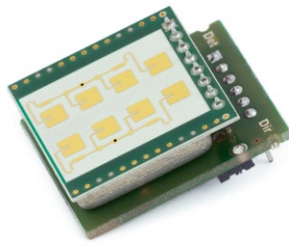


# K-LD2-EVAL

radar transceiver



## Features

- Powerful control panel software included
- Easy K-LD2 parameter setting over GUI
- Converted units for easy development
- Real-time streaming of ADC values and FFT spectrum
- Saves time to market and reduces NRE

## Applications

- Optimizing parameters for the K-LD2 sensor in your application
- Getting started with the K-LD2
- Learning about the potential of a K-LD2 sensor

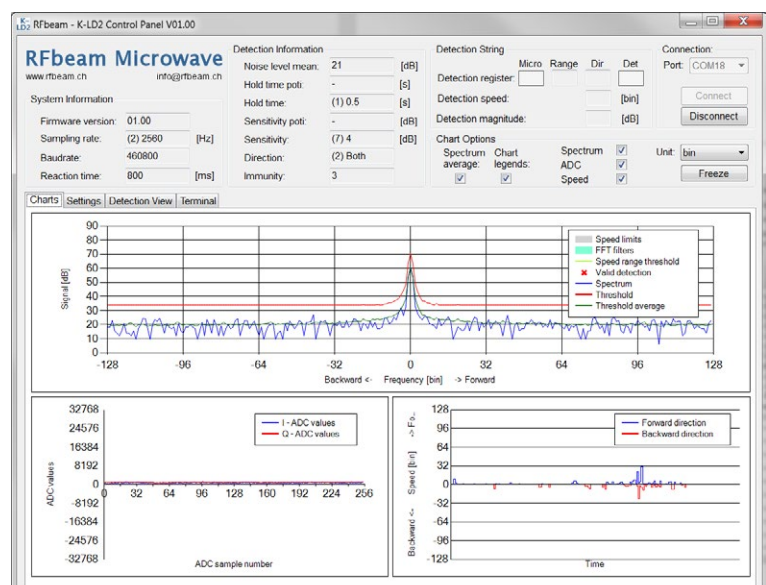
## Description

The K-LD2 Evaluation Kit is a fully operational movement detector. The evaluation board visualises the two digital outputs of the K-LD2 over LED's. Two potentiometers allow quick adjustments of the sensor's sensitivity and hold time.

With the included powerful Control Panel software, development time is reduced drastically. All the parameters can be modified using the Control Panel, without having to look at the command list of the K-LD2. The influence of changed parameters can be directly checked in the real-time spectrum. Also ADC values and the dominant movements are displayed at the same time. Other parameters like sensitivity, filters and thresholds are directly shown in the spectrum to allow visual control. A unit conversion function allows to see spectrum and detection information either in bin, Hz or km/h. Simply save different settings of your K-LD2 and load them later for comparison or to order preprogramed K-LD2 sensors from RFbeam.

