RFbeam Microwave GmbH

data sheet

K-LD7-EVAL

K-LD7 evaluation kit

Features

- Easy evaluation of the digital radar sensor K-LD7
- 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
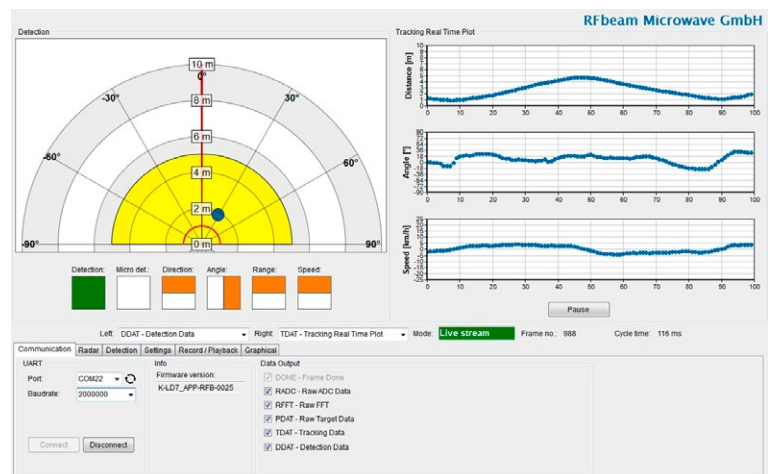
Applications

- Getting started with the K-LD7
- 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-LD7 sensor

Description

The K-LD7 evaluation kit is a fully operational distance triggered movement detector. It visualises all four digital outputs of the K-LD7 over LED's and features an easy connection to a PC over a USB to serial cable which is also included in the kit.

With the supplied powerful Control Panel software, 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-LD7. 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. Further 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

APPLICATION IDEAS
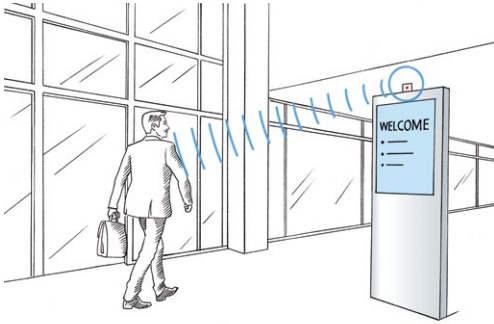
Movement detection

The K-LD7 can be used for a lot of movement detection applications with an excellent interference suppression due to the integrated tracking filter. The ability to measure the distance and angle of the object opens a whole new field of possibilities in the movement detection.
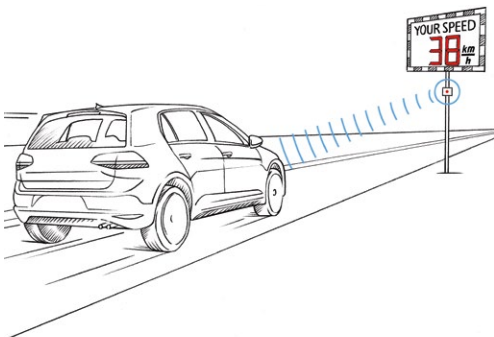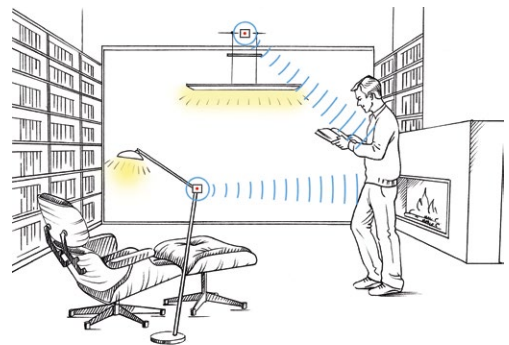
Key Features

– Limit detections to a specific area
– Differentiate between approaching and receding objects
– Easily differentiate if an object is near or far away
– Filter out cross traffic based on the angle information

Indoor and Outdoor Lighting

With a typical detection distance of 15m for persons and 30m for cars the sensor is perfect for lighting applications. The angle and distance measurement allows simple counting applications.

