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USER GUIDE

FD70

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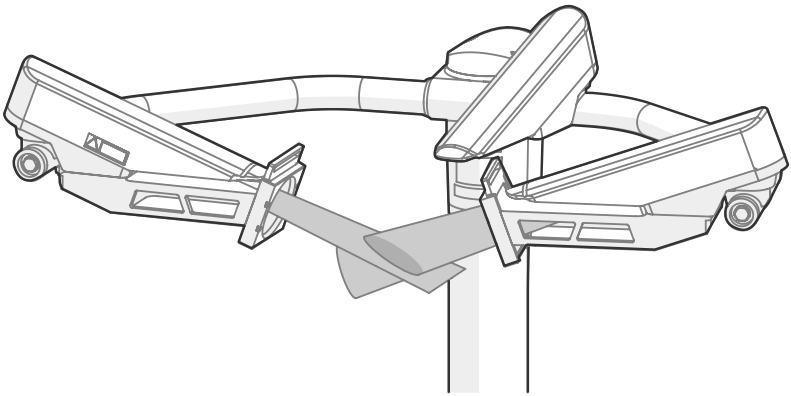


M212268EN-E

Calibration and Cleaning Guide

Vaisala Forward Scatter Sensor

FD70



VAISALA

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1. Cleaning and calibration

1.1 Overview of preventive maintenance

Table 1 Preventive maintenance of FD70

Task	Frequency
Clean the transmitter and receiver windows	Annually or more often if conditions require it
Perform guided calibration check using **`mode calcheck`** command, (and, if needed, calibration adjustment using **`mode adjust`** command)	Annually
Send field calibrator kit to Vaisala for calibration	Every 3–5 years

WARNING! Follow local and state legislation and regulations on occupational safety.

WARNING! Do not perform installation or maintenance procedures when there is a risk of thunderstorm or lightning activity in the area.

WARNING! To avoid injuries and to avoid damaging the instrument, do not place a ladder or similar against the instrument.

WARNING! Some instruments and sensors or versions are heated. To avoid injury, do not touch heated parts when heating is on.

WARNING! When the `TX optical power` alarm is on, disconnect power before performing any maintenance operations on the transmitter.

WARNING! Do not look directly in the transmitter with magnifying optics (such as glasses, binoculars and telescopes).

WARNING! When operating the forward scatter sensor, do not look at the transmitter of the forward scatter sensor from the beam direction.

CAUTION! Only qualified maintenance personnel may perform maintenance procedures.

CAUTION! To maximize performance, complete the maintenance tasks according to the recommended schedule.

1.2 Field Calibrator Kit for FD70 Series

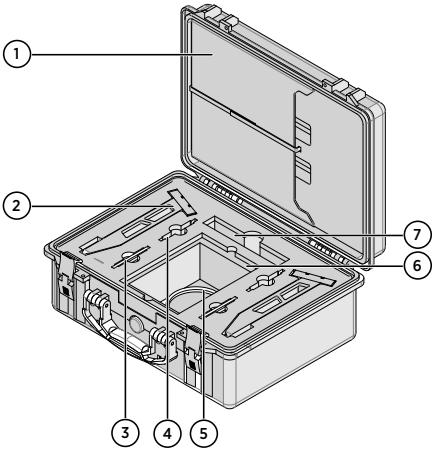


Figure 1 Field Calibrator Kit for FD70 Series

1 Laptop shelf
2 Calibrator (for transmitter and receivers) (2 pcs)
3 Zero signal plate (2 pcs)
4 (Empty slots, 2 pcs)
5 Ethernet maintenance cable
6 Cleaning cloths (10 pcs, not shown) Calibrator certificate and quick guide (not shown)
7 Toolkit (not shown)

The toolkit is included in the Field Calibrator Kit, or is available separately. It contains the following equipment:

- Cable ties
- Set of Allen keys:
  - 3 mm hex screwdriver model
  - 4 mm standard model
  - 5 mm standard model
  - 6 mm standard model
- Spanner 33 / 22 mm (for plastic glands in the feedthrough flange)
- Torx T8 screwdriver
- Plastic safety key (for unlocking cable ferrites)

In addition, the following tools are required:

- Wrench set, including at least:
  - 10-mm wrench
  - 24-mm wrench
- Cable cutters
- Cable stripper
- Flathead screwdriver
- Side-cutting pliers
- Spirit level

For configuration, a laptop and an Ethernet maintenance cable are required.