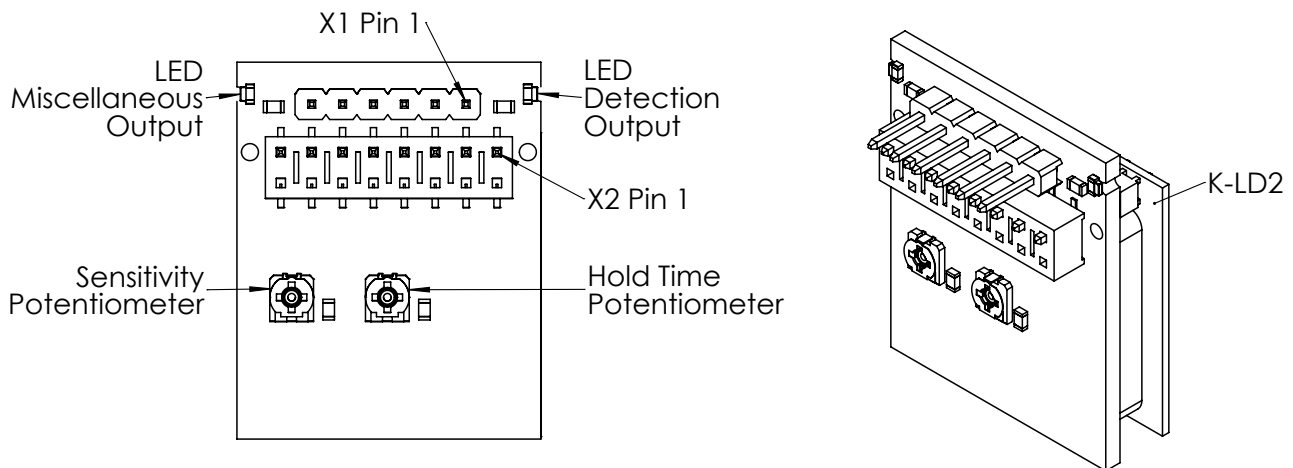
## Control Panel

**Figure 1: Control Panel GUI overview**



# Pin Configuration and Functions

**Figure 2: Pin configuration and functions**



**Table 1: X1 FTDI Connector**

Pin No.	Name	Colour on FTDI cable	Description
1	GND	Black	Device ground supply pin
2	CTS#	Brown	Clear to send control input
3	VCC	Red	Power supply pin (5V)
4	TXD	Orange	Transmit asynchronous data output.
5	RXD	Yellow	Receive asynchronous data input.
6	RTS#	Green	Request to send control output

**Table 2: X2 K-LD2 Connector**

Pin No.	Name	Description
2	GND	Ground pin
4	Detect 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	Hold Time In	Analogue hold time input
14	Sensitivity In	Analogue sensitivity input.
16	Misc. Out	Digital miscellaneous output



Connect the K-LD2 to the connector X2 as shown in the picture above. Please refer to the K-LD2 datasheet 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 FTDI-Driver by double clicking the FTDI\_setup.exe and follow the guided installation.
4. Install the K-LD2 Control Panel by double clicking the setup.exe file. If no .net framework is installed, the installer will install it automatically.

## Quick Start

1. Connect the K-LD2 to the X2 connector of the evaluation kit as shown in Figure 2: 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 part of the FTDI cable with your PC
4. Start the K-LD2 Control Panel Software
5. Select the correct Port and click the Connect button.
6. Check the application information on the following pages for a fast overview.
7. Play with the parameters in the Settings Tab



Connect the K-LD2 and the FTDI cable with the correct polarization to prevent any damage.

---

## Application Information

On the following page, four different application ideas with their key features are listed. The software package of the evaluation kit delivers a predefined .eep settings file for each idea. This file can be imported directly in the control panel over the load settings button in the settings tab.

Decide which application you want to evaluate, load the settings file and start to optimise the parameters according to your needs.

To restart parametrizing, you can reload the .eep file or use the Restore factory settings button. Once you are satisfied with the found configuration use the save settings button.

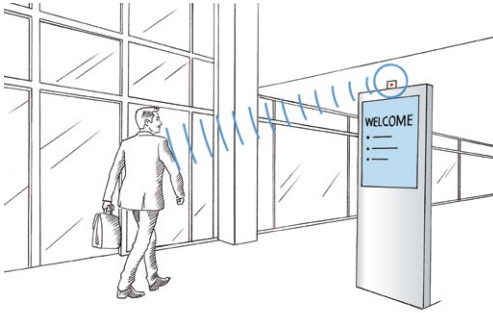


The K-LD2 can also be factory configured with your settings. Contact RFbeam for more information.



Do not do distance and time critical tests when the Control Panel is connected. Timing is influenced by the transferred data.

# APPLICATION IDEAS



## Movement detection

The K-LD2's default parameters are already optimised for movement detection. It is not necessary to reconfigure anything.

### Key Features:

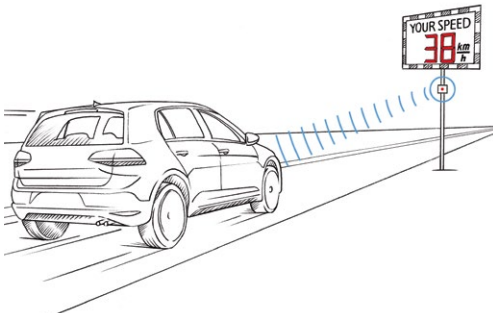
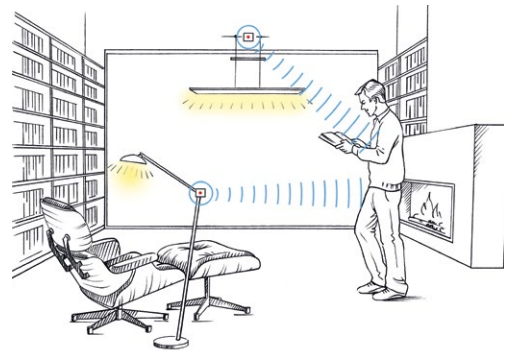
- Change hold time with potentiometer
- Change sensitivity with potentiometer
- Evaluate detection output
- Evaluate miscellaneous output as direction indicator

## Indoor lighting

The typical situation in which an automatic light switches off even when you're in the scope of the sensor. The micro detection feature of the K-LD2 solves this problem by evaluating very slow movements to retrigger a valid detection.

### Key Features:

- Use micro detection for retriggering
- Micro detection threshold
- Sampling rate
- Use miscellaneous output as micro detection



## Speed measurement

Build a speed board or count the passing objects. Objects can also easily be divided into speed classes.