Key Features

– Detects targets in difficult conditions
– Limit detection to a specific area
– Simple object counting based on the angle information
– Micro detection feature for indoor use

Speed measurement

The K-LD7 can track speed, direction, distance and angle of a target up to 30m. This allows for simple distance triggered speed measurements in a limited area.

Key Features

– Smooth speed information due to internal tracking filter
– Measure speed at specific distance
– Limit detection to a specific area
– Limit detection to a specific direction

Blind spot detection

A simple blind spot detection can be realised based on the distance and angle measurement of the K-LD7.

Key Features

– Detects targets in difficult conditions
– Smooth angle and distance information
  due to internal tracking filter
– Limit detection to a specific area
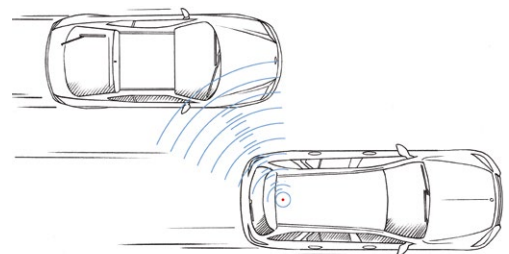– Only detect approaching targets due to direction information

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PIN CONFIGURATIONS AND FUNCTIONS

Figure 1: Pin configuration and functions
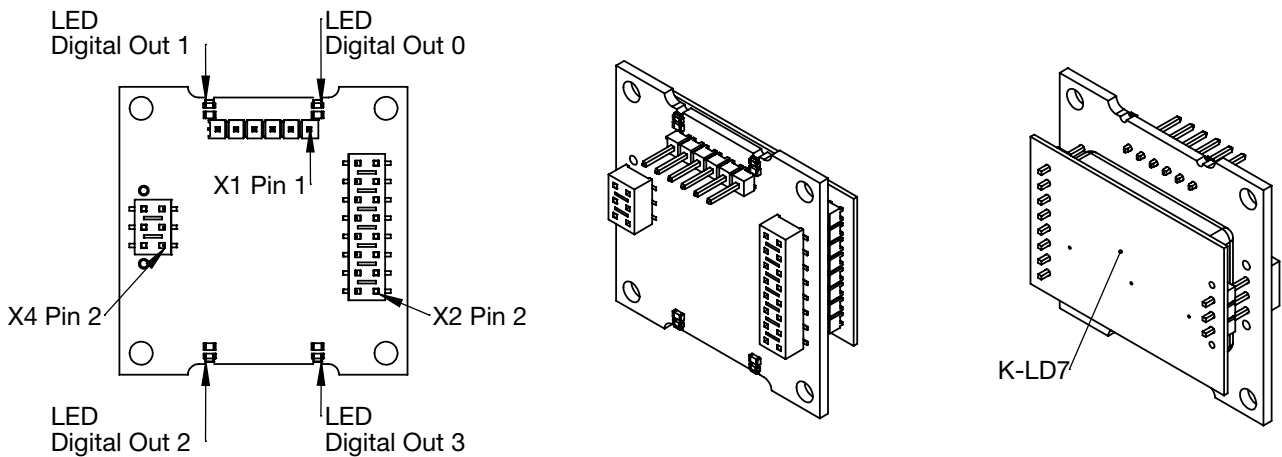
Table 1: K-LD7 connector description

Connector	Pin. No.	Name	Description
FTDI cable X1	1	GND	Device ground
	2	CTS#	Clear to send control input
	3	VCC	Power supply pin (5V)
	4	TXD	Transmit data output
	5	RXD	Receive data input
	6	RTS#	Request to send control output
K-LD7 X4	1,3,5	Mounting	These pins are only for mounting. ⚠ Leave this pins floating and do not connect them to any potential.
K-LD7 X2	2	GND	Ground pin
	4	Digital out 0	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 out 1	Digital miscellaneous output 1
	14	Digital out 2	Digital miscellaneous output 2
	16	Digital out 3	Digital miscellaneous output 3

Connect the K-LD7 to the connector X2 and X4 as shown in the picture above. Please refer to the datasheet of the K-LD7 for a detailed pin description.