The Field Calibrator Kit provides space for you to store your own bottle of cleaning detergent.

Store the calibrator kit with its contents in a clean and dry place.

1.3 Cleaning windows

WARNING! When maintaining the forward scatter sensor, do not look at the transmitter of the forward scatter sensor from the beam direction.

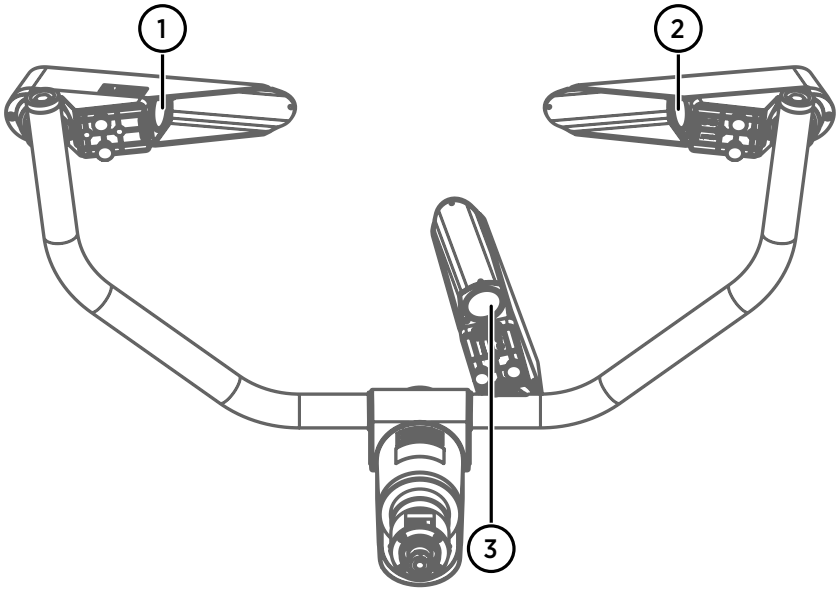


Figure 2 Transmitter and receiver windows

1 Transmitter window
2 Main receiver window
3 Side receiver window

The sensor can compensate for a reasonable amount of window contamination, but when a certain limit is exceeded, cleaning is required.

Vaisala recommends cleaning the transmitter and receiver windows:

- Annually. If the conditions require, clean more often. For example, at airports, clean every 3 months.
- When the response to a **`status`** command includes a contamination warning (W) or alarm (A).
- When suggested by the guided window check (**`mode windowcheck`**).

Table 2 Window cleaning options

Without maintenance connection		With maintenance connection	
+	Laptop not needed	–	Laptop needed for establishing maintenance connection
–	No immediate indication of success	+	Indicates cleaning success
–	No metadata of cleaning date	+	Stores the cleaning date as metadata

Without maintenance connection		With maintenance connection	
–	No indication of adjustment needs	+	Indicates need for adjustment
–	Measurement values are disturbed by cleaning process	+	Measurement values are slashed/ invalidated during cleaning process

While cleaning the windows, also clean Vaisala HUMICAP Humidity and Temperature Probe HMP155 and the window of Vaisala Background Luminance Sensor LM21 if installed. For instructions, see *HMP155 User Guide (M210912EN)* and *Background Luminance Sensor LM21 User's Guide*.

1.3.1 Cleaning windows without maintenance connection

- Soft, lint-free cloths (2 pcs)
- 50 % isopropyl alcohol

WARNING! When the `TX optical power` alarm is on, disconnect power before performing any maintenance operations on the transmitter.

