1 Product Information

1.1 Features

- Pre-mounted V-LD3-RFB radar sensor, designed for human detection and multi-object tracking up to 20 meters
- Access to SPI, UART, JTAG, and CAN interfaces for complete control and customization during development
- Compact design with simple USB-C connectivity for easy integration with your host PC
- Generates a detailed 3D point cloud for both static and moving targets, perfect for real-time object tracking
- No calibration required - the evaluation kit comes pre-calibrated and pre-programmed for immediate use
- Compatible with Texas Instruments' low-power SDK, providing flexibility for firmware development and customization.

1.2 Description

Experience the full capabilities of RFbeam's V-LD3-RFB radar sensor module through our easy-to-use evaluation kit. Powered by Texas Instruments' low-power IWRL6432 chipset, the V-LD3 is perfect for human detection and multi-object tracking up to 20 meters, making it an ideal solution for advanced radar applications.

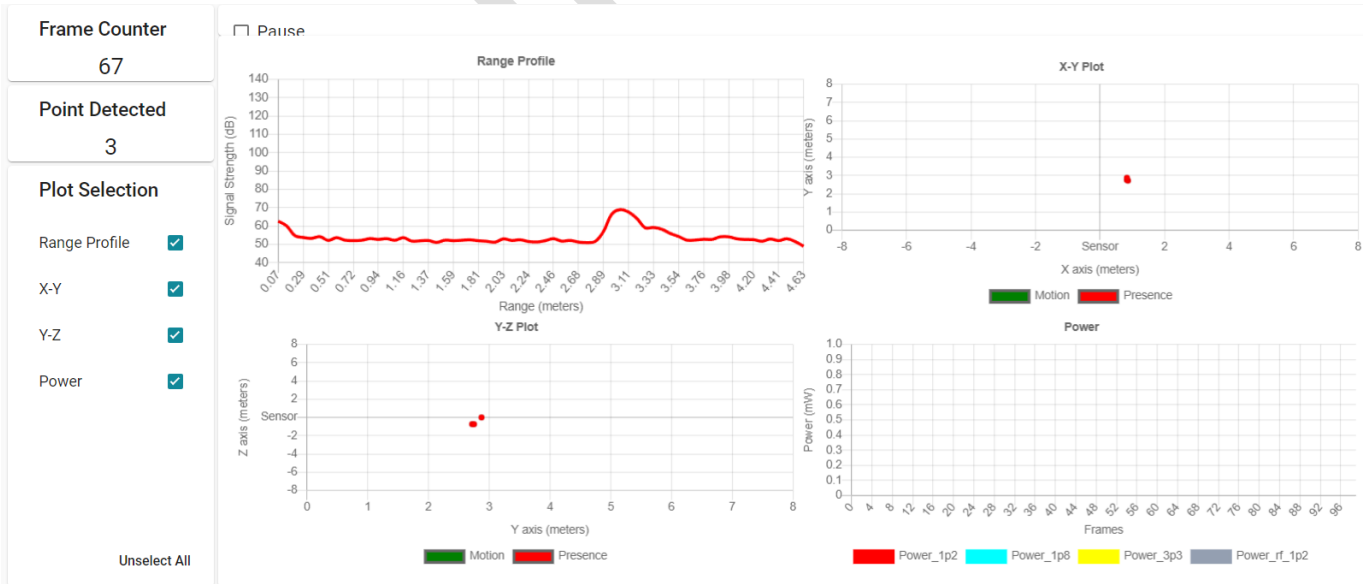
The V-LD3-RFB comes pre-programmed with TI's innovative motion and presence detection demo and includes a human/non-human classifier, making setup and testing effortless. Optimized onboard antennas, pre-calibrated RF frontend, and a compact design make this sensor module ready for immediate use in your radar projects.

With the V-LD3 sensor already mounted, RFbeam's evaluation kit provides immediate access to all the advanced features you need for development. The kit includes full access to sensor pins, SPI RAW data capture, JTAG, and CAN interfaces. Simply connect via USB-C to start evaluating the IWRL6432 chipset's extensive capabilities for your project.

No need to wait - start exploring advanced radar functionality today with the V-LD3-RFB Evaluation Kit, designed to streamline your development process!

