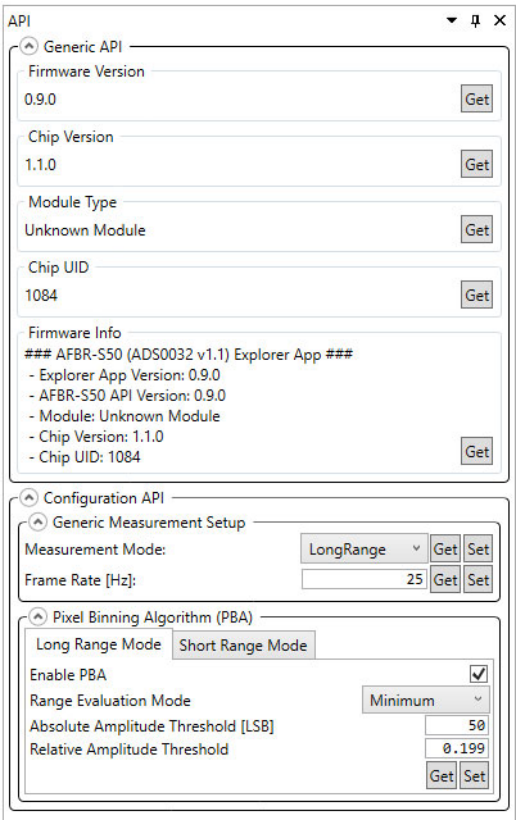
1.4 Performing a Distance Measurement

1. Start the Explorer Application, *AFBR.S50.Explorer.exe*.
2. Open the port.

3. Choose a measurement mode and frame rate both before and while measuring:
   – Before a port has been chosen:

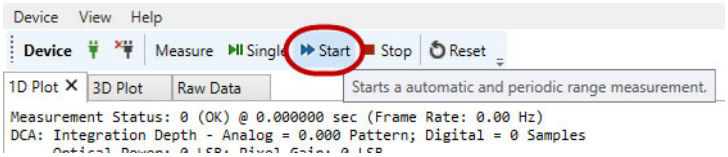


– After a port has been chosen and connected:



NOTE: Information on the loaded firmware is automatically read and displayed in the Generic API section. The firmware information in the screenshot above is just an example and may differ for each individual part.

4. Start the measurement by clicking **Start**.



CAUTION! To troubleshoot problems with starting the measurement, see Troubleshooting and FAQs.

Chapter 2: AFBR-S50 Explorer

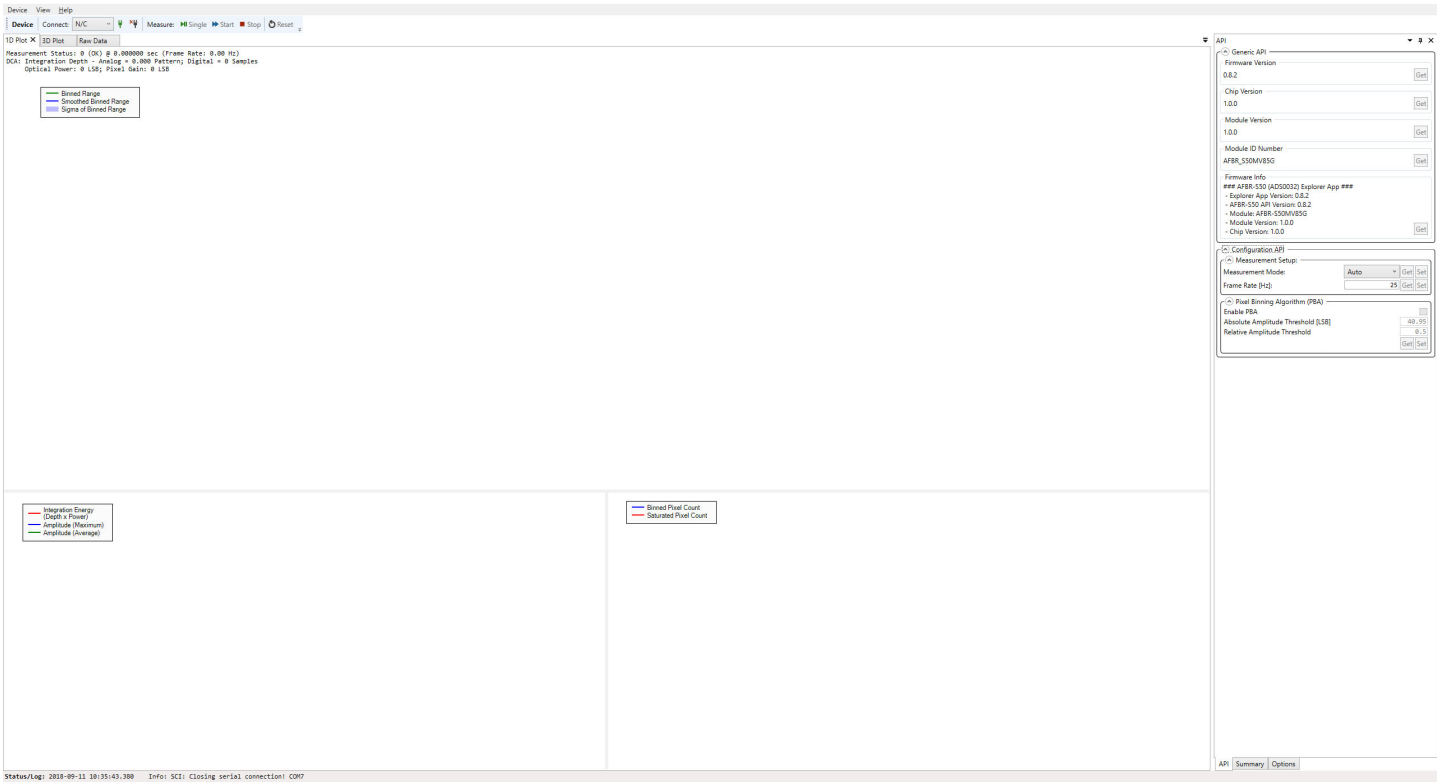
This section is intended to make the user familiar with the graphical user interface (GUI) of the AFBR-S50 Explorer application and support the evaluation of a given ToF sensor device.

