



## User Guide

UG000416

# TMF8x0x

## EVM User Guide

TMF8x0x-EVM

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# 1 Introduction

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

## 1.1 EVM Kit Content

Below is a checklist of what is included in the ToF EVM kit.

- ToF sensor EVM enclosure and sample glass (some EVMs come without an enclosure)
- USB type A to micro-USB cable(s)
- USB Flash drive with EVM GUI software
- EVM documentation (including this guide)

**Figure 1:**  
**Kit Content**



## 1.2 Ordering Information

Ordering Code	Description
TMF8701-EVM	TMF8701 ToF Evaluation Module
TMF8701-DB	TMF8701 ToF Daughter Board
TMF8801-EVM	TMF8801 ToF Evaluation Module
TMF8801-DB	TMF8801 ToF Daughter Board
TMF8805-EVM	TMF8805 ToF Evaluation Module

Ordering Code	Description
TMF8805-DB	TMF8805 ToF Daughter Board

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## 2 Setting Up the EVM

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

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### 2.1 Setting Up the EVM Hardware

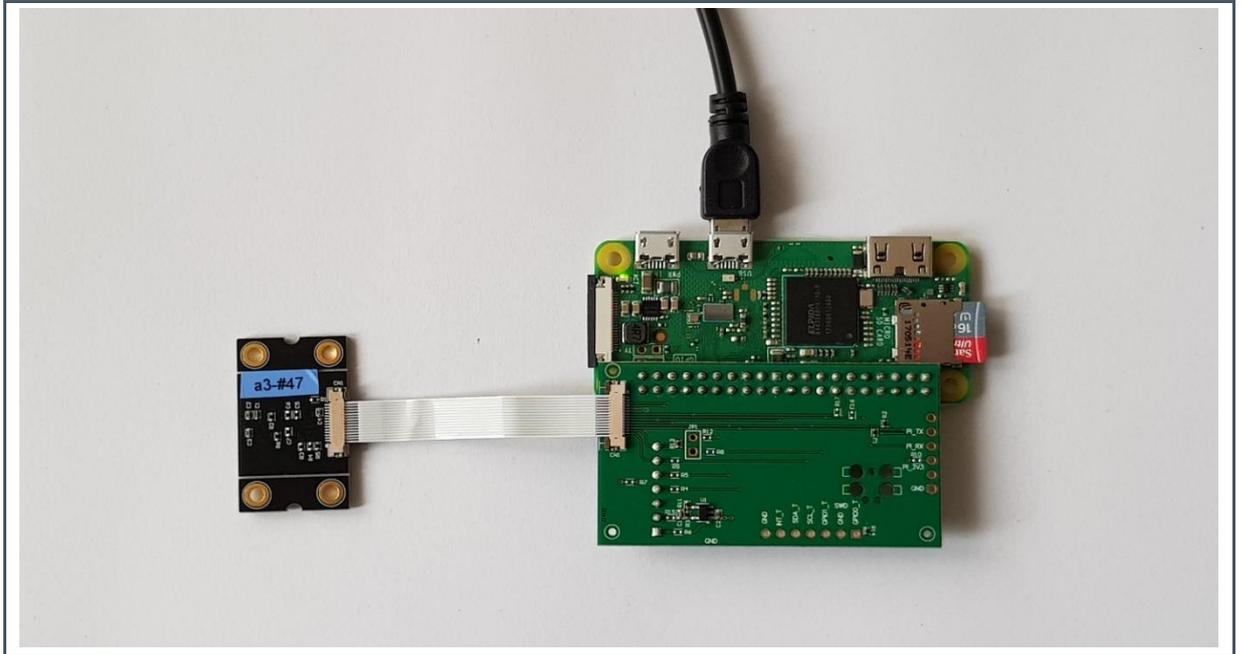
The ToF sensor enclosure is already assembled and ready to plug in to a PC. The EVM with the enclosure exposes only one micro-USB connector:

**Figure 2:**  
EVM with Enclosure



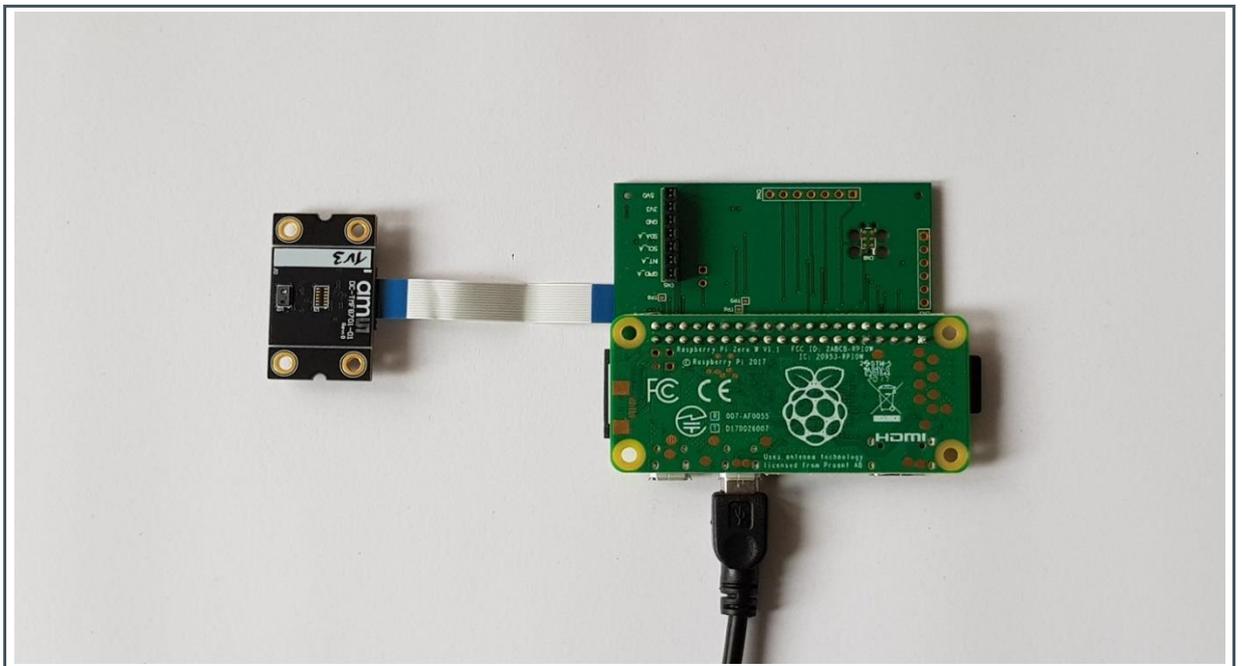
On EVMs without enclosure (or if the enclosure has been removed) plug in the micro-USB connector to the USB connector closer to the center of the Raspberry PI Zero W board (see Figure 3)

**Figure 3 :**  
**EVM Without Enclosure – Front Side (TMF8x0x facing to table)**



The TMF8x0x is shown when placing the Raspberry Pi Zero W on the backside (see Figure 4)

**Figure 4 :**  
**EVM Without Enclosure – Back Side (TMF8x0x facing to ceiling)**



### 2.1.1 Install the EVM USB Windows (one-time only)

When the EVM is plugged into the PC Windows should recognize the EVM as a “Removable Disk”. If your PC does not automatically install the necessary USB drivers, the mountable drive contains USB drivers for both Windows and Mac. Install the necessary USB drivers:

- `ams_raspicdc_setup.exe`
- `ams_raspirndis_setup.exe`

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

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## 2.2 Installing the EVM Graphical User Interface

The ToF EVM GUI software is included on the USB flash drive. Launch the Windows installer and choose the desired installation options. The EVM graphical user interface executable is titled `ToF_EVM_GUI.exe`.

# 3 Using the EVM Software

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

## 3.1 EVM GUI “Histogram Display” Tab

The Histogram Display Tab is the primary context of the ToF EVM demo software and it has the most control options available. Here the user can get an overview of object detection as well as histogram graphing. Please refer to Figure 5 for a breakdown of the various components in the Histogram Display Tab.

