



Software manual
ifm Vision Assistant

GB

Radar area sensor with CAN, distance mode

R2D101
R2D103
R2D201

Contents

1	Preliminary note	3
1.1	Symbols used	3
1.2	Legal and copyright information	3
1.3	Open source information	3
2	Safety instructions	4
3	Intended use	5
4	Getting started	6
5	Disclaimer of warranties	7
6	Installation	8
6.1	System requirements	8
6.2	Hardware	8
6.3	Software	8
6.3.1	Uninstall	8
6.4	Command line parameters	9
7	Start page	12
7.1	Connecting the device	13
7.1.1	Connecting a new device automatically	13
7.1.2	Connecting a new device manually	14
7.1.3	Connecting a device already in use	14
7.2	Playing back image captures	14
7.2.1	Converting an image capture	15
7.3	Monitoring Tool	15
8	Layout of user interface	17
9	Monitor	19
9.1	Process values	20
9.2	Live image monitor	21
9.3	Display options	22
9.4	Recording	23
9.5	Point details	24
10	Radar settings	25
10.1	Region of Interest (ROI)	26
10.2	Range filter	26
10.3	Clipping volume	27
10.4	Extended parameters	28
11	Device setup	32
11.1	General	32
11.2	CAN	34
12	CAN interface description	37
12.1	SAE J1939 interface	37
12.2	Parameter mapping	40
12.3	Other device functions	45
	Glossary	46

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 ifm Vision Assistant to connect the device with the software (→ [Connecting a new device automatically](#) □ 13).
- ▷ ifm Vision Assistant opens with the [Monitor] view.

Set the sensor mode:

- ▶ Go to the [Device setup] area.
- ▶ Select [General].
- ▶ Select [Sensor mode] and set [Distance].
- ▶ After changing the sensor mode, click the  button at the top of the screen.
- ▷ The device is in the newly set mode. The navigation bar and the setting options in the individual sections change accordingly.

Select target:

- ▶ Configure the global filter characteristics in the [Radar settings] area, define the volume clipping for each of the max. 4 regions of interest (ROIs) and specify the filter characteristics for each ROI. If necessary, use a corner reflector as an adjustment aid to set the volume clipping.
- ▶ Go to the Monitor area.
- ▷ The [Process values] section in the left part of the screen shows the current measured values of the selected target reflections in each ROI. The selected target reflections are marked with a crosshair in the live image.

Configure the process value output:

- ▶ Configure the output of the process values via the CAN interface in the [Device setup] area: [CAN](#) (→ □ 34).

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- the software or the software content will be free of bugs, errors, viruses or other defects,
- 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: 2.8.x or newer



Other versions

- ▷ 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

Install the ifm Vision Assistant:

- ▶ Download the ifm Vision Assistant from the website: www.ifm.com
- ▶ Copy the zip file to a directory on the PC and unzip.
- ▷ The ifm Vision Assistant is installed and can be started via the “ifmVisionAssistant.exe”.



The ifm Vision Assistant does not start

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

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.

Deleting 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 ifm Vision Assistant by attaching 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 ifm Vision Assistant via the command 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 ifm Vision Assistant with command line parameters via Windows:

- ▶ Right-click on [ifm Vision Assistant].
- ▶ Click on [Properties] in the submenu.
- ▶ Click on the [Shortcut] tab.
- ▶ Click on the [Target] field 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 terminating ifm Vision Assistant.
<code>-log</code>	Creates a log file for detailed error analysis. The log file is saved in the following folder: "%APPDATA%\ifm_electronic\ifmVisionAssistant\logs"

Command line parameter	Description
<code>-autoconnect filename.xml</code>	Automatically establishes the connection to a device. The file " filename.xml " must contain the following XML code: <pre><?xml version="1.0" encoding="UTF-8"?> <sensor> <sensorType>R2Dxxx</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 windows size and position of ifm Vision Assistant (incl. Windows 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 including Windows 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: " +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
<code>-frameless</code>	Starts ifm Vision Assistant without the native Windows frame window.
<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. " -1 ": unlimited recording time
<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.
<code>-cmd "Mon:g2d:deviceByIndex=2"</code>	Sets the video source by index. For example, an external frame grabber can be used as a video source. For notebooks, index=" 1 " is often the built-in camera.
<code>-cmd "Mon:g2d:deviceByName=Hauppauge Cx23100 Video Capture_2"</code>	Sets the video source by name. For example, an external frame grabber can be used as a video source.

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 key combination “Ctrl+F4” closes ifm Vision Assistant.