The AFBR-S50 Explorer software connects to the AFBR-S50MV85G evaluation board via the USB interface. It receives the measurement data from the firmware running on the NXP board's microcontroller and displays it in a convenient way. Furthermore, the ToF sensor device can be configured and calibrated by using the AFBR-S50 Explorer GUI.

2.1 AFBR-S50 Explorer Overview

Open the AFBR-S50 Explorer. The following screen displays:

Figure 2: AFBR-S50 Explorer Display Screen



The AFBR-S50 Explorer main window consists of the following five basic elements:

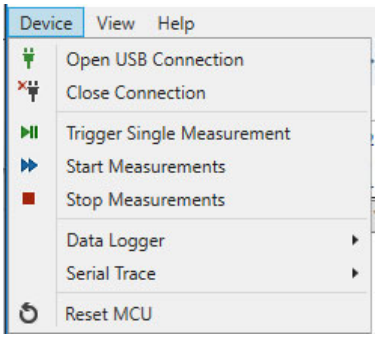
- Menu bar
- Controller tool bar
- Data visualization windows
- Tool windows
- Status bar

2.2 Exploring the Menu Bar

The AFBR-S50 Explorer menu bar includes the following three elements:

- Device
- View
- Help

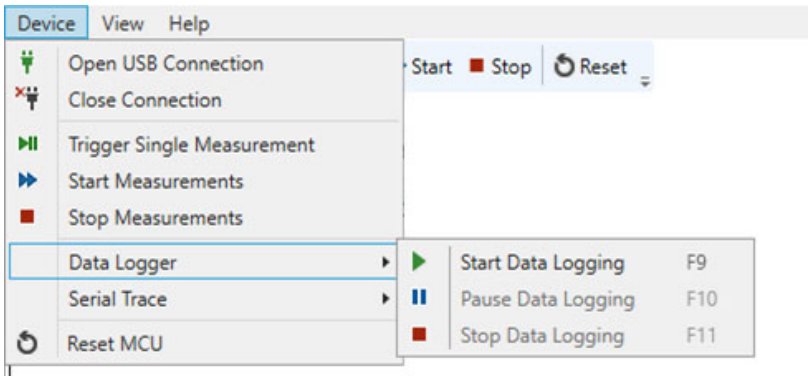
Figure 3: Device Menu



From the Device menu, options are available to open and close the USB connection, trigger measurements, create a log data file over a data logger to store measurement data, monitor and store the communication of the serial interface, and, once connected, reset the microcontroller on demand.

All data measured by the ToF sensor device can be logged to a file for plotting and evaluating the measurement results. The log file is saved to the entered path.

Figure 4: Data Logging Options



The data logger starts recording once a destination path and file are chosen. In addition, another small menu bar for the data logger is available.

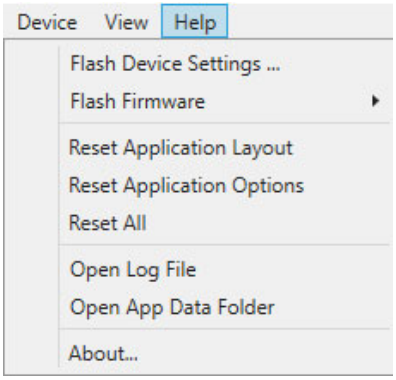
After clicking **Stop**, a message appears in the explorer application with the information and the saved number of samples.

Figure 5: Data Logger Recording Options

For formatting reasons, open the created log file either with an advanced text application (for example, Notepad++) or import it directly into a data analysis program. Another helpful debug feature is to perform a Serial Trace of all the bus transfers between the microcontroller and the connected device. After the start of a Serial Trace, the application asks for a path to save the Serial Trace Data. Both the Measurement Log Data and the Serial Trace are saved as .dat files.

The Help Menu is used to flash the AFBR-S50MV85G Firmware to the connected microcontroller, open recently logged data, reset the application values to default, and find information on the GUI itself.

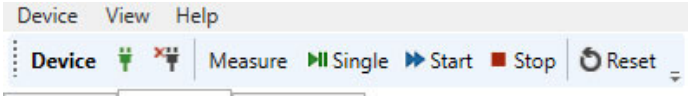
Figure 6: Help Menu



The AFBR-S50 Controller Tool Bar gives quick access to the most important operation elements regarding measurement and Reset of the microcontroller. On the left it delivers a simple connect and disconnect menu to open up a connection via USB port to the microcontroller on the evaluation kit board.

- Single: Sends a trigger signal to the device to perform a single measurement frame. Afterwards the device goes to idle state.
- Start: Starts a periodic measurement loop.
- Stop: Stops the periodic measurement loop and makes the device go to idle state. Note that this only stops the measurement loop and prevents new measurements to be triggered. However, it does not stop a currently ongoing measurement frame.