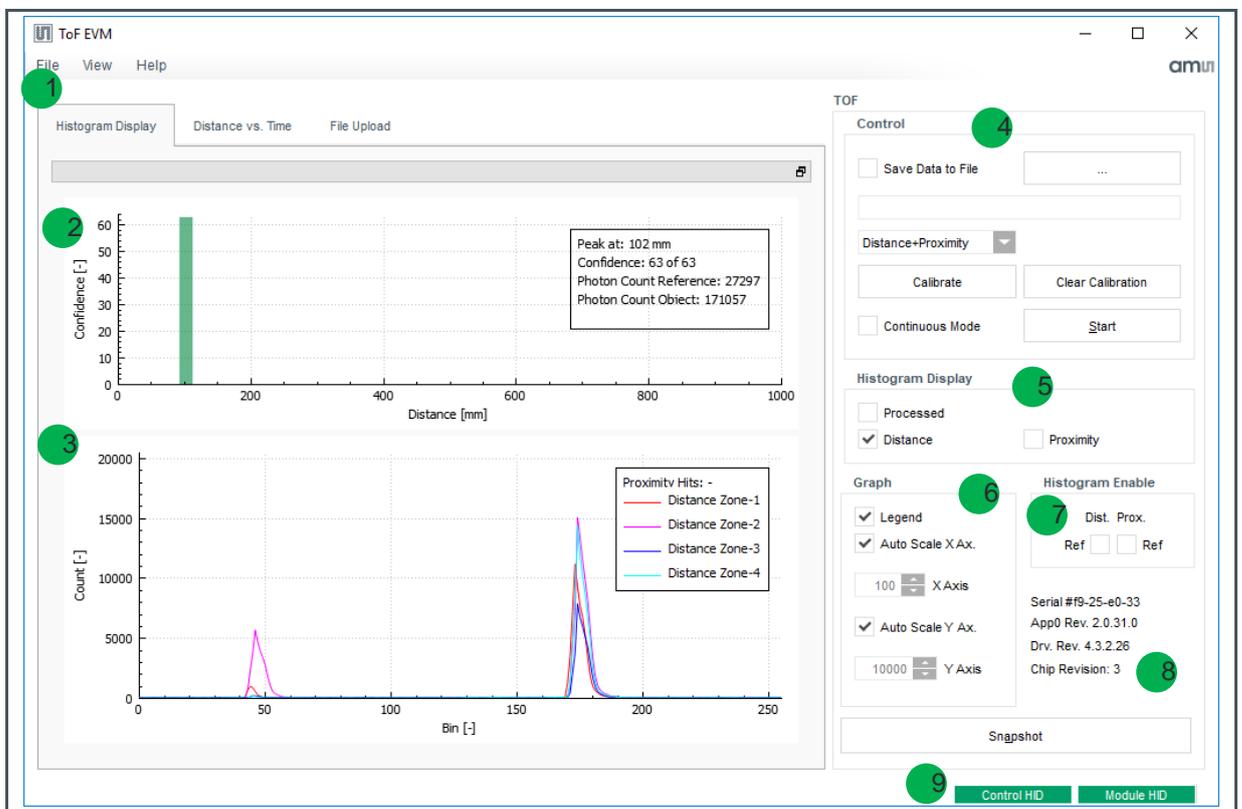


### Information

If you want to use the histograms for TMF8701 please contact **ams** to provide the software which shows histograms. The default software with the EVM only shows the distance chart.

TMF8801 software shows the histograms by default.

Figure 5 :  
Histogram Display Tab TMF8701



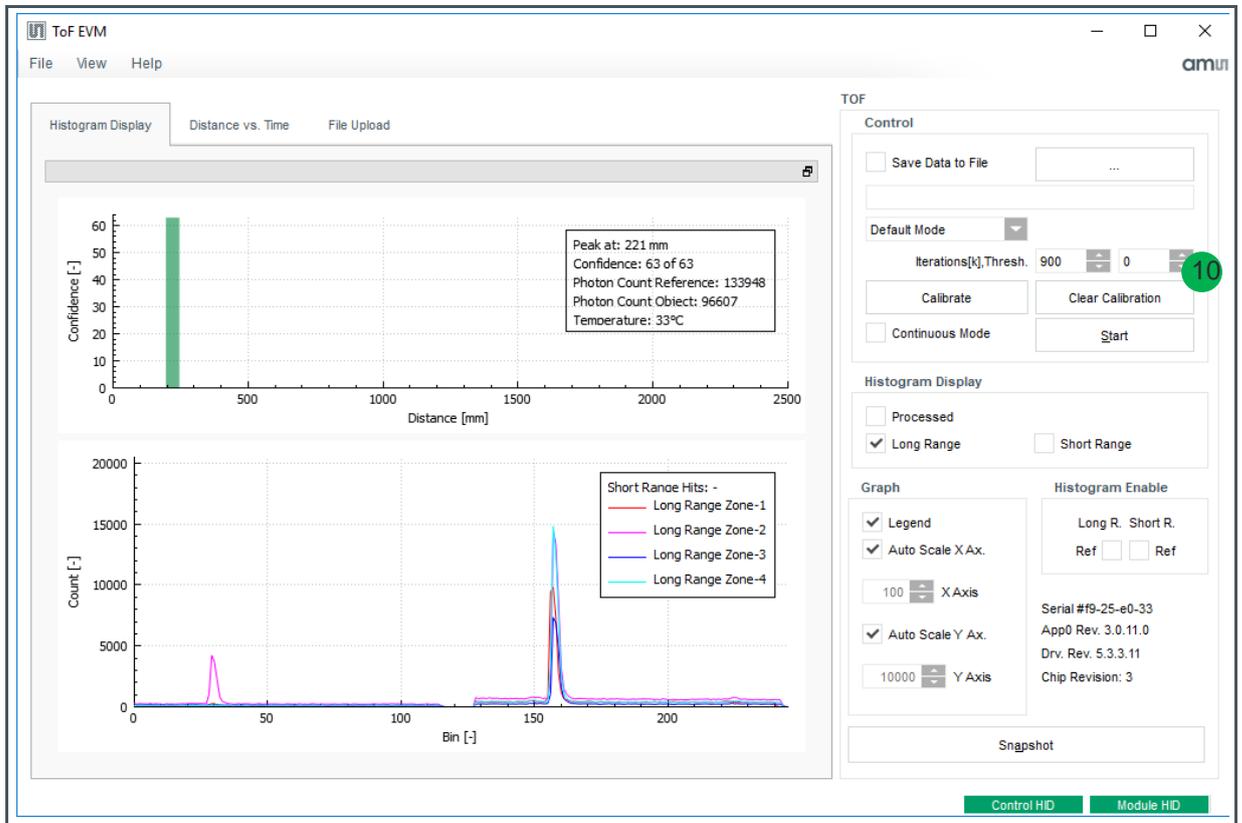
The relevant information and control option labels are:

1. View context, consists of:
  - The “Histogram Display” tab for distance and histogram information
  - The “Distance vs Time” tab for object tracking over time and responsiveness
  - “File upload” tab for updating various software files on the EVM demo kit
2. Distance graph that plots the distance an object is detected vs the confidence in the detection of an actual object
3. Histogram plotting area for various histograms
4. “Control” box for data logging, continuous vs snapshot data retrieval, calibration trigger and clear, and operating mode selection
5. “Histogram Display” box for selecting which histogram to display
  - Distance and proximity show raw histograms directly from the TDCs.
  - Processed shows a histogram which is already combined of all TDCs and corrected for ambient light effects.
6. “Graph” box for changing graphing options
7. “Histogram Enable” box for selecting Reference TDC channels
8. Snapshot feature, serial number, EVM kit software revision, and firmware and hardware revision of the ToF sensor chip in the currently connect EVM kit
9. Connection status indicators

### 3.1.1 EVM GUI “Histogram Display” Tab TMF8801/TMF8805

The GUI from version 2.x.x.x onwards automatically detects if a TMF8701 or TMF8801/TMF8805 is connected. If a TMF8701 is connected, see section just above. For TMF8801/TMF8805 the Histogram display Tab is shown in following Figure 6:

Figure 6 :  
Histogram Display Tab TMF8801/TMF8805



Additionally to all the controls available for TMF8701, the TMF8801/TMF8805 GUI adds following control (10):

- Mode of operation: High Performance mode, default mode, low power mode. These are predefined setting for iterations and threshold.
- Iterations / threshold:
  - Define the number of iterations for acquisition. An iteration is typically 26.6ns, so e.g. 900k iterations result in 24ms acquisition time. Calculation time is approximately 9ms, so the total ranging time is 33ms.
  - Threshold: Detection threshold. It is ok to stay at default 0 setting.



**Information**

To get fastest ranging time, disable all histogram display functions.

### 3.1.2 Distance vs Confidence Graph

This is a plot of the detected object's distance vs the confidence value (range 0 – 63) of the given detection. The X axis indicate the distance in millimeters and the Y axis indicates the confidence value.

### 3.1.3 Histogram Plot

This is a plot of the TDC histogram information based off the selections in the “Data” box and the “Histogram Display” box. The X axis indicates the “time buckets” in 100 picosecond increments, and the Y axis indicates the number of photonic triggers/hits at the given time interval.

### 3.1.4 “Graph” Box

The Graph box controls the display parameters of the histogram plots. You can enable/disable auto scaling of the independent axes or optionally set a fixed range to display. The graphing legend box will show labels for the various histograms as well as precise distance and confidence values in the distance vs confidence graph.

### 3.1.5 “Control” Box

#### Logging Data

For logging Data:

1. Click “...” and use the File Explorer to fill out a log file path
2. Select the “Save data to file” option
3. Perform desired data collection
4. De-select “Save data to file” option
5. View the contents of the entered file path to observe the collected data



#### Attention

Be careful when logging with multiple data options selected over a long period of time. With all histograms enabled and continuous logging the resulting log file can be almost 1 GB in size in 1 – 2 hours.

