



Software manual
ifm Vision Assistant
Radar distance sensor CAN

GB

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1 Preliminary note

You will find instructions, technical data, approvals and further information using the QR code on the unit / packaging or at documentation.ifm.com.

1.1 Symbols used

- ✓ Requirement
- Instructions
- ▷ Reaction, result
- [...] Designation of keys, buttons or indications
- Cross-reference
-  Important note
Non-compliance may result in malfunction or interference.
-  Information
Supplementary note

1.2 Legal and copyright information

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1.3 Open source information

-  For more open source information see: documentation.ifm.com.

2 Safety instructions

Please read the operating instructions prior to set-up of the device. The device must be suitable for the application without any restrictions.

If the operating instructions or the technical data are not adhered to, personal injury and damage to property can occur.

3 Intended use

The software manual describes the following functions of the ifm Vision Assistant software:

- Recognising the device in the local subnet.
- Configuring the device.
- Collecting, storing and evaluating data of the device.
- Displaying detailed status information.
- Outputting the target reflections.

4 Getting started



Information on installation and electrical connection → Operating instructions for the device at www.ifm.com.

Start ifm Vision Assistant:

- ▶ Connect the device to the voltage supply.
- ▶ Connect the device to a PC via a CAN interface (e.g. EC2112).
- ▶ Install and start the ifm Vision Assistant software on the PC.
- ▶ Use the [Find sensor] button on the start page of the ifm Vision Assistant to connect the device with the software.
- ▷ ifm Vision Assistant opens with the [Monitor] view.

Select target:

- ▶ In the [Radar settings] area, define the selection rule and the limit value filters for each of the maximum of 8 regions of interest (ROIs) and configure the global filter properties in the [Advanced parameters] area.
- ▶ If necessary, use a corner reflector as an adjustment aid to align the sensor.
- ▶ Go to the [Monitor] area.
- ▷ The display of the target reflections in the live image depends on the filter setting in the upper image area (Tab. 5: Live image operating elements → [20](#)).
- ▶ Select the required ROI using the  button.
- ▷ The selected target reflection of the selected ROI is marked with a crosshair in the live image.
- ▷ The [Process values] section on the left-hand side of the screen shows the current measured values of the selected target reflections of all ROIs.

Configure the process value output:

- ▶ Configure the output of the process values via the CAN interface in the [Device setup] area:
- See the chapter Device configuration > [CAN](#) (→ [30](#)).

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- any results, output, or data provided through or generated by the software will be accurate, up-to-date, complete or reliable,
- the software will be compatible with third party software,
- any errors in the software will be corrected.

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2. Upon complete payment of the purchase price for the customer-specific application program, ifm transfers the non-exclusive, locally and temporarily unrestricted usage right thereof to the customer, without the customer acquiring any rights of any kind to the standard software module on which the individual or customer-specific adaptation is based. Notwithstanding these provisions, ifm reserves the right to produce and offer customer-specific software solutions of the same kind for other customers based on other terms of reference. In any case ifm retains a simple right of usage of the customer-specific solution for internal purposes.
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6 Installation

6.1 System requirements

Software

The following software is required for operation.

- Operating system: Windows 10 (32/64 bits)
- ifm Vision Assistant software 2.9.6 or higher



Other versions of software and firmware may contain modified or new functions that are not described in this software manual.

Hardware

The following hardware is required for operation:

- Hard disk: min. 1 GB free memory space
- Monitor: Resolution of min. 1024x768 pixels, 32-bit colour depth

Accessories



Information about available accessories at www.ifm.com

6.2 Hardware



Detailed information on installation and electrical connection can be found in the operating instructions of the device: documentation.ifm.com

6.3 Software

Installing ifm Vision Assistant

- ▶ Download the ifm Vision Assistant: documentation.ifm.com
- ▶ Copy the zip file to a directory on the PC and unzip.
- ▶ ifm Vision Assistant is installed and can be started via `ifmVisionAssistant.exe`.



ifm Vision Assistant does not start

- ▷ If ifm Vision Assistant does not appear within 5 to 10 seconds after starting:
 - ▶ Check the system requirements.
 - ▶ Check the unzipped zip file for completeness.

Obtaining a licence

A licence key is required to activate the Monitoring Tool. The licence can be obtained online:

- Monitoring Tool incl. connection to 6 devices: [E3D310](#)
- Connection to an additional device: [E3D311](#)

Activating the Monitoring Tool

- ▶ Start `ifmVisionAssistant.exe`.
- ▶ Click the [Monitoring Tool] tile.
- ▶ Activate the licence online or offline.

6.3.1 Uninstall

Uninstalling the ifm Vision Assistant

- ▶ Delete the installation folder of the ifm Vision Assistant.
- ▷ The ifm Vision Assistant is uninstalled.



Existing settings and log files are not deleted.

Delete the settings and log files

- ▶ Delete the following directory: `%AppData%\ifm electronic\ifmVisionAssistant`

6.4 Command line parameters

The command line parameters influence the start of the ifm Vision Assistant by appending parameters to the exe file. Several parameters can be appended one after the other, separated by a space.

Command line parameters via command prompt

Start the ifm Vision Assistant via the prompt:

- ▶ In the prompt, add the command line parameters after `ifmVisionAssistant.exe` separated by a space.
- ▷ Example: `ifmVisionAssistant.exe -log`

Command line parameters via Windows

Start the ifm Vision Assistant with command line parameters via Windows:

- ▶ Right-click the shortcut of the [ifm Vision Assistant].
- ▶ Click on [Properties] in the submenu.
- ▶ Click on the [Shortcut] tab.
- ▶ Click the field [Target] and move the cursor to the end of the line.
- ▶ Enter a space followed by the command line parameter.
- ▶ Click [OK].

Available command line parameters

The following command line parameters are available:

Command line parameter	Description
<code>-disableclosebtn</code>	Disables the button for exiting the ifm Vision Assistant.
<code>-log</code>	Creates a log file for detailed error analysis. The log file is saved in the following folder: <code>%APPDATA%\ifm electronic\ifmVisionAssistant\logs</code>

Command line parameter	Description
<code>-autoconnect filename.xml</code>	Automatically establishes the connection to a device. The file <code>filename.xml</code> must contain the following XML code: <pre><?xml version="1.0" encoding="UTF-8"?> <sensor> <sensorType>RxDxxx</sensorType> <addressType>IP</addressType> <name>My_sensor</name> <address> <ip>192.168.0.69</ip> <pcic_port>50010</pcic_port> <web_port>80</web_port> <mac>00:02:01:21:b9:ee</mac> </address> </sensor></pre> ► Adjust the information in the XML file: IP address, ports, etc.
<code>-geometry [screen]:[width]x[height]+[x]+[y]</code>	Sets the window size and position of the ifm Vision Assistant (incl. window frame). The minimum window size is 1024x768 pixels. Example: <pre>-geometry 1:1380x768+0+0</pre> The window is placed on screen 1 (screen=1). The window size incl. Windows window frame is set to 1380x768 (width = 1380 and height = 768). The window is positioned at the top left (x=0 and y=0). When negative values are entered for the window position x and y, the opposite corner is used as zero point. Example: <pre>+0+0 window at the top left -0+0 window at the top right +0-0 window at the bottom left -0-0 window at the bottom right</pre>
<code>-frameless</code>	Starts the ifm Vision Assistant without the native Windows frame.
<code>-cmd "Mon:rec:startRecording=file.dat"</code>	Switches to the [Monitor] area after the start and starts recording data. A PowerShell script can be used to automatically insert the date and time into the file name of the recording: <pre>-cmd "Mon:rec:startRecording=c:/dat/\$(Get-Date).ToString('yyyy-dd-MM_hh-mm-ss'))_Cam.dat"</pre>
<code>-cmd "Mon:rec:durationSecs=-1"</code>	Sets the duration of the recording in seconds. <pre>-1 : unlimited recording time</pre>
<code>-cmd "Mon:rec:fileSplitSizeMB=3000"</code>	Splits the recorded data into blocks. The block size can be set in MB. The file names of the blocks contain a continuous counter.

Kiosk mode

In kiosk mode, the Windows frame is hidden and ifm Vision Assistant cannot be closed normally by the user. The mode is ideal for trade fairs and demonstrations.

Use the kiosk mode:

- Use the following command line parameters in succession:

```
ifmVisionAssistant.exe -disableclosebtn -frameless
```



The ifm Vision Assistant can be closed with the key combination [Ctrl+F4].

7 Start page

The start page contains the basic functions of the ifm Vision Assistant.