Figure 7: AFBR-S50 Controller Tool Bar



2.3 Measurement Views

Below the AFBR-S50 Controller Tool Bar, all measurement data gathered by the ToF sensor device can be displayed in three different views: 2D Plot, 3D Plot, and Raw Data. Each of the three views are discussed in the next sections and contains information on:

Measurement Status gives information on the timestamp of the measured signal, the corresponding frame rate, the Dynamic Configuration Adaption (DCA, the number of Digital averaging Samples), optical power, and the pixel gain.

NOTE: The displayed Frame Rate may differ depending on the characteristics of your serial connection (for example, USB cable length, and so on).

Figure 8: Measurement Status Example

```
Measurement Status: 0 (OK) @ 3552.554128 sec (Frame Rate: 25.00 Hz)
DCA: Integration Depth - Analog = 8.000 Pattern; Digital = 32 Samples
     Optical Power: 31 LSB; Pixel Gain: 15 LSB
```

2.3.1 1D Plot View

The 1D Plot View consists of three plots and shows the measurement data in real time. It is the standard measurement view displayed after the first start of a measurement. The x-axis for every chart inside the 1D plot View reflects the number of measurement samples.

- Range Plot
- Amplitude Plot
- Pixel Count Plot

Figure 9: 1D Plot View GUI

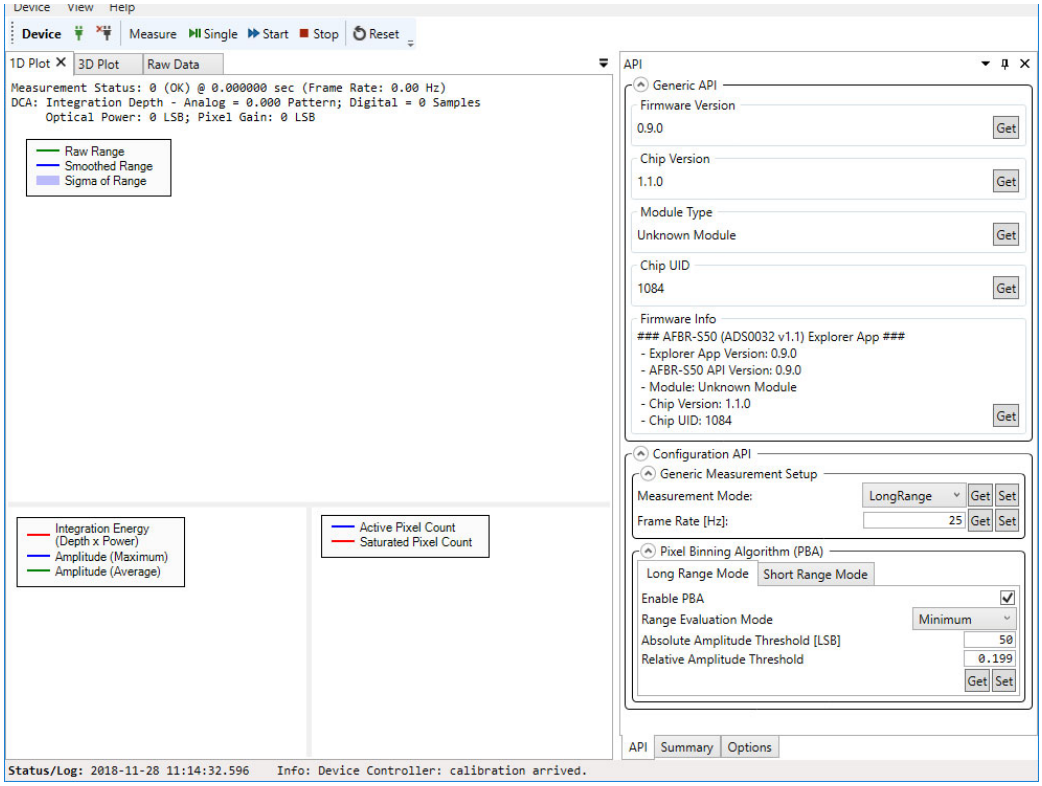
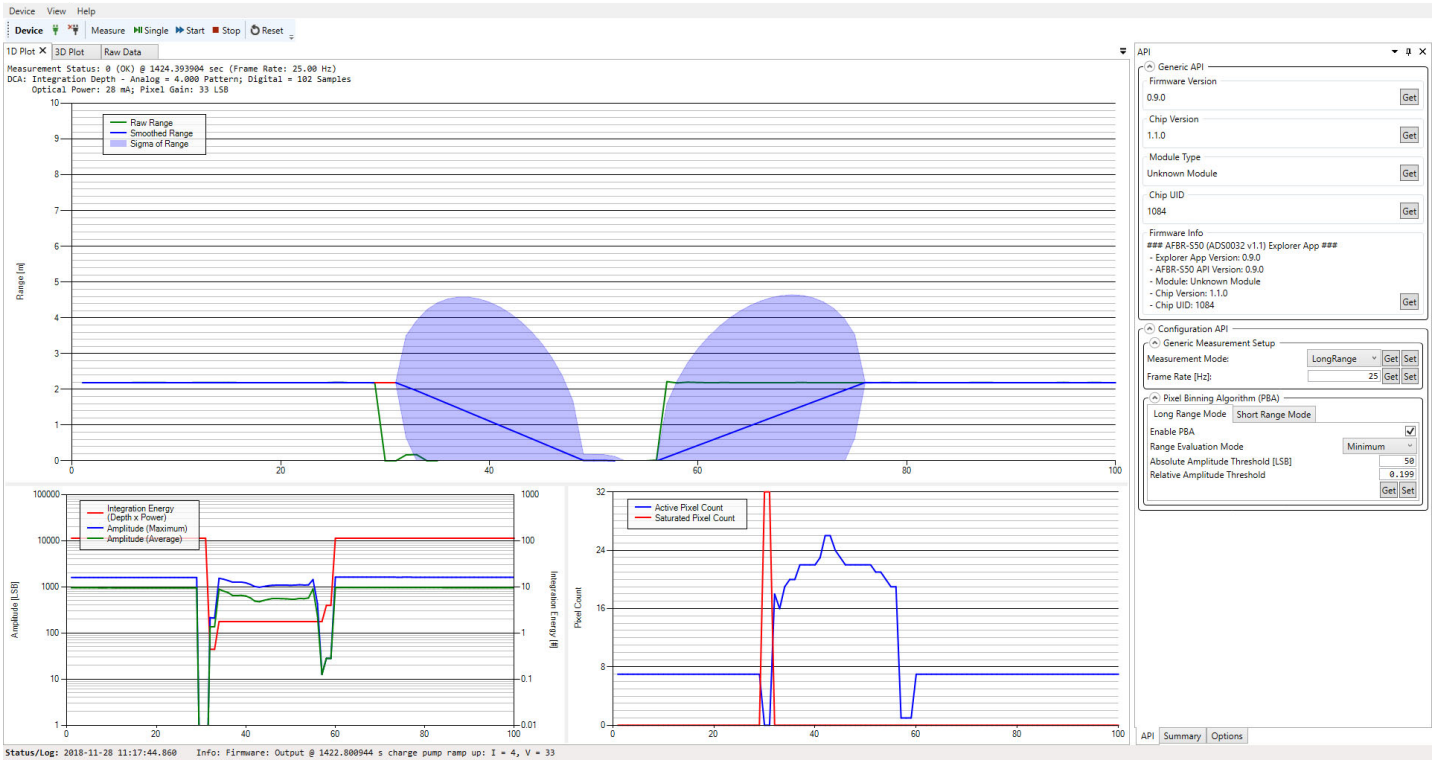


