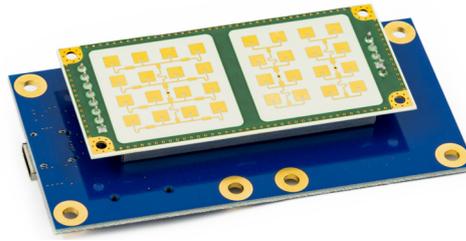


K-MD7-EVAL

K-MD7 evaluation kit



Features

- › Easy evaluation of the digital radar sensor K-MD7
- › Powerful control panel GUI included
- › Real-time streaming and visualisation of all sensor data
- › Data recording and playback including video using a webcam
- › Saves time to market and reduces NRE costs

Applications

- › Getting started with the K-MD7
- › Real-time optimisation of the radar parameters for different applications
- › Situation recording including video data for later analysis in the lab
- › Learning about the potential of a K-MD7 sensor

Description

The K-MD7 evaluation kit is a powerful tool to evaluate the use of the K-MD7 for your application idea. It features a tripod holder and visualises the digital output of the sensor over an LED. Further it features an easy connection to a PC over a simple USB connection without any needs for an external power supply.

With the supplied powerful Control Panel software, the development time is reduced drastically. All the sensor parameters can be modified using the Control Panel, without having to look at the command list of the K-MD7. The influence of changed parameters can be directly checked in the real-time views of the software. The control panel features a lot of different views including a histogram to analyse the measured data in detail. Furthermore it is possible to record all measured data and replay it directly in the software to analyse different application scenarios offline without the sensor.

Control Panel

Figure 1: Control panel

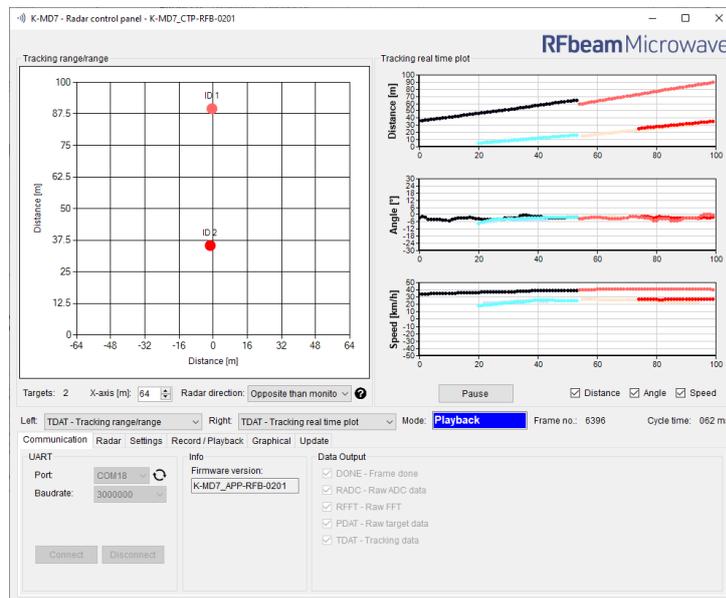
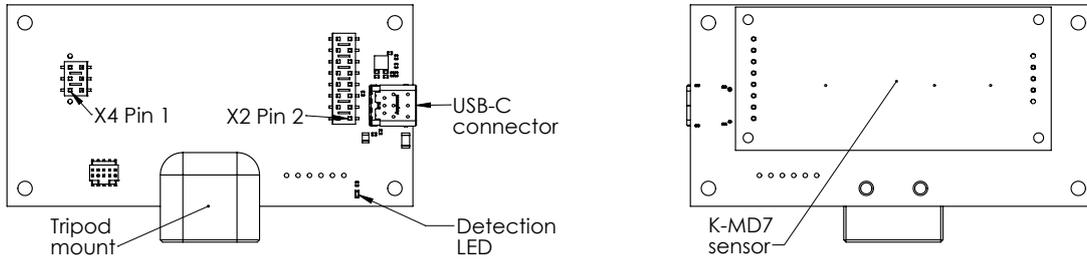


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1 Pin Configurations and Functions

Figure 2: Pin configuration and functions



The K-MD7 evaluation kit consists of an evaluation kit PCB in combination with a tripod mount and a K-MD7 sensor. There is an USB-C connector mounted on the PCB for powering and connection the K-MD7 directly to a PC. Further there is a detection LED mounted on the board to visualise if the sensor has detected any targets inside of a definable zone.