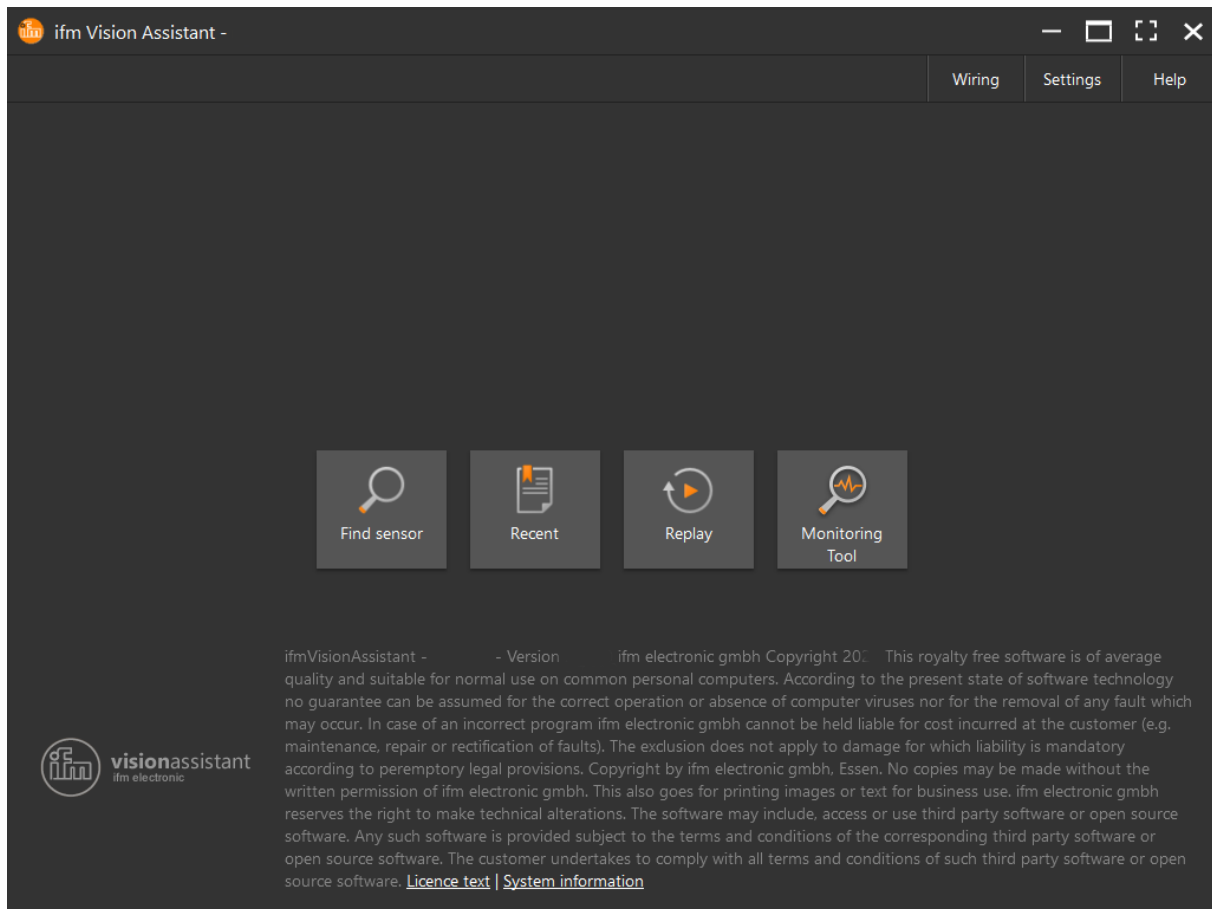


Fig. 1: Home page

Indicator	Name	Description
	Zoom out	Reduces the size of the window.
	Zoom In	Enlarges the window.
	Full screen	Displays the window in full screen mode.
	Exit	Closes the software.

Tab. 1: Title bar



With the F11 key, you can switch between full screen and window view.

Name	Description
[Device status]	Displays information about the hardware and firmware of the connected device. The information can be saved in a text file for diagnostics by the support staff. For the [Device status] function, the device must be connected.
[Wiring]	Displays information on wiring and connection aids.
[Settings]	Sets the language and colour of the user interface.

Name	Description
[Help]	Displays the documentation and contact details for support.

Tab. 2: Menu bar

Button	Name	Description
	Find device	Searches for connected devices and displays them in a list. For this function, the device must be connected.
	Recent	Displays list of devices that have already been used. For this function, the device must be connected.
	Replay	Plays back a saved image capture.
	Monitoring tool	Starts the Monitoring Tool.

Tab. 3: Buttons



If the devices are connected via the [Find sensor] or [Recent] buttons, the [Monitoring Tool] can no longer be started.

- ▶ Start the [Monitoring Tool] and then connect the devices.

7.1 Connecting the device

- ▶ Connect the device to the voltage supply.
- ▶ Connect the device to a PC via a CAN interface (e.g. EC2112).
- ▶ Install and start the ifm Vision Assistant software on the PC.
- ▷ The start page of ifm Vision Assistant opens.

The device can be connected to ifm Vision Assistant in different ways:

- ▶ [Connecting a new device automatically \(→ □ 12\).](#)
- ▶ [Connecting a new device manually \(→ □ 13\).](#)

If a device has already been connected to ifm Vision Assistant, it can be selected directly via the [Recent] button the next time the software will be started:

- ▶ [Connecting a device already in use \(→ □ 13\).](#)



Once the connection to the device has been established, a window for teaching the sensor position appears directly. Teaching can be undertaken subsequently at any time.

7.1.1 Connecting a new device automatically

- ▶ Click on the [Find sensor] button on the ifm Vision Assistant start page: 
 - ▷ ifm Vision Assistant searches for connected devices. A list shows the devices found and their settings.
- ▶ Click on a found device.
- ▷ The connection to the device will be established.



If the device is not found:

- ▶ Check the connections and the operating status of the device.
- ▶ Switch off the power supply to the device, restart ifm Vision Assistant and switch the device back on.
- ▶ [Connecting a new device manually \(→ □ 13\).](#)

7.1.2 Connecting a new device manually

- ▶ Click on the [Find sensor] button on the ifm Vision Assistant start page.
 - ▷ ifm Vision Assistant searches for connected devices. The device is not found.
- ▶ Click on the message [Manual connection].
 - ▷ The [Manual connection] window appears.
- ▶ In the list [Select type of sensor], click on the desired device.
- ▶ Further settings:
 - CAN adapter: first available device.
 - Baud rate 250 kbit/s
 - CAN protocol: J1939
 - Source address: 126



The baud rate and the source address can be changed later on. If multiple radar position sensors are used in a CAN network, they must have different source addresses.

- ▶ Click on the [Connection] button.
- ▷ A connection to the device will be established.

7.1.3 Connecting a device already in use

- ▶ Click on the [Recent] button on the ifm Vision Assistant start page.
 - ▷ The ifm Vision Assistant searches for recently used devices. A list shows the devices found and their settings.
- ▶ Click on a found device.
- ▷ The connection to the device will be established.

7.2 Playing back image captures

The [Replay] function plays back a saved image capture. Recordings are saved in the "Monitor" area. The function contains the following operating elements:

Operating element	Name	Description
	Previous image	Jumps to the previous image.
	Replay	Starts the replay.
	Next image	Jumps to the next image.
	Pause	Pauses the replay.
	Progress bar	Indicates the current position of the replay.
[Open other file]	Open other file	Opens another image capture.

Tab. 4: Operating elements

Playing back image captures

- ▶ Click on the [Replay] button: 

- ▷ A window for opening an image capture is displayed. The image captures are saved in the following folder by default: %appdata%\ifm_electronic\ifmVisionAssistant\capture
- ▶ Select an image capture.
- ▶ Click on the [Open] button.
- ▷ The image capture is displayed.

7.2.1 Converting an image capture

This function converts an image capture into another output format. The image capture is converted via the following operating elements.

Operating element	Type	Description
[Output format]	List	Sets the output format.
[Output file path]	Output field	Displays the set output directory.
[...]	Button	Sets the output directory.
[Output range]	List	Sets the output range.
[Convert]	Button	Starts converting the image capture.



Depending on the output format set, some operating elements are not displayed.

Output format

Output format	Description
[HDF5 ifm streams (*.h5)]	Flexible data container.
[ADTF data capture files (*.dat)]	Proprietary format.

Output range

Output range	Description
[Whole file]	Converts the whole image capture.
[From the current position to the end of the file]	Converts from the current position of the progress bar to the end of the image capture.
[From start to current position]	Converts from the start of the image capture to the current position of the progress bar.
[Only the next image]	Converts the next image of the image capture, viewed from the current position of the progress bar.

Converting an image capture:

- ✓ The saved image capture is opened.
- ▶ Change to the [Convert] section: .
- ▶ Set the file type under [Output format].
- ▶ Select the path and the file name under [Output file path].
- ▶ Set under [Output range] which part of the image capture is to be converted.
- ▶ Click on the [Convert] button.
- ▷ The converted image capture is saved under the selected file path.

7.3 Monitoring Tool

The Monitoring Tool can be purchased as additional software.

The Monitoring Tool contains functions for simultaneous monitoring of several devices. The devices are displayed in dashboards.

In the dashboard view, live images and status messages from the sensors are clearly displayed so that process sequences can be monitored both directly in the production environment and at a central location in real time.



Further information on the monitoring tool can be found at www.ifm.com.

8 Layout of user interface

The user interface is divided into the following areas:

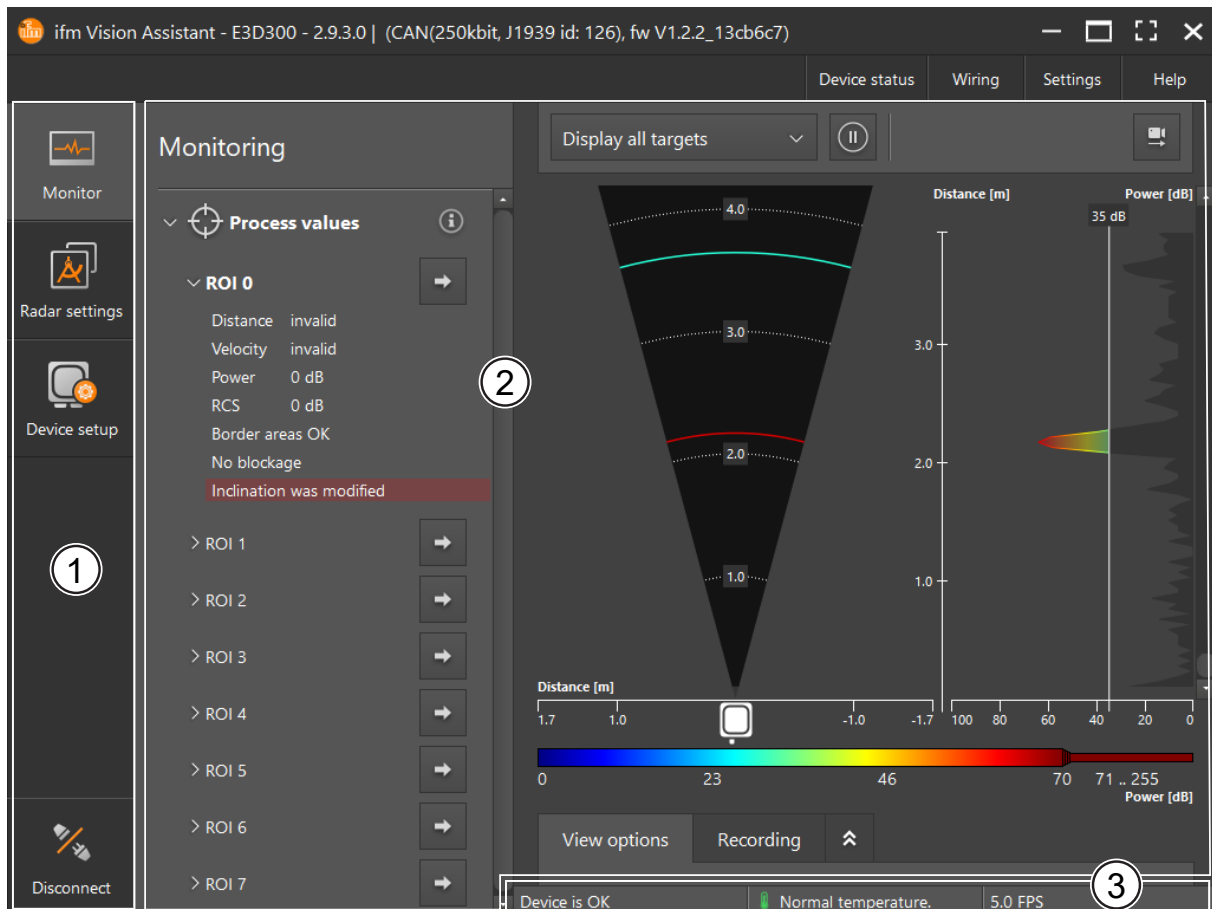


Fig. 2: User interface

- 1: Navigation bar
- 2: Main area
- 3: Status bar

1. Navigation bar

The buttons in the navigation bar are used to switch between the different areas of ifm Vision Assistant.