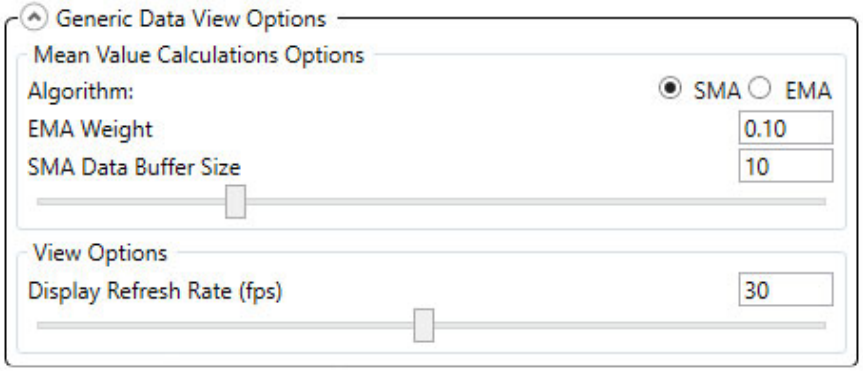
Figure 10: 1D Plot View Example



The Range plot element of the 1D Plot View is able to display up to four different range plots:

- Binned Range: Plots the average range over all pixels that are determined by the pixel binning algorithm. This value represents the current range in meters.
- Smoothed Binned Range: Plots a time based moving average of the Binned Range. To adjust the algorithm of the time-based moving average, go to the 1D Plot Options View inside the Options tab. A greater SMA data buffer size may result in a slower moving visualization.

Figure 11: Generic Data View Options

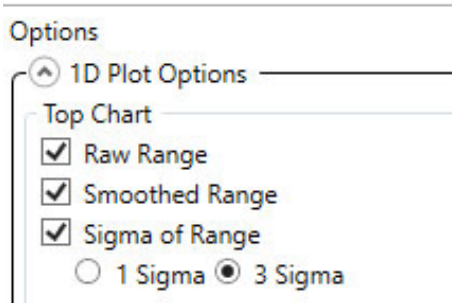


Choose between two different algorithms used for calculation of the averaged measurement results:

– Simple Moving Average: The mean calculated of the previous N data without any weighting. The SMA Data Buffer Size defines the magnitude used for SMA calculations.

  - Exponentially Weighted Moving Average: A type of an infinite impulse response filter that applies exponentially decreasing weighting factors. The weighting for each older datum decreases exponentially but never reaches zero. EMA Weight implies the quantifier used for the calculation of the EMA. Lower values result in less weighting of past measurement outcome and thus longer averaging times.
- Sigma of Binned Range: The blue cloud determines the current time based on moving the standard deviation of the sensor signal; inside the 1D Plot Options, choose between a deviation width of 1 Sigma and 3 Sigma.

Figure 12: 1D Plot Options



The different plots of the Range plot element can be turned either on or off by selecting the respective check boxes inside the Options Panel. It is also possible to change the minimum and maximum displayed range of the respective axis or select the Auto Scaling option.