INSTALLATION

1. Connect the delivered USB Stick to your PC.
2. Open the installer folder on the stick.
3. Install the K-LD7 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.

QUICK START

1. Connect the K-LD7 to the X2 and X4 connector of the evaluation kit as shown in Figure 1: Pin configuration and functions.
2. Connect the FTDI cable to the X1 connector of the evaluation kit. The black wire of the cable has to be connected to the pin 1 of the connector X1.
3. Connect the USB side of the FTDI 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.
4. Start the K-LD7 Control Panel software.
5. Select the correct COM port and click the connect button.
6. If the communication does not work, switch to a lower baud rate and retry.
7. On a system with multiple webcams, a dialog will pop up. Select the webcam you want to use.
8. The Mode indicator switches to Live stream and the software is ready to use.

> ⚠ Connect the K-LD7 and the FTDI cable with the correct polarization to prevent any damage.

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-LD7.

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

**Figure 2: Overview control panel areas**
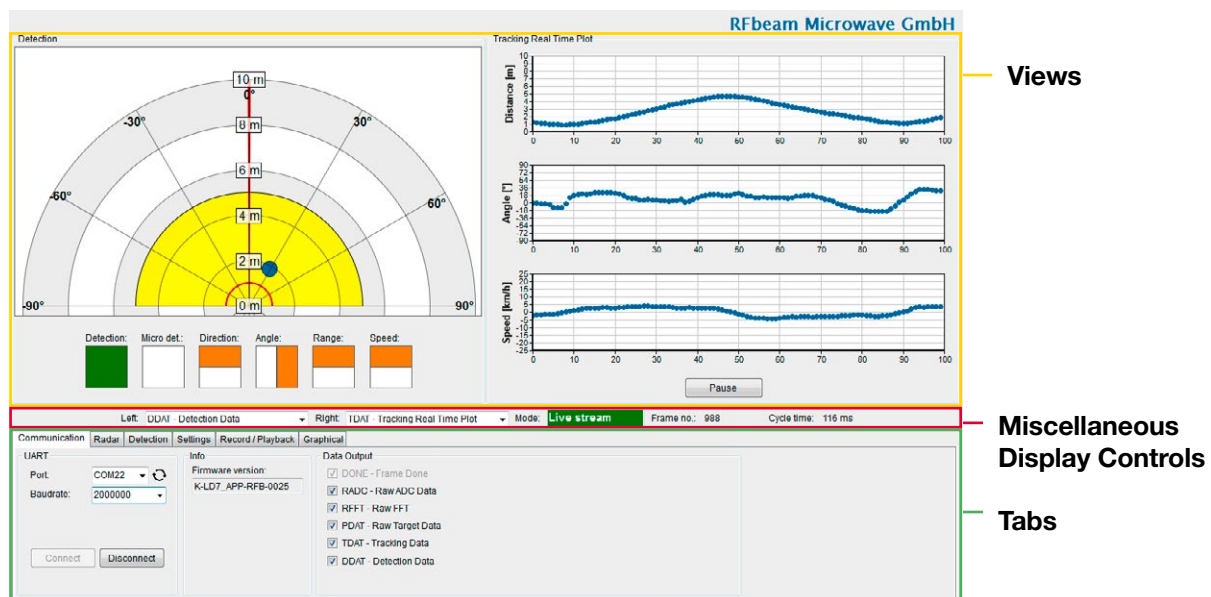
There are many views to select in the miscellaneous display controls area. All of them have a preceded shortcut based on the data output which is used in the views (RADC, RFFT, PDAT, TDAT, DDAT).
To use the different views the according data output needs to be enabled.

For example, if «PDAT – RAW Target Data» is turned on in the «Data output» section, the views on the right will start to visualise the K-LD7 data.