Button	Name	Description
	Monitor	Displays the received data of the device.
	Radar settings	Displays the setting options for selecting the target reflections.
	device set-up	Displays the device setup.
	Disconnecting	Disconnects from the device.

2. Main area

The main area displays the area selected with the navigation bar. In the example above, this is the [Monitor] area with the status display on the left, the live image on the right and the tabs in the lower screen area.

3. Status bar

The status bar shows current device information:

- The current device status:
 - Normal operating status: "Device is OK".
 - Diagnostic messages: e.g. "Function check"
 - Warnings or error message: e.g. "Maintenance required"
- The temperature of the device: e.g. "Temperature normal"
- The **Frame ID**
- The refresh rate (FPS = frame per seconds) at which the signals from the sensor are displayed in ifm Vision Assistant.

9 Monitor

In operating mode, the [Monitor] area displays the regions of interest (ROIs), the target reflections and, to the left, the process values of the **selected target reflections**.

The display of the target reflections depends on the selection made in the list field at the top of the live image:

- Display all targets
- Display all moving targets
- Display filtered targets
- Display process values



► Select the required ROI using the  button.

▷ The **selected target reflection** of the selected ROI is displayed in the live image.

The following applies to the **selected target reflections:**

- In each region of interest (ROI), a target reflection can be selected that corresponds to the criteria of the respective ROI in the [Radar settings] area. As there are 8 ROIs, there can be a maximum of 8 selected target reflections.
- A selected target reflection is marked with a crosshair if the corresponding ROI was previously selected. Your process values are shown in the status display.

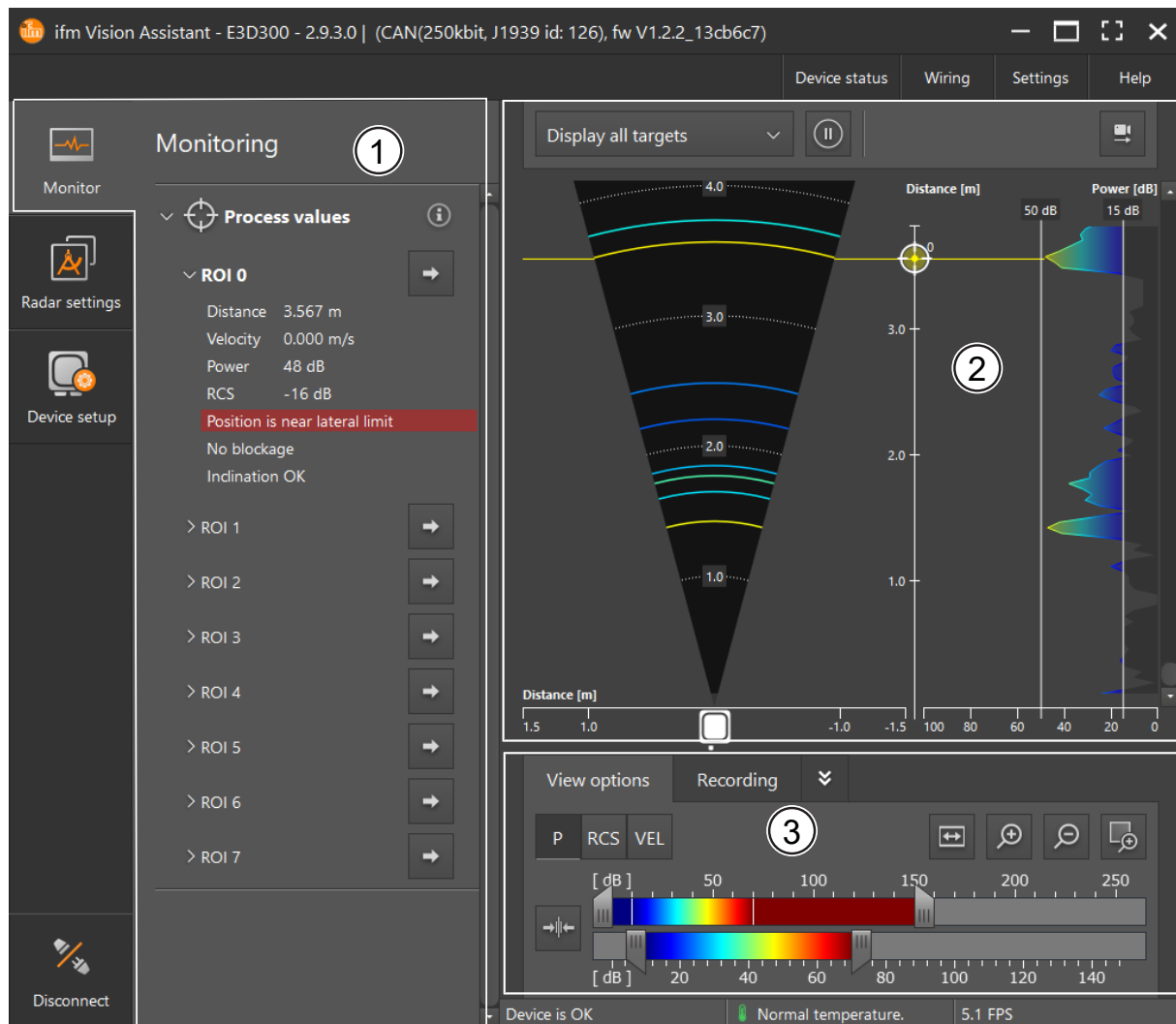


Fig. 3: Monitor

- 1: Status indicators
 - **Process values** (→ [19](#)) the selected target reflection of the selected ROI
 - Status messages (e.g. "Inclination has been changed")
- 2: Live image monitor
 - **Target reflections**
 - **Selected target reflection**: The number on the crosshair indicates the selected ROI.
 - Scale for distance and power (→ [Range filter](#) [24](#)).
- 3:
 - **Display options** (→ [20](#))
 - **Recording** (→ [22](#))

9.1 Process values

The [Process values] section shows the current measured values of the **selected target reflection** in the selected ROI. The selected target reflection is marked with a crosshair in the live image.

The following process values are displayed:

- Distance in metres
- Velocity in metres per second
 - Negative sign when the target reflection is moving towards the sensor.
 - Positive sign when the target reflection moves away from the sensor.
- **Power** in decibels
- **RCS** in decibels

- Status messages about the device:
 - Notification about exceeded limit areas (→ [Range filter](#)  24)
 - Message on device inclination (→ [Inclination](#)  28)

9.2 Live image monitor

The live image shows the **target reflections** in the selected **ROI** as coloured lines.

A list field at the top of the screen can be used to select whether all target reflections, all moving target reflections, filtered target reflections or only the selected target reflection of the selected ROI is displayed.

The selected target reflection of the selected ROI is marked with a crosshair.

The live image is continuously updated.

The colours used for the target reflections can be set (→ [Setting the colour range](#)  21).



- Enlarge/reduce live image by scrolling with the mouse button.
- Centre the live image using the right scroll bar.

Display / operating element	Name	Description
	Crosshair	Marking of the selected target reflection whose region of interest (ROI) was selected in the left image area. The position number corresponds to the selected ROI.
	List: • Display all targets • Display all moving targets • Display filtered targets • Display process values	Selection of the target reflections to be displayed. The selected target reflection in the currently selected ROI is marked with a crosshair. • All targets: Display of all target reflections detected by the device, regardless of the radar settings and selected ROI. • All moving targets: display of all target reflections with a velocity other than 0 m/s. • Filtered targets: Display of all target reflections of the selected ROI that correspond to the set criteria → [Radar settings]. • Process values: Display of the selected target reflection of the selected ROI. All other target reflections will be hidden.
	Freeze the current result	The live image and the process values in the status display will no longer be updated.

Tab. 5: Live image operating elements

9.3 Display options

With the [View options] tab, the display of the live image can be adjusted.

Operating element	Name	Description
P	Power	Opens the colour setting for the process value 'power'
RCS	RCS	Opens the colour setting for the process value 'RCS'
VEL	Velocity	Opens the colour setting for the process value 'velocity'

Operating element	Name	Description
	Colour range	The colour of the target reflections can be set using the two sliders: The colour range is from dark blue (= lowest measured value) to turquoise, green, yellow orange and dark red (= highest measured value). The colour setting applies to the process value selected via the P, RCS or VEL button. There is no colour setting for the process value 'distance' because the distance can be checked via the coordinates in the live image.
	Button	Automatically adjusts the colour range.
	Upper slider	Sets the colour range roughly.
	Lower slider	Sets the colour range accurately.
	Fit to window	Adjusts the image area of the live image to the window size.
	Zoom defined area	Enlarges a selectable image area of the live image.
	Zoom out	Reduces the image zone of the live image. The zoom level can also be changed using the mouse wheel.
	Zoom in	Enlarges the image zone of the live image. The zoom level can also be changed using the mouse wheel.

Tab. 6: Operating elements view options

Setting the colour range

- ▶ Select process value with the buttons [P], [RCS] or [VEL].
- ▶ Use the upper sliders to set the required measuring range.
- ▶ Use the lower sliders to adjust the colour spectrum within the range set above: Move the sliders to split up the colour range more finely.
 - ▷ The lower colour range is marked in the upper colour range by white lines.