7 Start page

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

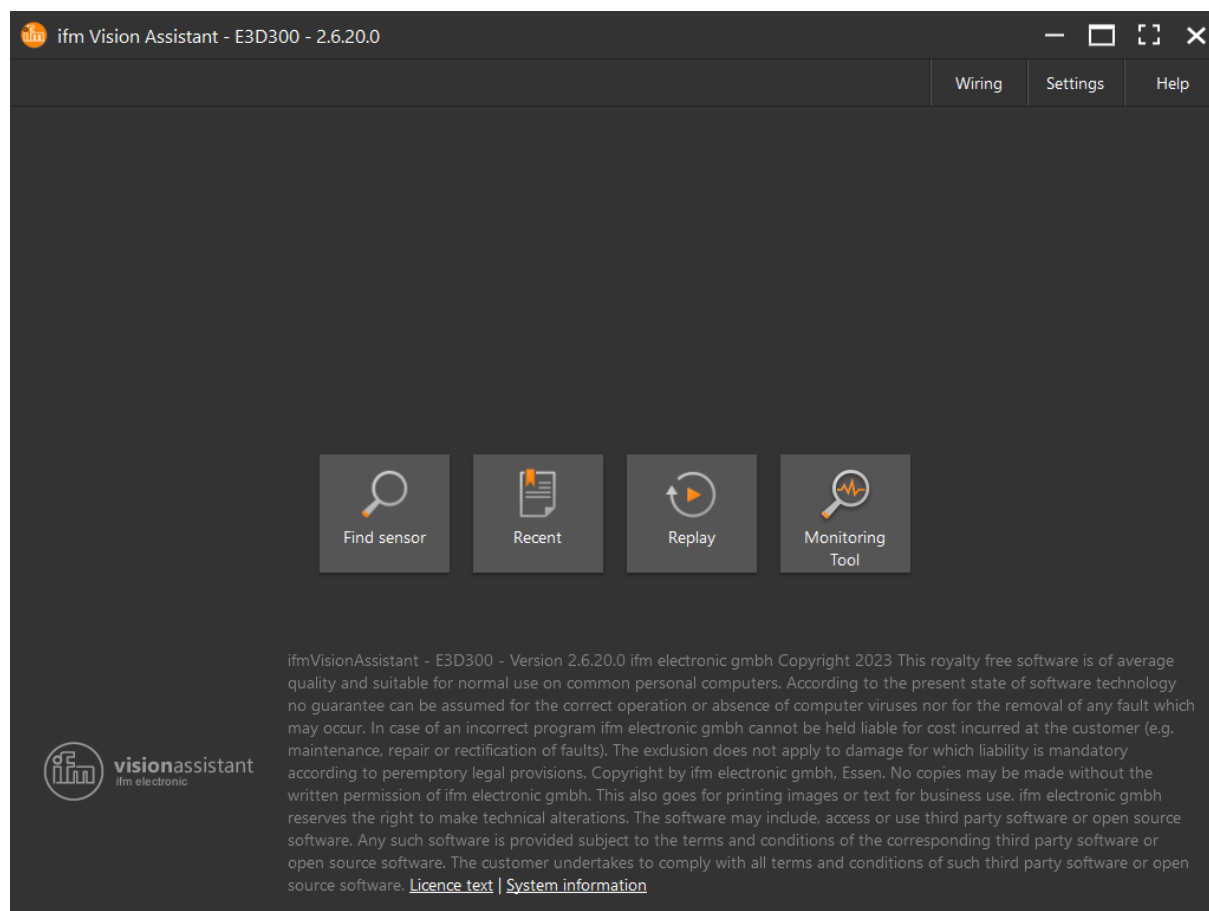


Fig. 1: Start page

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

Tab. 1: Title bar



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

Name	Description
[Wiring]	Displays information on wiring and connection aids.
[Settings]	Sets the language and colour of the user interface.
[Help]	Displays the documentation and contact information of the support.

Tab. 2: Menu bar

Button	Name	Description
	Find sensor	Searches for connected devices and displays them in a list. For this function, the device must be connected.
	Recent	Displays devices that have already been used before in a list. 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 \(→ 13\)](#).
- ▶ [Connecting a new device manually \(→ 14\)](#).

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 \(→ 14\)](#).



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.



The device will start in the mode that was last set. The factory setting is the area mode.

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 \(→ 14\)](#).

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

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 4 ROIs, there can be a maximum of 4 selected target reflections.
- The selected target reflection is marked with a crosshair and its process values are shown in the status display.



The process values of each target reflection can be displayed using the mouse-over function ([→ Point details](#) [□ 24](#)).



A maximum of 128 target reflections with selectable process values and selectable sorting are output from the region of interest (ROI) ([→ CAN](#) [□ 34](#)).



Deselecting process values for message transmission to the CAN interface directly affects the live image. Example:

- ▷ If the process value [RCS] is deselected, the target reflections are displayed without differences in colour, provided that the value [RCS] is selected under [View options].

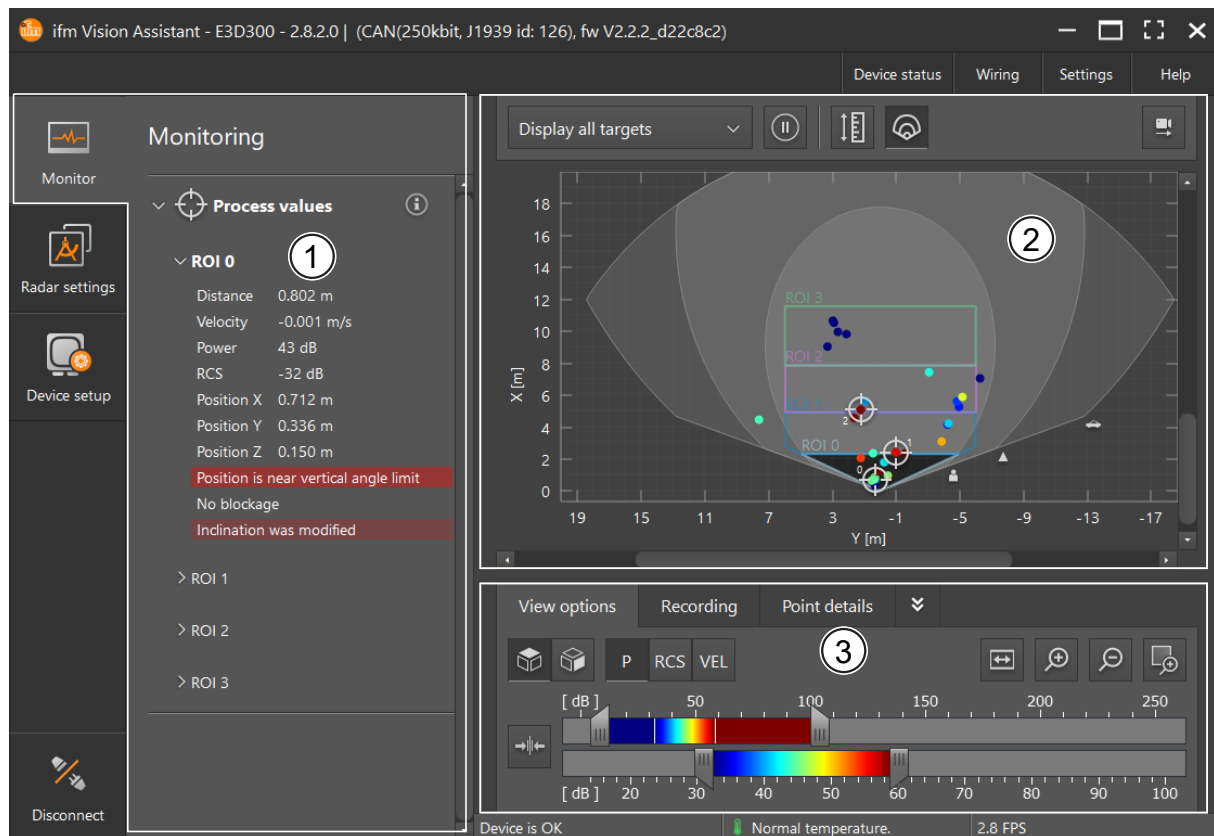


Fig. 3: Monitor area

- 1: Status indications
 - [Process values](#) (→ [20](#)) of the selected target reflections
 - Status messages about the device
- 2: Live image monitor
 - [Target reflections](#)
 - [Selected target reflections](#)
 - [Region of Interest \(ROI\)](#) (→ [26](#))
- 3: Tabs
 - [Display options](#) (→ [22](#))
 - [Recording](#) (→ [23](#))
 - [Point details](#) (→ [24](#))

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.