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

Figure 3: Data output example
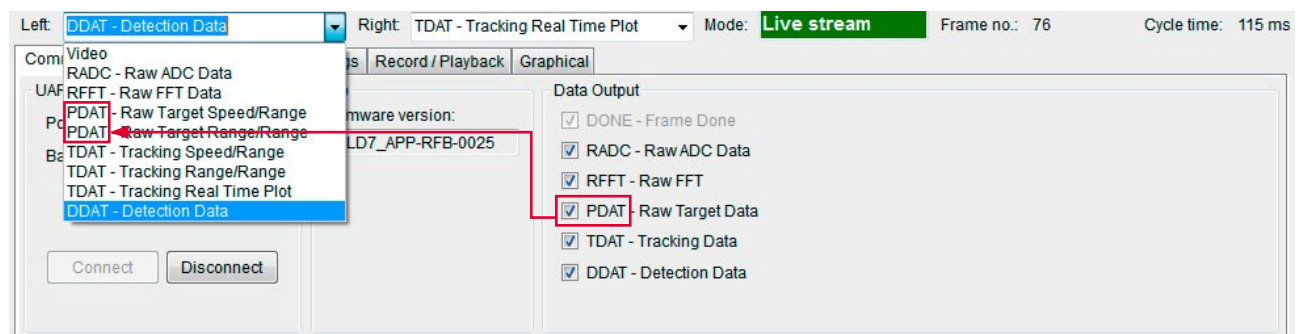
Views

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.
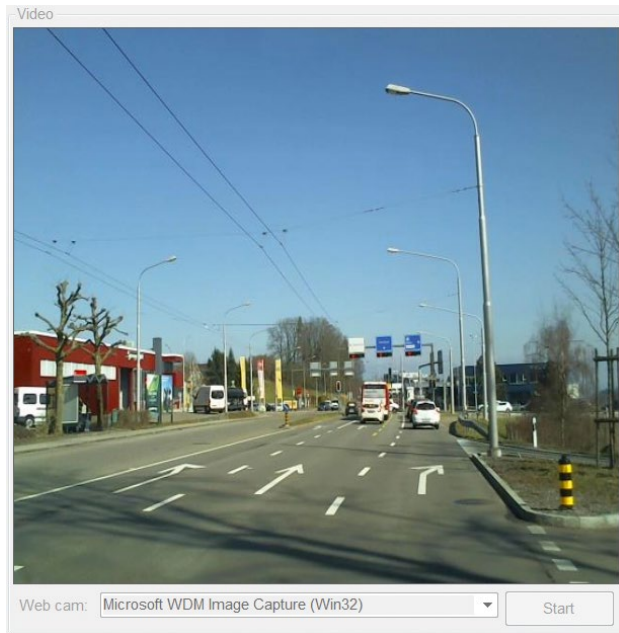
Video

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.
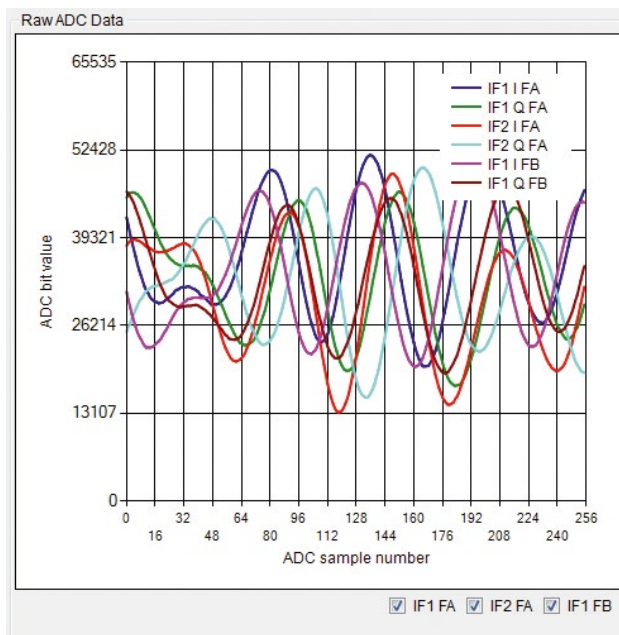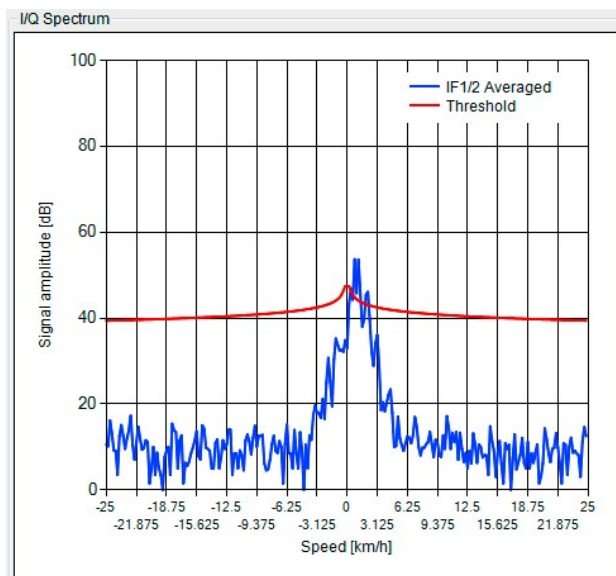