The reflection lines will be immediately updated in the live image according to the colour setting.

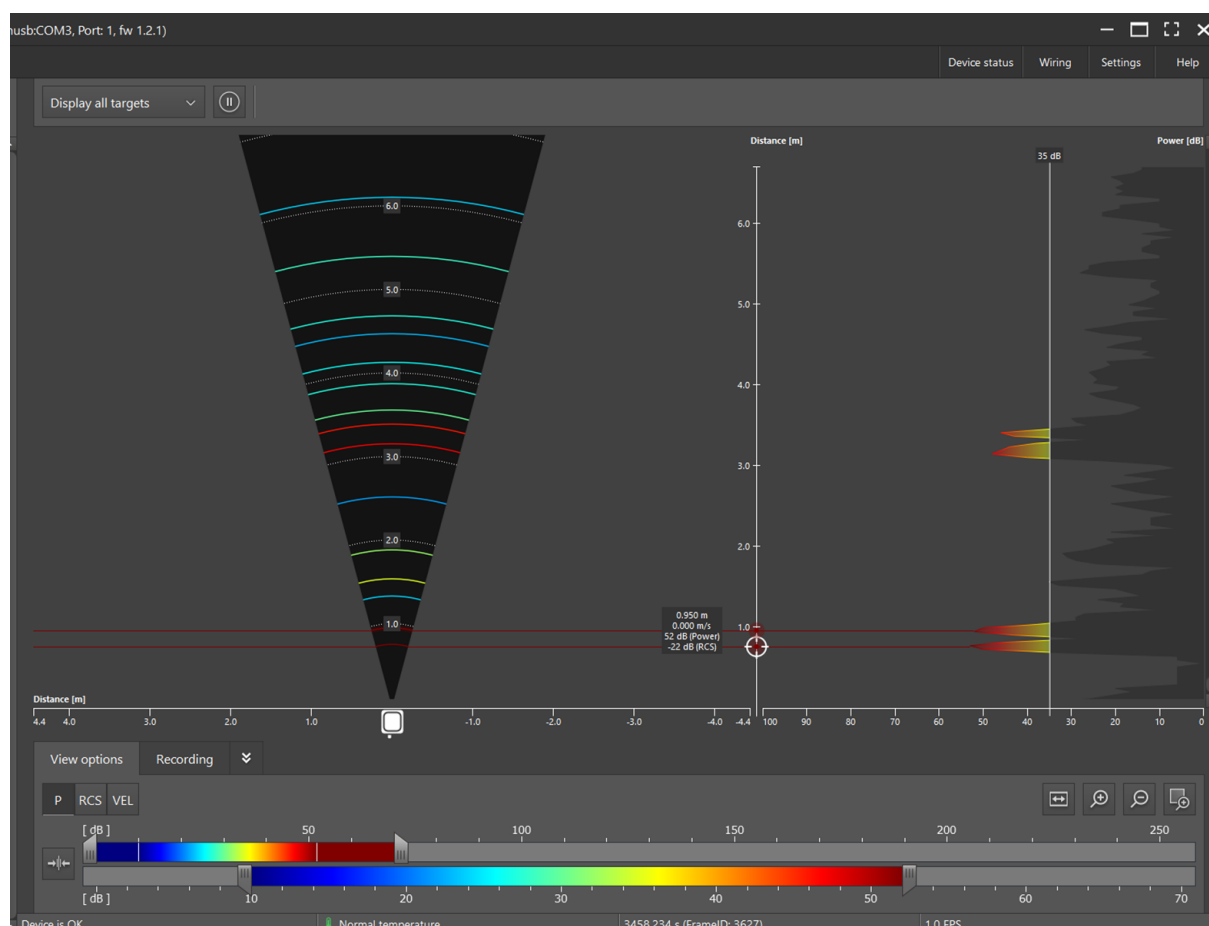


Fig. 4: Colour range example for P (power): The darker the shade of red, the greater the power of the reflection line in dB



By clicking on a colour range, the entire colour range can be moved by holding down the left mouse button.

9.4 Recording

With the [Record options] tab, the measurements of the device can be recorded in a video or image.

Operating element	Name	Description
Duration	List: - Infinite 1 min 2 min 4 min 8 min	Sets the duration of the image capture. Approx. 20 MB/minute are required. If the duration is set to [Continuous], the image capture is limited by the free memory capacity of the data carrier.
File size	List: - No splitting 100 MB 700 MB (CD-R) 1 GB 4.7 GB (DVD-R)	The [No splitting] file size is limited by the free space of the data carrier and the set duration.
	Start/Stop	Starts or stops the image capture. The recording will be saved in a file with the extension "*.h5".
- / 02:00	Image capture time	Shows the duration of the current image capture and the maximum capture time.

Tab. 7: Recording operating element

10 Radar settings

In the [Radar settings] area, the settings for selecting the **selected target reflection** can be managed. Changes to the settings will be updated directly in the live image.

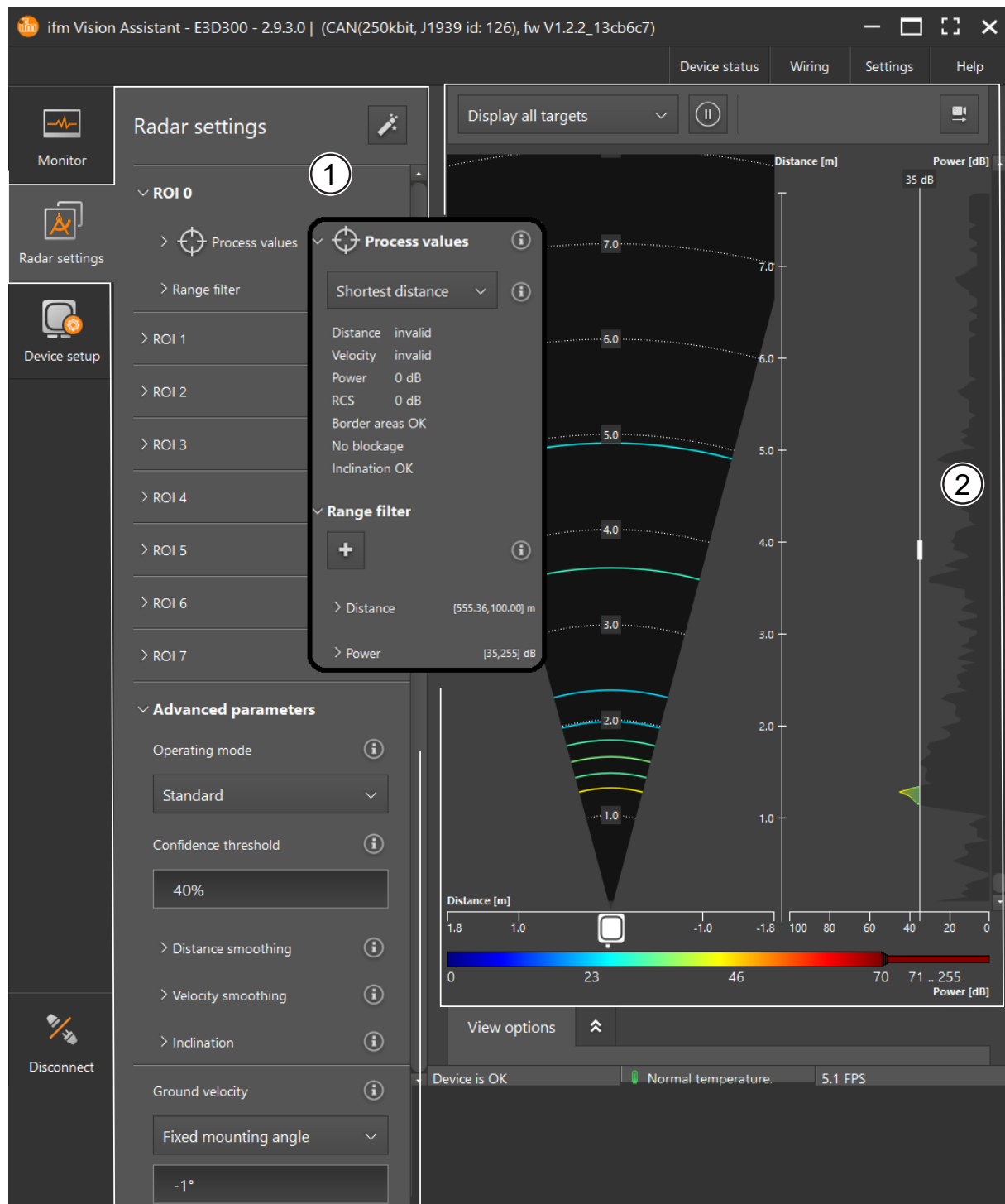


Fig. 5: Radar settings

- 1: Setting range
 - [Region of Interest \(ROI\)](#) (→ [24](#))
 - [Range filter](#) (→ [24](#))
 - [Advanced parameters](#) (→ [26](#))
- 2: Live image radar settings

10.1 Region of Interest (ROI)

Up to 8 regions of interest (**ROI0...ROI7**) can be configured and selected for the process value output.

Each ROI has its own **selected target reflection** that corresponds to the selection criteria (selection rule, range filter) for this ROI.

In addition, the global settings from the [Advanced parameters] area are applied equally to all ROIs:

See also: [Advanced parameters](#) (→ [26](#)).

In the live image, the selected target reflection of the selected ROI is marked with a crosshair. The number on the crosshair indicates the corresponding ROI.

ROI configuration:

- ▶ Click on [**> ROI x**] in the left part of the screen to select the ROI to be configured.
- ▷ The settings area opens and shows the [Process values] section.
- ▷ The process values of the selected target reflection in the selected ROI are displayed.
- ▶ Open the list field [**∨**] and choose a selection rule.
 - Shortest distance
 - Strongest power
 - Strongest RCS
 - Highest absolute velocity
 - Longest distance
- ▶ In the [Range filter] section, set the limit values for velocity, RCS, distance and power of the target reflections:

See also: [Range filter](#) (→ [24](#)).

10.1.1 Range filter

Threshold values for the process values can be defined for each individual **ROI** using the limit value filter, which reduces the selection of target reflections.