Figure 13: 2D Plot Options

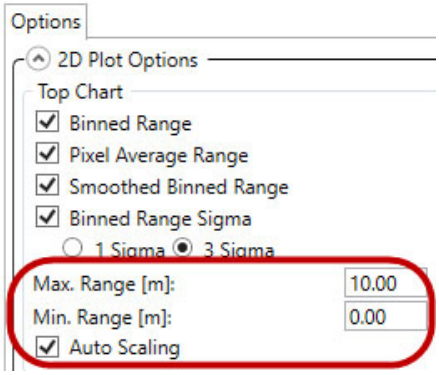
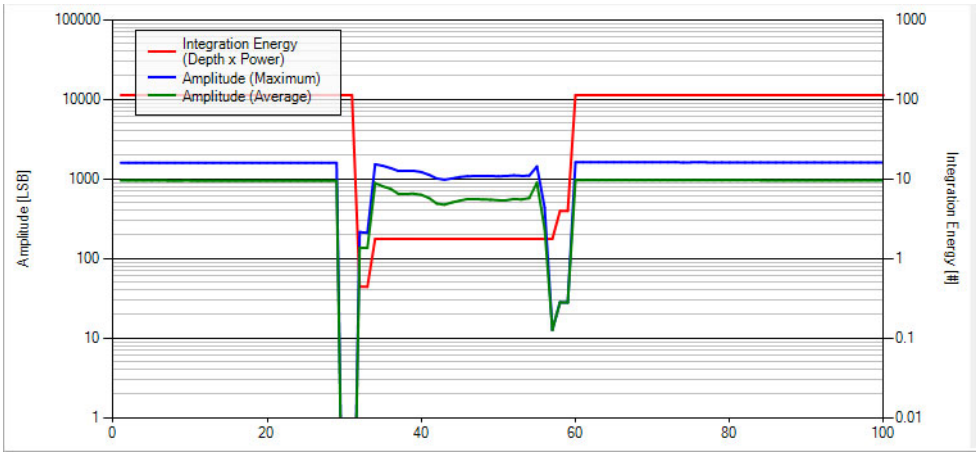
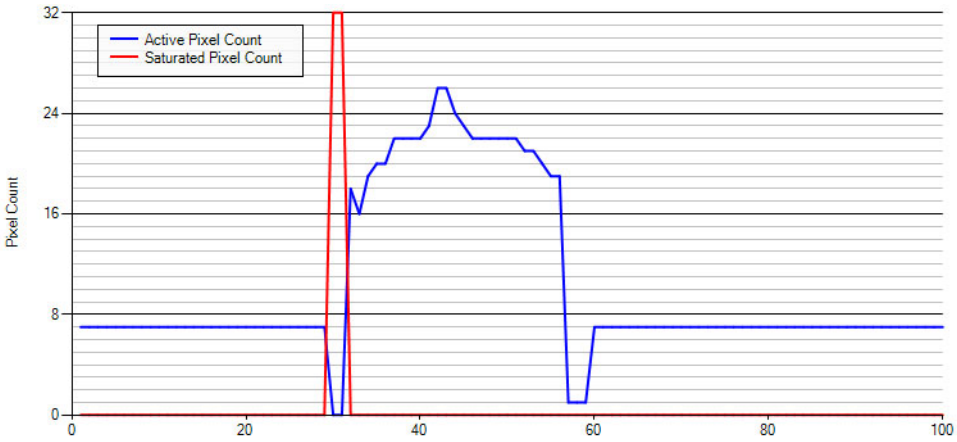


Figure 14: 2D Plot Example



- Integration Energy: Calculated by the integration depth per sample times the optical output power.
- Amplitude (Maximum) Plot: Shows the current maximum measurement signal amplitude which is determined by averaging all pixels that are selected by the Pixel Binning Algorithm.
- Amplitude (Average) Plot: Shows the current maximum measurement signal amplitude which is determined by averaging all pixels that are selected by the Pixel Binning Algorithm.