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### Finding Software Version Information

The software versions of the ToF EVM GUI, EVM kit, and ToF firmware are displayed in the lower right hand corner of the ToF EVM GUI as well as logged to the data file selected in section Logging Data.

The format of the version information in the log file:

```
#VER;ToF Serial Number;App0 Version Number;GUI Version Number;Host Driver Version Number  
#VER;01-00-80-0b;01.02.04.00;1.0.0.0;01.01.00.00
```

### Continuous vs Snapshot Data Retrieval

Selecting the “Continuous Mode” box will force the EVM GUI to continuously pull data from the EVM demo kit for displaying in real time. If continuous is not selected the data will only be updated each time the user selects the “Start” button.

### Operating Mode Selection

This drop-down box shows the available operating modes available to the ToF device. Some examples are “distance + proximity” or “proximity” only. The object detection graph will scale accordingly for the supported distances in the current operating mode.

### Trigger/Clear Calibration

The “Clear Calibration” button will clear the current devices factory calibration data and resume measurements with the current EVM GUI parameters. During this short time the device is reset and all graphs will stop updating until the reset is complete. The “Calibrate” button will trigger a factory calibration measurement. Both calibration and clearing the calibration take approximately 1 - 2 seconds to complete.



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#### Attention

When performing factory calibration no object should be within 400mm of the ToF sensor’s field of view and use low ambient light (avoid high IR content).

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## 3.1.6 “Histogram Display” Box

### TMF8701

The Data box indicates which histogram types are displayed in the histogram plotting area.

- Distance measurement histograms (only applicable when “distance” mode is enabled)

- Proximity histograms
- Processed histograms

### TMF8801/TMF8805

The Data box indicates which histogram types are displayed in the histogram plotting area.

- Short and long range histograms  
These are the raw histograms directly from the TDC channels. See datasheet for description of long / short range.
- Processed histograms  
Processed shows a histogram which is already combined of all TDCs and corrected for ambient light effects

### 3.1.7 “Histogram Enable” Box

This box allows the user to select the reference TDC channels for display in the histogram plotting area. The GUI will always display TDC channels 1-4 if long range / short range respectively distance or proximity histograms are enabled.

### 3.1.8 Histogram Snapshot Control

The Histogram Snapshot button allows the user to “freeze frame” the current histogram plot while still plotting the real time histograms concurrently. This gives the ability examine two histogram plots (one in real time, the other a snapshot) at the same time in the histogram plotting area. Hitting the “Clear” button deletes the saved snapshot histograms.

### 3.1.9 Connection Status Indicators

Connection status indicators between the EVM GUI software and the ToF EVM software running in the enclosure.

- “Control HID” is the connection status with the enclosure software
  - A RED icon indicates there is no good connection with the enclosure software
  - A GREEN icon means the connection is good
- “Module HID” is the connection status with the ToF demo software
  - A RED icon indicates that there is a problem communicating with the ToF demo software or an internal software error.
  - A GREEN icon means the ToF software connection is good

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## 3.2 EVM GUI “Distance vs Time” Tab

The Distance versus Time tab replaces the distance vs confidence graph and histogram plot with a single display of the object data reported over the previous 3.5 seconds. The control options to the right of the window have the same meaning as the “Histogram Display” tab with some of the histogram displaying options removed.

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## 3.3 EVM GUI “File Upload” Tab

The File Upload tab provides a way to upload new firmware binaries to the EVM kit. When logging is enabled the various software versions and revisions of the GUI and on the EVM kit are logged as well.

### 3.3.1 Active Modules Box

After selecting the “Update Information” button the relevant information about the currently running user modules and kernel modules will be updated.

