

# AFBR-S50MV85G Evaluation Kit Quick Start Guide

**User Guide** 

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Chapter 1: Getting Started	4
1.1 Evaluation Kit Overview	4
1.2 Hardware and Software Setup	4
1.3 Updating the Firmware	6
1.4 Performing a Distance Measurement	7
Chapter 2: AFBR-S50 Explorer	9
2.1 AFBR-S50 Explorer Overview	9
2.2 Exploring the Menu Bar	10
2.3 Measurement Views	12
2.3.1 1D Plot View	12
2.3.2 3D Plot View	16
2.3.3 Raw Data View	18
Appendix A: Troubleshooting and FAQs	19
A.1 Related Documents	19
A.2 The Following Error Occurs While Installing the SDK	19
A.3 Communication Between the AFBR-S50 Explorer and Sensor Fails	19
Revision History	21
AFBR-S50MV85G-EK-UG100; January 10, 2019	21

# **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.

伊 AFBR-S50 SDK Setup	- 🗆 X	E Windows Security	×
Custom Setup	BROADCOM <sup>*</sup>		
Select the way you want features to be installed.		Would you like to install this device software?	
Click the icons in the tree below to change the wa	y features will be installed.		
		Name: AFBR-S50 Driver Package	
AFBR-SS0 Explorer     Documentation     Firmware Binaries     Default Device Settings	The AFBR-S50 Explorer (v0.9.0.28022); an evaluation GUI for the AFBR-S50 Sensor modules.	Publisher:	
AFBR-SSO API API Library Files	This feature requires 2090KB on your hard drive. It has 3 of 3 subfeatures selected. The subfeatures require 2284KB on your hard drive.	Always trust software from Install Don't Inst	all
Location: C: \Program Files (x86)\Broadco	m\AFBR-550 SDK\ Browse Back Next Cancel	You should only install driver software from publishers you trust. <u>How can I decide</u> <u>which device software is safe to install?</u>	

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.

Device 🕴 🎽	Flash Device Settings	Ć	Reset
Plot X 3D F	Flash Firmware	•	Flash ".\Firmware\AFBR.S50.ExplorerApp.v0.9.0KL46z_ADS0032v1.0.srec"
asurement S	Reset Application Layout		Flash ".\Firmware\AFBR.S50.ExplorerApp.v0.9.0KL46z_ADS0032v1.1.srec"
Measurement S DCA: Integrat Optical	Reset Application Options Reset All	, Di	gital = 0 Sámples
R S	Open Log File Open App Data Folder		

- **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:

PI		<b>-</b> д >
Generic API ———————————————————————————————————		
Firmware Version		Get
Chip Version		Gat
Module Type		Ger
Chip UID		Get
Firmware Info		Get
<ul> <li>Configuration API</li> <li>Generic Measurer</li> <li>Massurer</li> </ul>	ment Setup	v Cat Cat
Frame Rate [Hz]:		<ul><li>Get Set</li><li>∞ Get Set</li></ul>
Pixel Binning Algo	prithm (PBA)	
Long Range Mode Enable PBA Range Evaluation Mo Absolute Amplitude Relative Amplitude T	Short Range Mode ode Threshold [LSB] hreshold	Average v 40.95 0.5 Get Set

- After a port has been chosen and connected:

ΑΡΙ			<b>-</b> д ×
Generic API			
Firmware Version			1
0.9.0			Get
Chip Version			
1.1.0			Get
Module Type			
Unknown Module			Get
Chip UID			
1084			Get
- Module: Unknown - Chip Version: 1.1.0 - Chip UID: 1084	Module		Get
C Generic Measure	ment Setup	~	
Measurement Mode:		LongRange	Get Set
Frame Rate [Hz]:			25 Get Set
Pixel Binning Algo	orithm (PBA)		
Long Range Mode	Short Range Mod	le	
Enable PBA			~
Range Evaluation Mo	ode	Min	imum ~
Absolute Amplitude	Threshold [LSB]		50
Relative Amplitude T	hreshold		0.199
			Get Set
Ľ			