1.3 Control Panel

Figure 1: TI low power SDK OOB demo visualizer



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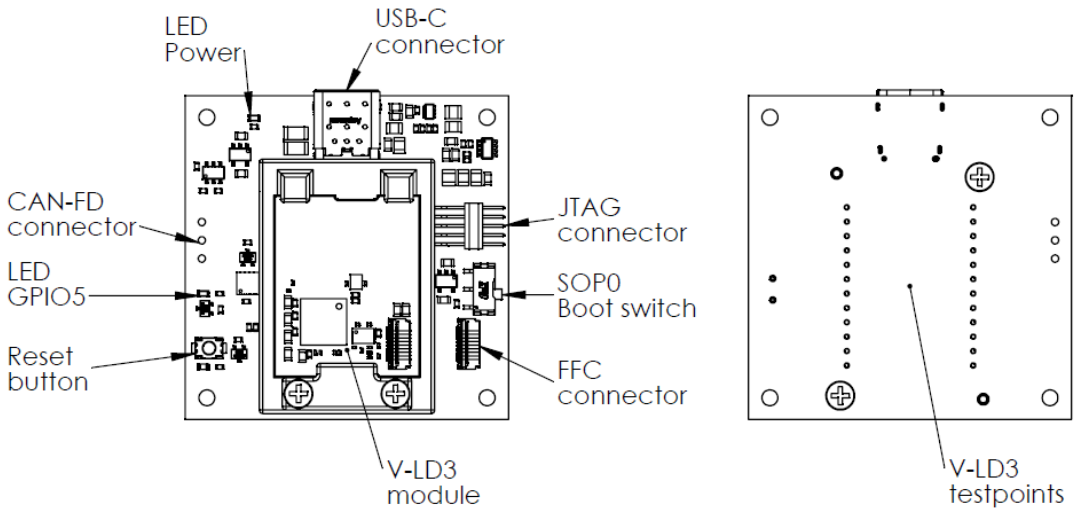
2 Pin Configurations and Functions

Figure 2: Pin configuration and functions



The V-LD3 Evaluation Kit consists of a PCB with a mounted V-LD3 module connected via spring-loaded contacts. The kit features an FTDI FT4232 chipset, enabling direct access to multiple interfaces through a single USB-C connection to a host PC. The USB-C interface also provides power to the board.
In addition, the board includes the following peripherals, directly accessible on the PCB:

- JTAG connector for direct use with TI's XDS110 debugger
- SOP0 boot switch and reset button for easy bootloader access
- FFC connector for off-board V-LD3 module connection
- GPIO5 user LED for custom signaling
- CAN-FD connector with on-board transceiver (PHY)
- Test points for all V-LD3 SMT pads for easy probing and debugging

2.1 JTAG connector

The JTAG connector provides direct access to the JTAG interface of the IWRL6432 chipset mounted on the V-LD3 module. It supports debugging and programming using Texas Instruments' XDS110 JTAG debug probe, and is directly compatible with the included TI 20-pin to Arm Cortex 10-pin adapter.

Table 1: JTAG connector description

Connector	Pin. No.	Name	Description
JTAG connector X107	1	VCC	+3.3V VIO supply
	2	SWDIO/TMS	JTAG test mode select
	3	GND	GND
	4	SWDCLK/TCK	JTAG test clock input
	5	GND	GND
	6	SWO/TDO	JTAG test data output
	7	KEY	Not connected
	8	NC/TDI	JTAG Test data input
	9	GND	GND
	10	nRESET	nRESET signal

2.2 SOP0 boot switch

The SOP0 boot switch can be used in combination with the reset button to change the IWRL6432 boot mode. To change the boot mode, set the switch to the desired position and press the reset button to apply the configuration.

Table 2: SOP0 boot switch description

Connector	Position	Name	Description
SOP0 boot switch SW101	1-2	Prog mode	Pulls the SOP0 to GND
	2-3	Run mode	Releases the SOP0 pin -> Pull up on the V-LD3 module

2.3 FFC connector

The FFC connector allows the V-LD3 module to be connected off-board via an FFC cable. The connector features top and bottom contacts and uses the same pinout as the connector on the V-LD3 module, without any signal mirroring. This allows for a direct 1:1 connection using a standard FFC cable.

Attention:
Before using the FFC connection, make sure to remove the V-LD3 module from the spring contacts to avoid electrical conflicts.