### Key Features:

- Sampling rate
- Speed range threshold
- Low & high speed limit
- Use miscellaneous output as range indicator

## Interference suppression

The K-LD2 can independently avoid wrong detections caused by fluorescent light. Additional interferences suppression can be achieved with the immunity feature to achieve an extremely robust sensor.

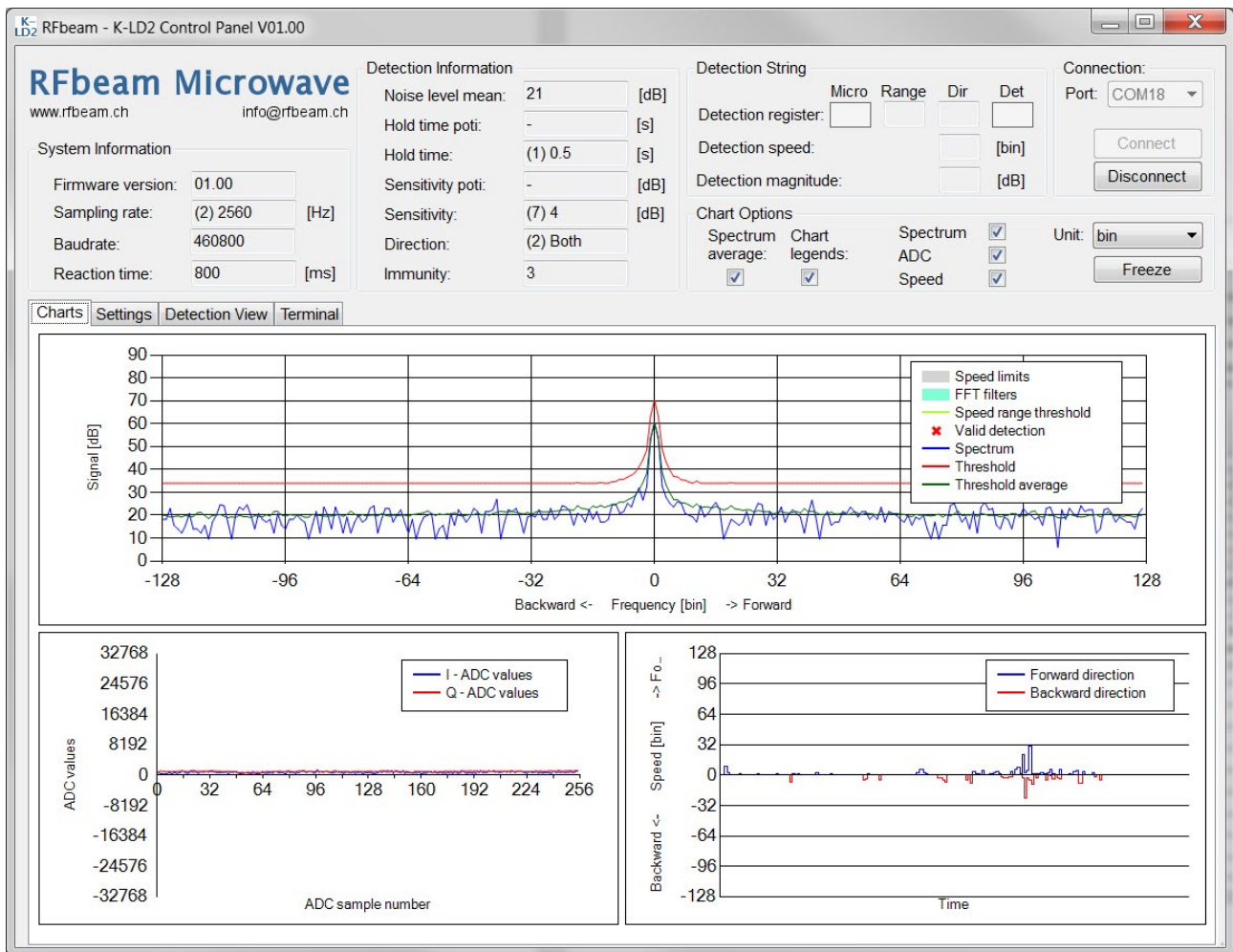
### Key Features:

- Immunity
- Sampling rate
- Sensitivity



# Control Panel Overview

Figure 3: Charts tab overview



The figure above shows the connected K-LD2 Control Panel in the Charts tab. This is the main tab for observing the behaviour of the K-LD2. On the following pages, the different areas of this tab are described.

System Information	
Firmware version:	01.00
Sampling rate:	(2) 2560 [Hz]
Baudrate:	460800
Reaction time:	800 [ms]

## System Information

Except for the Reaction time, all values are system parameters and can be set or read from the device.