Figure 15: Active Pixel Count vs. Saturated Pixel Count

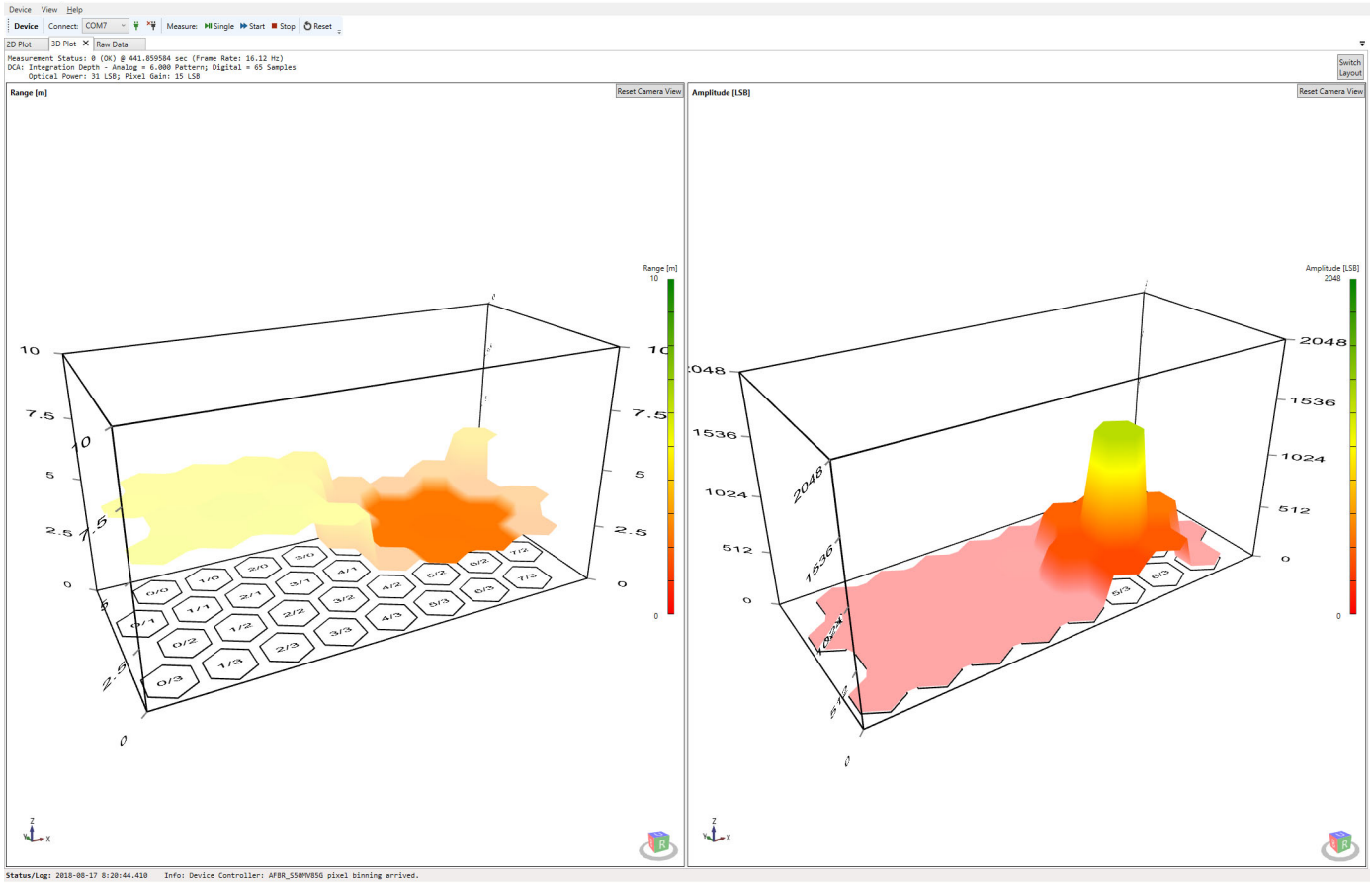


- Active Pixel Count: The value of Active Pixel Count reveals the number of pixels that are used for calculating range and amplitude with respect to the current Pixel Binning Algorithm.
- Saturated Pixel Count: The value of Saturated Pixel Count reveals the number of pixels being in saturation state due to too much optical power received.

2.3.2 3D Plot View

The second tab of the Data Visualization Window opens the 3D Plot View revealing more pixel-specific information on the measured range and amplitude in real time:

Figure 16: 3D Plot View



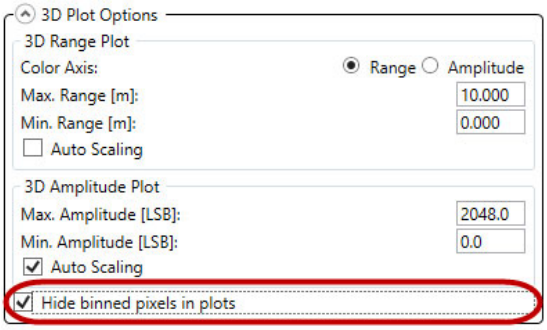
This 3D Plot View shows the retrieved measurement signal of every single pixel of the sensor's pixel matrix.

- 3D Range: The left plot shows the time based average range values for each available pixel.
- 3D Amplitude: The right plot inside the 3D plot view shows the time based average amplitude values for each available pixel.

There is also a Color axis for each of the two 3D plots that highlights the corresponding signal magnitude.

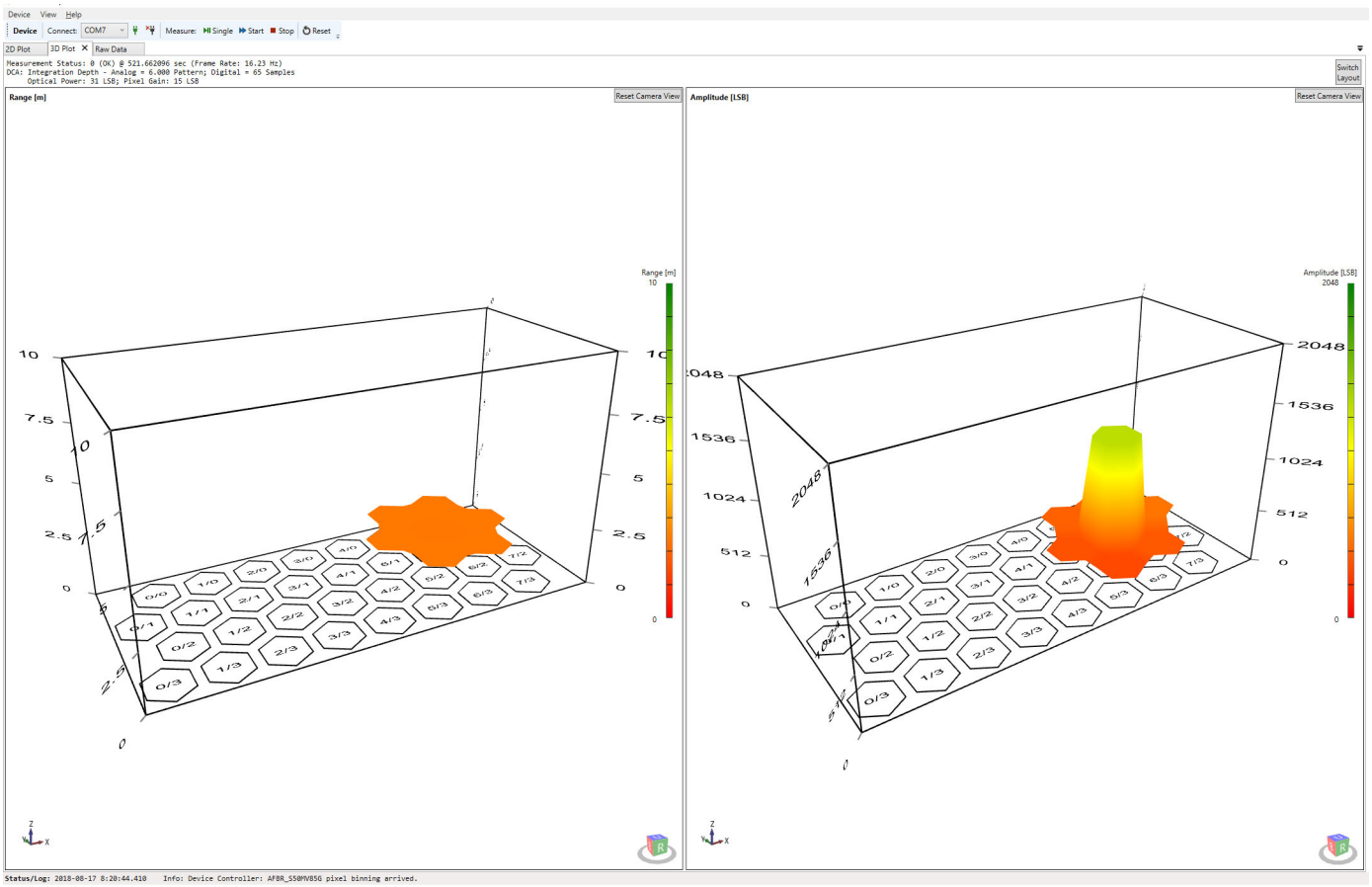
Hide binned pixels to see only pixels considered valid for the measurement by enabling the **Hide Binned Pixels in Plots** option in the 3D Plot options tab.

