TMF8829 EVM

User Guide

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1 Introduction

The TMF8829 Time-of-Flight (hereafter referred to as 'ToF') EVM demonstration kit provides a way to evaluate TMF8829 optical sensors from ams-OSRAM AG. This document is a basic user guide for the setup and operation of the TMF8829 EVM software.

1.1 Kit content

Below is a checklist of what is included in the TMF8829_EVM_DB_DEMO kit.

- TMF8829 sensor EVM enclosure and sample glass (some EVMs come without an enclosure)
- USB type A to micro-USB cable(s)

1.2 Ordering information

Product type	Ordering code	Description
TMF8829_EVM_DB_DEMO	Q65115A1849	Evaluation kit for TMF8829

2 Setting up the EVM

This section describes the necessary setup to start using the EVM software.

2.1 Setting up the TMF8829 EVM hardware

The TMF8829 sensor enclosure is already assembled and ready to plug in to a PC. The EVM with the enclosure exposes only one micro-USB connector. This hardware kit comprises a Raspberry Pi running a ZeroMQ server (see chapter 2.5). No additional software apart from the EVM GUI is needed for operation.

Figure 1: EVM with enclosure

2.2 Install the EVM USB windows driver (only once)

When the EVM is plugged into the PC, Windows should recognize the EVM as a “Removable Disk”. Install this USB driver (right-click and choose “Install” from the context menu):

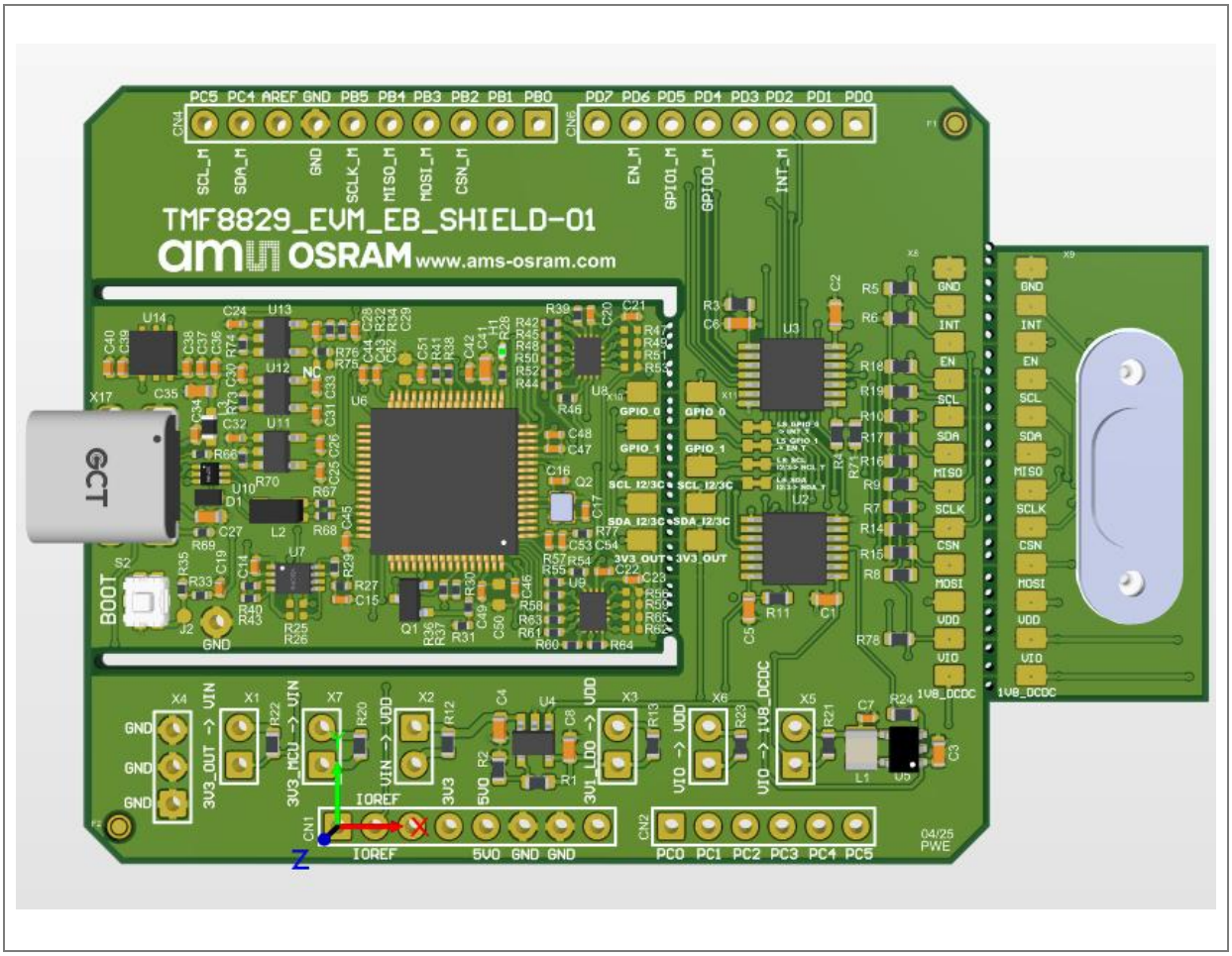
- ams-raspi-rndis.inf

This step is only necessary during first-time setup but will need to be repeated if you’re using the EVM software on a new PC.

2.3 Setting up the TMF8829 shield board

Connect the shield board with a USB-C cable to your PC. Download and run the shield board ZeroMQ server for this setup (see chapter 2.5).