If no process values are displayed, none of the target reflections in the live image match the filter criteria in the [Radar settings] area.

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
- [Position X](#) / [Position Y](#) / [Position Z](#) in metres

- Status messages about the device:
 - Messages about the covering of the device
 - Notification about exceeded limit areas (→ [Range filter](#) , Clipping volume
 - Message on the inclination of the device



Call up explanations for position X / position Y / position Z:

- ▶ Click on the following symbol in the top right-hand corner of the live image: 
- ▶ Click on "Inclination " to access additional explanations.

9.2 Live image monitor

The live image shows the target reflections in the **area to monitor** of the sensor as coloured dots.

A list field in the upper part of the image can be used to select whether all **target reflections**, all moving target reflections, filtered target reflections or only the **selected target reflections** will be displayed.

The maximum of 4 selected target reflections are marked with crosshairs.

The live image will be continuously updated.

The colours used for the target objects can be set.



- ▶ Enlarge/reduce live image by scrolling with the mouse button.
- ▶ Centre the live image using the right and bottom scroll bars.

Display / operating element	Name	Description
	Crosshair	Marking of the selected target reflections whose process values are displayed in the left part of the screen. The number indicates the ROI in which the target reflection is located. If the crosshair has more than one number, then the marked target reflection has been selected in several overlapping ROIs.
	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 reflections are marked with a crosshair. • All targets: display of all target reflections detected by the device within the detection area. • All moving targets: display of all target reflections with a velocity other than 0 m/s. • Filtered targets: display of all target reflections that match the set criteria → [Radar settings]. • Process values: display of the selected target reflections. 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.
	Measure distance between two points	▶ Freeze the current result. ▶ With the mouse button pressed, draw a line between two target reflections. The distance between the two target reflections is displayed in the live image.

Display / operating element	Name	Description
	Show detection areas	Showing and hiding the three detection areas of the radar position sensor. The areas are shown in three shades of grey and represent the entire area to monitor. The detection areas are marked with the following symbols:  : Area in which a person is detected.  : Area in which a corner reflector with an edge length of 50 mm is detected.  : Area in which a car is detected. In order for a target reflection to be detected, it must have a sufficient RCS value.

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
	Switch to top view	Shows the sensor's field of view in top view.
	Switch to side view	Shows the sensor's field of view in side view.
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'
	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.

 Before setting the measuring range, it may be useful to display the maximum and minimum process values in a selection of relevant target reflections: [Point details](#) (→ [24](#)).

- ▶ 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 points will be immediately updated in the live image according to the colour setting.

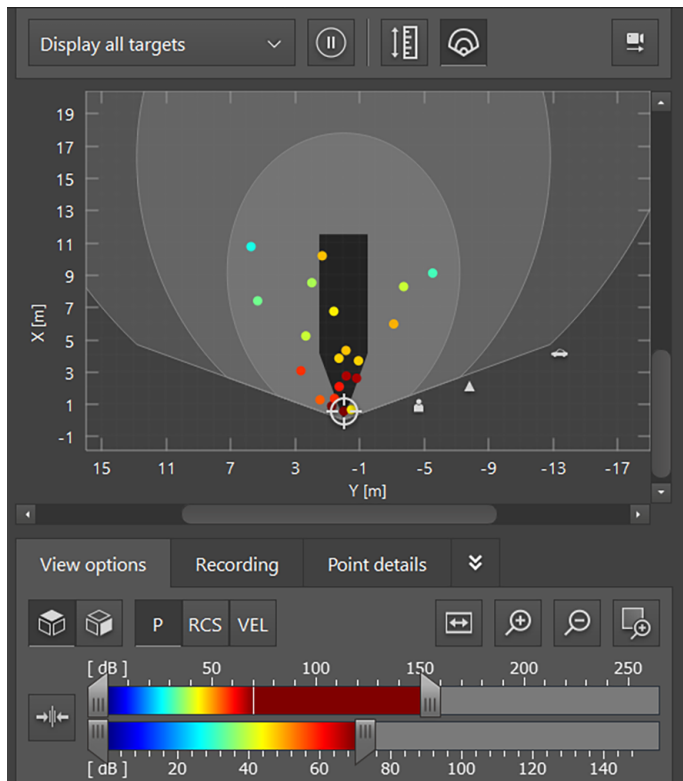


Fig. 4: Colour range example for P (power): The darker the shade of red, the greater the power of the reflection point in dB

 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.

Operating element	Name	Description
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

9.5 Point details

In the [Process values] status indication on the left side of the window, only the process values of the selected target reflection marked with the crosshairs are displayed.

The process values of freely selectable target reflections can be retrieved via the [Point details] tab.

- Selecting an operating element: Highlight a single target reflection by clicking or select several target reflections by dragging a range.
- ▷ The table in the lower part of the screen shows the process values of the selected target reflection. If more than two target reflections are selected, the maximum and minimum measured values of the detected targets will be displayed as well as the number of all detected target reflections within the selection.

Operating element	Description
	Tool for selecting a single target reflection in the live image.
	Tool for selecting a rectangular area and selecting all target reflections contained in it.
	Tool for selecting a circular area and selecting all target reflections contained in it.

Tab. 8: Operating elements point details



The process values of a target reflection are also displayed when the mouse pointer remains on the required target reflection (mouse-over function).

10 Radar settings

In the [Radar settings] area, the 4 regions of interest (ROIs) are defined and the settings for selecting the **selected target reflections** in each of the 4 ROIs are managed.

Clicking [> ROI x] in the left part of the screen opens the setting area for the respective ROI (→ [Region of Interest \(ROI\)](#) [26](#)).