Table 1: Pin function description

Connector	Pin. No.	Name	Description
K-MD7 X4	1, 3, 5	Mounting	These pins are for mounting only. <div style="border: 1px solid black; padding: 2px; margin-top: 5px;"> ⚠ Leave these pins floating and do not connect them to any potential. </div>
K-MD7 X2	2	GND	Ground pin
	4	Detection out	Digital detection output
	6	VCC	Power supply pin (3.2 to 5.5V)
	8	RX	Serial interface RX input
	10	TX	Serial interface TX output
	12	Digital IO 1	Reserved for future use, do not connect
	14	Digital IO 2	Reserved for future use, do not connect
	16	Digital IO 3	Reserved for future use, do not connect

2 Installation

1. Connect the delivered USB Stick to your PC.
2. Open the installer folder on the stick.
3. Install the K-MD7 Control Panel by double clicking the setup.exe file. If no .net framework is installed, the installer will install it automatically.

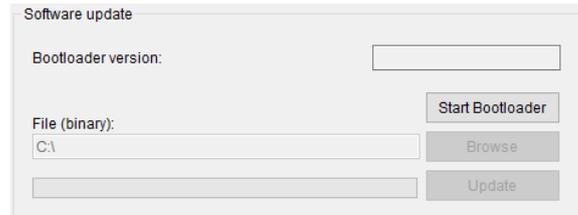
 To use the integrated video function, install and test your webcam before you go to the next chapter. Please download and install necessary drivers for the webcam from the manufacturer website.

3 Quick Start

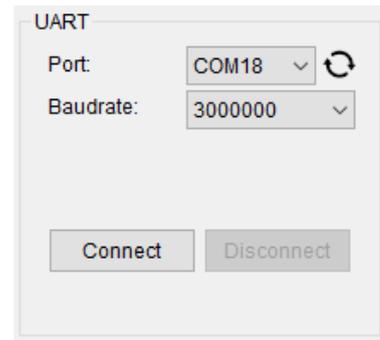
1. Connect the USB cable to the X1 connector of the evaluation kit.
2. Connect the other side of the USB cable with your PC and wait until the serial COM port driver is installed. If the driver does not install automatically, install it by double clicking the FTDI_setup.exe in the installer folder of the USB stick.
3. Start the K-MD7 Control Panel software.
4. Select the correct COM port and click the connect button.
5. On a system with multiple webcams, a dialog will pop up. Select the webcam you want to use.
6. The Mode indicator switches to Live stream and the software is ready to use.

4 Software Update

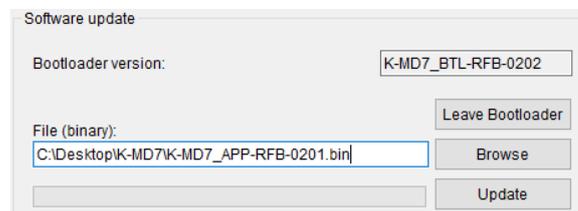
1. Connect the USB cable to the X1 connector of the evaluation kit and to your PC.
2. Start the K-MD7 control panel and connect to the sensor. The mode display shows «Live stream» to indicate that the sensor has started to the application.
3. Switch to the Update tab and jump to the bootloader by pressing the «Start Bootloader» button



4. Reconnect to the sensor by pressing the «Connect» button. Now the mode display shows «Bootloader» to signal that the control panel is connected to the bootloader.



5. Use the «Browse» button to select the firmware update file provided by RFbeam Microwave and press the «Update» button to start the update.



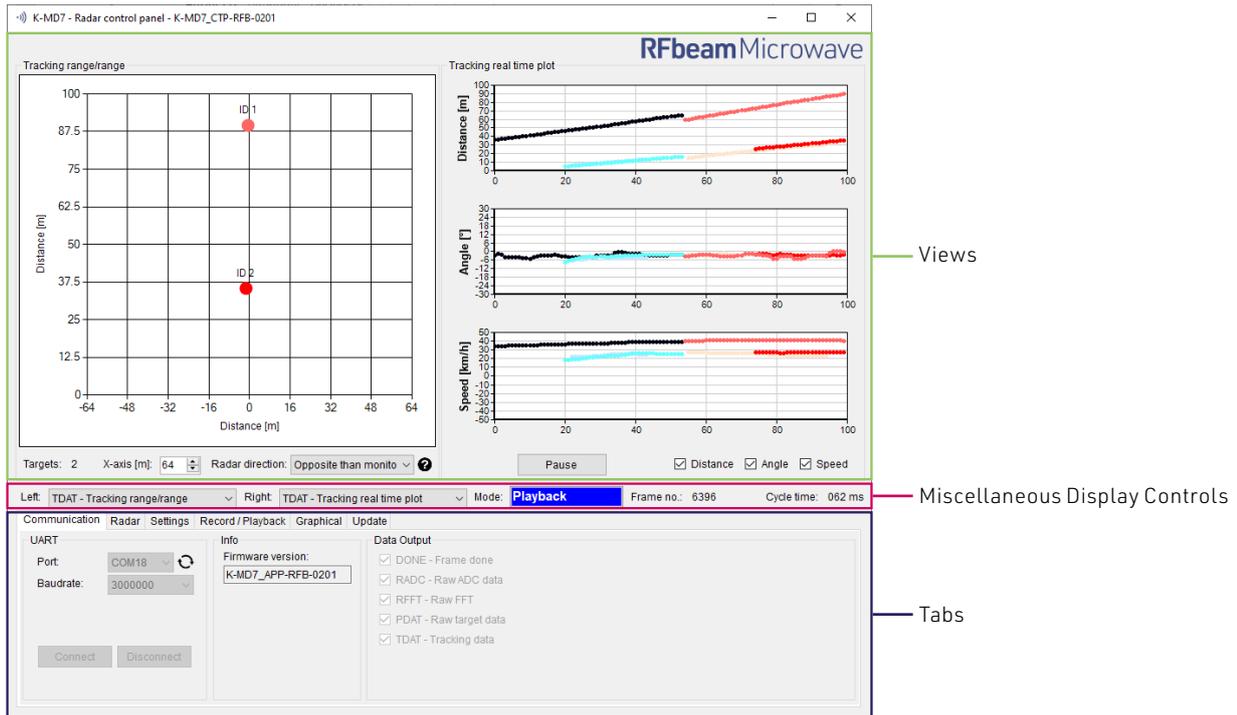
6. Wait until the process has finished. A message box indicates if the update was successful. The application starts automatically and by switching to the communication tab it is possible to directly connect to the sensor.