Figure 2: Shield board

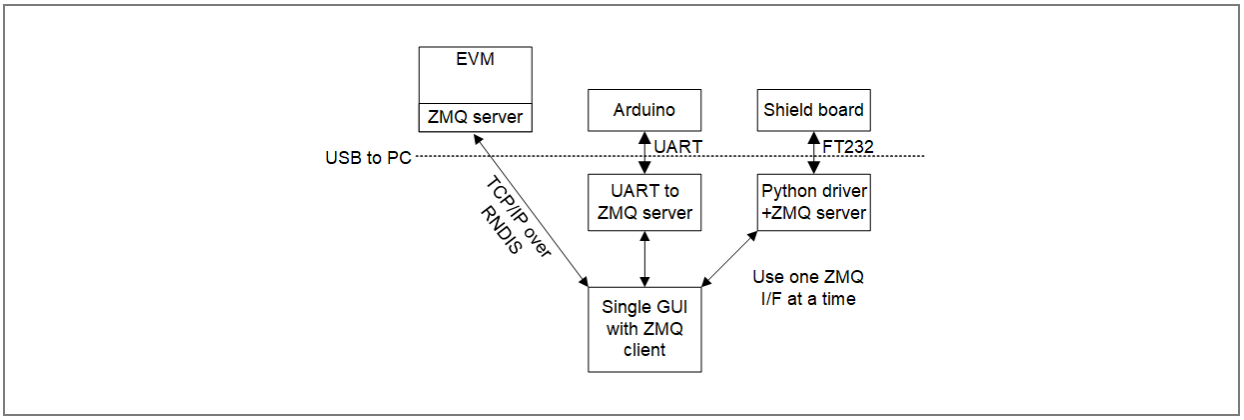


2.4 Install the EVM graphical user interface

1. Please download the latest EVM GUI software from the ams OSRAM website: ams-osram.com/tmf8829
2. Launch the Windows installer and choose the desired installation options.

2.5 EVM components

Figure 3: EVM components



The abbreviation ZMQ in Figure 3 stands for ZeroMQ. ZeroMQ is used as central communication technology for the EVM software stack.

The ZeroMQ server provides sensor data and offers an interface for sensor configuration. The ZeroMQ client consumes the sensor data and either displays it (EVM GUI) or logs it (active or passive logger).

Information:

Please refer to zeromq.org for more information about ZeroMQ.

The TMF8829 EVM software stack comprises these components:

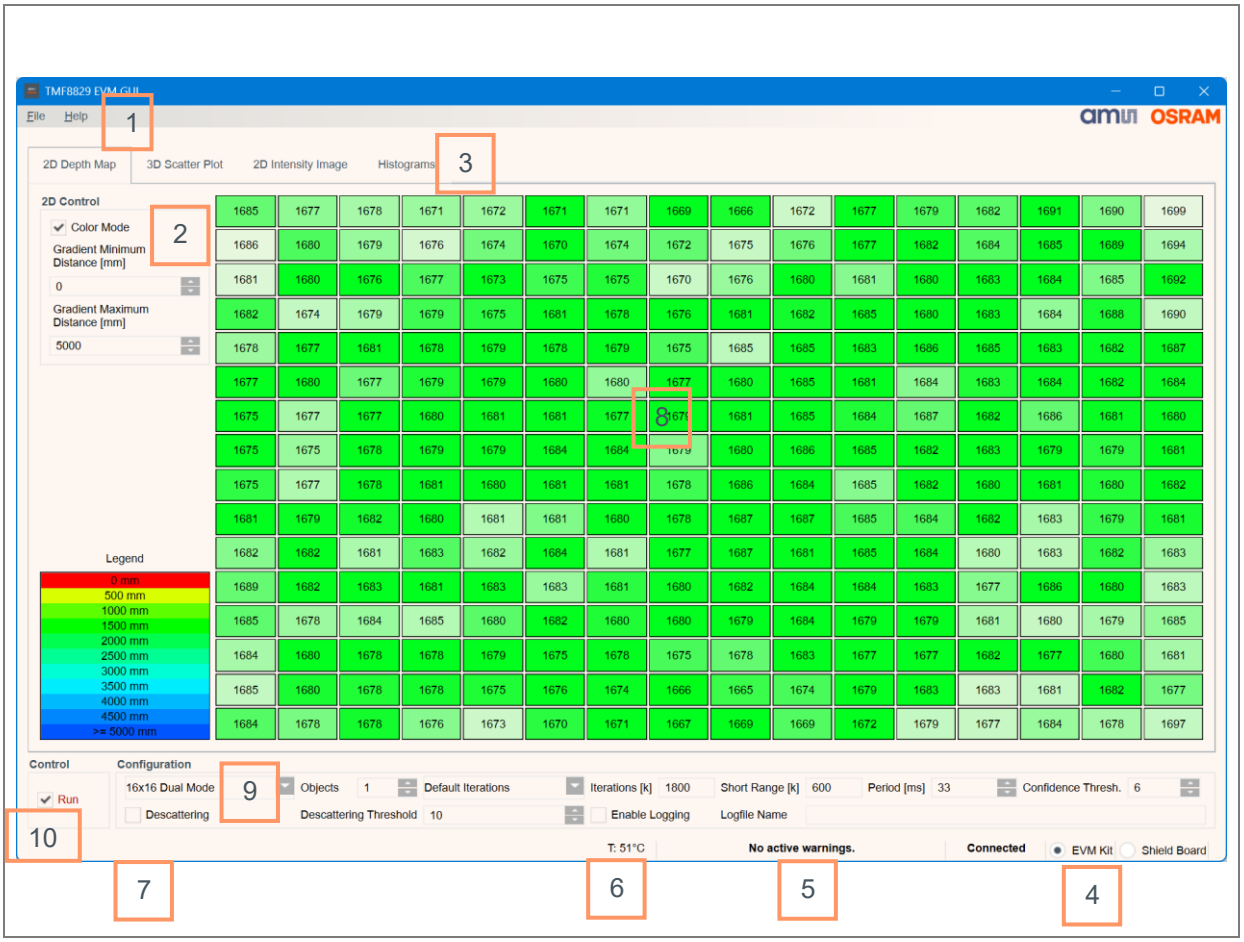
- The EVM hardware with the mobile phone form factor – see Figure 1. It contains the TMF8829 sensor controlled by a Raspberry Pi Zero W. The ZeroMQ server runs directly on the Raspberry Pi.
- Or the TMF8829 sensor on a shield board controlled by an Arduino Uno (or compatible). In this case the ZeroMQ server retrieves sensor data via UART from the Arduino and provides the same interface as the ZeroMQ on the Raspberry Pi. The ZeroMQ server in this case is a program that runs on your Windows computer.
- Or the TMF8829 sensor on a shield board controlled by the integrated STM32H503 USB to I²C controller. The ZeroMQ server in this case is a program that runs on your Windows computer and directly interacts with the TMF8829 sensor with I²C transfers.
- The TMF8829 EVM GUI that works with all three setups described above.