For the selected ROI, the black-coloured volume clipping with its limiting lines is displayed in the live image. The volume clipping can be changed by dragging the limiting lines (→ [Clipping volume](#) [27](#)).

In the live image, the same functions as in the [Monitor] area are available.

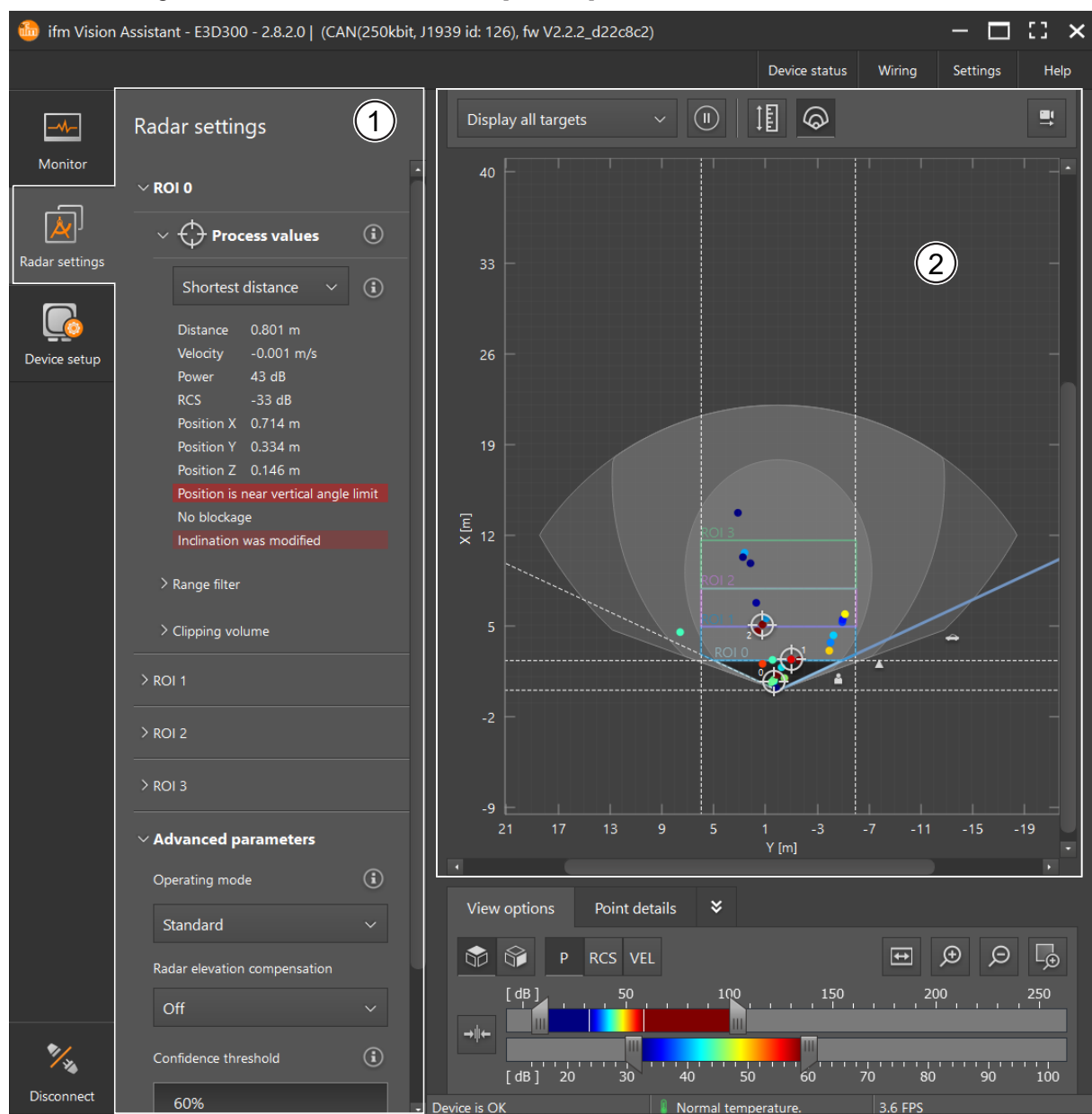


Fig. 5: Radar settings

- 1: Settings area
 - [Region of Interest \(ROI\)](#) (→ [26](#))
 - [Range filter](#) (→ [26](#))
 - [Clipping volume](#) (→ [27](#))
 - [Extended parameters](#) (→ [28](#))
- 2: Live image radar settings

10.1 Region of Interest (ROI)

Up to 4 regions of interest (**ROI0...ROI3**) 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, volume clipping) for this ROI.

In addition, the global settings from the [Advanced parameters] area are applied equally to all ROIs: [Extended parameters](#) (→ [28](#)).

The selected target reflection is marked with a crosshair in the live image. 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 and power of the target reflections: [Range filter](#) (→ [26](#)).
- ▶ In the [Volume clipping] section, define the **field of view** of the ROI: [Clipping volume](#) (→ [27](#)).

10.2 Range filter

Threshold values for the process values can be set via the range 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 [+]:
 - RCS
 - Velocity



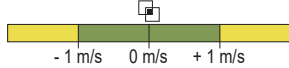
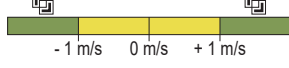
The range filter for power is already available.



There is no range filter for distance, as this filtering is performed by the sensor's field of view, see [clipping volume].

- ▶ 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.

Operating element	Name	Description
	Deleting a filter	The filter will be deleted after confirmation.

Operating element	Name	Description
	Within the range	Additional criterion for velocity filter:  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:  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.
	Telephoto	Automatic adjustment of the histogram view to the changed settings.

Tab. 9: Filter operating elements

10.3 Clipping volume

The **field of view** of the sensor can be set as a volume clipping for each of the 4 regions of interest (ROIs). The field of view is shown as a black area within the **area to monitor**.



The clipping volume has the function of a range filter for distance.



The selection rule for selecting the selected target reflection only considers target reflections within the clipping volume.