RADC – Raw ADC Data

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-LD7 datasheet.

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.

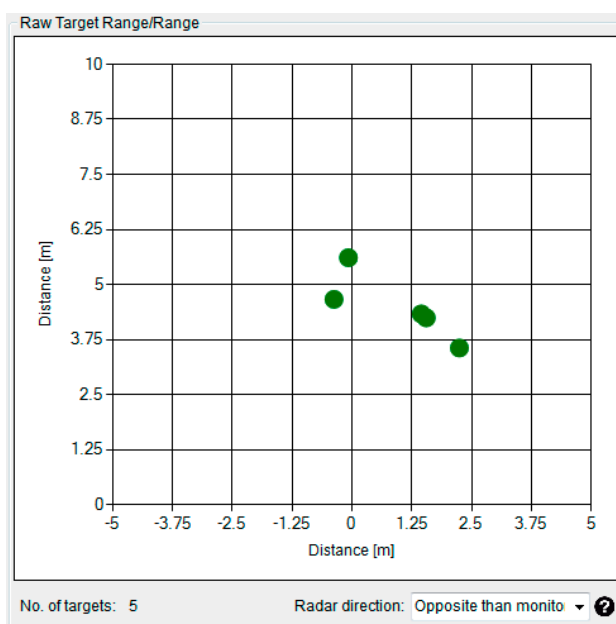A detailed description about the processing in the sensor can be found in the K-LD7 datasheet.
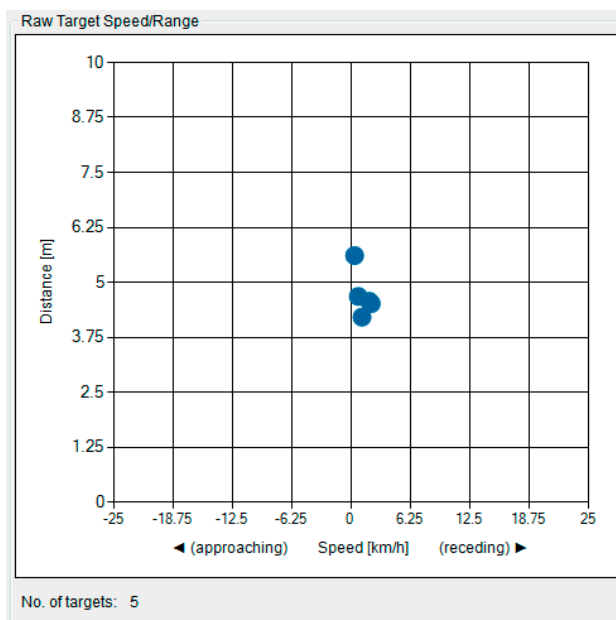
PDAT – Raw Target Speed/Range

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

No. of targets:
Count of actually reported raw targets

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.