Figure 17: Hide Binned Pixels Option



Invalid pixels that do not satisfy the binning criteria will disappear from the plot.

Figure 18: Hidden Binned Pixels



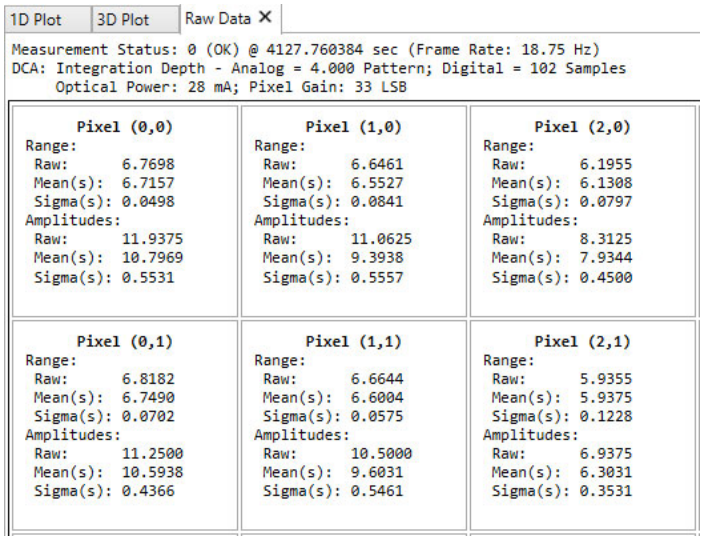
For a closer look at each pixel, zoom and rotate the 3D plots using the mouse.

- To move a plot, click and hold the scroll wheel.
- Rotate the plots by clicking and holding the right mouse button.
- Use the scroll wheel to zoom in and out.
- Double-click the scroll wheel to reset a plot to its default point of view.

2.3.3 Raw Data View

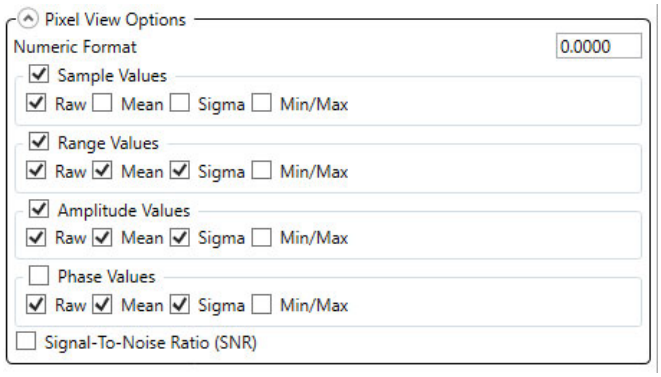
Raw Data view gives additional details about each pixel's measured range and amplitude results including the corresponding mean values and signal deviations (referred to as sigma). Furthermore, Mean and Sigma of both Raw Range and Raw Amplitude can be displayed as either SMA or EMA weighted (Mean(s), Mean(e), Sigma(s), Sigma(e)). The above screenshot shows not all Pixels for reason of better overview. Keep in mind that the choice of SMA and EMA affect the displayed values of Sigma and Mean in different ways.

Figure 19: Raw Data View



Choose which of the results to keep visible or hidden by selecting the associated Pixel View Options from the Options Panel. In addition, the Numeric Format of the displayed results can be adapted.