The Reaction time is calculated in the K-LD2 Control Panel. The formula is given in the K-LD2 datasheet.



The Reaction time is a theoretical value and is not accurate when the Control Panel is connected to the device. The Timing is influenced by the data transfer.

Detection Information	
Noise level mean:	21 [dB]
Hold time poti:	- [s]
Hold time:	(1) 0.5 [s]
Sensitivity poti:	- [dB]
Sensitivity:	(7) 4 [dB]
Direction:	(2) Both
Immunity:	3

## Detection Information

These parameters allow a quick overview of the most important settings of the detection algorithm, while studying the chart tab.



There are two fields each for the Hold time and the Sensitivity. They are only filled with a value when they are active. This let you quickly verify, if the potentiometer or the software value is in use.

Detection String				
	Micro	Range	Dir	Det
Detection register:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Detection speed:				[bin]
Detection magnitude:				[dB]

## Detection String

The Detection String is a parameter which can be read from the K-LD2. It contains all information about the current detection. Except for the micro flag all parameters are latched and hold their value during the current detection.

Check the K-LD2 datasheet for further information.

Chart Options	
Spectrum average:	<input checked="" type="checkbox"/>
Chart legends:	<input checked="" type="checkbox"/>
Spectrum	<input checked="" type="checkbox"/>
ADC	<input checked="" type="checkbox"/>
Speed	<input checked="" type="checkbox"/>
Unit:	bin
<input type="button" value="Freeze"/>	

## Chart Options

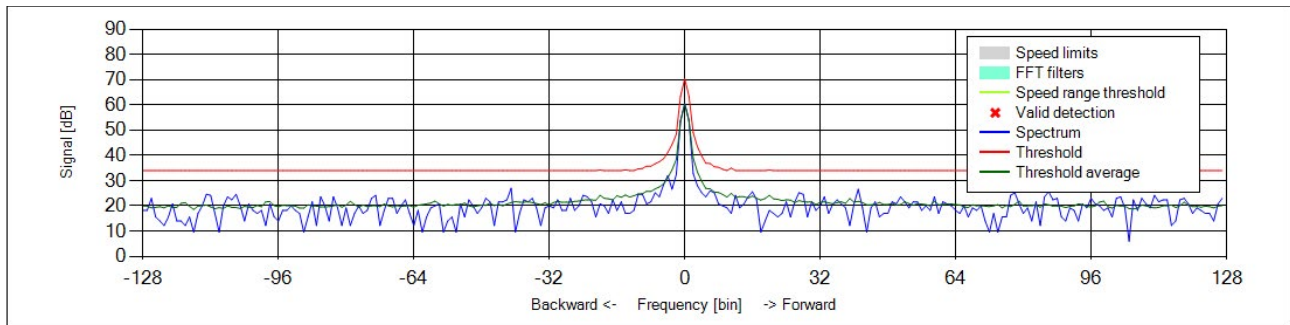
The Chart Options contain all possible settings for the Charts tab.



The Unit can be changed only in the K-LD2 Control Panel. The K-LD2 delivers the data in bin. Conversion instructions can be found in the K-LD2 datasheet.



## Spectrum Chart



The spectrum chart allows detailed analysis of the K-LD2's detection algorithm. The datasheet of the K-LD2 gives an in-depth look into the theory of operation of the sensor.

### Spectrum (blue)

This is the direct result of the complex 256 point FFT over the ADC samples. Forward (approaching) movements are shown in the right plane and backward (receding) movements in the left plane. The bin in the middle represents the DC bin.

### Spectrum average (green)

This is the average over multiple FFT frames.

### Threshold (red)

When a movement in the Spectrum crosses this line, it is evaluated by the detection algorithm, which decides, if it is a valid signal or a disturbance.

### Valid detection (red cross)

Shows the exact position of the actual detection. The information is taken from the Detection string and is therefore held during the whole detection.

### Speed range threshold (lime green)

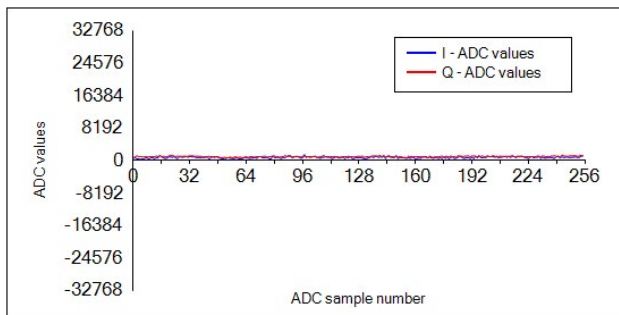
Shows the current value of the Speed range threshold parameter.

### FFT filters (turquoise)

Marks the position of the set FFT filters parameter.