- **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

Bandar (1997) 1977 - B. 20 Marcan Million Million Bana (1997)		
Device Connect N/C T T Measure Pisingle Pisingle Start Stop O Keset		
1D Plot X 3D Plot Raw Data		API * # X
Hessurement Status: 0 (OK) # 0.000000 sec (Frame Rate: 0.00 Hz) DGA: Totagenting Darbi - Analyse & DAD Patterner, Daital = 8 Samplar		( Generic API
Optical Power: 0 LSS; Pixel Gain: 0 LSB		082
		100 USA
- Brend Range Service Oracle Device		Chip Version
Signa of Binned Range		1.0.0 (Get
		Module Version
		1.0.0 Get
		Module ID Number
		AFBR S50MV85G Get
		Artis (2004/1952 000) Finanza Inő - Finanza Inő - Statis Colo 2005 Estan App ### - Jakis Colo 2004 (2005 Estan App ### - Altis Colo 2004 (2005 Estan App ### - Altis Colo 2004 (2005 Estan App ### - Altis Colo 2004 (2005 Estan App ### - Macaurement Mode - Colo Version 1.0.0 000 - Macaurement Mode - Statis Finans Application (PA) - Statis Finanzia Application (PA) - Statis F
- Dagatas Energy Dagatas Alexandro - Dagatas Alexandro - Angeludas (Alexandro)	Brund Plat Court     Shund Plat Court	
		API Summary Options
Status/Log: 2018-09-11 10:35:43,300 Info: SCI: Closing serial connection! COM7		

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

¥ ×₩	Open USB Connection Close Connection	St	art 🔳 Stop	ð Reset <sub>₽</sub>	
►II	Trigger Single Measurement Start Measurements				
•	Stop Measurements				
-	Stop Measurements Data Logger	• •	Start Data	a Logging	F9
-	Stop Measurements Data Logger Serial Trace	• •	Start Data	a Logging ta Logging	F9 F10

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

ර් Reset 🝦	Data Logger:	II Pause	E Stop	Ŧ
Stops the	currently ongoing	g data logg	ing.	

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

Flash Device Settings	
Flash Firmware	•
Reset Application Layout	
Reset Application Options	
Reset All	
Open Log File	
Open App Data Folder	
About	

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

terre view help	
Device 🕴 🎬 Measure 🕅 Single 🍽 Start 🔳 Stop 🖸 Reset	
1D Plot × 3D Plot Raw Data	▼ API
Measurement Status: 0 (OK) @ 0.000000 sec (Frame Rate: 0.00 Hz)	Generic API
DCA: Integration Depth - Analog = 0.000 Pattern; Digital = 0 Samples	Firmware Version
optical Power, 0 150, Pixel dain, 0 150	0.9.0 Get
Raw Range	Chip Version
Sigma of Range	1.1.0 Get
	Module Type
	Unknown Module Get
	Chip UID
	1084 Get
Integration Energy (Depth x Power) Amplitude (Maximum) Amplitude (Average)	Firmware Info ### AFBR-S50 (ADS0032 v1.1) Explorer App ### - Explorer App Version: 0.9.0 - AFBR-S50 API Version: 0.9.0 - Module: Unknown Module - Chip Version: 1.1.0 - Chip UID: 1084
	API Summary Options
Status/Log: 2018-11-28 11:14:32.596 Info: Device Controller: calibration arriv	ved.

#### 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 timebased 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

wean value calculations Options	
Algorithm:	SMA O EMA
EMA Weight	0.10
SMA Data Buffer Size	10
View Options	
Display Refresh Rate (fps)	30

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

ma

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

<ul> <li>2D Plot Options —</li> </ul>	
Top Chart	
✓ Binned Range	
✓ Pixel Average Rar	nge
Smoothed Binned	d Range
✓ Binned Range Sig	gma
○ 1 Sigma ● 3	Sigma
Max. Range [m]:	10.00
Min. Range [m]:	0.00
Auto Scaling	