5 Control Panel

The control panel contains many configuration options. The structure of the panel views is designed to guide through the different steps of the radar processing, which is described in detail in the datasheet of the K-MD7.

The control panel consists of three different areas which are described in detail in the next chapters.

Figure 3: Overview control panel areas

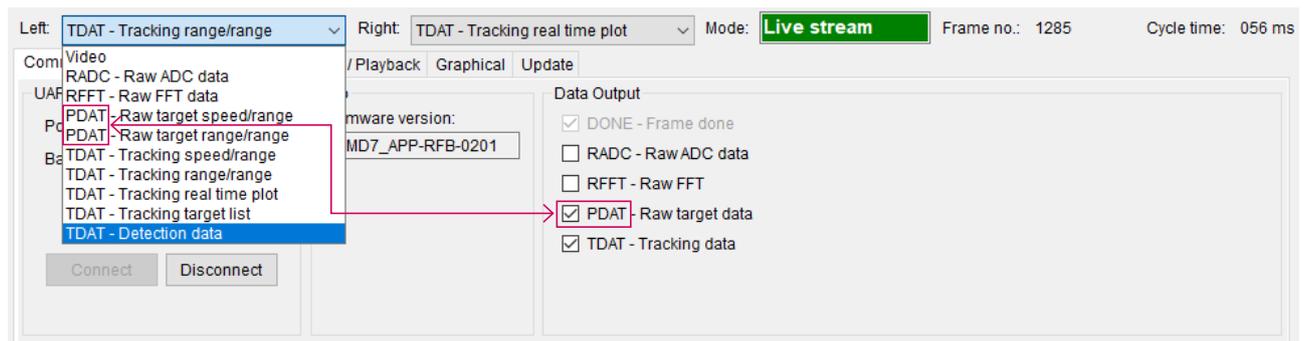


There are many views to select in the miscellaneous display controls area. All of them have a preceded shortcut based on the data output which is used in the views (RADC, RFFT, PDAT, TDAT). To use the different views the according data output needs to be enabled.

For example, if «PDAT – RAW Target Data» is turned in the «Data output» section, the views on the right will start to visualise the K-MD7 data.

- PDAT – Raw Target Speed/Range
- PDAT – Raw Target Range/Range

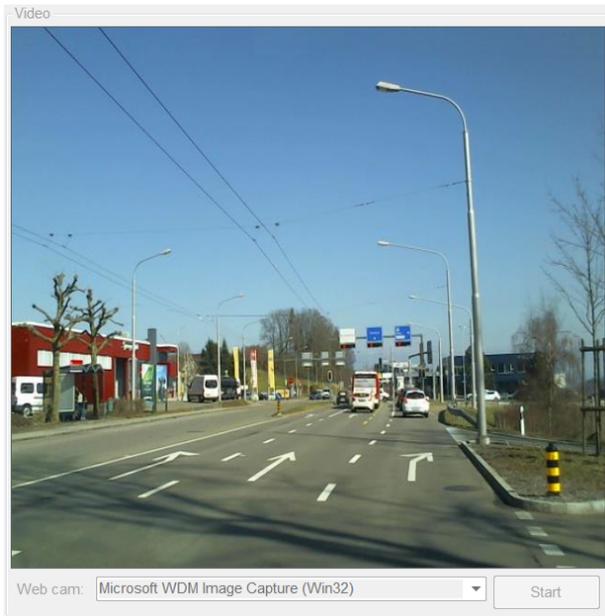
Figure 4: Data output example



5.1 Views

The control panel features the possibility to simultaneously show two views in parallel to visualise the sensor data in different ways. How to switch between the different views is described in the chapter Miscellaneous Display Controls on page 10.