The TMF8829 ZeroMQ sensor data loggers that can either run standalone (active logger that also configures the sensor for measurements) or in parallel to the EVM GUI (passive logger that only captures the sensor data, use the GUI for sensor configuration).

3 Using the EVM software

This section describes the operation and capabilities of the EVM Graphical User Interface (EVM GUI).

Figure 4: EVM GUI overview



3.1 GUI elements overview

1. Main Menu
2. Controls for data visualization (different for each tab)
3. Main tab selector, switch between measurement result displays
4. EVM controller selector
5. Firmware warnings display
6. Sensor temperature
7. Status Line
8. Main content for the current tab
9. Measurement configuration controls
10. Control to start / stop measurements

3.2 GUI element description

3.2.1 Main menu

The main menu contains these entries:

3.2.1.1 “File” menu

- “Show Log Window” – display the communication protocol log window.
- “Update Target Controller” – update driver and server software on the EVM controller (Raspberry Pi).
- “Exit” – leave the EVM GUI.

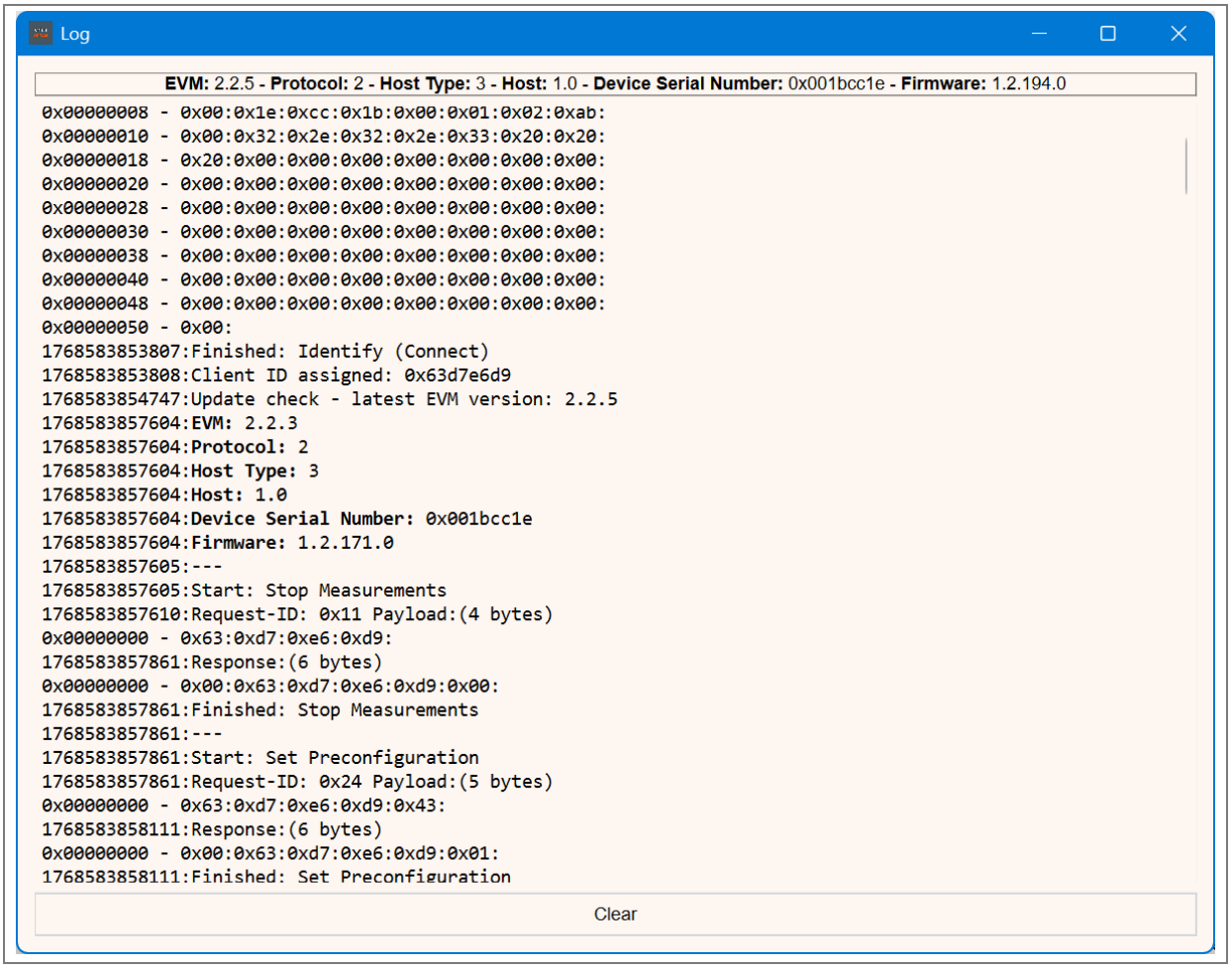
3.2.1.2 “Help” menu

- “About” – shows version information and copyright notices.

3.2.2 Log window

The log window lists the ZeroMQ protocol messages exchanged between the EVM GUI and the host controller. Please read the ZeroMQ protocol description to decode the messages.

Figure 5: Log window



Here you can also find:

- The EVM version
- The ZeroMQ protocol version
- The host controller type
  - Arduino: 2
  - Raspberry Pi: 3
  - STM32H503: 4
- The revision of the host driver (e.g. the Linux driver version of your EVM kit)
- The serial number of the TMF8829 sensor in your setup
- The firmware revision running on your TMF8829 sensor

3.2.3 About dialog

Open the “About” dialog to read the EVM GUI license text and to check the version of the program.

Figure 6: About dialog

3.2.4 EVM controller selector

Figure 7: EVM controller selector

Select the correct controller for the TMF8829 sensor here. Choose EVM for the EVM kit with mobile phone form factor. Choose “Shield Board” for setups that use the TMF8829 shield board.