During window cleaning, measurement data is invalid.

During window cleaning, keep the interface unit door closed.

1. Using low pressure, spray 50 % isopropyl alcohol on the window. Spray enough solution to dissolve and loosen any dirt.
2. Wipe the glass window with a soft lint-free cloth and 50 % isopropyl alcohol.

CAUTION! Do not use pressure washers.

CAUTION! Be careful not to scratch the window surfaces or touch the measurement unit windows with bare hands.

3. Take a new, clean cloth and wipe the window until it is clean.
4. Wait until the window is dry.

1.3.2 Performing guided window check using maintenance connection

- Field calibrator kit for FD70 (FDA701)
- Maintenance laptop with terminal software
- Soft, lint-free cloths (2 pcs)
- 50 % isopropyl alcohol

Window check (**`mode windowcheck`**) does not change any values.

Shortcut	Description
TAB	Auto-completes a command, argument, parameter, or parameter value after typing first characters, as far as typed input appears unique.
TAB-TAB	Prints available items. For example, type 's<TAB-TAB>' to see commands beginning with 's'.

You can cancel the process at any point.

1. Establish a maintenance connection to FD70.

   For instructions, see *FD70 Installation Guide (M212221EN)*.

2. Type the following commands:

```
level 2
```

```
mode windowcheck
```

For the side receiver, type the following command:

```
mode windowcheck 2
```

Follow the onscreen instructions.



The window contamination values can be slightly negative, which is normal.

3. If prompted to clean the transmitter and receiver windows, do the following.
   a. Using low pressure, spray 50 % isopropyl alcohol on the glass windows. Spray enough solution to dissolve and loosen any dirt.
   b. Wipe the window with a soft, lint-free cloth until the window is clean.
   c. Take a new cloth and wipe the window until it is clean.
   d. Wait until the windows are dry.

During window cleaning, measurement data is invalid.

During window cleaning, keep the interface unit door closed.

CAUTION! Do not use pressure washers.

CAUTION! Be careful not to scratch the window surfaces or touch the measurement unit windows with bare hands.

The system monitors the window contamination values during the cleaning.

Table 3 Window contamination values

Value	Description
-1.5 % > < 1.5 %	Window check passed; windows are clean
1.5–10 %	Window cleaning is recommended
> 10 %	Window cleaning is mandatory

You may need to clean the windows twice.

4. If the cleaning is successful, no further actions are needed.

   If the window check fails after re-cleaning (the window contamination value stays above 1.5 %), the window transparency may have permanently decreased.
   - A minor decrease in transparency can be taken into account with calibration adjustment (**`mode adjust`**). See Performing calibration adjustment (page 17).
   - If the window transparency loss is high or the window is damaged, a replacement hood is needed.

5. When done, close the maintenance connection.

```
close
```

The window check date is stored in the system as metadata.

1.4 Performing calibration check

- Field calibrator kit for FD70 (FDA701)
- Maintenance laptop with terminal software

FD70 has a transmitter, a main receiver and a side receiver, depending on the configuration you have chosen. The following procedure describes the general calibration checking steps. Perform calibration for the main receiver and transmitter, and then perform the same calibration steps for side receiver and transmitter.

Before you start, clean the windows as instructed in section Cleaning windows (page 5).

During window cleaning, measurement data is invalid.

Calibration check (**`mode calcheck`**, **`mode calcheck 2`**) does not change any values.

Table 4 Requirements for calibration check

Property	Requirement
Visibility	> 2000 m (6560 ft)
Present weather	Calibration is not recommended to be carried out in heavy rain or in bright sunshine

Perform calibration check:

- At least every 12 months.
- In case of severe physical or mechanical impact.