Table 3: FFC connector description

Connector	Pin. No.	Name	Description
FFC connector X100	1	+1.8V	+1.8V VCC supply
	2	GND	GND
	3	nRESET	nRESET input
	4	SOP0	SOP0 boot mode input
	5	UART TX	UART TX output, IWRL6432 Pin E10
	6	UART RX	UART RX input, IWRL6432 Pin F11
	7	GPIO5	GPIO5, IWRL6432 Pin J10
	8	VCCIO	+3.3V VIO supply
	9	GND	GND
	10	+1.8V	+1.8V VCC supply

2.4 GPIO5 user LED

GPIO5 is connected to a green user LED via a FET switch. In Texas Instruments' default examples, this GPIO is used both as a status indicator and as a trigger output for raw SPI data capture. For this reason, GPIO5 is also routed to the FTDI FT4232 bridge, enabling access and monitoring from the host PC.

2.5 CAN-FD connector

The evaluation kit includes a 3-pin, 2.54 mm pitch CAN-FD connector footprint. The connector is not pre-assembled, allowing users to either solder a cable directly or mount a connector of their choice.

A CAN-FD transceiver (PHY) is placed between the IWRL6432 pins and the connector to ensure proper signal conditioning. Additionally, the CAN-FD interface is equipped with ESD protection diodes and a pre-mounted 120 Ω termination resistor.

Table 4: CAN-FD connector description

Connector	Pin. No.	Name	Description
CAN-FD connector X105	1	CAN-	CAN-FD negative signal
	2	GND	GND
	3	CAN+	CAN-FD positive signal

2.6 V-LD3 SMT pads

All SMT pads of the V-LD3 module are routed through spring contacts to the evaluation kit. Each pin is accessible via dedicated test points on the bottom side of the PCB, providing convenient access for probing and debugging.

To facilitate development, each test point is labeled on the silkscreen with the corresponding signal name and where applicable, the associated IWRL6432 pin number.

2.7 FTDI FT4232 bridge

The FTDI FT4232 bridge offers multiple options for direct communication between the host PC and the IWRL6432 chipset. A single USB-C connection provides access to four virtual COM ports by default (Port A, B, C, and D), which appear automatically on the host system.

Using FTDI's D2XX direct access drivers allows reconfiguration of the FT4232 to unlock its full capabilities, including MPSSE, BitBang, and UART modes.

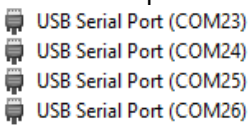
Table 5: FTDI FT4232 bridge connection description

Chip	Port	Mode	Usage
FTDI FT4232HQ U202	A	MPSSE mode	SPI RAW data capture (supported by TI SDK)
	B	MPSSE mode	1.8V supply current measurement via I2C (not supported by TI SDK)
	C	BitBang mode	Automatic V-LD3 update option (not supported by TI SDK)
	D	RS232 mode	Main UART access for configuration, data readout or firmware update

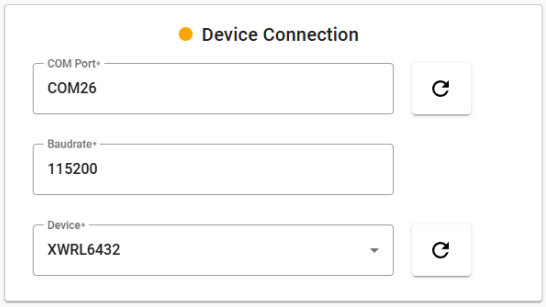
3 Quick Start

3.1 mmWave SDK Visualizer

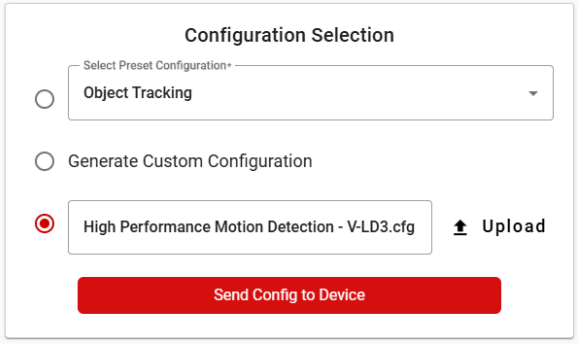
1. Connect the USB-C cable to the USB-C connector of the evaluation kit.
2. Connect the other end of the USB cable to your PC and wait until the serial COM port driver is installed.
3. The FTDI chip on the evaluation kit will show up as 4 virtual COM ports in the device manager:



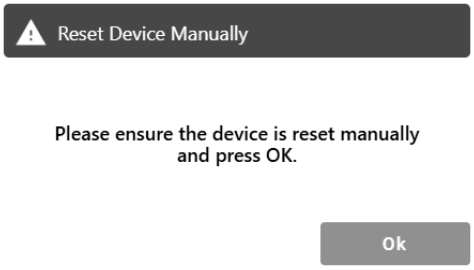
4. The default UART communication port is connected to the channel D of the FTDI chip. This is usually the last listed port in the device manager (for example COM26 in the picture above).
5. Check that the SOP0 boot switch is set to the “Run” position
6. Download the latest version of the TI MMWAVE-L-SDK here https://www.ti.com/tool/MMWAVE-L-SDK
7. Install the SDK and start the visualizer software located in the folder */tools/visualizer* of the installation directory.
8. TI provides a Low Power Visualizer User Guide in the */docs* folder */tools/visualizer* of the installed SDK.
9. Switch to the Configuration Dashbord and select or type in the correct COM port of channel D from the FTDI chip and select a baudrate of 115200 and the XWRL6432 as device:



10. Upload a custom configuration under “Configuration Selection” and press “Send Config to Device”. RFbeam provides a few optimized settings for the V-LD3 together with the evaluation kit:



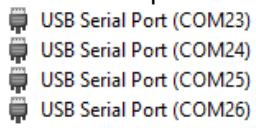
11. Reset the device manually over the reset button and press Ok in the popup:



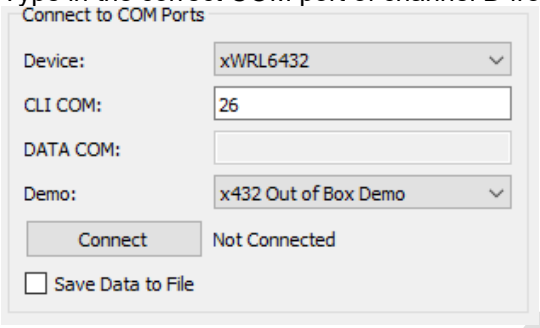
12. The visualizer will write the configuration to the V-LD3 and starts visualizing the measurement data.

3.2 Radar toolbox industrial visualizer

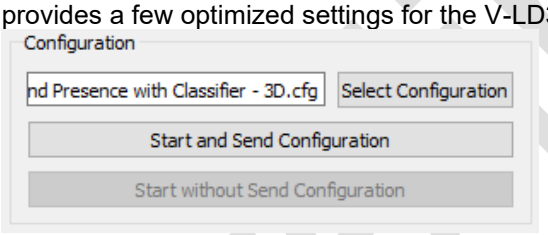
13. Connect the USB-C cable to the USB-C connector of the evaluation kit.
14. Connect the other end of the USB cable to your PC and wait until the serial COM port driver is installed.
15. The FTDI chip on the evaluation kit will show up as 4 virtual COM ports in the device manager:



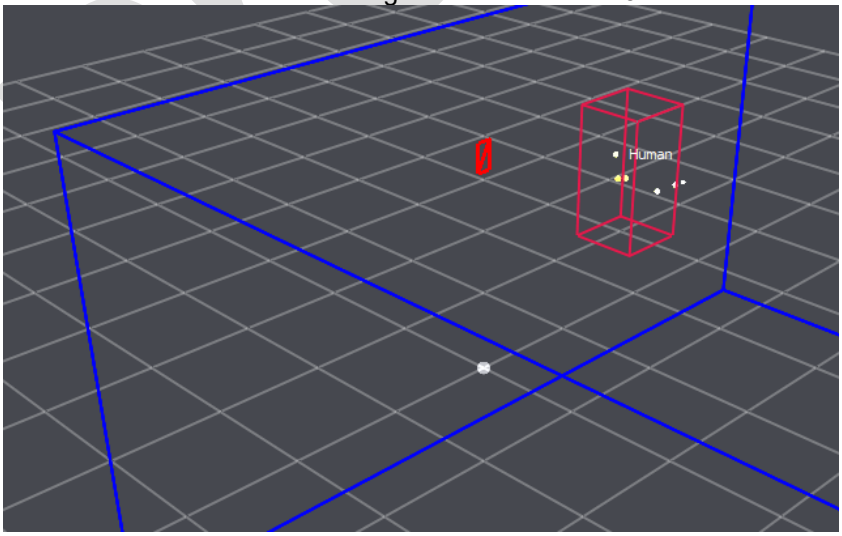
16. The default UART communication port is connected to the channel D of the FTDI chip. This is usually the last listed port in the device manager (for example COM26 in the picture above).
17. Check that the SOP0 boot switch is set to the “Run” position
18. Download the latest version of the TI RADAR-TOOLBOX here https://www.ti.com/tool/download/RADAR-TOOLBOX/
19. Install the radar toolbox and start the industrial visualizer software located in the folder *\tools\visualizers\Applications_Visualizer\Industrial_Visualizer* of the installation directory.
20. TI provides an Applications Visualizer User Guide in the folder *\tools\visualizers\Applications_Visualizer\docs* / of the installed SDK.
21. Type in the correct COM port of channel D from the FTDI chip and press the Connect button:



22. Upload a custom configuration under “Select Configuration” and press “Start and Send Configuration”. RFbeam provides a few optimized settings for the V-LD3 together with the evaluation kit:

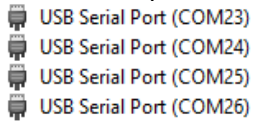


23. The visualizer will write the configuration to the V-LD3 and starts visualizing the measurement data.

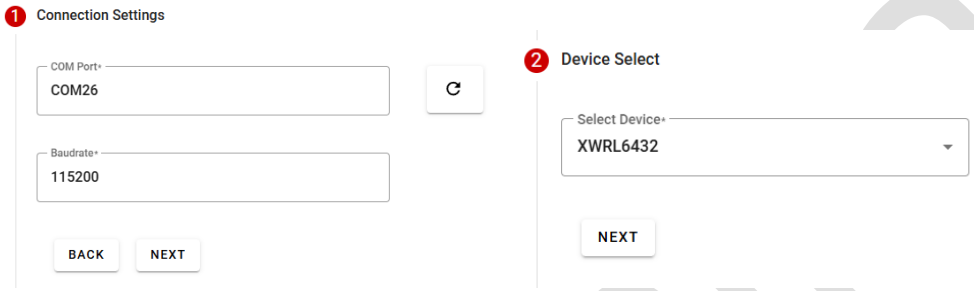


4 Software Update

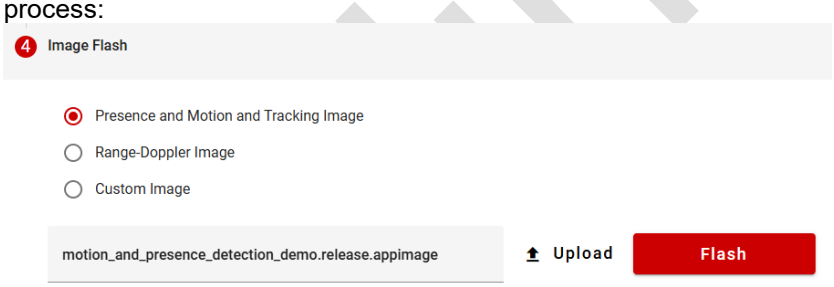
1. Connect the USB-C cable to the USB-C connector of the evaluation kit.
2. Connect the other end of the USB cable to your PC and wait until the serial COM port driver is installed.
3. The FTDI chip on the evaluation kit will show up as 4 virtual COM ports in the device manager:



4. The default UART communication port is connected to the channel D of the FTDI chip. This is usually the last listed port in the device manager (for example COM26 in the picture above).
5. Download the latest version of the TI MMWAVE-L-SDK here https://www.ti.com/tool/MMWAVE-L-SDK
6. Install the SDK and start the visualizer software located in the folder /tools/visualizer of the installation directory.
7. TI provides a Low Power Visualizer User Guide in the /docs folder /tools/visualizer of the installed SDK.
8. Switch to the Flash page and select or type in the correct COM port of channel D from the FTDI chip and select a baudrate of 115200. Press next and select the XWRL6432 as device and press again next:



9. Ignore the board switch settings information in the visualizer but check that the SOP0 boot switch is set to the "Prog" position and press the reset button once on the V-LD3 evaluation kit. Confirm the settings by pressing the button "Switch Settings Confirmed"
10. Select a flash image or upload the one you want to program and press the "Flash" button to start the update process:



11. Wait until the update has finished and switch back the SOP0 switch to the "Run" position. Press the reset button on the evaluation kit and the module will be ready again.

5 Antenna Information

5.1 Antenna array geometry

The antenna array of the V-LD3 differs from the default patterns used in TI's evaluation kits. To ensure correct operation, customers must configure the appropriate antenna geometry using the CLI command `antGeometryCfg`. Using the correct configuration is mandatory when working with the V-LD3. Detailed information is provided in the V-LD3 datasheet.