No. of targets:
Count of actually reported raw 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.
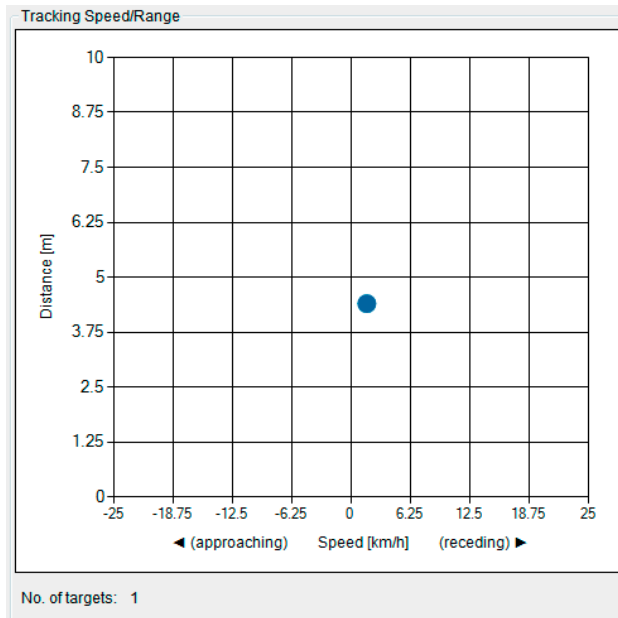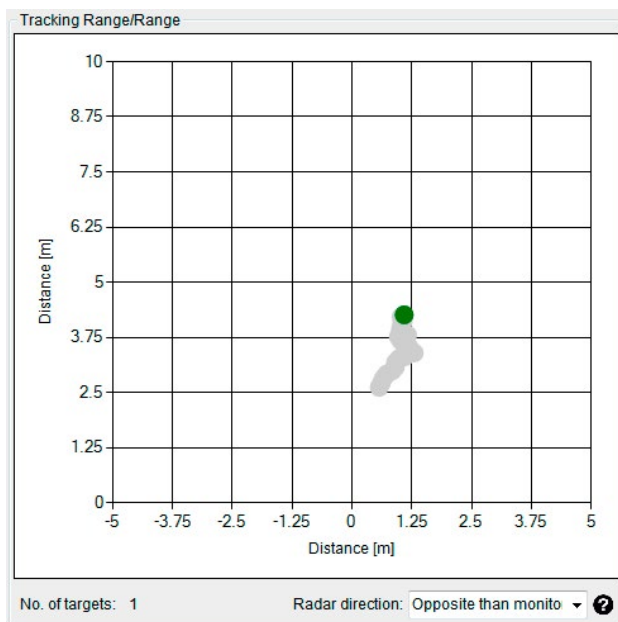
TDAT – Tracking Speed/Range

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

> The tracking filter is limited to one target and a distance of 30m. The No. of targets will always be 0 or 1.

TDAT – Tracking Range/Range

Compare this view with the corresponding raw view (PDAT) to see the improvements of the tracking filter. The view colours the points according to the direction of the movement and features also a persistence of the tracked target.

> The tracking filter is limited to one target and a distance of 30m. The No. of targets will always be 0 or 1.

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.
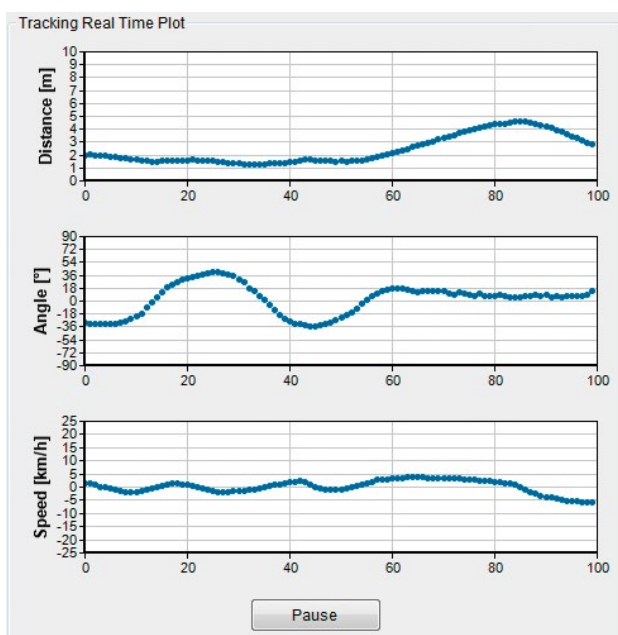
TDAT – Tracking Real Time Plot

This view is very helpful to analyse the tracked target. It visualises the distance, angle and speed over the time.