Calibration check has the following phases:

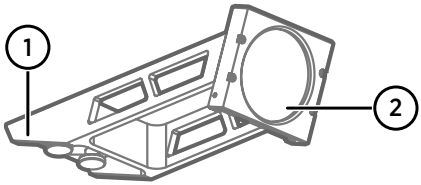
- Preparation
- Zero signal calibration check
- Scatter signal calibration check

The result of the calibration check is one of the following:

- Pass: the calibration is valid
- Fail: calibration adjustment is needed

You can cancel the process at any point.

1. Before you start, check the opaque glass of the calibrators and clean them if necessary.



1 Calibrator
2 Opaque glass

Be careful not to scratch the calibrators, especially the opaque glass. Damaged calibrators have a negative effect on the calibration.

2. Establish a maintenance connection to FD70.
3. Type the following commands:

```
level 2
```

```
mode calcheck
```

For the side receiver, type the following command:

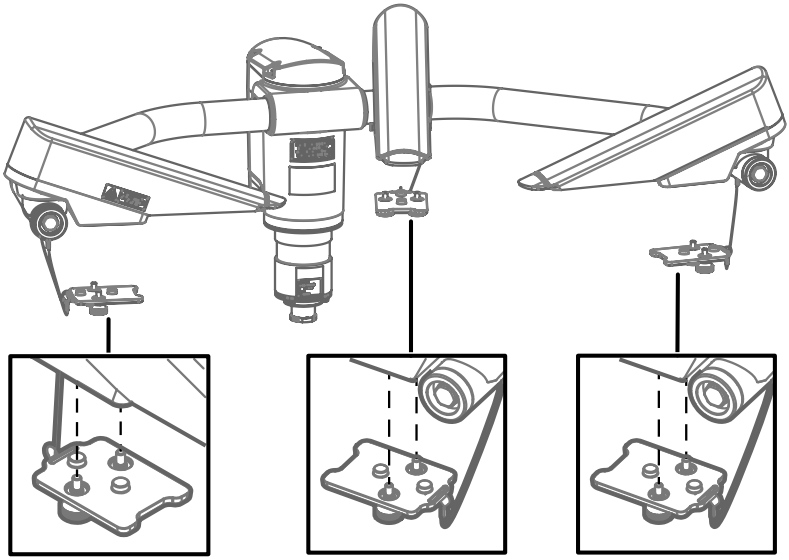
```
mode calcheck 2
```

Follow the onscreen instructions.

4. When prompted for **Calibrator Signal Value**, type the 4-digit value.

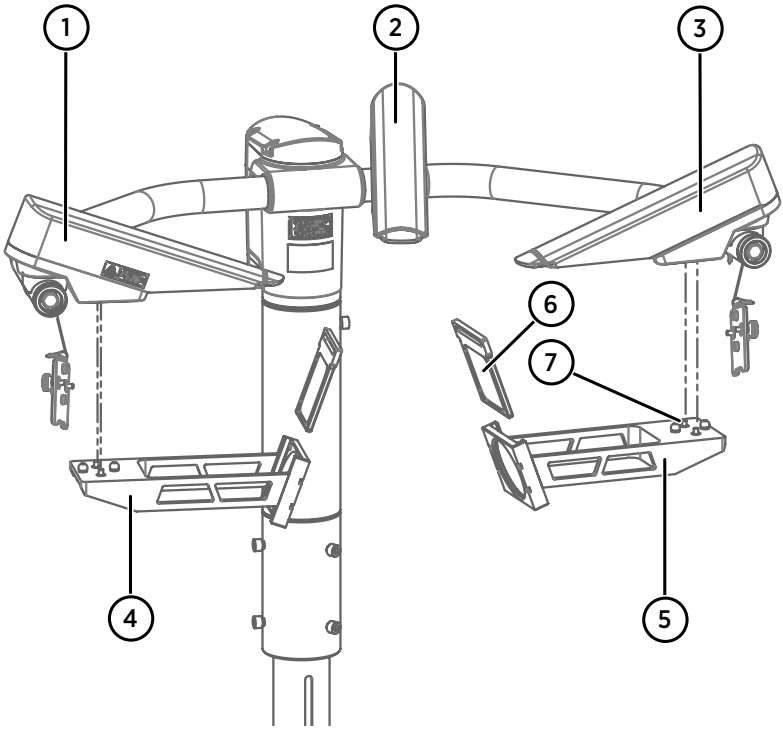
The same value is printed on the calibrator certificate, on the calibrator labels, and the calibrator case.