Recommended CLI command for V-LD3 antenna geometry

```
antGeometryCfg 1 0 0 1 1 2 1 1 0 2 1 3 2.5 2.5
```

5.2 Calibration

TI will support a feature in the future what allows for a simpler management of calibration data as mentioned in the data sheet. RFbeam will use this feature as soon as it is available to deliver pre-calibrated modules to our customers.

By default, TI recommends using standard values for the `compRangeBiasAndRxChanPhase` command in their .cfg files:

```
compRangeBiasAndRxChanPhase 0.0 1 0 -1 0 1 0 -1 0 1 0 -1 0
```

To achieve optimal performance, per-module calibration in an anechoic chamber is required. This should be done using the exact chirp and frame settings intended for deployment and can be performed via the CLI command `measureRangeBiasAndRxChanPhase`.

RFbeam provides this calibration data for each engineering sample, using the supplied demo .cfg configurations, ensuring best-in-class performance out of the box.

As mentioned in the datasheet, TI plans to introduce a feature that simplifies the management of calibration data. RFbeam will adopt this feature as soon as it becomes available to supply pre-calibrated modules to our customers.

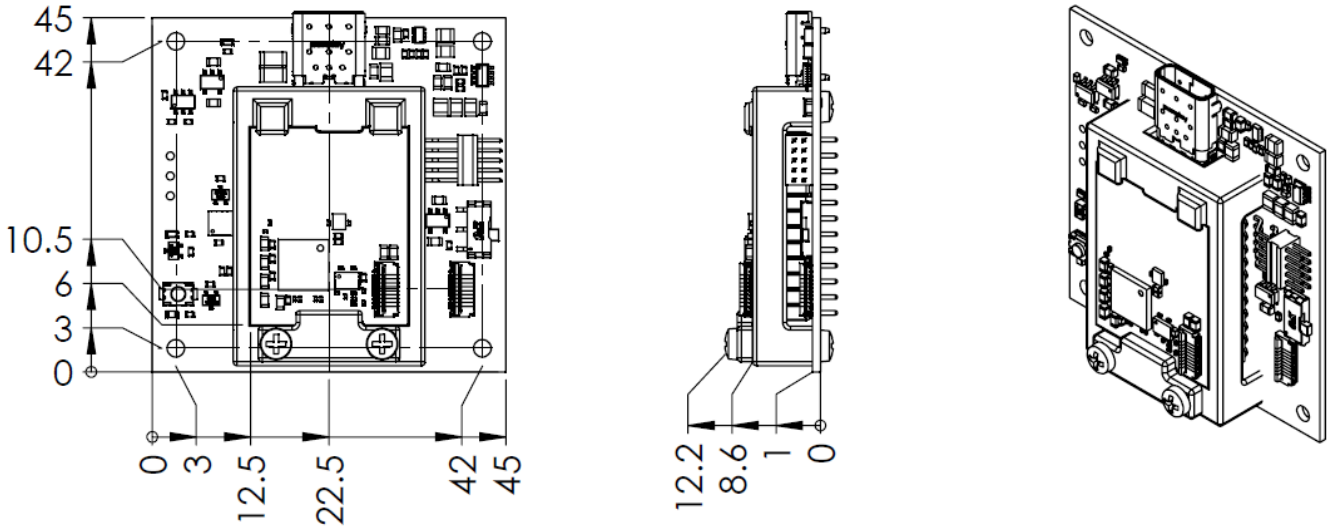
6 Hardware information

6.1 Schematic and bill of material

Full schematic and bill of material can be downloaded from the RFbeam Microwave homepage under Downloads on the product site for the V-LD3 evaluation kit.

6.2 Outline Dimensions

Figure 3: Outline dimensions in millimetre



7 Order Information

The ordering number consists of different parts with the structure below

Figure 4: Ordering number structure

Product	–	Customer	–	HW variant	Supply
V-LD3-EVAL		**= RFB** for standard products		**= 00** for standard variant	**= H** for 3.3V…5V version

Table 6: Available ordering numbers

Ordering number	Description
V-LD3-EVAL-RFB-00H	Standard V-LD3 evaluation kit

8 Packing list

1. Assembled evaluation kit with mounted V-LD3 sensor
2. USB-C to USB-A cable

9 Revision History

05 / 2025 – Revision A: Initial Version