The selection rule for selecting the selected target reflection only considers target reflections within the filtered area.

- ▶ Activate the range filter for the process values via the button [**+**]:
 - Distance
 - Velocity
 - RCS
 - Power
- ▶ Enter the minimum and maximum limits for the respective filter or set them by dragging the handles in the histogram.
- ▷ The filter settings take effect immediately and change the display of the target reflections in the live image.

The limit values for the power can be set both in the [Range filter] section in the status display and directly in the live image:

- ▶ Click and drag the lines ① and ② in the live image:

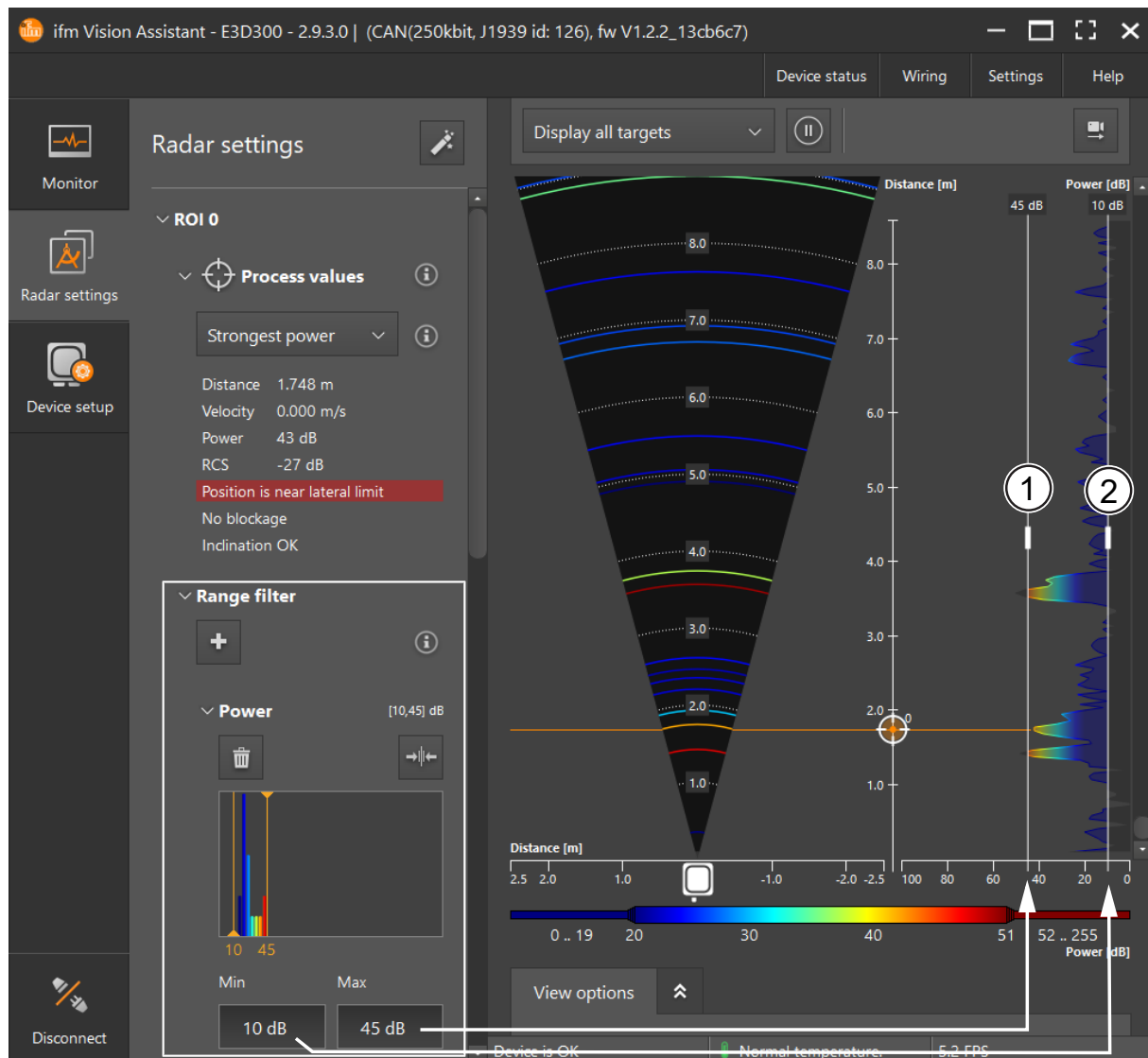


Fig. 6: Power range filter

Operating element	Name	Description
	Deleting a filter	The filter will be deleted after confirmation.
	Within the range	Additional criterion for velocity filter: -1 m/s 0 m/s +1 m/s Only target reflections within the set range are taken into account. In the example shown: Only target reflections with a velocity of less than 1 m/s in positive direction (away from the sensor) or negative direction (towards the sensor) are considered. This also includes static targets (velocity = 0 m/s).
	Out of range	Additional criterion for velocity filter: -1 m/s 0 m/s +1 m/s Only target reflections outside the set range are taken into account. In the example shown: Only target reflections with a velocity of more than 1 m/s in positive direction (away from the sensor) or negative direction (towards the sensor) are considered, i.e. no static targets.

Operating element	Name	Description
	Telephoto	Automatic adjustment of the histogram view to the changed settings.

Tab. 8: Filter operating elements

10.2 Advanced parameters

Additional application-specific settings can be made on the radar sensor via [Advanced parameters] .

The global settings from the [Advanced parameters] area are taken into account equally for all ROIs.



The selection rule for selecting the selected target reflection only considers target reflections that correspond to the extended parameter settings.

10.2.1 Operating mode

Depending on the device type, different operating modes can be selected to optimise the sensor for the corresponding area of application.

The operating modes differ in the maximum distance, the distance resolution, the maximum speed, the speed resolution and the measuring frequency.

Selectable operating modes:

- Standard
- Long range



Not all devices have the option of selecting an operating mode.
Detailed information on the operating modes: Data sheet at [ifm.com](https://www.ifm.com).

10.2.2 Confidence threshold

The confidence threshold is a measure of the quality of the position of a detected target reflection determined by the sensor. Each position of a target reflection is defined by a confidence value. Target reflections whose confidence values are below the set limit value are filtered out.

- A low confidence threshold increases the number of reflections displayed.
- A high confidence threshold decreases the number of target reflections displayed.

Factory setting: 40%

10.2.3 Smoothing

When smoothing is activated, an exponential moving average will be formed from the process value of the selected target reflection. The smoothing filter reduces fluctuation of the process value in the case of rapidly changing measured values.

Two smoothing filters are available:

- Distance smoothing
- Velocity smoothing

The smoothing filter influences the process value according to the following formula:

Smoothed process value =
 Weighting factor * current measured value + (1 - weighting factor) * moving average value

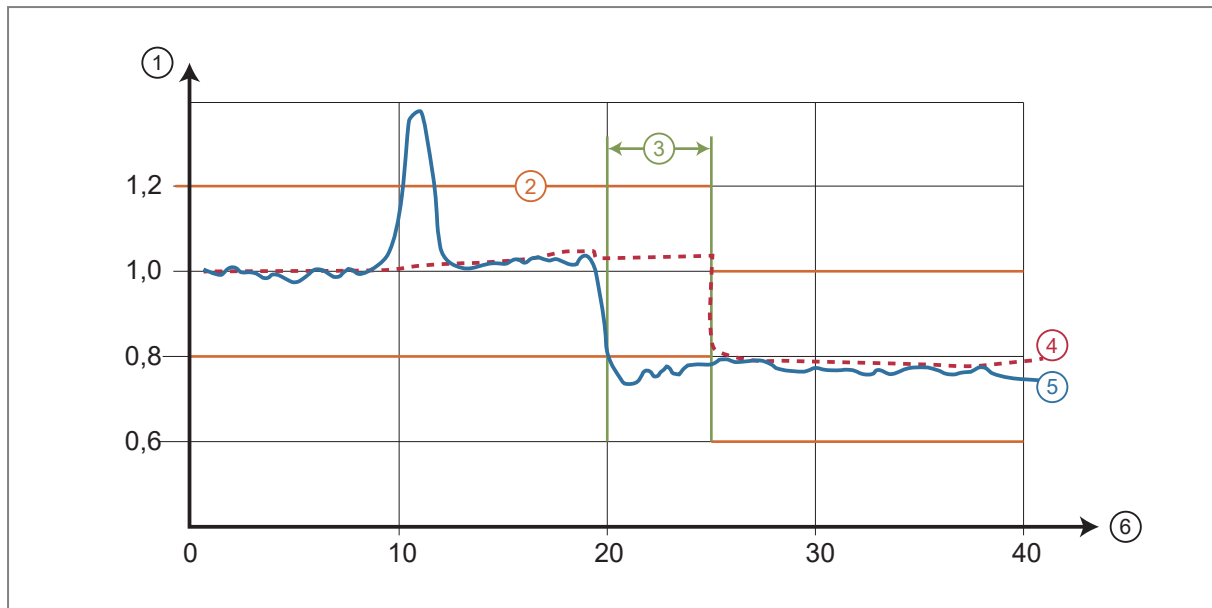


Fig. 7: Influence of the smoothing filter on the process values 'distance' or 'velocity'

- 1: Process value (distance or speed)
- 2: Tolerance
- 3: Duration
- 4: Smoothed process value
- 5: Non-smoothed process value
- 6: Time

Weighting factor

Weighting factor The weighting factor determines how strongly the current measured value is taken into account in the moving averaging of the process value.

Example (compare above formula):

With a weighting factor of 0.1, 10 % of the current measured value will be included in the averaging of the process value (distance or velocity). With a weighting factor of 1, only the current measured value will be output (no averaging).

Tolerance

The tolerance setting can be used to ignore measured value outliers. Current measured values outside the tolerance range will not be taken into account when averaging the process value.

Distance smoothing example:

If the current moving average is set at 1 m and a tolerance of 0.2 m, only distance values of 0.8...1.2 m will be considered.

Duration

The duration is used to set how long an outlier must be outside the tolerance range in order to be taken into account as the current measured value for averaging the process value.

Example:

With a setting of 500 ms, only reflections that occur outside the tolerated distance for longer than 500 ms will be taken into account. However, this only applies if no other target reflection is within the tolerance range during the same time.