### Speed limit (grey)

Marks the filtered areas when using the Low speed limit and High speed limit parameters.

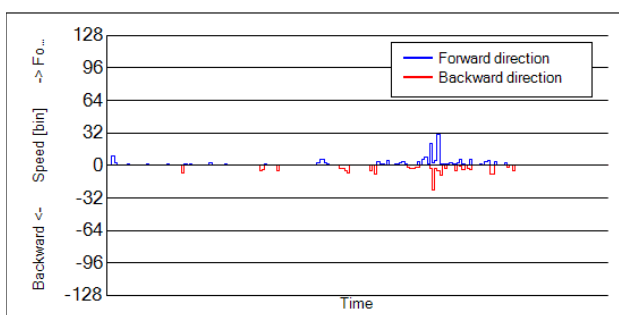


## ADC chart

The measured ADC values of the I and Q-channel are displayed here.

This is particularly interesting for verifying if the signals are clipping or for learning how radar works.

Please refer to the K-LD2 datasheet for more information.



## Speed chart

This chart shows the result of the parameter Get target string (C01). It returns the speed of the highest magnitudes in the forward (right plane) and backward (left plane) part of the spectrum.

# Settings Tab

Figure 4: Settings Tab overview

**RFbeam Microwave**  
www.rfbeam.ch info@rfbeam.ch

System Information  
Firmware version: 01.00  
Sampling rate: (9) 11520 [Hz]  
Baudrate: 460800  
Reaction time: 178 [ms]

Connection:  
Port: COM18  
Connect  
Disconnect

Charts Settings Detection View Terminal

**EEPROM System Parameters**  
Sampling rate: (9) 11520 [Hz]  
Start up learn: 16 [blocks]  
Function of miscellaneous output: (2) Range  
Minimum threshold offset: 30 [dB]  
Minimum threshold margin: 10 [dB]  
Threshold noise adaption speed: 10 [blocks]  
Use FFT average: ☒  
Use sensitivity potentiometer: ☒  
Use hold time potentiometer: ☒  
Use micro detection for retriggering: ☐

**EEPROM Detection Parameters**  
Hold time: (1) 0.5 [s]  
Sensitivity: (7) 4 [dB]  
Immunity: 3  
Direction to detect: (2) Both  
Low speed limit: 0 [bin]  
High speed limit: 0 [bin]  
Speed range threshold: 0 [bin]  
Micro detection threshold: 6  
FFT filter width: 2 [bin]

**Reset**  
Reset

**Handle Parameters**  
Restore factory settings Load settings Save settings ⓘ

**EEPROM Array Parameters**  
Index (0) (1) (2) (3) (4) (5) (6) (7) (8) (9)  
Hold time array: 0.2 0.5 1.0 2.0 5.0 10.0 20.0 40.0 80.0 160.0 [s]  
Sensitivity array: 34 28 22 18 14 10 6 4 2 0 [dB]  
FFT filter array: 0 0 0 0 0 0 0 0 [bin]

The figure above shows the Settings tab. This is the main tab for changing the parameters of the K-LD2. On the following pages, the different areas of this tab are described.

In all dropdowns, the number written in brackets is the real parameter sent to the K-LD2. It is displayed here to make it easier when starting to configure the K-LD2 with a terminal.



If you manually enter a value into a numeric box you need to hit enter to send it to the K-LD2.



EEPROM System Parameters

Sampling rate: (9) 11520 [Hz]

Start up learn: 16 [blocks]

Function of miscellaneous output: (2) Range

Minimum threshold offset: 30 [dB]

Minimum threshold margin: 10 [dB]

Threshold noise adaption speed: 10 [blocks]

Use FFT average: ☒

Use sensitivity potentiometer: ☒

Use hold time potentiometer: ☒

Use micro detection for retriggering: ☐

## EEPROM System Parameters

The EEPROM System Parameters are a cluster of parameters which are normally only optimised in the development for a specific application.

EEPROM Detection Parameters

Hold time: (1) 0.5 [s]

Sensitivity: (7) 4 [dB]

Immunity: 3

Direction to detect: (2) Both

Low speed limit: 0 [bin]

High speed limit: 0 [bin]

Speed range threshold: 0 [bin]

Micro detection threshold: 6

FFT filter width: 2 [bin]

## EEPROM Detection Parameters


The EEPROM Detection Parameters are a cluster of parameters, which can be adapted as appropriate in the end product at the customer location.

Reset

## Reset

Some parameters need a Reset to take effect.

Handle Parameters



## Handle Parameters

Use the buttons to handle your parameters of the K-LD2.