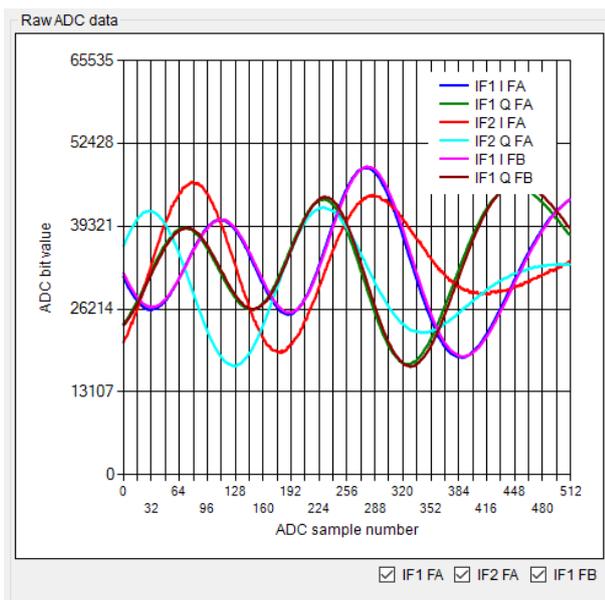
5.1.1 Video



If a webcam is connected to the PC it is possible to show the video picture in this view.

To start the video stream, the button «Start» needs to be pressed.

5.1.2 RADC – Raw ADC data

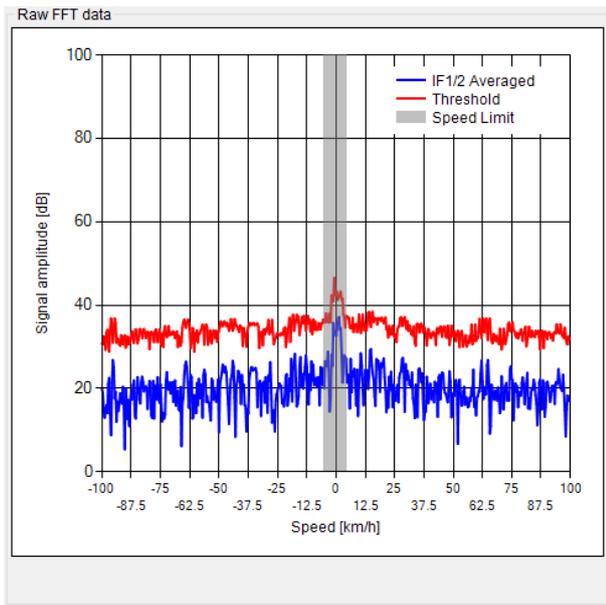


The RADC view shows all sampled ADC channels of the sensor.

It is possible to enable and disable the different groups of channels using the checkboxes below the graph.

A detailed description about the RADC values can be found in the K-MD7 datasheet.

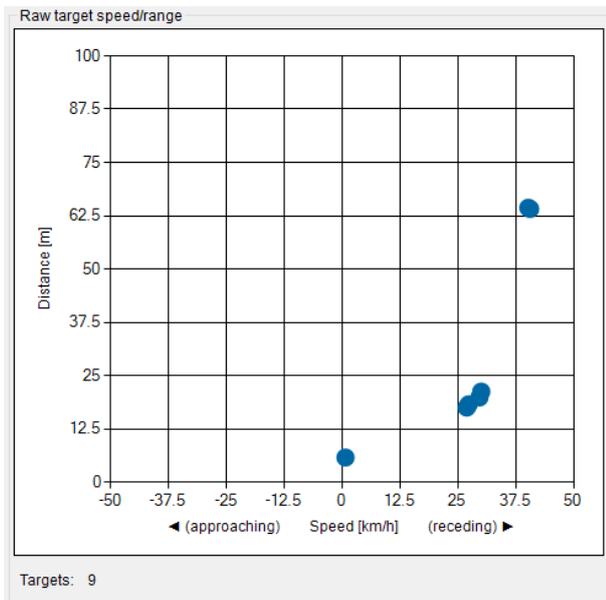
5.1.3 RFFT – Raw FFT data



The RFFT view shows the average frequency spectrum of the two receiving channels. Further the threshold is visualised. Each movement which generates a frequency with an amplitude above the threshold is used for the calculation of the raw targets.

A detailed description about the processing in the sensor can be found in the K-MD7 datasheet.