Parameter setting:

- Activate the smoothing filter by clicking on the check box.
- Configure the filter by setting weighting factor, tolerance and duration.

10.2.4 Inclination

A change in position of the sensor in vertical or horizontal direction is detected by the sensor. By setting an inclination tolerance, it can be determined from which position change a message is output in the [Monitor] area.

Current inclination

The current inclination of the sensor can be defined via two parameters:

- [Pitch]: Vertical inclination up or down along the y-axis
 - [Roll]: Horizontal inclination to the left or right along the x-axis
- Update the current inclination of the sensor with the [↻] button.

Nominal inclination

The nominal inclination describes the required mounting position of the sensor.

- Set the required inclination manually via the parameters [Pitch] and [Roll].

- or -

- Adopt current inclination values of the sensor with the [⌵] button.



In the [Monitor] or [Radar settings] areas, a window can be opened with explanations of the X, Y and Z positions and to teach the nominal inclination.

- Click on the following symbol in the top right-hand corner of the live image: .
- Click on "Inclination ⓘ" to access additional explanations.
- Activate the check box at the bottom of the window and click [OK] to accept the current inclination as the nominal inclination.

Inclination tolerance

The inclination tolerance describes the maximum permissible deviation between the current inclination and the nominal inclination.

When the inclination tolerance is exceeded, a status message is provided.

- Set the inclination tolerance manually via the [Pitch] and [Roll] parameters.

10.2.5 Speed over ground

If the sensor is mounted on a mobile object, the sensor surface must be mounted at an angle of between 30 and 45° to the floor. The mounting angle must be set so that the speed is correctly output by the sensor:

- Select one of the following options in the [Speed over ground] section:
- Dynamic (via tilt pitch): The vertical inclination of the sensor is determined automatically.
 - Fixed mounting bracket: Manually enter the angle of inclination in the input field that opens.



As vibrations can have an influence on the inclination value, it is recommended that the fixed mounting angle is used for the calculation.

11 Device setup

11.1 General

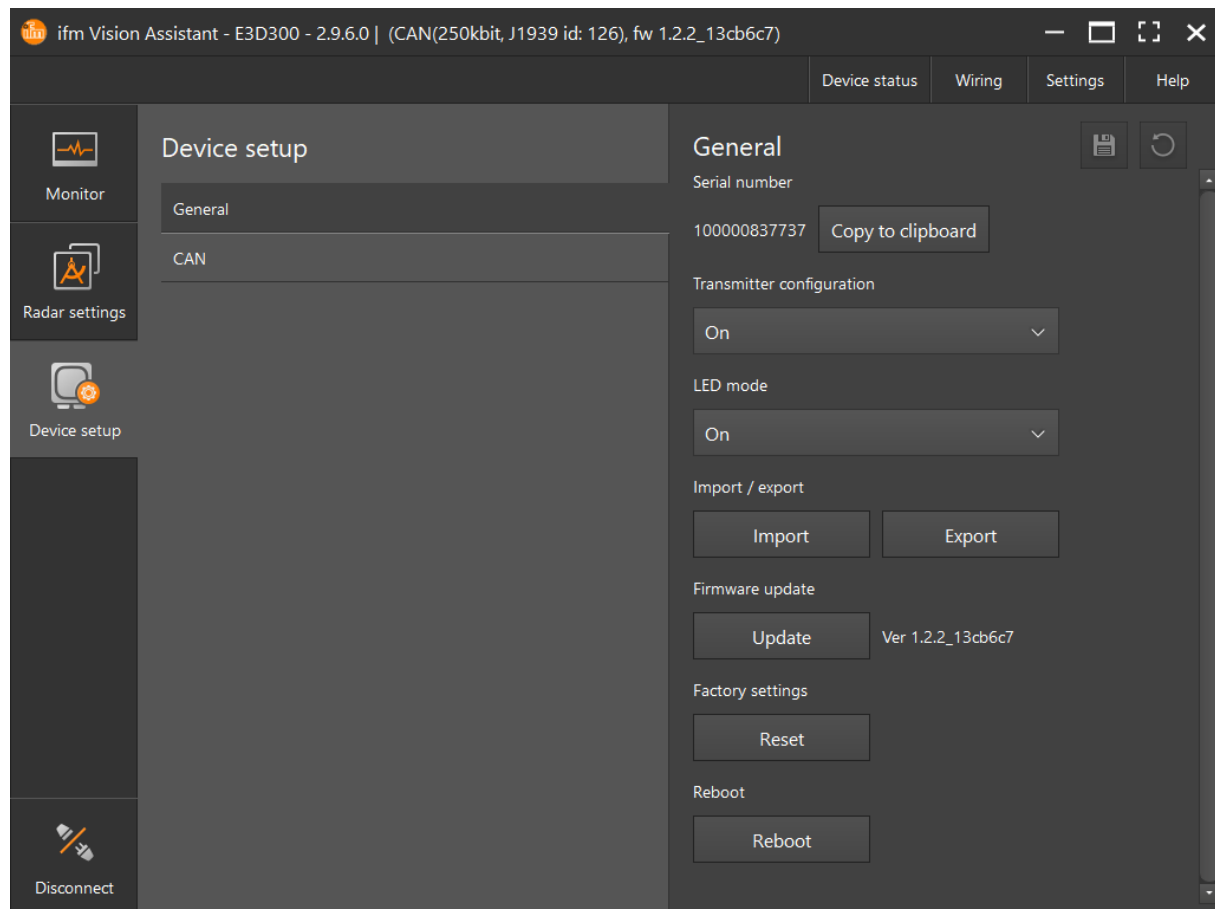


Fig. 8: Device setup - General

Serial number

The serial number of the device is displayed here and can be copied to the clipboard using the [Copy to clipboard] button.

Transmitter configuration

Setting to enable and disable the radar transmitting unit.

- Off: transmitter permanently off
- On: transmitter permanently on

LED mode

The status LED on the device can be switched off permanently by selecting [Off].

Import / export

The settings made in the ifm Vision Assistant can be saved to a file with the extension *.cfg using the [Export] command. This saves the settings and they can be transferred to the same device or to other devices using the [Import] command.

Firmware update

The [Update] command is used to transfer the latest firmware to the device via the CAN interface.

Factory settings

The [Reset] command is used to reset the device to the default settings. This affects all changed application-specific parameters.

Sensor reboot

The [Reboot] command is used to restart the device. The settings made are retained.

For example, a reboot is required if the baud rate or the address of the device has been changed.

11.2 CAN

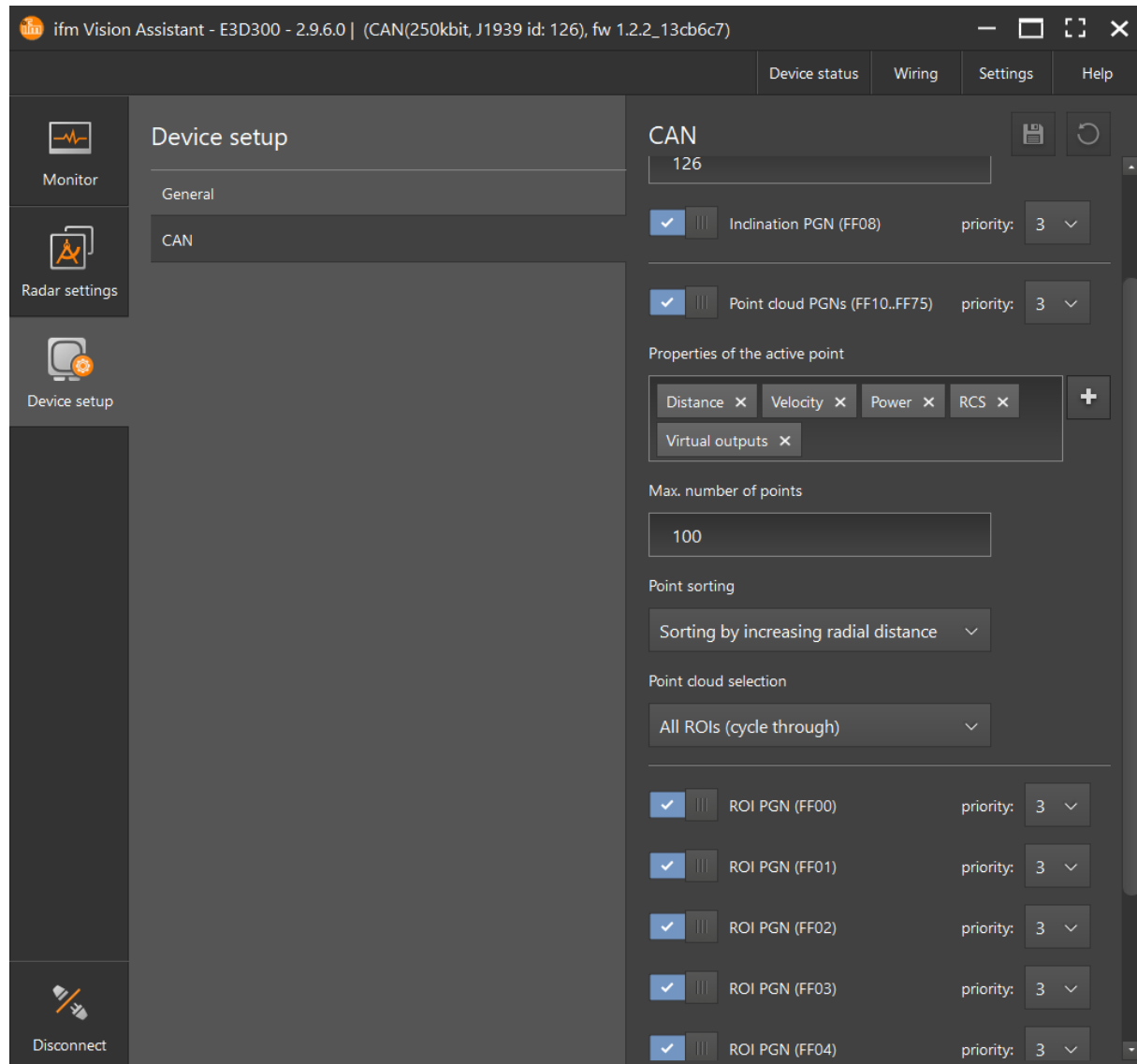


Fig. 9: Device configuration – CAN

Baud rate

The number of target reflections that can be transmitted via the CAN interface depends on the set baud rate:

Baud rate	Number of target reflections
1 Mbaud	96
800 kbaud	72
500 kbaud	48

Baud rate	Number of target reflections
250 kbaud	24
125 kbaud	12



All radar position sensors in a CAN network must have the same baud rate.