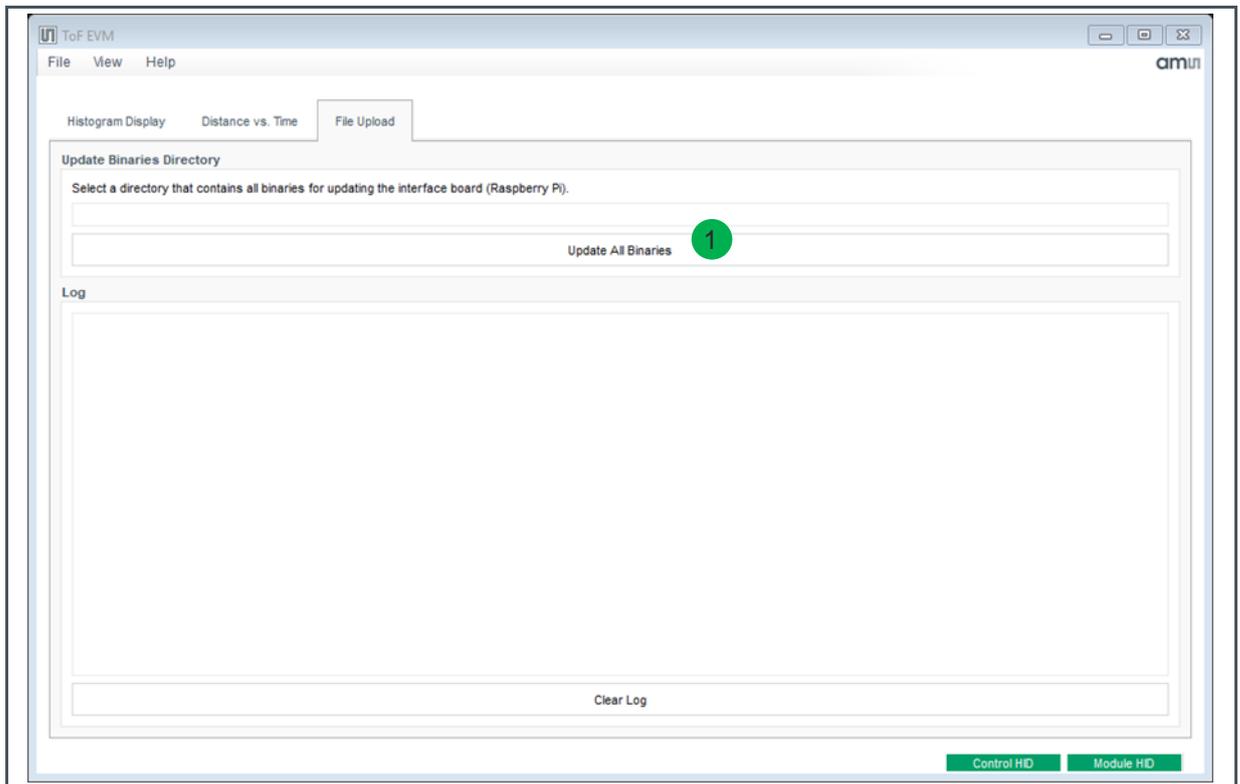
### 3.3.2 Upload File Box

You can enter a specific target file path and select a desired local file to upload to the EVM kit software. If updating a currently running module, that module must be unloaded first by using the “Unload” button, then uploading the new version of the module and then selecting the “Load” button to reload the module. The user must select whether it is a kernel module or user module that is to be loaded/unloaded and fill in the module name.

## 3.4 Upgrading the EVM Firmware

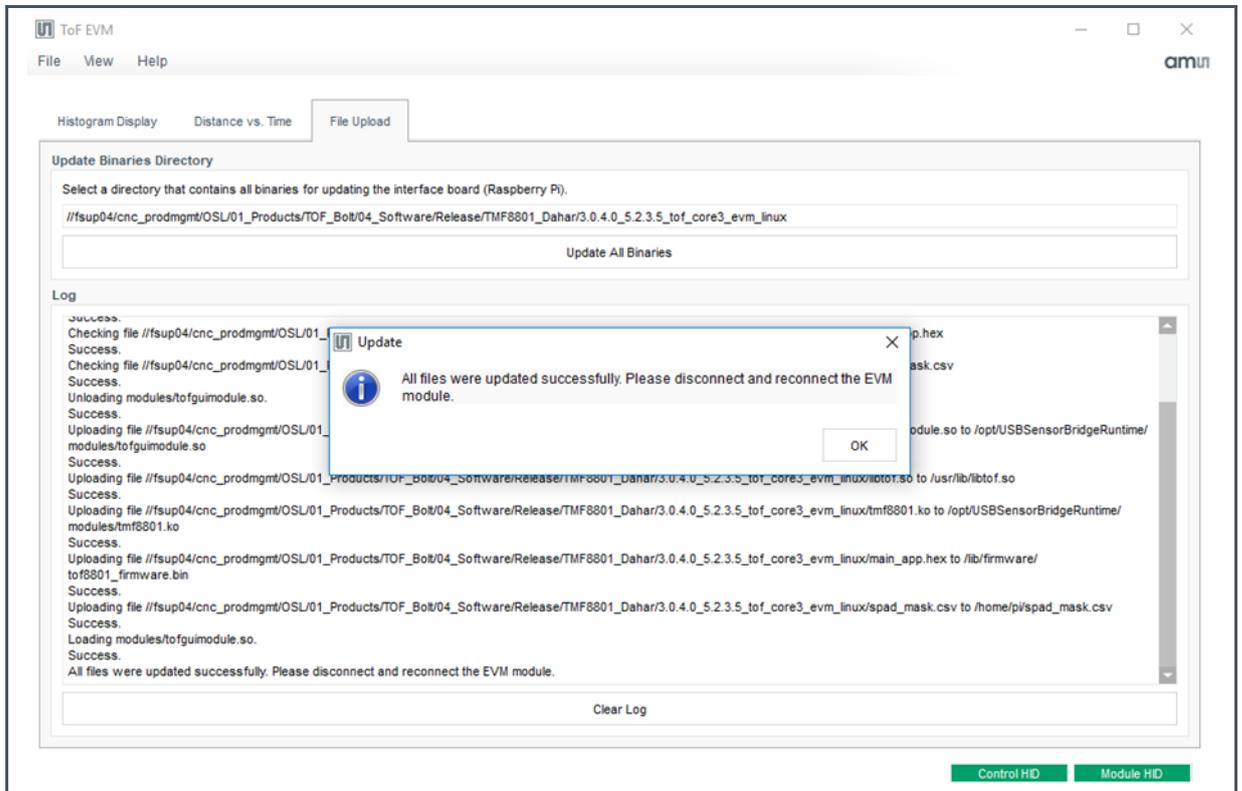
To upgrade the EVM use following tab:

**Figure 7 :**  
**Firmware Upgrade GUI 2.x.x.x**



Press “Update All Binaries” – see **1** above – and select directory where the new firmware is located. Use “Select Folder” in the directory selection box to start the firmware upgrade. Power cycle the EVM once firmware upgrade is finished (see Figure 8).

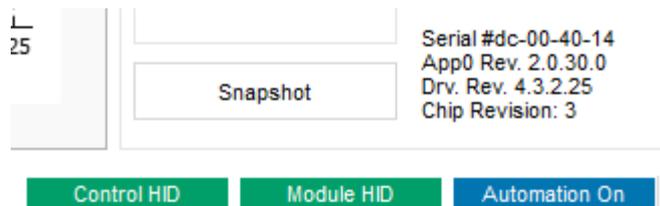
Figure 8 :  
Firmware Upgrade Finished -> Power Cycle EVM



## 3.5 Automation of Measurements

The EVM firmware allows control through a separate (e.g. customer) program. The communication link is achieved through TCP/IP using TCP port 39999 on the host where the EVM GUI is running.

1. To start the automation mode the automation host needs to open a TCP connection to 127.0.0.1 port 39999  
To use 127.0.0.1 (localhost), the automation host must run on the same machine as the EVM GUI. Once connected the GUI shows following status:



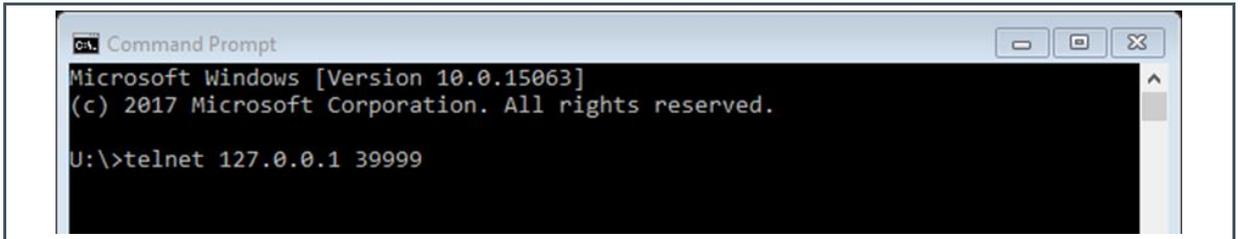
2. After the connection is established, the EVM sends version and calibration information to the automation host.  
This will look like this:  
#VER;dc-00-40-14;2.0.30.0;1.6.0.0;4.3.2.25;7;3  
#CAL;02;21;37;00;0F;15;80;F9;F0;FF;FC;17;34;00;04
3. To trigger a single measurement the automation host has to send the character "m" to the EVM GUI
4. To switch the distance measurement algorithm mode send these characters to the EVM GUI from the automation host (only TMF8701)  
"d" -> distance mode  
"p" -> proximity mode  
"b" -> combined mode
5. The EVM GUI sends all histograms the user selects with the checkboxes in the GUI. The default is the "Processed" histogram
6. The protocol for the measurement data is described in document TMF8XXX\_Logfile\_Format.docx

### 3.5.1 Automation Example Session

To operate following example, the EVM GUI needs to be started first.