The connection status line indicates if the EVM GUI is currently connected to a ZeroMQ server (or disconnected).

3.2.5 Firmware warnings display

Figure 8: Firmware warnings

This text line shows either “No active warnings” or one or more of these warnings:

- CP Overload (SPAD charge pump overload)
- VCDRV Overload (VCSEL driver overload)
- VCDRV Burst Exceeded

3.2.6 Measurement configuration

Figure 9: Measurement configuration

These controls set the most fundamental measurement settings:

- Deselect the “Run” checkbox to stop the sensor.
- The sensor resolution – the number of zones in the field-of-view of the sensor.
  - The long-range mode with 8x8 zones measures target distances up to 12m.
  - High accuracy modes offer increased accuracy with decreased maximum distance compared to standard modes. Please refer to the datasheet for details.
  - Dual mode configurations combine high accuracy for the short range with the extended measurement range of the matching long range mode.
- The maximum number of detectable objects per zone (1 up to 4).
- The number of measurement iterations – the higher the number the better the sensor performance. But more iterations also increase the measurement time.
- The iteration selection dropdown list offers three preselected values:
  - Default mode for a good balance between sensor performance and measurement time
  - Low power mode to optimize current consumption
  - High performance mode to optimize for sensor performance and measurement distance
- The number of iterations for the short-range measurement in dual mode.
- The measurement period (time between two measurements). The sensor firmware will try to match the measurement period. If the number of iterations is too high to finish within the period, the sensor will deliver results as fast as possible (best effort).
- The object detection confidence threshold. This setting helps to filter false positive object detections. The higher this number the higher the required signal (reflected light from object) to noise (ambient light) ratio. The default value of “6” should work for the most scenarios.
- “Descattering”: Enable this checkbox to apply a de-scattering software filter to remove ghost targets from the measurements results. Higher descattering thresholds mean more thorough ghost target removal.

  The descattering filter divides the field-of-view of the sensor into discrete distance ranges. For each distance span it removes objects with low confidence compared to the object with the highest confidence in that range.

  The source code for this post processing filter is available on: github.com/ams-OSRAM/tmf8829_driver_descattering_filter
- The GUI can also log measurement data and histograms (only when the histogram tab is active). The GUI creates JSON files with the same data format as the dedicated python loggers.
- Click on “Enable Logging” and select a file name for the log file. The GUI shows the log file with its full path in the line “Logfile Name”.

Information:

- The GUI logs data into the computer's memory before writing it to a file. This function uses quite a lot of RAM and is not intended for data capture over a long time.

Information:

- Spin-boxes (e.g. for Iterations) do not track every single value change during editing. If you enter a new number in a spin box, please press the ENTER key to send the updated configuration value to the sensor.

3.2.7 TMF8829 sensor data

The TMF8829 sensor's field of view is divided into 8 by 8 and up to 48 by 32 zones.

The TMF8829 EVM GUI can process up to four objects (targets) per zone.

Each object (target) can be represented with a data tuple:

- x position in millimeters relative to the sensor
- y position in millimeters relative to the sensor
- z position in millimeters relative to the sensor
- Confidence (that there is an object at the x/y/z position)

3.2.8 2D depth map

This data visualization shows all the zones in the field-of-view of the TMF8829 sensor.

The color mode shows each zone with the z position of the target as number and as a matching color.

You can control the color representation by adjusting the minimum gradient distance (z position values equal or below this setting will be represented as red) and maximum gradient distance (z position values equal or above this setting will be represented as dark blue).

Please check the legend for quick reference. The GUI will not display the z position as number in high-resolution mode (32x32 or 48x32), only as matching color.

Figure 10: 2D depth map, color mode

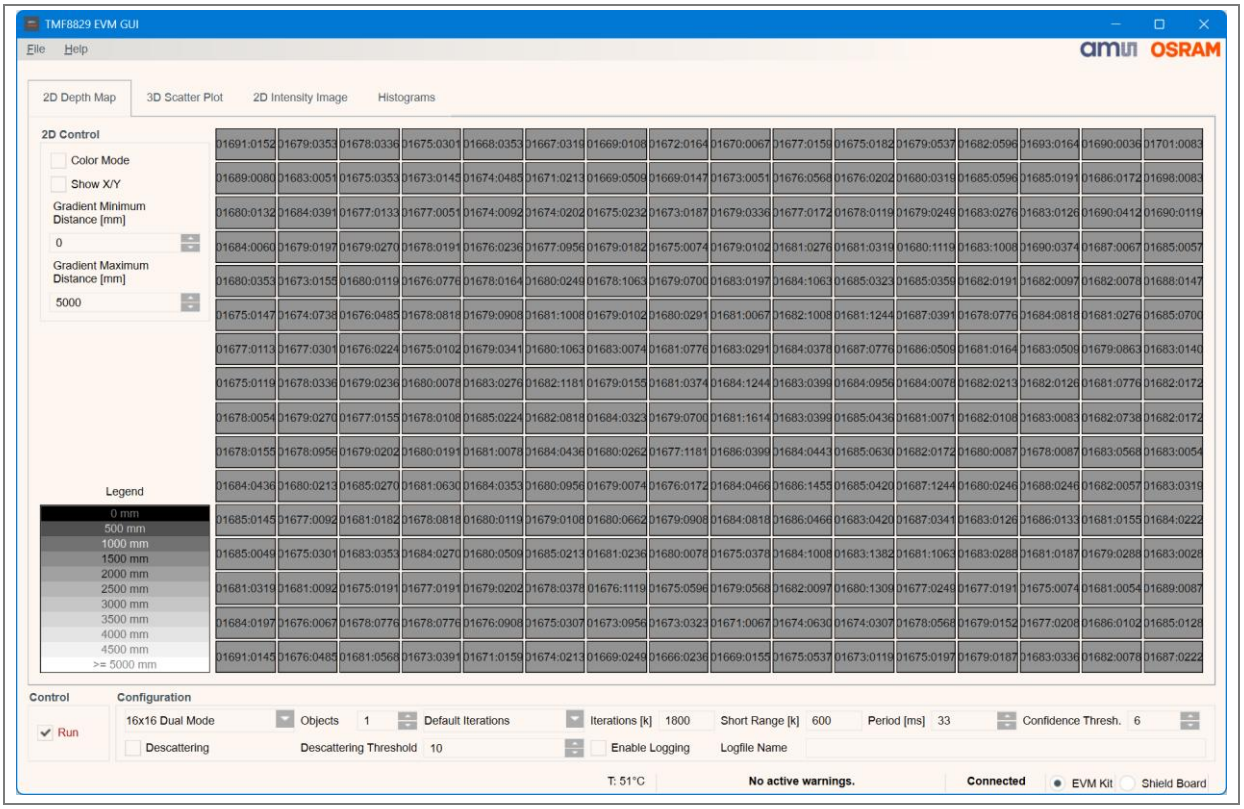
The grayscale mode shows each zone with the z position of the target as number and as a matching shade of gray. It also shows the confidence for a detected target.