Device address

1...255



All devices in a CAN network have their own address. The lower the value, the higher the priority of the messages sent by a device.

PGNs (Parametergruppennummern)

- Inclination PGN (FF08), priority 0...6
- Point clouds PGNs (FF10...FF75), priority 0...6

The required PGNs (parameter group numbers) can be activated or deactivated according to the CAN bus load requirements using the slider.

The priority with which information is transmitted can be set for individual parameter groups. The higher the value, the faster the messages will be transmitted.

Properties of the active point

Process values of the selected target reflection and other target reflections displayed in the live image monitor ([→ Monitor](#) 18) that are transmitted via the CAN interface.

- Distance
- Velocity
- Power
- RCS
- Virtual outputs



Deselecting individual process values directly affects the target reflections in the live image ([→ Monitor](#) 18).

Maximum number of points

Maximum number of target reflections from the live image that are transmitted via the CAN interface. The maximum possible number of target reflections is 100. The target reflections are selected according to the chosen sorting (see below).

Sorting points

Criterion by which the target reflections whose process values are transmitted via the CAN interface are selected from all the target objects displayed in the live image. The number of target reflections specified in the field [Max. number of points] is selected according to the sorting.

- Sorting by increasing power
- Sorting by decreasing power
- Sorting by increasing RCS
- Sorting by decreasing RCS
- Sorting by increasing velocity
- Sorting by decreasing velocity
- Sorting by increasing radial distance
- Sorting by decreasing radial distance

Point cloud selection



The point cloud is a selection from the totality of all target reflections of an **ROI**. The selection is made via the CAN settings [Properties of the active point], [Maxi. number of points] and [Point sorting].

The **region of interest (ROI)** from which the point cloud is transmitted via the CAN interface can be specified:

- All ROIs: The point clouds of the individual ROIs are transmitted cyclically one after the other.
- Only ROI x: The point cloud of the selected ROI is transmitted continuously.

ROI-PGN (FF00...FF07)

The process data results of the **selected target reflections** from ROI 0 to ROI 7 are transmitted according to the specifications in the chapter "Proprietary protocol in PDU format 2".

The required PGNs (parameter group numbers) can be activated or deactivated according to the CAN bus load requirements using the slider.

The priority with which information is transmitted can be set for individual parameter groups. The higher the value, the faster the messages will be transmitted.

12 CAN interface description

12.1 SAE J1939 interface

The device has a standardised SAE J1939 interface. All measured values and parameter groups can be accessed via the J1939 protocol. The individual configuration can be saved in the internal permanent memory (flash).

12.1.1 Overview and structure of the SAE J1939 protocol

The SAE J1939 protocol uses a 29-bit CAN identifier (extended frame format CAN 2.0B). A J1939 message has the following structure:

J1939 message			
29-bit CAN identifier			Data
Priority	Parameter Group Number (PGN)	Source address	User data of the message
28..26	25..8	7..0	0..8 bytes



Parameter Group Number (PGN)			
Ext. Data Page	Data Page	PDU Format (PF)	Target address / group extension (PS)
25	24	23..16	15..8



PDU format 1 (specific)	
00h - EFh	Target Address (DA)
23..16	15..8

PDU format 2 (global)	
F0h - FFh	Group Extension (GE)
23..16	15..8

12.1.1.1 PDU format 1

This format defines a message which is sent to a defined device. In this case the PDU-specific byte (PS) is the target address (DA) of the device. If the value of the PDU format field (PF) is between 0x00 and 0xEF, it is a PDU format 1 message.

For proprietary messages (manufacturer-specific) the PDU format value 0xEF is defined.

Ext. data page bit = 0 and data page bit = 1.

12.1.1.2 PDU format 2

This format defines a message which is sent globally. In this case the PDU specific byte (PS) corresponds to the group extension (GE). If the value of the PDU format field (PF) is between 0xF0 and 0xFF, it is a PDU format 2 message.

For proprietary messages (manufacturer-specific) the area PDU format (PF) and group extension (GE) 0xFF00 – 0xFFFF is defined.

Ext. data page bit = 0 and data page bit = 0.

12.1.2 Proprietary protocol in PDU format 1

The parameters of the device are listed in a table that is accessed per 16-bit index. To access the sensor parameters in reading or writing the proprietary PDU format 1 message is used. PDU format (PF) corresponds to the value 0xEF. In this case the PDU-specific byte (PS) is the target address (DA) of the device which is to receive the message.

Example

- Address target unit (ECU): 0x7E
- Address control unit / master: 0x14
- Priority of the message: 3

CAN identifier	8-byte data frame			
ID	Parameter index	Read/Write	Status	4-byte data
29 bits	2 bytes	1 byte	1 byte	

Requirement: Master → ECU

CAN identifier	8-byte data frame							
0xDEF7E14	LSB	MSB	RW	0	LSB	..	..	MSB

Response: Master ← ECU

CAN identifier	8-byte data frame						
0xDEF147E	Index	RW	SC	LSB	..	..	MSB

Parameter index: 2-byte parameter index.

RW: Read parameter → 0x00 / write parameter → 0x01

SC: Status code

- 0x00: OK
- 0x01: Parameter value too small
- 0x02: Parameter value too big
- 0x03: Parameter index does not exist
- 0x04: Parameter can only be read
- 0x05: Parameter can only be written
- 0x06: No access to parameter
- 0x07: Invalid data size
- 0x08: Parameter writing blocked
(example: The value to be written is already set in the sensor)
- 0x09: Invalid command
- 0x0A: Unknown error

12.1.2.1 Configuration examples

- Address target unit (ECU): 0x7E
- Address control unit / master: 0x14
- Priority of the message: 3

Example 1:

- Set the maximum limit for the number of objects to 9, index 0x2011

Requirement: Master → ECU

CAN identifier	8-byte data frame							
0xDEF7E14	0x11	0x20	0x01	0x00	0x09	0x00	0x00	0x00

Response: master ← ECU, status code: OK

CAN identifier	8-byte data frame							
0xDEF147E	0x11	0x20	0x01	0x00	0x09	0x00	0x00	0x00

Example 2:

- Read internal temperature, index 0x203

Requirement: Master → ECU

CAN identifier	8-byte data frame							
0xDEF7E14	0x03	0x02	0x00	0x00	0x00	0x00	0x00	0x00

Response: master ← ECU, status code: OK

CAN identifier	8-byte data frame							
0xDEF147E	0x03	0x02	0x00	0x00	0x024	0x00	0x00	0x00

Result: 3.6 degrees

12.1.3 Proprietary protocol in PDU format 2

The measured data of the sensor is sent cyclically via proprietary PDU format 2 messages. PDU format (PF) corresponds to the value 0xFF. In this case, the PDU-specific byte (PS) is the group extension (GE).

In the following, these parameter groups are referred to as transmit PGNs (TxPGNs).

Depending on the use case, the required PGNs can be activated or deactivated based on the CAN bus load requirements.

The list of TxPGNs that are transmitted is shown in the following table. For details on the signals contained in each PGN and the periodicity of each PGN see the J1939 DBC file of the CAN sensor.

Value	PGN	Description
Process Data Output PV Inclination	PGN 0xFF08	Transfers the inclination information of the sensor every frame
Process Data Output for Distance mode ROI 0	PGN 0xFF00	The process data results of the selected target reflection from ROI 0 are written to two PGNs and output according to the ROI configuration.
Process Data Output for Distance mode ROI 1	PGN 0xFF01	The process data results of the selected target reflection from ROI 1 are written to two PGNs and output according to the ROI configuration.
Process Data Output for Distance mode ROI 2	PGN 0xFF02	The process data results of the selected target reflection from ROI 2 are written to two PGNs and output according to the ROI configuration.
Process Data Output for Distance mode ROI 3	PGN 0xFF03	The process data results of the selected target reflection from ROI 3 are written to two PGNs and output according to the ROI configuration.

Value	PGN	Description
Process Data Output for Distance mode ROI 4	PGN 0xFF04	The process data results of the selected target reflection from ROI 4 are written to two PGNs and output according to the ROI configuration.
Process Data Output for Distance mode ROI 5	PGN 0xFF05	The process data results of the selected target reflection from ROI 5 are written to two PGNs and output according to the ROI configuration.
Process Data Output for Distance mode ROI 6	PGN 0xFF06	The process data results of the selected target reflection from ROI 6 are written to two PGNs and output according to the ROI configuration.
Process Data Output for Distance mode ROI 7	PGN 0xFF07	The process data results of the selected target reflection from ROI 7 are written to two PGNs and output according to the ROI configuration.
Point Cloud Radial Distance values	32 PGN PGN 0xFF10 ... PGN 0xFF2F	Up to four radial distance values can be written in each PGN, and the corresponding PGNs are transferred depending on the number of recognised points
Point Cloud Velocity values	32 PGN PGN 0xFF30... PGN 0xFF4F	Up to four velocity values can be written in each PGN, and the corresponding PGNs are transferred depending on the number of recognised points
Point Cloud Power values	19 PGN PGN 0xFF50... PGN 0xFF62	Up to seven performance values can be written in each PGN, and the corresponding PGNs are transferred depending on the number of detected points
Point Cloud RCS values	19 PGN PGN 0xFF63... PGN 0xFF75	Up to seven RCS values can be written in each PGN, and the corresponding PGNs are transferred depending on the number of detected points
Process Data Output Full Point Cloud Trailer	PGN 0xFF76	The PGN contains the summary of the number of points in the current frame, the Frame ID, CRC of the point cloud data, device status

12.2 Parameter mapping

Proprietary communication profile

12.2.1 Parameter indices

Index	Type	Value	Unit	Step	Range	R/W
0x1000	uint8	Activate ROI0 TxPGN 0: disabled 1: enabled (default)			0...1	R/W
0x1001	uint8	Priority ROI0 TxPGN priority (default 3)		1	0...7	R/W
0x1002	uint8	Activate ROI1 TxPGN 0: disabled 1: enabled (default)			0...1	R/W
0x1003	uint8	Priority ROI1 TxPGN (default 3)		1	0...7	R/W
0x1004	uint8	Activate ROI2 TxPGN 0: disabled 1: enabled (default)			0...1	R/W
0x1005	uint8	Priority ROI2 TxPGN (default 3)		1	0...7	R/W
0x1006	uint8	Activate ROI3 TxPGN 0: disabled 1: enabled (default)			0...1	R/W