## EEPROM Array Parameters

EEPROM Array Parameters

Index	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
Hold time array:	0.2	0.5	1.0	2.0	5.0	10.0	20.0	40.0	80.0	160.0	[s]
Sensitivity array:	34	28	22	18	14	10	6	4	2	0	[dB]
FFT filter array:	0	0	0	0	0	0	0	0	0	0	[bin]

### Hold time array and Sensitivity array

10 elements wide arrays to store the hold time and sensitivity curve. They are indexed over the Hold time and Sensitivity parameters or over the external potentiometers if the flags Use hold time potentiometer or Use sensitivity potentiometer are set.

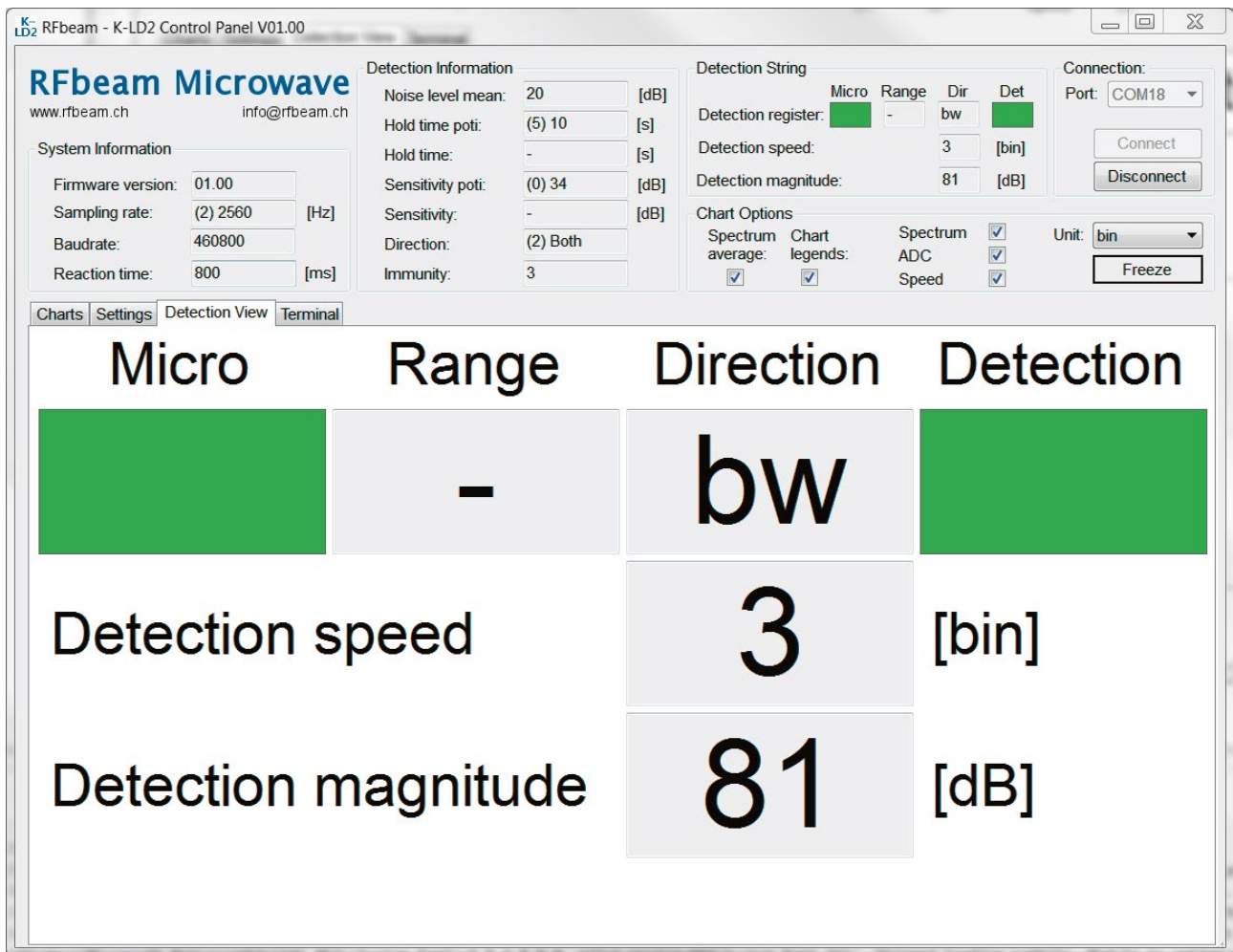
### FFT filter array

8 elements wide array to set up filters in the spectrum. The width is defined over FFT filter width.

Please refer to the K-LD2 datasheet for more information.