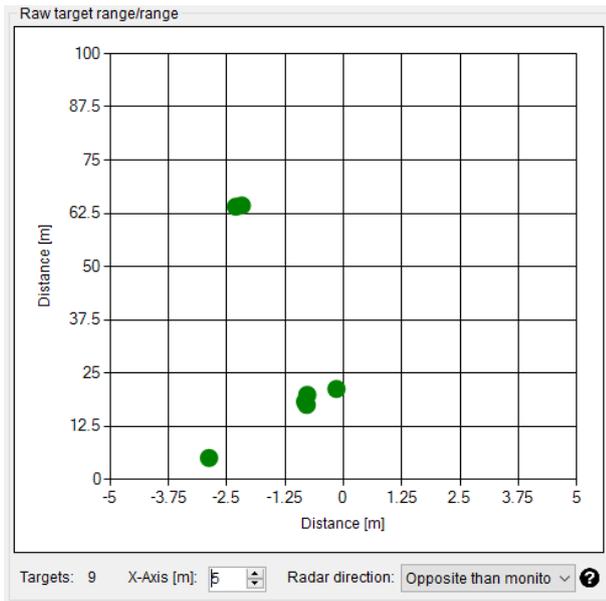
5.1.4 PDAT- Raw target speed/range



This view contains all the found raw targets and visualise them in distance and speed.

No. of targets:
Count of actually reported raw targets (Max. 24 targets).

5.1.5 PDAT - Raw target range/range

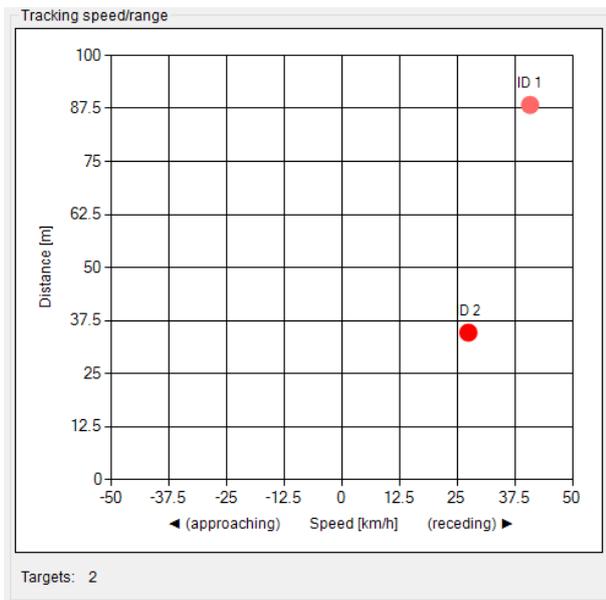


This is one of the most interesting views, as the information of the targets is interpreted and shown in a two-dimensional map. The targets show the radar's view of the real world and colours the points according to the direction of the movement. It is possible to change the scaling of the X-axis.

No. of targets:
Count of actually reported raw targets (Max. 24 targets).

Radar direction:
Defines the direction of the radar to the monitor. If «Same as monitor» is used, the webcam video has to be mirrored to correspond to the data.

5.1.6 TDAT - Tracking speed/range

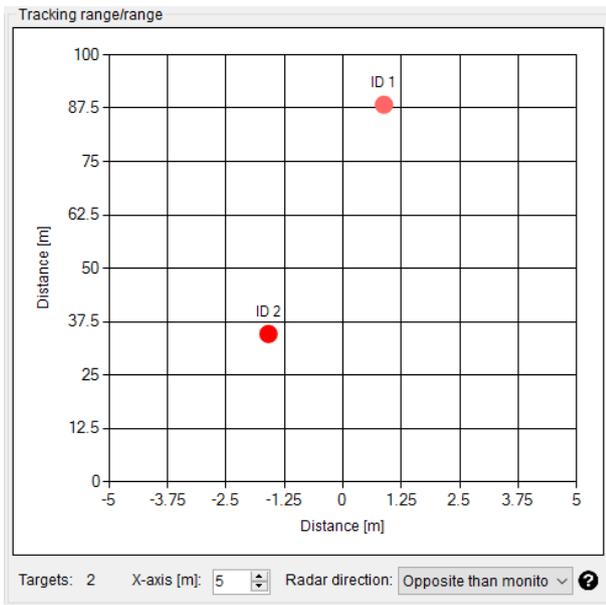


Compare this view with the corresponding raw view (PDAT) to see the improvements of the tracking filter.

The view also shows the tracking channel ID of each object in combination with a unique colour for each ID.

No. of targets:
Count of actually reported tracked targets (Max. 8 targets)

5.1.7 T DAT - Tracking range/range



Compare this view with the corresponding raw view (PDAT) to see the improvements of the tracking filter. It is possible to change the scaling of the X-axis.

The view also shows the tracking channel ID of each object in combination with a unique colour for each ID.