It is further possible to freeze the view with the button below the charts.

DDAT – Detection Data

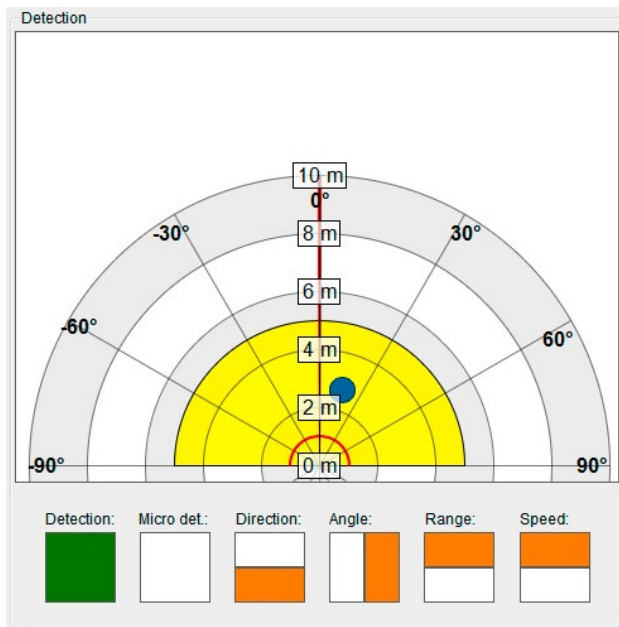The sensor features a detection filter to only generate a detection based on adjustable parameters like distance, angle and speed. The detection information is stored in the DDAT message and also routable to the digital outputs. This view visualises the detection filter settings in a polar plot. Further it also shows the DDAT data to signal a valid detection.

A detailed description about the detection filter and processing in the sensor can be found in the K-LD7 datasheet.

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.

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

Figure 4: Miscellaneous display controls

Left: DDAT - Detection Data   Right: TDAT - Tracking Real Time Plot   Mode: **Live stream**   Frame no.: 31   Cycle time: 116 ms
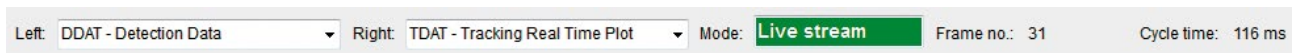
Table 2: Different possible modes

Mode	Description
Disconnected	No connection to the K-LD7
Live Stream	The control panel is connected to the K-LD7 and receives data
Record	Data will be recorded to the PC
Playback	Recorded data will be played and visualised

Tabs

This chapter describes the different control tabs of the software. It is possible to control all the parameters of the K-LD7 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-LD7.

Communication

Figure 5: Communication tab

UART	Info	Data Output
Port: COM15 ⟳	Firmware version:	☑ DONE - Frame Done
Baudrate: 2000000	K-LD7_APP-RFB-0011	☐ RADC - Raw ADC Data
		☐ RFFT - Raw FFT
		☑ PDAT - Raw Target Data
Connect Disconnect		☑ TDAT - Tracking Data
		☑ DDAT - Detection Data

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 (arrows right 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-LD7.

> 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.

Info

When a K-LD7 is connected this indicator gives an information about the firmware version of the sensor.

Data Output

Select which output is sent from the radar to the control panel. The according views can only show data if the corresponding data outputs are enabled.

> ⚠ 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.

Radar

Figure 6: Radar tab

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 chapter Radar Settings of the K-LD7 datasheet.