#### 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

Color Axis:	Range O Amplitude
Max. Range [m]:	10.000
Min. Range [m]:	0.000
Auto Scaling	
3D Amplitude Plot	
Max. Amplitude [LSB]:	2048.0
Min. Amplitude [LSB]:	0.0
✓ Auto Scaling	

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

D Plot 3	D Plot	Raw Data 🗙				
easurement CA: Integr Optica	Status ation D al Power	: 0 (OK) @ 41 epth - Analog : 28 mA; Pixe	27.760 = 4.0 1 Gain	384 sec (F 00 Pattern : 33 LSB	rame Rate: 18 ; Digital = 1	8.75 Hz) 02 Samples
Pix	el (0.0)		Pixe	1 (1.0)		Pixel (2.0)
Range:		Ran	e:		Range:	
Raw:	6.7698	Ray		6.6461	Raw:	6.1955
Mean(s):	6.7157	Mea	an(s):	6.5527	Mean(	s): 6.1308
Sigma(s)	: 0.0498	Si	zma(s):	: 0.0841	Sigma	(s): 0.0797
Amplitude	s:	Amp	itudes	S : (	Amplit	udes:
Raw:	11.937	5 Ray	v:	11.0625	Raw:	8.3125
Mean(s):	10.796	9 Mei	an(s):	9.3938	Mean(	s): 7.9344
Sigma(s)	: 0.5531	Si	gma(s):	: 0.5557	Sigma	(s): 0.4500
Pix	el (0,1)		Pixe	el (1,1)	. 0	Pixel (2,1)
Range:		Ran	ge:		Range:	
Raw:	6.8182	Ray	1:	6.6644	Raw:	5.9355
Mean(s):	6.7490	Mea	in(s):	6.6004	Mean(	s): 5.9375
Sigma(s)	: 0.0702	Si	gma(s):	: 0.0575	Sigma	(s): 0.1228
Amplitude	5:	Amp.	itudes	5:	Amplit	udes:
Raw:	11.250	Ø Rai	1:	10.5000	Raw:	6.9375
Mean(s):	10.593	8 Mei	an(s):	9.6031	Mean(	s): 6.3031
Sigma(s)	: 0.4366	Si	ma(s)	: 0.5461	Sigma	(s): 0.3531

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

Numeric Format	0.0000
Sample Values	
🗹 Raw 🗌 Mean 🗌 Sigma 🗌 Min/Max	
Range Values	
🗹 Raw 🗹 Mean 🗹 Sigma 🗌 Min/Max	
Amplitude Values	
🖌 Raw 🖌 Mean 🖌 Sigma 🗌 Min/Max	
Phase Values	
🗸 Raw 🗸 Mean 🗸 Sigma 🗌 Min/Max	
Signal-To-Noise Ratio (SNR)	

# **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.

Generic API     Firmware Version     Module Version     Module ID Number     Firmware Info	G G G G
Chip Version Module Version Module ID Number	G
Module Version Module ID Number	G
Module ID Number	G
Firmware Info	
	G
Configuration API     Measurement Setup:     Measurement Mode:	Auto V Get S
Frame Rate [Hz]: ( ) Pixel Binning Algorithm (PBA) Enable PBA Absolute Amplitude Threshold [LSB] Relative Amplitude Threshold	∞ Get S
	Measurement Setup: Measurement Mode: Frame Rate [Hz]: (     Pixel Binning Algorithm (PBA) Enable PBA Absolute Amplitude Threshold [LSB] Relative Amplitude Threshold

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

Device #	Flash Device Settings		<b>O</b> Reset	
	Flash Firmware	•	Flash ".\Firmware\AFBR.S50.ExplorerApp.v0.9.0KL46z_ADS0032v1.0.srec"	
leasurement S	Reset Application Layout		Flash ".\Firmware\AFBR.S50.ExplorerApp.v0.9.0KL46z_ADS0032v1.1.srec"	
)CA: Integrat Optical	Integrat Optical Reset Application Options Reset All		Digital = 0 Samples	
S Open Log File Open App Data Folder Getting Started API Reference Manual				

**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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