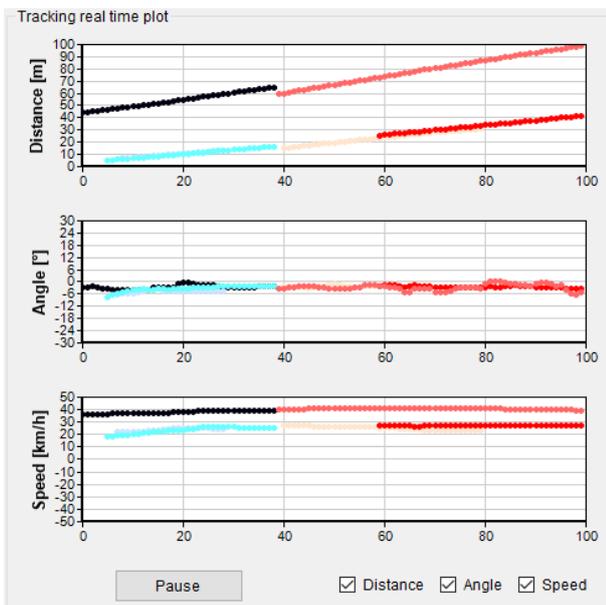
No. of targets:

Count of actually reported tracked targets (Max. 8 targets)

Radar direction:

Defines the direction of the radar to the monitor. If «Same as monitor» is used, the webcam video has to be mirrored to correspond to the data.

5.1.8 T DAT - Tracking real time plot



This view is very helpful to analyse the tracked targets.

It visualises the distance, angle and speed over the time.

It is further possible to freeze the view with the button below the charts or to enable or disable sub views by the checkboxes.

The targets are coloured with a unique colour per tracking channel ID.

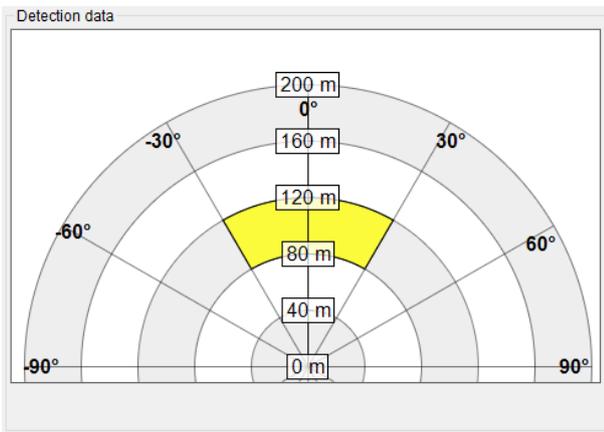
5.1.9 TDAT - Tracking target list

Tracking target list					
Track	ID	Distance [m]	Angle [°]	Speed [km/h]	Magnitude [dB]
	1	110.6	-2.5	38.0	46.8
	2	49.1	-2.2	25.8	43.5

This view shows all TDAT targets in a table including distance, angle, speed and magnitude information. This is very helpful to analyse the tracked targets in combination with the real time or range/range plot.

The targets are coloured with a unique colour per tracking channel ID.

5.1.10 TDAT-Detection data



The sensor features a customisable detection zone filter to signal a detection on digital output 0 if in minimum one TDAT target is inside of the defined yellow detection zone.

A detailed description about the detection zone filter and processing in the sensor can be found in the K-MD7 datasheet.

5.2 Miscellaneous Display Controls

The middle of the control panel is used to control which views are visualised in the views area. It is easy to switch between the different views using the two drop down lists. Further the mode of the GUI, the actual frame number and the cycle time of the frames is displayed.

Figure 5: Miscellaneous display controls



It is not possible to display the same view left and right at the same time.

Table 1: Different possible modes

Mode	Description
Disconnected	No connection to the K-MD7
Live Stream	The control panel is connected to the K-MD7 and receives data
Record	Data will be recorded to the PC
Playback	Recorded data will be played and visualised
Bootloader	K-MD7 is in bootloader mode and ready for a firmware update

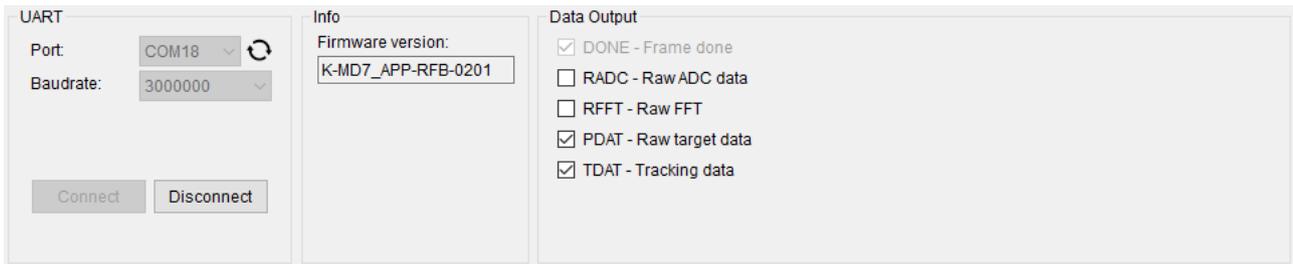
5.3 Tabs

This chapter describes the different control tabs of the software. It is possible to control all the parameters of the K-MD7 and all the functions of the control panel over these tabs.