- Set the top or side view via the [Anzeigeoptionen] tab:  / 
- Display detection areas via the button in the live image: 
- Set upper and lower limits for the clipping volume: either by using the input fields in the left settings area, or by dragging the limiting lines in the live image.
- The settings take effect immediately. If the previously selected target reflection is no longer within the newly set clipping volume, a new target will be selected.

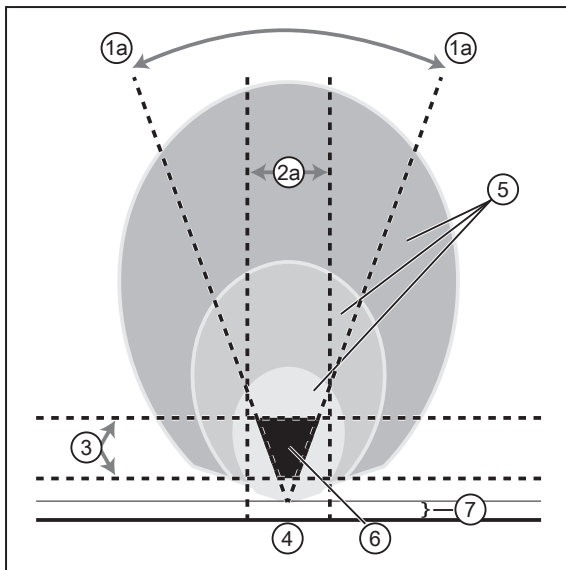


Fig. 6: Volume limitation top view

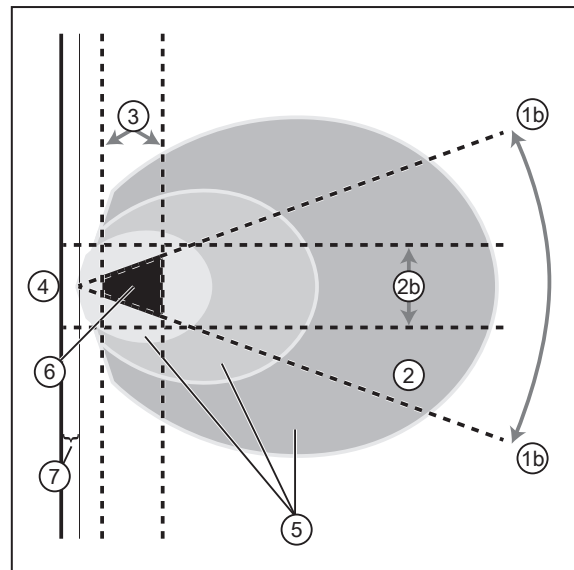


Fig. 7: Volume limitation side view

1a:	Horizontal angle: angle of aperture with top view to the right and left (-70°...70°)
2a:	Lateral limitation: straight-line limitation when viewed from above to the right and left
1b:	Vertical angle: angle of aperture for side view down and up (-25°...25°)
2b:	Height limitation: straight-line limitation with side view downwards and upwards
3:	Distance limitation: minimum and maximum distance of the object to the sensor
4:	Centre point of the sensor
5:	Area to monitor of the sensor (3 detection areas)
6:	The sensor's set field of view (= volume clipping = ROI)
7:	Dead space within which no signal evaluation is possible

Tab. 10: Limit values for the volume clipping



The limit values refer to the centre of the sensing face.
More information → Operating instructions.

10.4 Extended parameters

The settings in the [Advanced parameters] area affect all regions of interest (ROIs).

10.4.1 Operating mode

By setting the operating mode, it is possible to choose between a higher area to monitor or a higher accuracy:

Operating mode	Standard (factory setting)	Long range
Max. distance	20 m	50 m
Distance resolution	100 mm	360 mm
Max. velocity	± 4.6 m/s	± 15 m/s
Velocity resolution	0.15 m/s	0.38 m/s
Switching frequency	20 Hz	20 Hz



The values are for orientation only. More detailed information can be found in the respective technical data sheets at documentation.ifm.com.

10.4.2 Radar elevation compensation

Radar elevation compensation can be used to automatically adjust the field of view when the position of the sensor changes in the vertical direction (pitch).

- [Off]:
The field of view remains constant when the sensor is tilted (pitched).
- [Ground aligned]:
The field of view is realigned according to the inclination of the sensor. By restricting the Height limitation, the viewing area is cut off upwards and downwards.

Factory setting: Off



► In the [View options] tab, switch to side view to see the effect of the [Ground aligned] setting in the live image.

10.4.3 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: 60%

10.4.4 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 = $\text{Weighting factor} * \text{current measured value} + (1 - \text{weighting factor}) * \text{moving average value}$

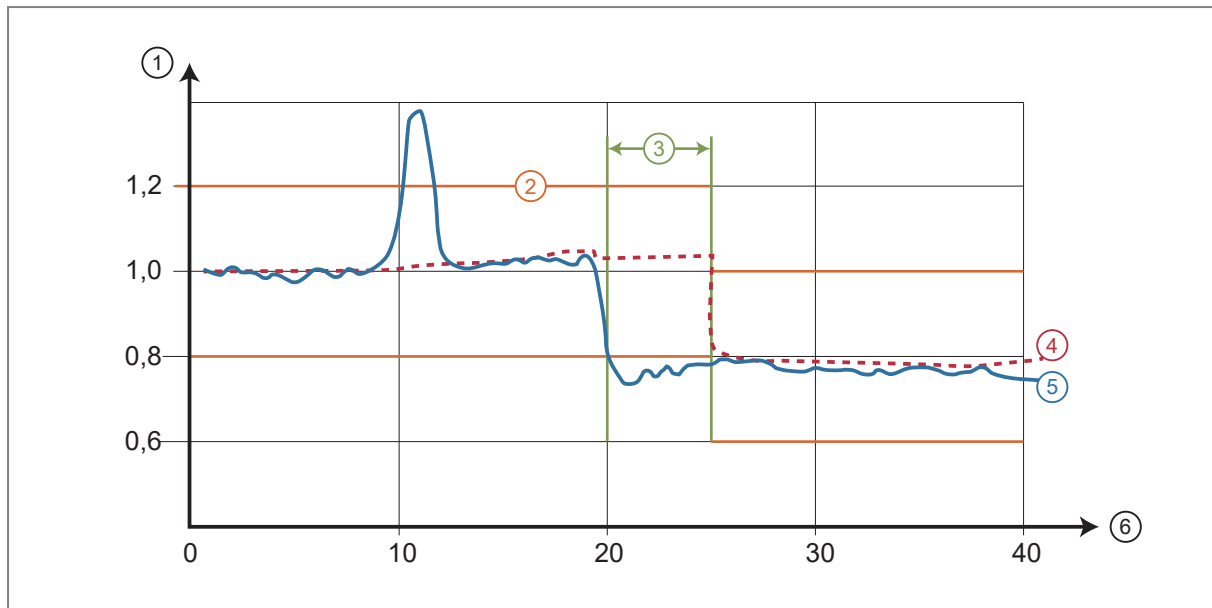


Fig. 8: Influence of the smoothing filter on the process values 'distance' or 'velocity'

- 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.