You can opt to display the x and y position of the target, too if you enable the check box “Show X/Y”.

The grayscale representation works like the color representation with configurable gradient distances. Minimum is black. Maximum is white.

The GUI will not display any data as number in high-resolution mode (32x32 or 48x32), only the z position as matching shade of gray.

Figure 11: 2D depth map, grayscale mode



3.2.9 3D scatter plot

This visualization shows all measured targets (up to four for each zone) with their true position in 3D space (X/Y/Z).

There are four possible options to represent the object data tuple:

1. “Only Distance” – show the targets in 3D space, do not represent the confidence.
2. “Show Confidence” – show the targets in 3D space, represent the confidence as shade of gray for the cubes in the graph. Dark gray for low confidence, white for high confidence.
3. “Colored Distance” – show the targets in 3D space, use the z position to select a color from the spectrum from red (near) to blue (far). Color representation works like the 2D depth map.

4. “GUI Performance Mode” – use a single color and cube size for all cubes in the graph. Greatly increases the performance of this graph for slower PCs. Recommended for 32x32 or 48x32 mode and more than one object per zone.

Restrict the range of the displayed z-axis with the control “Maximum Distance [mm]”. This is the maximum position in z direction.

If you check “Tilt Axis” the projection into 3D space will change. This allows you to view the graph from all possible directions.