 A more detailed parameter description of the sensor can be found in the datasheet of the K-MD7.

5.3.1 Communication

Figure 6: **Communication tab**



5.3.1.1 UART

To connect to the sensor, select the correct COM port of the evaluation kit in the port drop down list. The list can be updated over the refresh function (circular arrows on the right side of the drop down list) if the COM port is not shown correctly. Select the maximal baud rate and press the Connect button to start the communication with the K-MD7.

 If the highest baud rate does not work select a lower baud rate and try to reconnect. A lower baud rate can increase the cycle time when data intensive outputs like RADC or RFFT are enabled.

5.3.1.2 Info

When a K-MD7 is connected this indicator gives an information about the firmware version of the sensor.

5.3.1.3 Data Output

Select which output is sent from the radar to the control panel. The respective views can only show data if the corresponding data outputs are enabled. The control panel uses the streaming mode of the sensor to speed up the data communication.

 The cycle time can increase due to more enabled data outputs or the power of the PC. Data intensive outputs like RADC and RFFT can slow down the communication.

5.3.2 Radar

Figure 7: Radar tab

Radar			
Range [m]:	200	Min./Max. distance [%]:	40 60 = 80..120m
Speed [km/h]:	100	Min./Max. angle [°]:	-30 30
Threshold offset [dB]:	12	Min./Max. speed [%]:	5 100 = 5..100km/h
Base frequency:	Middle	Detection direction:	Both
Tracking filter type:	Standard		

This tab controls the main settings of the processing chain in the radar sensor. By changing these parameters, it is very easy to adapt the sensor to the needs of an application and check the influences in real time. A detailed description of all parameters can be found in the chapters Radar Settings and Detection settings of the K-MD7 datasheet.

For example, if the goal is to measure objects in the 100m distance and 50km/h speed range, but cars are moving at 150m with 150km/h, the 200m distance range and 200km/h speed range setting must be used or the threshold offset needs to be increased until the cars are no longer visible in the raw targets.

It is very important to set the distance and speed range settings to values that match with the distance and speed of the expected targets in the detection area of the sensor.

 Wrong settings can generate false sensor outputs. It is possible that strong targets outside the configured distance or speed range can create false reflections.

5.3.3 Settings

Figure 8: Settings tab

Load settings	Factory settings
Load settings (K-MD7 will be updated): <input type="text" value="C:\K_MD7_Settings.bin"/> <input type="button" value="Browse"/>	Restore factory settings: <input type="button" value="Restore"/>
Save settings: <input type="text" value="C:\K_MD7_Settings.bin"/> <input type="button" value="Browse"/>	

The settings tab features the possibility to easily save and reload the complete settings of a sensor. This makes it easy to duplicate a useful dataset to multiple sensors. Further it is possible to restore the default factory settings.

5.3.4 Record/Playback

Figure 9: **Record/Playback tab**

This tab can be used to record and playback the sensor data to the hard disk. It is also possible to store the video data in parallel what can be helpful to interpret the measured data in the playback mode.

5.3.4.1 Record data

To record data, you first need to specify a path where to store the data on the PC. By selecting the Store video checkbox, it is possible to also store a picture per frame from the webcam. The recording of the data can then easily be controlled over the Start and Stop button.

The software creates for every recording a new subfolder with a timestamp of the recording in the selected folder and stores there a raw binary file with all received sensor data packets and the video pictures when selected. Refer to the datasheet for detailed information about the packet structure, commands and messages in the stored binary file.

 The record feature records the complete data output of the sensor specified in the communication tab under Data output. The performance of the recording may vary based on the following circumstances:

- Performance of the used PC
- Use of the video capture feature
- Enabled data output
- Used baud rate

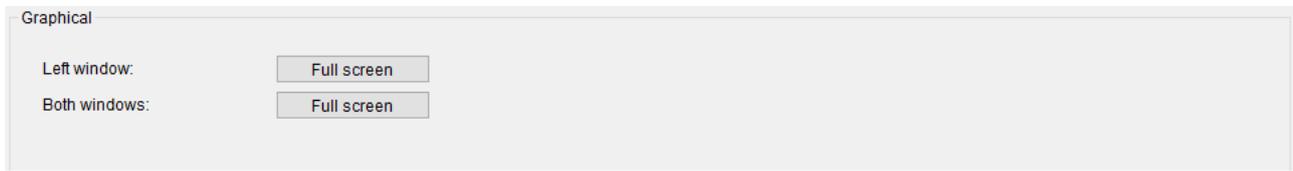
5.3.4.2 Playback data

To playback the recorded data, the control panel must be disconnected. By selecting a folder of a recorded sequence, it is possible to start, stop and pause a recording by a controlled cycle time. Even the start of the frame number in the recorded data can be chosen.