10.4.5 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.

11 Device setup

11.1 General

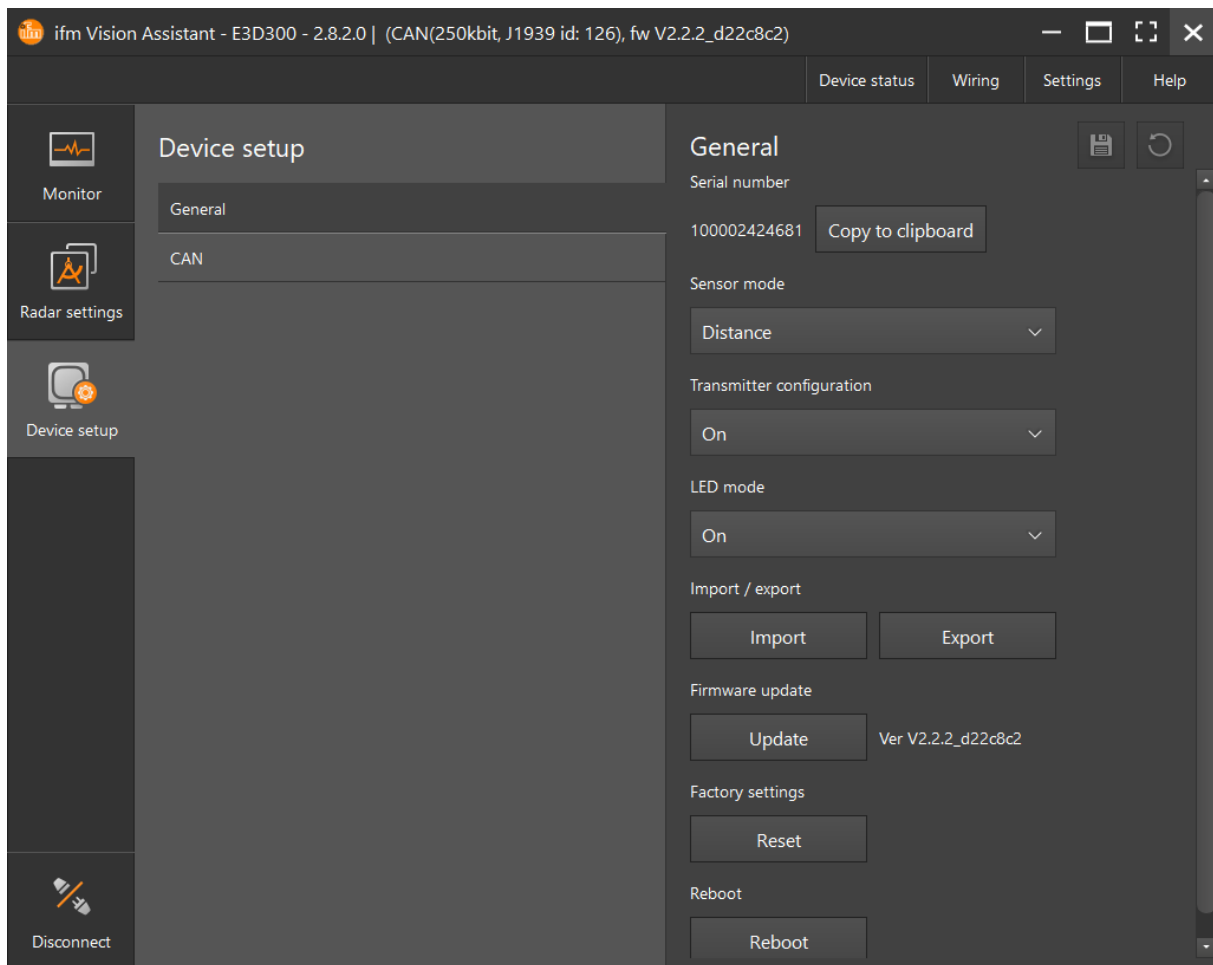


Fig. 9: Device setup - General

Serial number

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

Sensor mode:

- [Distance]: The sensor switches to the distance monitoring application.
 - [Area]: The sensor switches to the area monitoring application with definable alarm zones.
- After changing the sensor mode, click the  button at the top of the screen.
- ▷ The device is in the newly set mode. The navigation bar and the setting options in the individual sections change accordingly.