Figure 12: 3D scatter plot, only distance

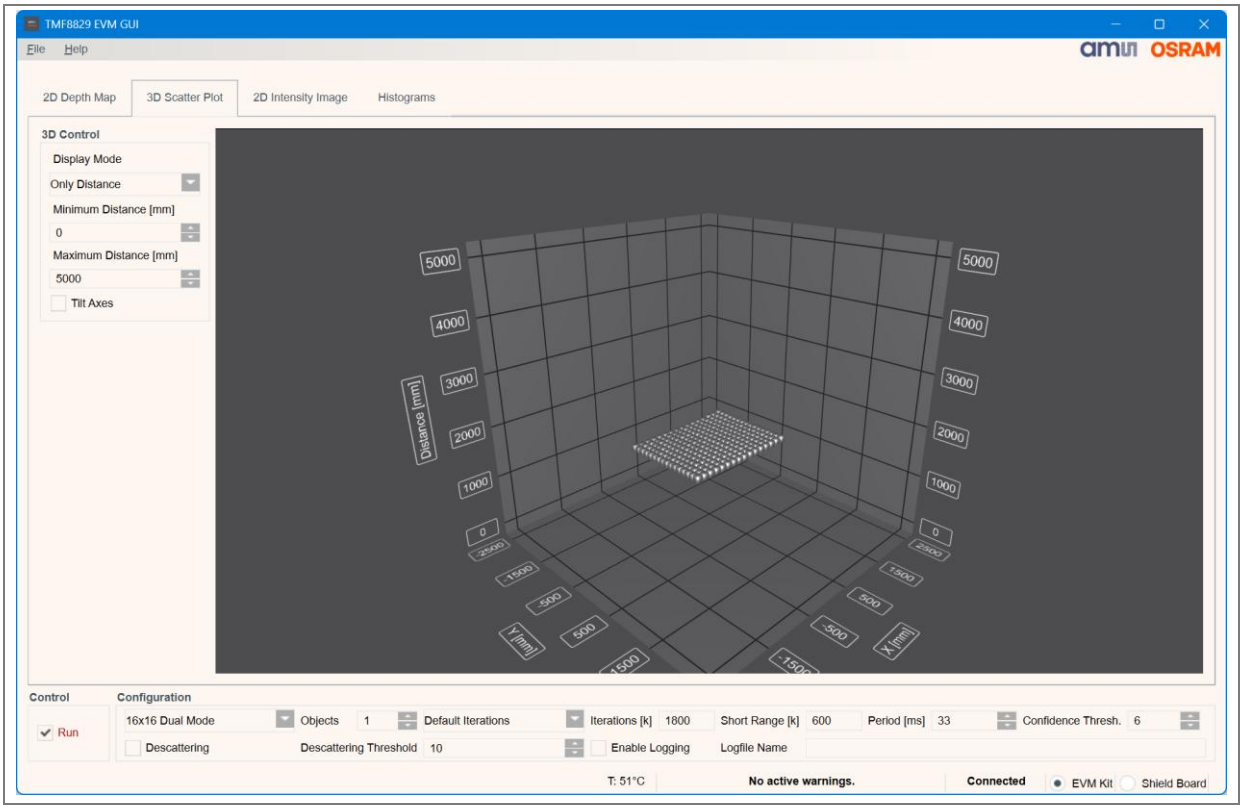


Figure 13: 3D scatter plot, show confidence

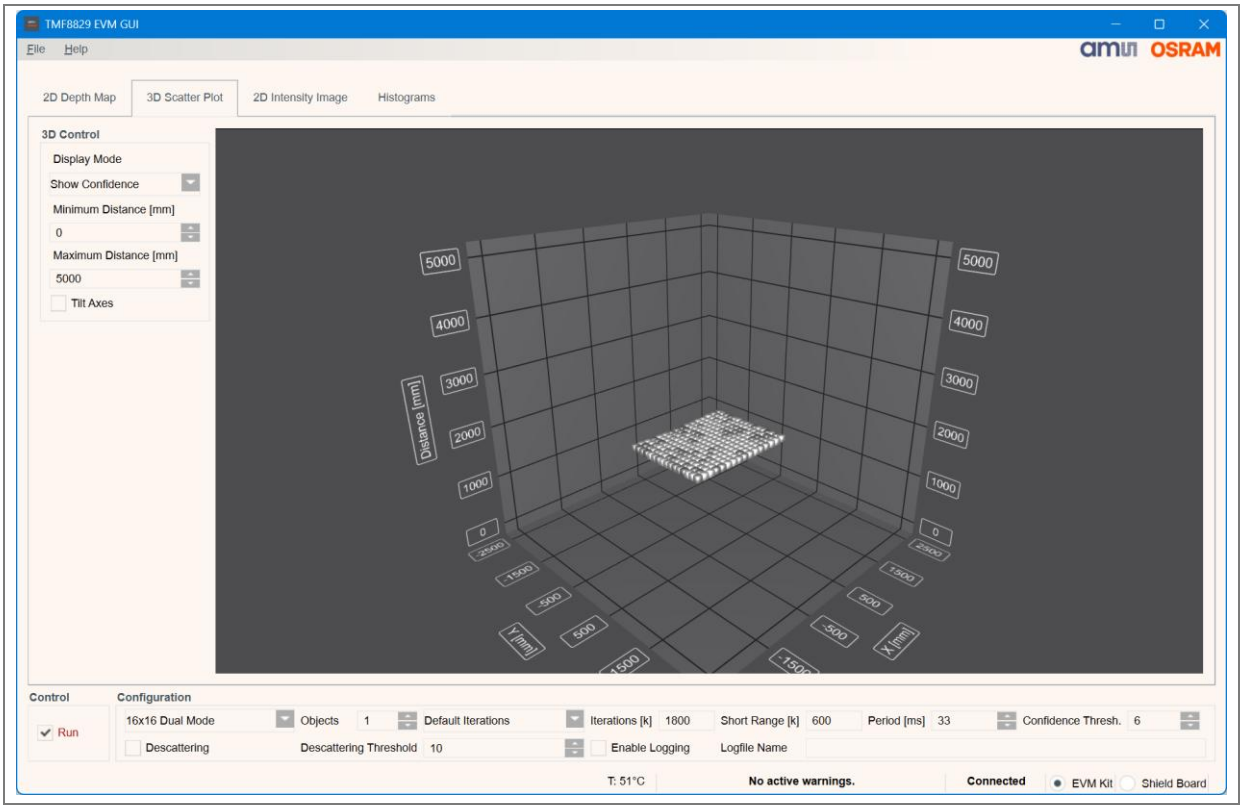


Figure 14: 3D scatter plot, colored distance

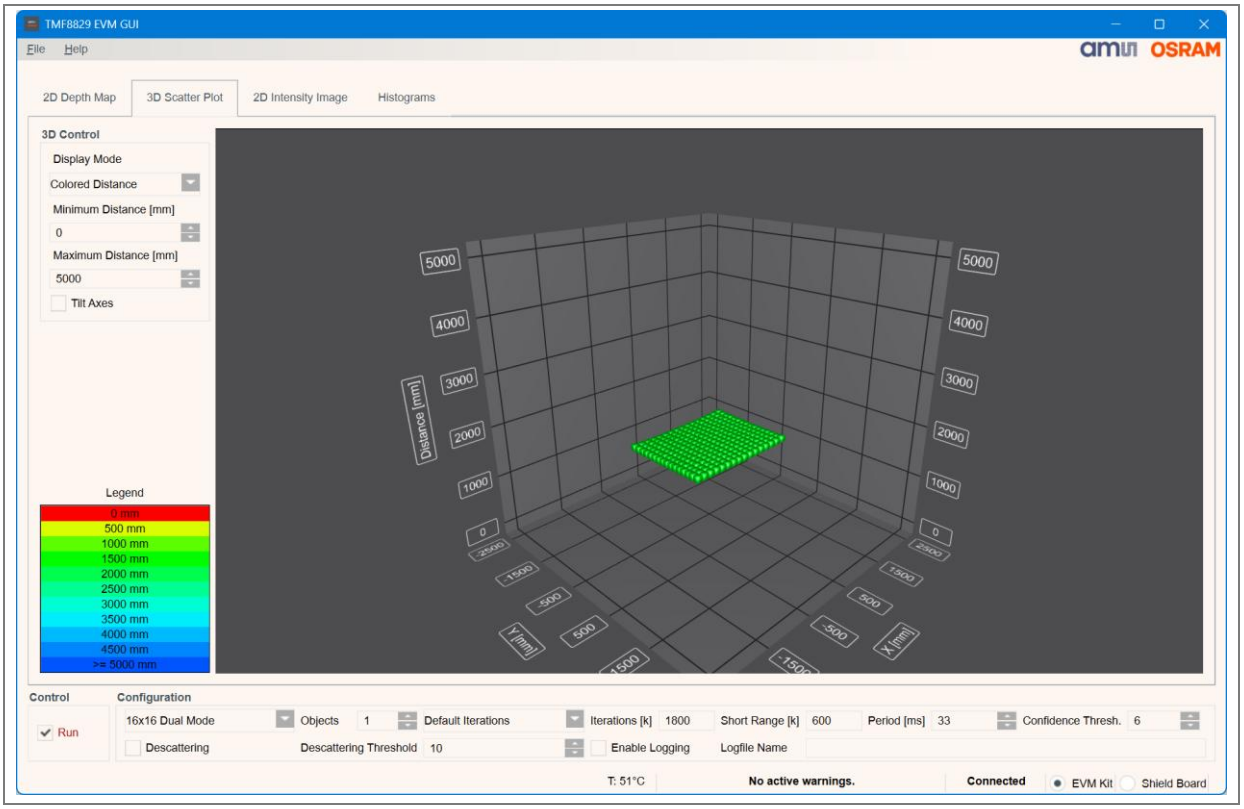
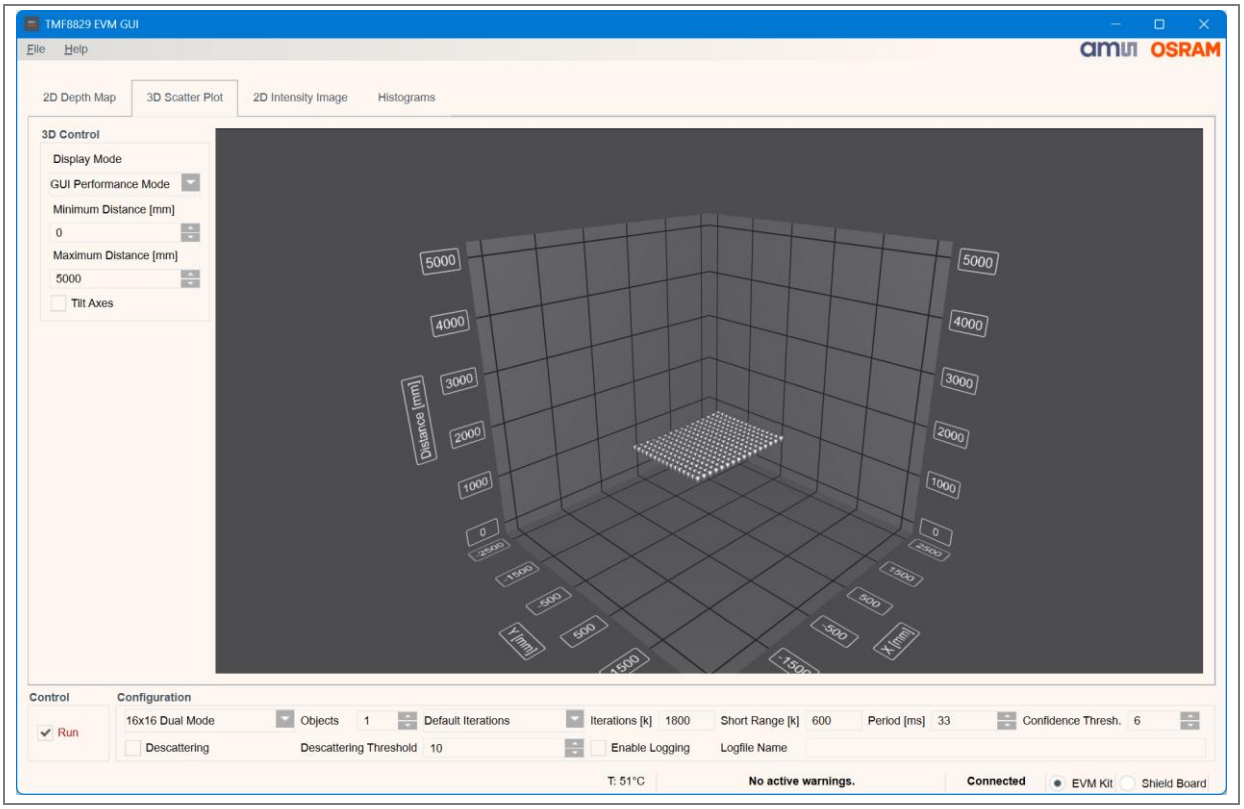