Index	Type	Value	Unit	Step	Range	R/W
0x1007	uint8	Priority ROI3 TxPGN (default 3)		1	0...7	R/W
0x1008	uint8	Activate ROI4 TxPGN 0: disabled 1: enabled (default)			0...1	R/W
0x1009	uint8	Priority ROI4 TxPGN (default 3)		1	0...7	R/W
0x100A	uint8	Activate ROI5 TxPGN 0: disabled 1: enabled (default)			0...1	R/W
0x100B	uint8	Priority ROI5 TxPGN (default 3)		1	0...7	R/W
0x100C	uint8	Activate ROI6 TxPGN 0: disabled 1: enabled (default)			0...1	R/W
0x100D	uint8	Priority ROI6 TxPGN (default 3)		1	0...7	R/W
0x100E	uint8	Activate ROI7 TxPGN 0: disabled 1: enabled (default)			0...1	R/W
0x100F	uint8	Priority ROI7 TxPGN (default 3)		1	0...7	R/W
0x1020	uint8	Point cloud PGN group selection 0: disabled 31: enable all Bit 0: Distance Bit 1: Velocity Bit 2: Power Bit 3: RCS Bit 4: VirtualMixedOutput				R/W
0x1021	uint8	max number of Point targets			0...103 tbd (0...128)	R/W
0x1022	uint8	Priority if Point cloud PGNs (default 3)		1	0...7	R/W
0x1030	uint8	0-7: Point target selection according to specified ROI index 8: All targets				
0x1031	uint8	Point Cloud Sorting 0: No Sorting Same order as provided by the Front End 1: increasing Power 2: decreasing Power 3: increasing RCS 4: decreasing RCS 5: increasing Velocity 6: decreasing Velocity 7: Increasing Radial Distance 8: Decreasing Radial Distance 9-31: Reserved		1	0...31	R/W
0x1041	uint16, uint16	ROI Id, Selection rule 0: Shortest Distance (default) 1: Strongest Power 2: Strongest RCS 3: Smallest Velocity 4: Highest Velocity 5: Highest Absolute Velocity 6: Longest Distance			0...6	R/W
0x1046	uint16, uint16	ROI Id, Range min (default: 0.1)	m	0.01	0...100	RW (?)

Index	Type	Value	Unit	Step	Range	R/W
0x1047	uint16, uint16	ROI Id, Range max (default: 11.50)	m	0.01	0...100	RW (?)
0x104C	uint16, sint16	ROI Id, Velocity min (default: -100)	m/s	0.01	-100...100	RW (?)
0x104D	uint16, sint16	ROI Id, Velocity max (default: 100)	m/s	0.01	-100...100	RW
0x104E	uint16, uint16	ROI Id, Power min (default: 35)	dB	1	0...255	RW
0x104F	uint16, uint16	ROI Id, Power max (default: 255)	dB	1	0...255	RW
0x1050	uint16, sint16	ROI Id, RCS min (default: -128)	dB	1	-128...127	RW
0x1051	uint16, sint16	ROI Id, RCS max (default: 127)	dB	1	-128...127	RW
0x300	uint8	Device address (default 0x7E)		1	0...255	R/W
0x301	uint16	Baud rate (default 250)	Kbit	1	125...1000	R/W
0x302	uint8	Factory reset 1: carry out a factory reset				W
0x303	uint8	Virtual Output CAN destination node ID		1	0-127	RW
0x400	uint8	Sensor Mode 0: Distance Sensor Mode (default)			0	R
0x500	uint8	Reset all TxPGN settings to default 1: Reset TxPGNs				W
0x600	uint8	Radar emitting disabled 0: radar enabled (default) 1: radar disabled			0...1	R/W
0x601	uint8	LEDs disable 0: normal LED operation (default) 1: LEDs always off			0...1	R/W
0x610	uint8	Teach sensor inclination 1: teach current sensor inclination				W
0x611	2x sint16	Inclination nominal Pitch / Roll	[°]	0.1	-180...180	R/W
0x612	2x sint16	Inclination tolerance Pitch / Roll	°	0.1	0...180	R/W
0x620	uint8	Reset inclination counter 1: reset counter				W
0x621	uint32	Inclination counter		1	0...inf	R
0x622	uint8	Reset blockage counter 1: reset counter				W
0x623	uint32	Blockage counter		1	0...inf	R
0x630	uint8	Radar Modulation mode 0: Normal 1: n/a 2: High Distance / High Velocity				R/W

12.2.2 Diagnostic parameters

Index	Type	Value	Unit	Step	Range	R/W
0x200	uint32	Device Status				R
0x201	uint32	Power cycles		1	0...inf	R
0x202	uint32	Operating hours	h	1	0...inf	R
0x203	sint16	Internal Temperature	°C	0.1	-40...125	R

Index	Type	Value	Unit	Step	Range	R/W
0x204	2x sint16	Inclination angle Pitch / Roll	°	0.1	-180...180	R

12.2.3 LEDs disable parameter

Index	Type	Value	Unit	Step	Range	R/W
0x601	uint8	LEDs disable 0: normal LED operation (default) 1: LEDs always off			0...1	R/W

12.2.4 DTC – Diagnostic Trouble Codes

The device performs basic diagnostics at regular intervals and reports its diagnostic status via the DM1 CAN message, which is sent each second. The details of the error codes are listed below.

Error name	System state upon error	DTC	SPN code	FMI	CM
EEPROM Errors - No comm. Response - EEPROM damaged blocks	Non-recoverable	0xFE00C	0x7f000	0xC	0
Backend to Frontend comm. Errors - No response - Negative response	Non-recoverable	0xFE02C	0x7f001	0xC	0
CAN communication errors - Comm. Overrun - CAN Driver error	Non-recoverable	0xFE04C	0x7f002	0xC	0
Watchdog Reset	Non-recoverable	0xFE06C	0x7f003	0xC	0
Application Invalid	Non-recoverable	0xFE08C	0x7f004	0xC	0
CAN Bus Off error	Recoverable	0xFE0AC	0x7f005	0xC	0
Under Temperature	Recoverable	0xFE0C1	0x7f006	0x1	0
Over Temperature	Recoverable	0xFE0E0	0x7f007	0x0	0
Under Voltage	Recoverable	0xFE104	0x7f008	0x4	0
Over Voltage	Recoverable	0xFE123	0x7f009	0x3	0
Power Backoff mismatch	Non-recoverable	0xFE16C	0x7f00B	0xC	0
Modulation mode mismatch	Non-recoverable	0xFE14C	0x7f00A	0xC	0

The layout of the signals in the DM1 message is listed below. The message size is determined depending on the number of active DTCs. A maximum of 5 error codes can be transmitted.

lamp status 16 bit	SPN1 16 bit	FMI1 5 bit	SPN1 High 3 bit	OC1 7 bit	CM1 1 bit
	SPN2 16 bit	FMI2 5 bit	SPN2 High 3 bit	OC2 7 bit	CM2 1 bit
	SPN3 16 bit	FMI3 5 bit	SPN3 High 3 bit	OC3 7 bit	CM3 1 bit
	SPN4 16 bit	FMI4 5 bit	SPN4 High 3 bit	OC4 7 bit	CM4 1 bit
	SPN5 16 bit	FMI5 5 bit	SPN5 High 3 bit	OC5 7 bit	CM5 1 bit

12.3 Other device functions

Device address (0x300) and baud rate (0x301) and factory setting (0x302)

In the case of a change, the device address, baud rate and factory setting do not become effective until after a reset ("Reset application", "Reset communication" or hardware reset).



The radar sensor from ifm is delivered with the device address (ECU) 126 and a baud rate of 250 kbit/s.

Glossary

Corner reflector

Corner reflectors consist of three electrically conductive surfaces that are at a 90° angle to each other. Due to this positioning, incident radar waves are optimally reflected to the sensor. Corner reflectors can be used as an adjustment aid or mounted on objects with low reflectivity to increase their RCS value. Corner reflectors can be ordered as accessories from ifm.

Frame ID

In an FMCW radar (Frequency-Modulated-Continuous-Wave-Radar), starting at a start frequency, the frequencies are continuously scanned until the stop frequency is reached. The difference between the start and stop frequency is the bandwidth. A pass from start to stop frequency is called a chirp and the total of all chirps in a period are called a frame. Each of these frames is described by a unique identifier, the frame ID.

Power

Power (P) is a measure of how well a target is detectable by radar, i.e. how much of the emitted energy is reflected from a target. The higher the P-value, the better the reflectivity and thus the visibility of the target. The P-value depends on the distance and the position of the object. The power reflected from the targets decreases with increasing distance from the sensor.

RCS

RCS stands for Radar Cross Section (radar signature) and is a measure of how well a target is detectable by radar, i.e. how much of the emitted energy is reflected from a target. The higher the RCS value, the better the reflectivity and thus the visibility of the target. The RCS value depends on factors such as material, size and angle of incidence, but not on the distance of the reflection target, as long as a reflection is not affected by the distance.

ROI

Region of Interest (ROI) is the area that is taken into account when evaluating the target reflections. Targets outside this area will not be taken into account. The area can be adjusted individually under the radar settings.

Selected target reflection

The selected target reflection is the target reflection selected from the totality of all target reflections via the selection rule (e.g. "Shortest distance") and further radar settings and marked by a crosshair. The process values of the selected target reflection are displayed in the [Monitor] area.

Target reflection

The radar sensor continuously emits electromagnetic waves reflected by objects (targets) and evaluated by the sensor. These target reflections depend on various parameters (see RCS) and are displayed in colour in the live image.

Velocity (target reflection)

Indicates the relative velocity of the target to the radar sensor. The velocity of the target reflection will be output with a negative sign when the target reflection moves towards the sensor. The velocity of the object is output with a positive sign when the target reflection moves away from the sensor. The X velocity describes the speed at which the target reflection moves along the X-axis, the Y velocity describes the movement along the Y-axis.