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

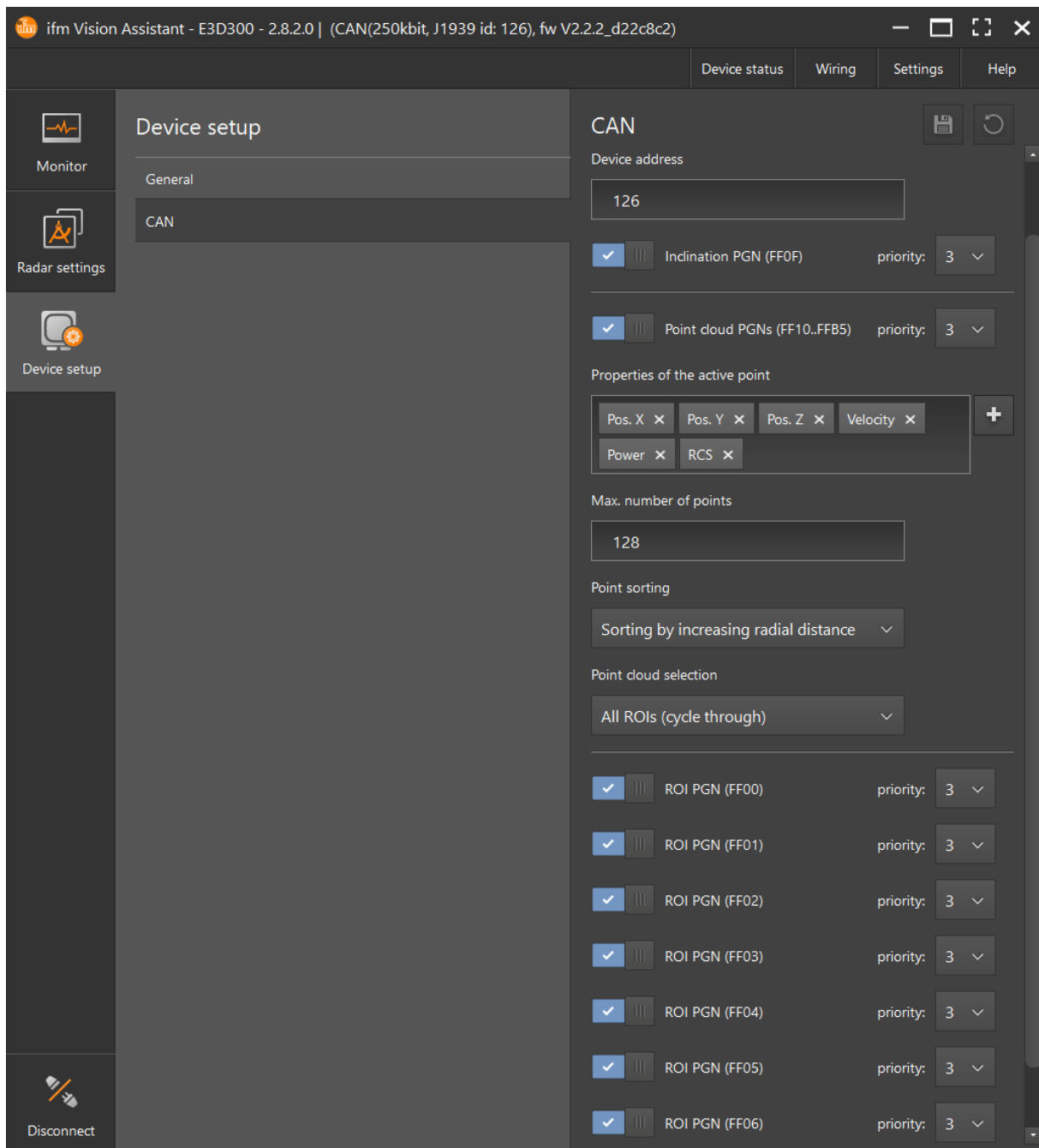


Fig. 10: Device configuration - CAN

Baud rate

- 125 kbit/s
- 250 kbit/s (factory setting)
- 1000 kbit/s



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.

PGN (parameter group numbers)

The required PGNs can be activated or deactivated according to the CAN bus load requirements using the slider.

The priority to transmit information can be set for individual parameter groups. The higher the value, the faster the messages will be transmitted.

- Inclination PGN (FF0F), priority 0...6
- Point clouds PGNs (FFB6...FFE9), priority 0...6

Properties of the active point

Process values of the selected target reflection and other target reflections displayed in the live image monitor (→ [Monitor](#)  19) that are transmitted via the CAN interface.

- Position X
- Position Y
- Position Z
- Velocity X
- Velocity Y
- Power
- RCS
- Confidence/object class



Deselecting individual process values directly affects the target reflections in the live image (→ [Monitor](#)  19).

Maximum number of points

Maximum number of target reflections from the live image (→ [Monitor](#)  19) that are transmitted via the CAN interface. The maximum possible number of target reflections is 128. 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 X
- Sorting by decreasing X
- Sorting by increasing Y
- Sorting by decreasing Y
- Sorting by increasing Z
- Sorting by decreasing Z
- Sorting by increasing power
- Sorting by decreasing power
- Sorting by increasing RCS
- Sorting by decreasing RCS
- Sorting by increasing velocity X
- Sorting by decreasing velocity X
- Sorting by increasing velocity Y

- Sorting by decreasing velocity Y
- Sorting by increasing radial distance
- Sorting by decreasing radial distance

PGN (parameter group numbers)

The process data results of the selected target reflection from ROI 0, ROI 1, ROI 2 and ROI 3 are each written in two PGNs and output according to the ROI selection in the [Radar settings] area ([→ Distance mode](#)  39).

The required PGNs 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. 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
- 0x0B: Error while reading or writing from ID tag

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).

The R2D CAN sensor operates in one of the two supported modes: the distance mode or the area mode.

A different set of TxPGNs is transmitted in each mode.

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

Below is a list of TxPGNs that are transmitted when the R2D CAN sensor is configured in the different modes. For details on the signals contained in each PGN and the periodicity of each PGN see the J1939 DBC file of the R2DCAN sensor.

12.1.3.1 Distance mode

Value	PGN	Description
Process Data Output PV Inclination	PGN 0xFF0F	Transfers the inclination information of the sensor every frame
Process Data Output for Distance mode ROI 0	PGN 0xFF00 PGN 0xFF01	The process data results of the selected target reflection from ROI 0 are written to two PGNs and output according to the ROI configuration.

Value	PGN	Description
Process Data Output for Distance mode ROI 1	PGN 0xFF02 PGN 0xFF03	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 0xFF04 PGN 0xFF05	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 0xFF06 PGN 0xFF07	The process data results of the selected target reflection from ROI 3 are written to two PGNs and output according to the ROI configuration.
Point Cloud X values	32 PGN PGN 0xFF10 ... PGN 0xFF2F	Up to four X values can be written in each PGN, and the corresponding PGNs are transferred depending on the number of recognised points
Point Cloud Y values	32 PGN PGN 0xFF30 ... PGN 0xFF4F	Up to four Y values can be written in each PGN, and the corresponding PGNs are transferred depending on the number of recognised points
Point Cloud Z values	32 PGN PGN 0xFF50 ... PGN 0xFF6F	Up to four Z values can be written in each PGN, and the corresponding PGNs are transferred depending on the number of recognised points
Point cloud Radial Distance values	32 PGN PGN 0x1FF10 ... PGN 0x1FF2F	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 0xFF70... PGN 0xFF8F	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 0xFF90... PGN 0xFFA2	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 0xFFA3... PGN 0xFFB5	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 0xFFEA	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 for distance mode