## Detection View Tab

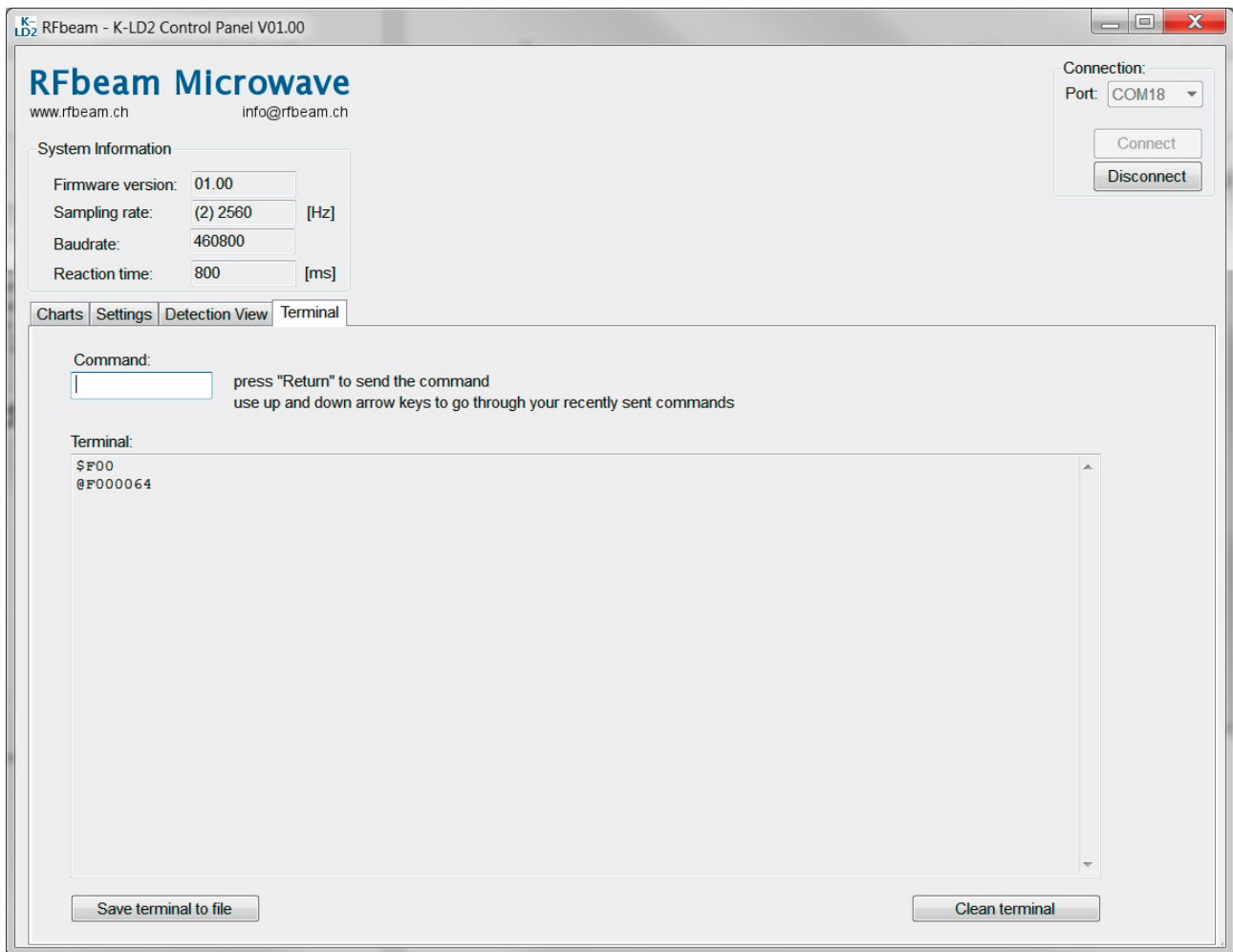
Figure 5: Detection View Tab overview



The figure above shows the Detection View tab. This tab has exactly the same content as the Detection String box. It is particularly useful when doing walking tests with the sensor because the results can be seen from far away.

# Terminal Tab

**Figure 6: Terminal Tab overview**



The figure above shows the Terminal tab. When you build up an application in which you want to control the K-LD2 over the serial interface, this tab allows an easy start with the command list.