The playback feature is a very powerful tool to do an in depth analysis of the recorded data. It gives the possibility to compare the recorded data easily in all available views when the according data output was enabled for the recording.

5.3.5 Graphical

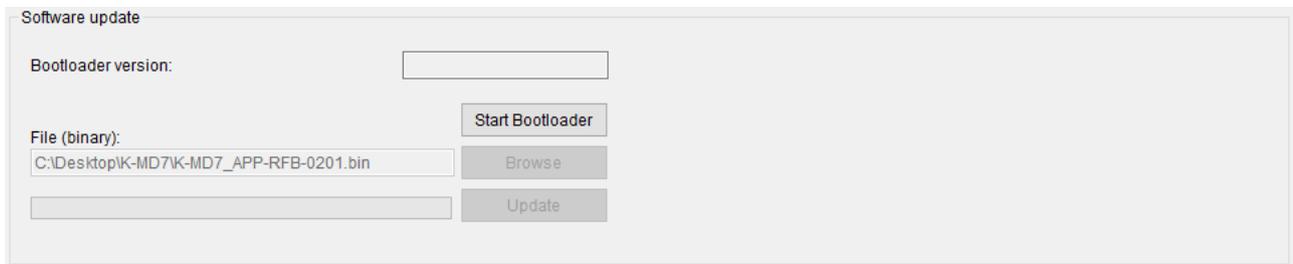
Figure 10: **Graphical tab**



This tab offers the possibility to open a second window with a full screen view. Only the left view or a view with both views can be opened via the two «Full screen» buttons.

5.3.6 Update

Figure 11: **Update tab**



This tab allows the update of the K-MD7 firmware over the serial interface. The sensor starts to the application per default. The «Start Bootloader» button gives the option to start the bootloader out of the application.

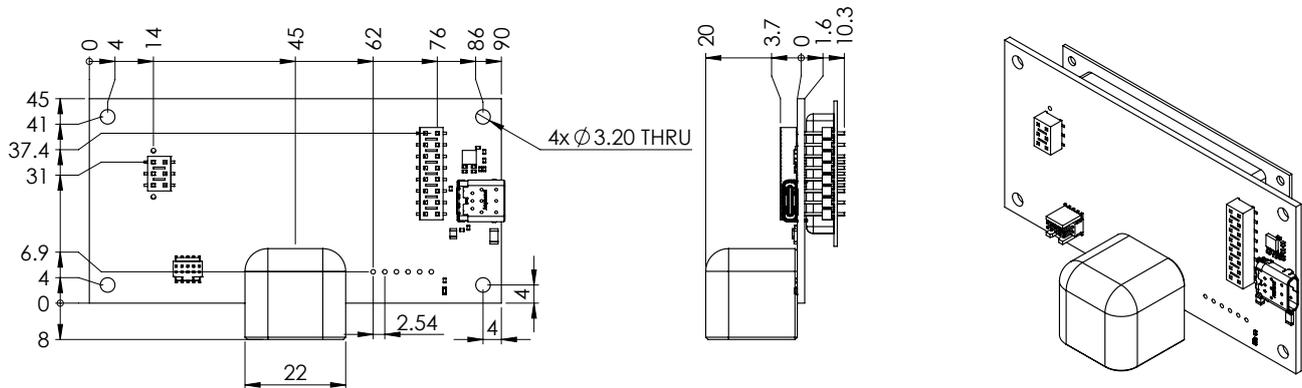
It is possible to update the firmware over the «Update» button after a successful connection to the bootloader.

 A step by step instruction how to update the firmware can be found in the chapter Software Update on page 4.

 Use only firmware update files provided by RFbeam Microwave.

6 Outline Dimensions

Figure 12: **Outline dimensions in millimetre**



7 Order Information

The ordering number consists of different parts with the structure below.

Figure 13: **Ordering number structure**

Product	-	Customer	-	HW variant	Supply
= K-MD7-EVAL		= RFB for standard products		= 00 for standard variant	= H for 3.3V...5V version

Table 3: **Available ordering numbers**

Ordering number	Description
K-MD7-EVAL-RFB-00H	Standard K-MD7 evaluation kit with powerful PC software

8 Packing list

1. Evaluation kit PCB board
2. USB cable
3. USB stick containing
 - a. Control panel software
 - b. Documentation
 - c. Example readout script
4. K-MD7 sensor

9 Revision History

04 / 2023 – Revision A: Initial Version

RFbeam does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and RFbeam reserves the right at any time without notice to change said circuitry and specifications.