Figure 20: Pixel View Options

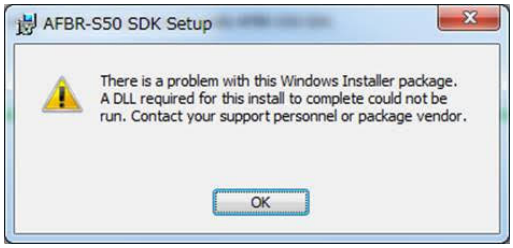


Appendix A: Troubleshooting and FAQs

A.1 Related Documents

- AFBR-S50MV85G Data Sheet
- AFBR-S50MV85G Software Release Notes

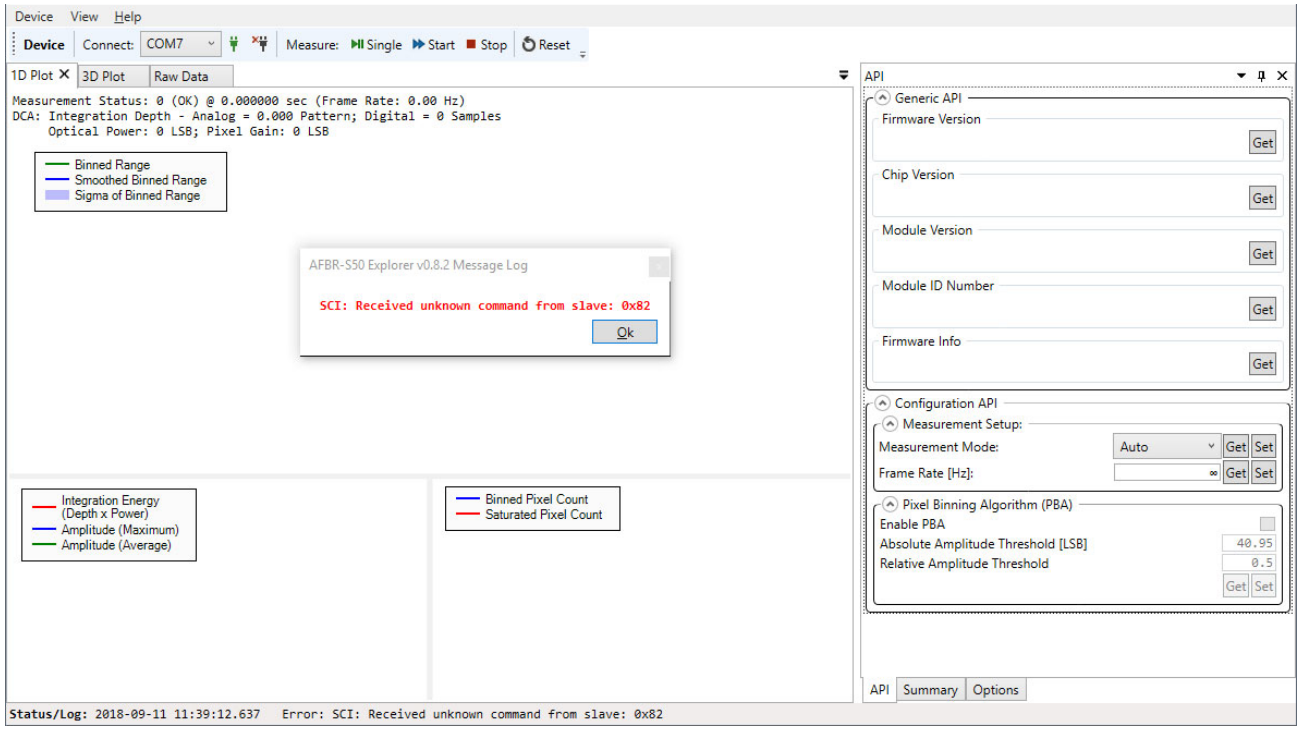
A.2 The Following Error Occurs While Installing the SDK



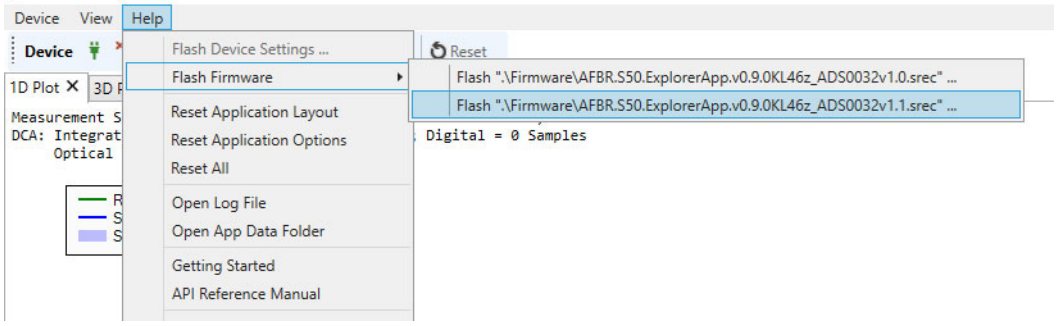
The reason for this error is an incompatible SDK installer version. When using a 32-bit system, choose the x86 installer. When using a 64-bit system, run the x64 installer.

A.3 Communication Between the AFBR-S50 Explorer and Sensor Fails

If an error message indicates that the software versions of the AFBR-S50 Explorer and microcontroller firmware do not match, or you receive an SCI (serial communication interface) error, you may have an older or incompatible FW running on the evaluation board.



Flash the appropriate firmware version onto the NXP microcontroller board by following the procedures in Updating the Firmware.



NOTE: There are different sensor versions v1.x available. If unsure of the sensor type, contact your Broadcom sales representative.

Revision History

AFBR-S50MV85G-EK-UG100; January 10, 2019

Initial release.

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