Figure 15: 3D scatter plot, GUI performance mode



3.2.10 2D intensity image

This data visualization shows all the zones in the field-of-view of the TMF8829 sensor. The TMF8829 VCSEL is per default operating and illuminating the objects. You can switch off the VCSEL in the measurement configuration group box.

The data represented here is selectable:

- The signal reflected from the target for each zone
- The background noise for each zone
- The crosstalk for each zone

The color mode shows each zone with the amount of light hitting the zone as number and as a matching color.

You can control the color representation by adjusting the minimum gradient distance (values equal or below this setting will be represented as red) and maximum gradient distance (values equal or above this setting will be represented as dark blue).

Please check the legend for quick reference. The GUI will not display the amount of light as number in high-resolution mode (32x32 or 48x32), only as matching color.

If you select “Show Cross Talk” the GUI will track the maximum crosstalk value across all received measurement data frames in absolute and relative values. You can reset the maximum crosstalk value calculation with the button “Reset” just below the crosstalk values.

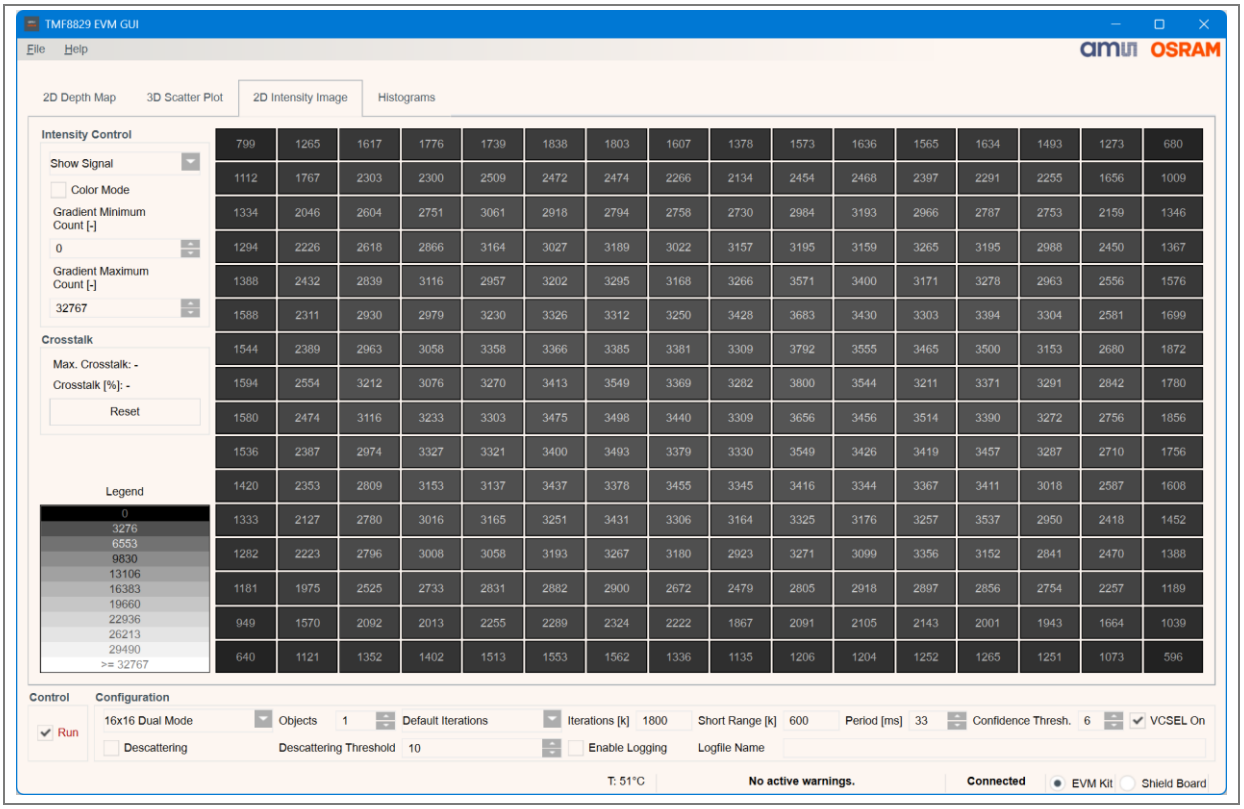
Figure 16: 2D intensity image, color mode