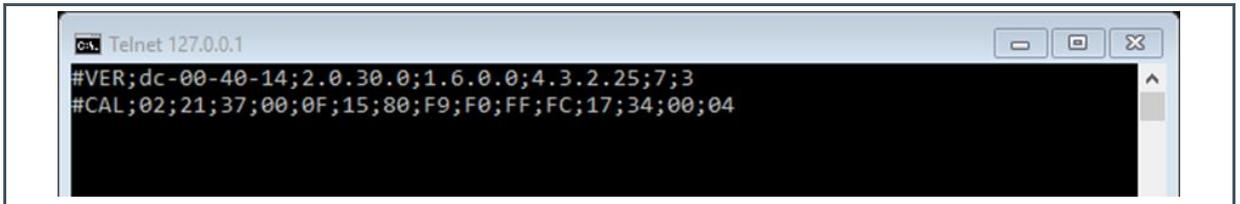
Start the Windows shell “cmd” and connect through Windows program telnet:

**Figure 9 :**  
**Telnet Command**



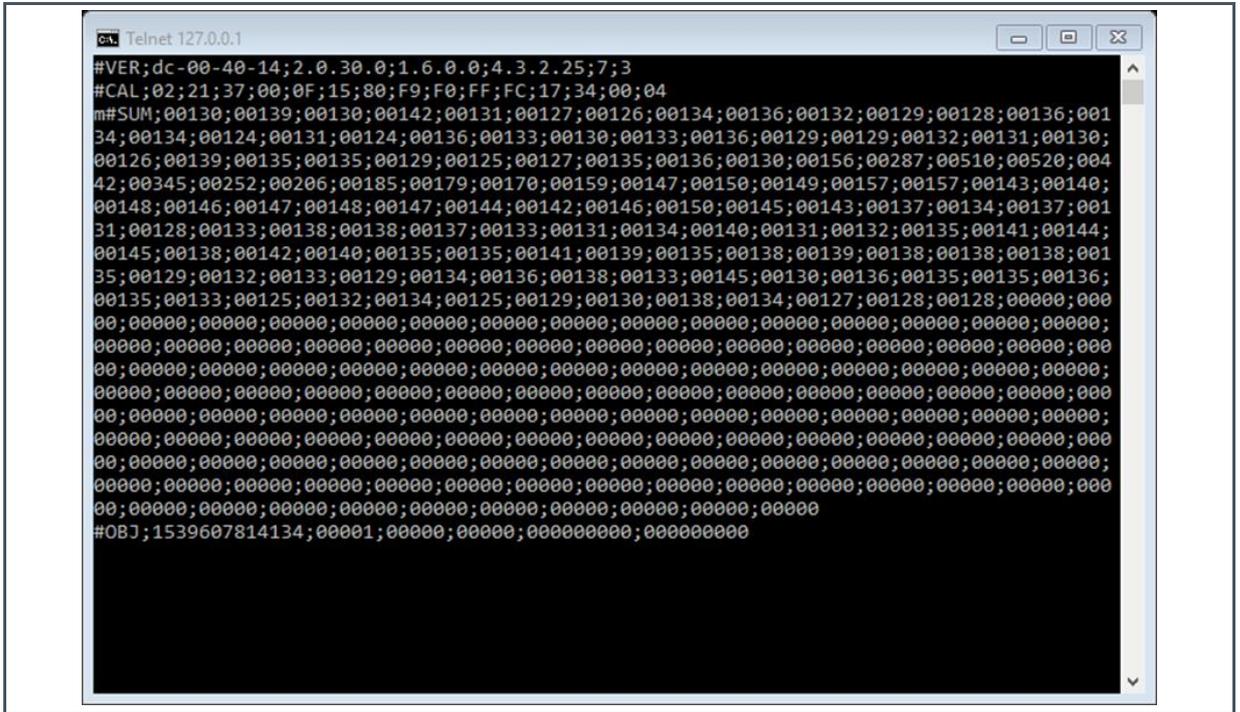
Immediate response and in the GUI the status ‘Automation On’ is displayed

**Figure 10 :**  
**Automation Example**



Press “m” executes one measurement and transfer the enabled histograms (in this case only the average histogram):

Figure 11 :  
Automation Result



Disabled “Processed” histogram display and used “m” – reported an object at 107mm distance, with 63 confidence:



## 4 Revision Information

Changes from previous version to current revision v4-00	Page
Updated document with new EVM GUI screenshots	7, 9
Updated document with TMF8805	

- 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.

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