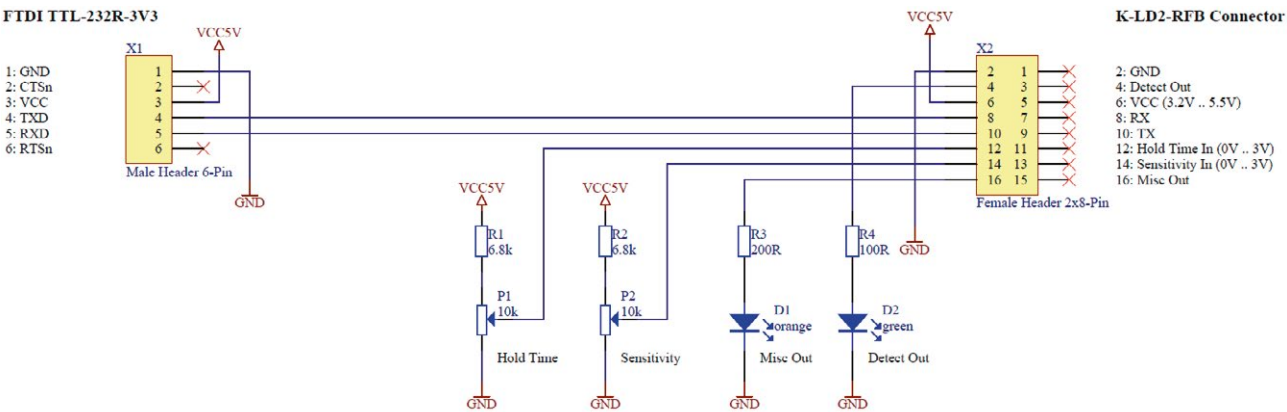
Please refer to the K-LD2 datasheet for the command syntax and a full list of available commands.



Some commands which change the baud rate or need a reset to be valid are not allowed in this Terminal. Please use a third party terminal for exploring such commands.

# Schematic

Figure 7: Schematic



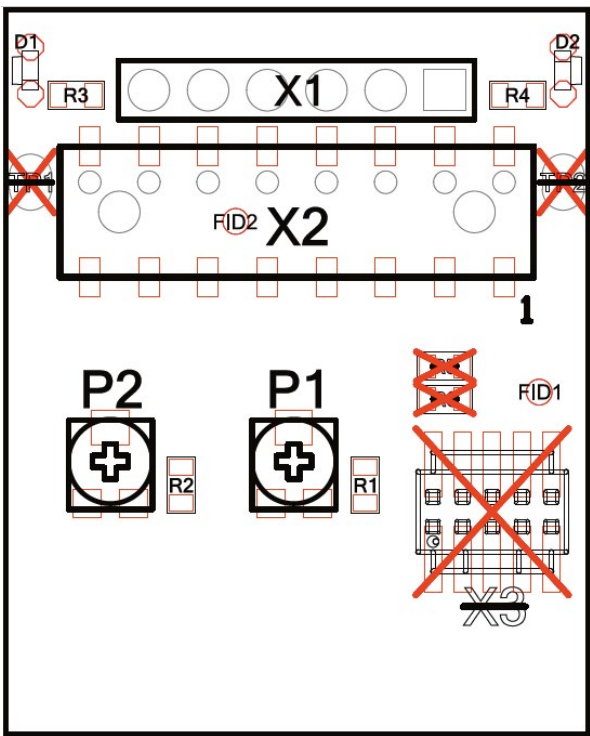
# Bill of materials

Table 3: Bill of material

Pos.	#	Reference	Typ	Case	Description
1	1.00	A1	RFB_560C	–	PCB 2 Layer
2	1.00	D1	LTST-S270KFCT	0603	SMD LED 0603 right angle orange
3	1.00	D2	LTST-S270GKT	0603	SMD LED 0603 right angle green
4	2.00	P1, P2	10k	SMD	Potentiometer 10k
5	2.00	R1, R2	6.8k	0603	Resistor 1% 0.063 W
6	1.00	R3	200R	0603	Resistor 1% 0.063 W
7	1.00	R4	100R	0603	Resistor 1% 0.063 W
8	1.00	X1	Male Header 6-Pin	THT	Header, 6-Pin, pitch = 2.54 mm
9	1.00	X2	Female Header 2x8-Pin	SMD	Female Header, 8-Pin, Dual row, Bottom entry

# Assembly

Figure 8: Assembly information

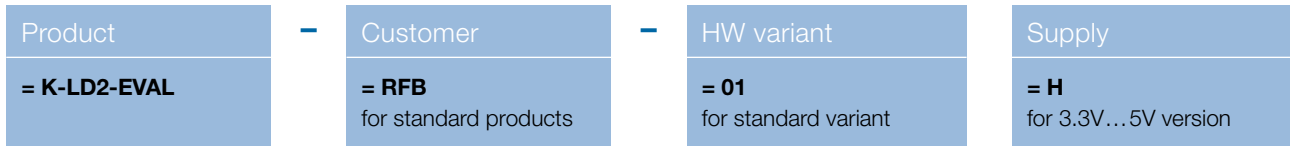


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## Ordering Information

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

**Figure 9: Ordering number structure**



**Table 4: Available ordering numbers**

Ordering number	Description
K-LD2-EVAL-RFB-01H	Standard K-LD2 evaluation kit

## Packing List

1. Evaluation kit PCB board
2. FTDI USB cable
3. USB stick containing
  - Control panel software
  - Prepared setting-files for a fast development start
  - Documentation
4. K-LD2 sensor

## Revision History

06/2017 – Revision A: Initial Version