5. When prompted to install the calibrators with zero signal plates, remove the protection caps from the transmitter and receivers.

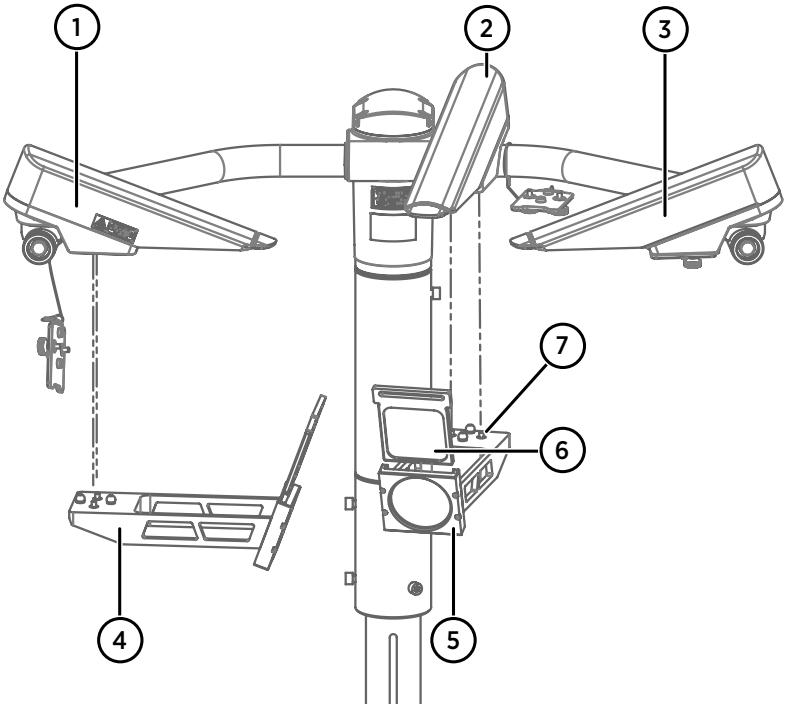


6. Attach the calibrators with zero signal plates on the transmitter and receiver.

   There is a dedicated calibrator for the transmitter and one for the receivers. Check the labels on the calibrators to make sure that you attach them correctly. The following figures show the calibrator attachment process for the main receiver and the side receiver.



1 Transmitter
2 Side receiver
3 Main receiver
4 Calibrator for transmitter (labeled)
5 Calibrator for receivers (labeled)
6 Zero signal plate (2 pcs)
7 Thumb screw (2 pcs / calibrator)