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

Index	Type	Value	Unit	Step	Range	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
0x1007	uint8	Priority ROI3 TxPGN (default 3)		1	0...7	R/W
0x1020	uint8	Point cloud PGN group selection Bit 0: Pos X PGNs Bit 1: Pos Y PGNs Bit 2: Pos Z PGNs Bit 3: Velocity PGNs Bit 4: Power PGNs Bit 5: RCS PGNs				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	Point cloud ROI filtering 0-3: Point target selection according to specified ROI index 4: One ROI each cycle				
0x1031	uint8	Point Cloud Sorting 0: No Sorting, same order as provided by the Front End 1: increasing X 2: decreasing X 3: increasing Y 4: decreasing Y 5: increasing Z 6: decreasing Z 7: increasing Power 8: decreasing Power 9: increasing RCS 10: decreasing RCS 11: increasing Velocity 12: decreasing Velocity 13: Increasing Radial Distance 14: Decreasing Radial Distance 15-31: 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

Index	Type	Value	Unit	Step	Range	R/W
0x1042	uint16, sint16	ROI Id, Horizontal angle min (default: -20)	°	1	-90...90	R/W
0x1043	uint16, sint16	ROI Id, Horizontal angle max (default: 20)	°	1	-90...90	R/W
0x1044	uint16, sint16	ROI Id, Vertical angle min (default: -15)	°	1	-90...90	R/W
0x1045	uint16, sint16	ROI Id, Vertical angle max (default: 15)	°	1	-90...90	R/W
0x1046	uint16, uint16	ROI Id, Position X min (default: 0.1)	m	0.01	-100...100	RW
0x1047	uint16, uint16	ROI Id, Position X max (default: 11.50)	m	0.01	-100...100	RW
0x1048	uint16, sint16	ROI Id, Position Y min (default: -1.5)	m	0.01	-100...100	RW
0x1049	uint16, sint16	ROI Id, Position Y max (default: 1.5)	m	0.01	-100...100	RW
0x104A	uint16, sint16	ROI Id, Position Z min (default: -1.0)	m	0.01	-100...100	RW
0x104B	uint16, sint16	ROI Id, Position Z max (default: 1.0)	m	0.01	-100...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

12.2.2 Parameter indices for distance mode and area mode

Index	Type	Value	Unit	Step	Range	R/W
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
0x350	CMDT	Application Configuration read (this triggers the CMDT message PGN 0x1FFFE)				R/W
0x400	uint8	Sensor Mode 0: Distance Sensor Mode (default) 1: Area Surveillance Mode			0...1	R/W
0x500	uint8	Reset all TxPGN settings to default 1: Reset TxPGNs				W
0x501	uint8	Transmit parameter group TxPGN 0x0F active 0: disabled 1: enabled			0...1	R/W

Index	Type	Value	Unit	Step	Range	R/W
0x502	uint8	Transmit parameter group TxPGN 0x0F priority (default 3)		1	0...7	R/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
						R/W
						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 3: Limited Bandwidth				R/W
0x631	uint8	Elevation compensation 0: disabled (default) 1: enabled			0...1	R/W
0x632	sint16	Calibration Translation X	m	0.001	-32...32	R/W
0x633	sint16	Calibration Translation Y	m	0.001	-32...32	R/W
0x634	sint16	Calibration Translation Z	m	0.001	-32...32	R/W
0x635	sint16	Calibration Rotation X	°	0.1	-180...180	R/W
0x636	sint16	Calibration Rotation Y	°	0.1	-180...180	R/W
0x637	sint16	Calibration Rotation Z	°	0.1	-180...180	R/W

12.2.3 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
0x204	2x sint16	Inclination angle Pitch / Roll	°	0.1	-180...180	R

12.2.4 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

12.2.5 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	0xFE000C	0x7f000	0xC	0
Backend to Frontend comm. Errors - No response - Negative response	Non-recoverable	0xFE002C	0x7f001	0xC	0
CAN communication errors - Comm. Overrun - CAN Driver error	Non-recoverable	0xFE004C	0x7f002	0xC	0
Watchdog Reset	Non-recoverable	0xFE006C	0x7f003	0xC	0
Application Invalid	Non-recoverable	0xFE008C	0x7f004	0xC	0
CAN Bus Off error	Recoverable	0xFE00AC	0x7f005	0xC	0
Under Temperature	Recoverable	0xFE00C1	0x7f006	0x1	0
Over Temperature	Recoverable	0xFE00E0	0x7f007	0x0	0
Under Voltage	Recoverable	0xFE0104	0x7f008	0x4	0
Over Voltage	Recoverable	0xFE0123	0x7f009	0x3	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

Area to monitor

The area to monitor is the maximum range that can be monitored by the sensor. It can be displayed as a grey area in the live image via the [Show detection areas] button. The area to monitor is divided into several detection areas. A restricted field of view can be set within the area to monitor.

Confidence

The confidence value is an indication of how reliable the detected position of the target reflection is. A high confidence value means that the position has been detected correctly with a high degree of certainty, while a low confidence value indicates greater uncertainty.

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.

Detection ranges

The detection ranges are parts of the area to monitor of a sensor with different target object detectability. The detection ranges serve as approximate reference values and refer to a free field without extraneous reflections.

Distance resolution

The distance resolution describes the minimum distance at which two targets can still be differentiated from each other. At a distance resolution of 100 mm, two targets can be 100 mm close together and still be perceived as two separate targets.

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.

Position X / Y / Z

The radar position sensor detects the position of a target reflection in the three planes X, Y and Z. The X and Y positions are indicated as process values. The positions describe the position of the target reflection in the three-dimensional coordinate system with the sensor centre as the origin: The X position is the distance to the sensor. The Y position is the lateral orientation to the sensor. The Z position is the up and down orientation.

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 performance 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.

Visible range

The visible range - also referred to as Field of View (FOV) - is the area that can be monitored by the sensor. The maximum visible range is identical with the area to monitor. The visible range can be reduced to a "volume clipping" (Region of Interest = ROI). This can be set in the [Radar settings] area.