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. For example, if the goal is to measure people in the 10m distance range and 25km/h speed

range, but cars are moving at 30m with 70km/h, the 100m distance range and 100km/h speed range setting must be used or the threshold offset needs to be increased until the cars are no longer displayed in the raw targets.

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

Detection

Figure 7: Detection tab

The detection tab controls mainly the detection filter that is used to generate the DDAT structure. It makes sense to use the DDAT – Detection Data view together with this control tab because it visualises

directly the used settings of the filter and the generated outputs of the DDAT structure. A detailed description of all parameters can be found in the chapter Detection settings of the K-LD7 datasheet.

Settings

Figure 8: Settings tab

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 factory settings.

Record/Playback

Figure 9: Record/Playback tab

This tab can be used to record and play-back 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.

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

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.

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.

OUTLINE DIMENSIONS

Figure 11: Outline dimensions in millimetre

HARDWARE INFORMATION

Schematic

Figure 12: Schematic

Bill of Materials

Table 4: Bill of materials

Pos.	#	Reference	Typ	Case	Description
1	1	A1	RFB_666B	–	Plain PCB
2	1	D1	LTST-S270TBKT	0603	SMD LED 0603 right angle blue
3	1	D2	LTST-S270KRKT	0603	SMD LED 0603 right angle red
4	1	D3	LTST-S270KFKT	0603	SMD LED 0603 right angle orange
5	1	D4	LTST-S270GKT	0603	SMD LED 0603 right angle green
6	1	R1	36R	0603	Resistor 1% 0.063W
7	2	R2, R3	200R	0603	Resistor 1% 0.063W
8	1	R4	100R	0603	Resistor 1% 0.063W
9	1	X1	Male Header 6-Pin	THT	Header, 6-Pin
10	1	X2	Female Header 2x8-Pin	SMD	Female Header, 8-Pin, Dual row, Bottom entry
11	1	X4	Female Header 2x3-Pin	SMD	Female Header, 3-Pin, Dual row, Bottom entry

Assembly
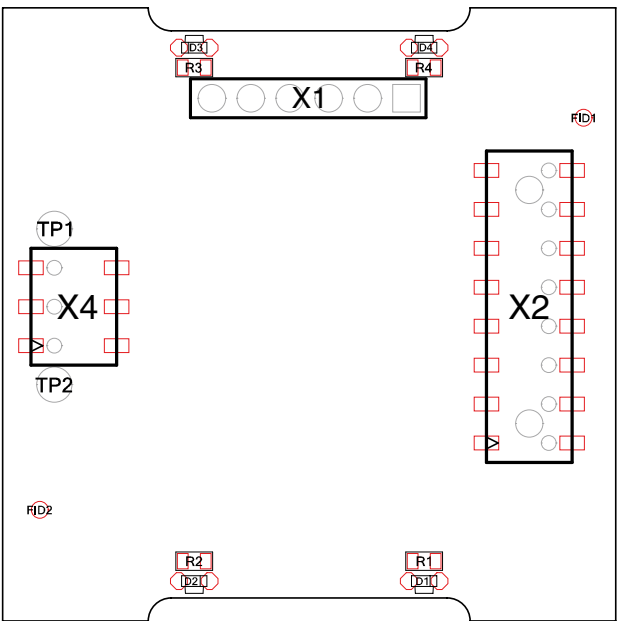
ORDER INFORMATION

The ordering number consists of different parts with the structure below

Figure 13: Ordering number structure

Product		Customer		HW variant	Supply
= K-LD7-EVAL	-	**= RFB** for standard products	-	**= 01** for standard variant	**= H** for 3.3 V … 5 V version

Table 3: Available ordering numbers

Ordering number	Description
K-LD7-EVAL-RFB-01H	Standard K-LD7 evaluation kit with powerful PC software

PACKING LIST

1. Evaluation kit PCB board
2. FTDI USB cable
3. USB stick containing
   – Control panel software
   – Documentation
   – Example readout script
4. K-LD7 sensor

REVISION HISTORY

09/2019 – Revision A: Initial Version

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[RFbeam](#):

[K-LD7-EVAL-RFB-01H](#)