The grayscale mode shows each zone with the amount of light as number and as a matching shade of gray.

The grayscale representation works like the color representation with configurable gradient distances. Minimum is black. Maximum is white.

The GUI will not display any numerical data in high-resolution mode (32x32 or 48x32).

Figure 17: 2D intensity image, grayscale mode

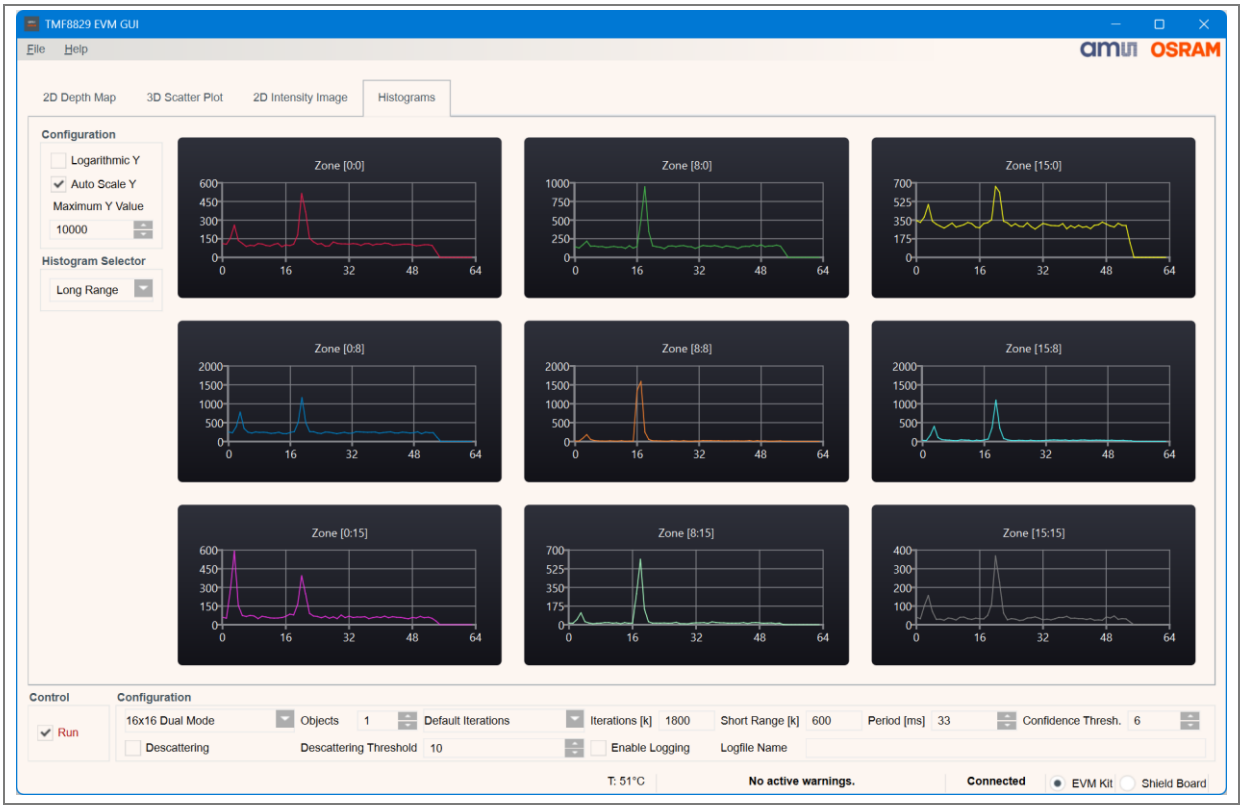


3.2.11 Histograms

This tab shows nine histogram graphs, one for the center zone, one for each corner zone and one for the middle of each border.

You can select a logarithmic representation of the graphs and switch auto-scaling on or off.

Figure 18: Histograms



3.3 ZeroMQ loggers

Please download the latest logger release from the ams OSRAM website.

4 Online resources

Please look for the most recent software and documentation on the ams OSRAM website ams-osram.com/tmf8829

You can find source code and executable programs also on the ams OSRAM github page: github.com/ams-OSRAM

The source code for the descattering filter is available on: github.com/ams-OSRAM/tmf8829_driver_descattering_filter

5 Revision information

Definitions

Draft / Preliminary:
The draft / preliminary status of a document indicates that the content is still under internal review and subject to change without notice. ams-OSRAM AG does not give any warranties as to the accuracy or completeness of information included in a draft / preliminary version of a document and shall have no liability for the consequences of use of such information.

Changes from previous released version to current revision v2-00	Page
Updated for latest EVM GUI version with new screen shots and description of descattering filter and the logging feature	all

- Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.
- Correction of typographical errors is not explicitly mentioned.

6 Legal information

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