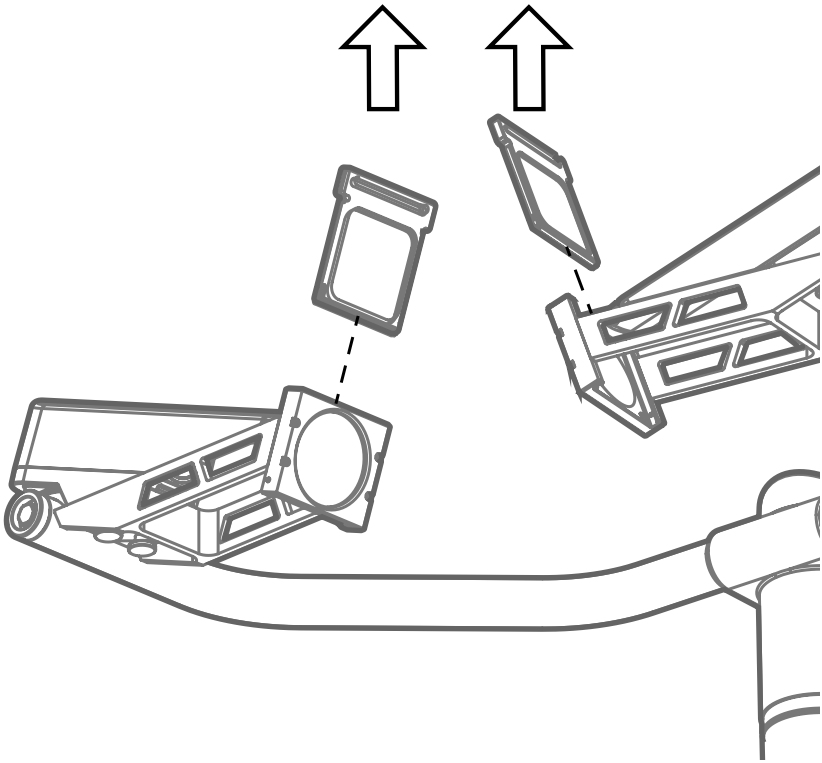


1 Transmitter
2 Side receiver
3 Main receiver
4 Calibrator for transmitter (labeled)
5 Calibrator for receivers (labeled)
6 Zero signal plate (2 pcs)
7 Thumb screw (2 pcs / calibrator)

The system performs zero signal calibration.

- The zero signal calibration passes if the zero signal value is within ±0.012.
- If the zero signal calibration fails, eliminate all possible reflections and external light sources.

7. When prompted, remove the zero signal plates.



The system performs scatter signal calibration. Keep the measurement area clear to avoid interference.

- The scatter signal calibration passes if the scatter signal value is within 3 % of the calibrator signal value.
- If the scatter signal calibration fails, calibration adjustment is needed (**`mode adjust`**, **`mode adjust 2`**).

8. When done, remove the calibrators, reattach the protection caps on the transmitter and receiver, and close the maintenance connection.

```
close
```

Write down the calibration check date.

1.5 Performing calibration adjustment

Do not perform calibration adjustment indoors.

- Field calibrator kit for FD70 (FDA701)
- Maintenance laptop with terminal software
- Soft, lint-free cloths (2 pcs)
- 50 % isopropyl alcohol

FD70 has a transmitter, a main receiver and a side receiver, depending on the configuration you have chosen. The following procedure describes the general calibration adjustment steps. Perform calibration for the main receiver and transmitter, and then perform the same calibration steps for side receiver and transmitter.

During the calibration adjustment, measurement data is invalid.

Calibration adjustment (**`mode adjust`**) sets new values related to the scatter measurement and window contamination measurement.

Table 5 Requirements for calibration adjustment

Property	Requirement
Visibility	> 2000 m (6560 ft)
Present weather	Calibration is not recommended in heavy rain or in bright sunshine.

Calibration adjustment is needed:

- If the window contamination status is not OK after window cleaning.
- If the calibration check is not OK after running **`mode calcheck`** command.
- When the transmitter or receiver module is replaced.
- When the transmitter or receiver hood is replaced.

Calibration adjustment has the following phases:

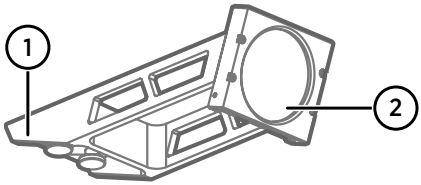
- Preparation
- Zero signal measurement
- Scatter signal measurement
- Scatter measurement adjustment

The result is:

- Pass: the calibration adjustment is valid
- Fail: the calibration adjustment is not valid. If it fails several times, contact Vaisala.

If you cancel the process at any point, the previous values are restored.

1. Before you start, check the opaque glass of the calibrators and clean them if necessary.



1 Calibrator
2 Opaque glass

Be careful not to scratch the calibrators, especially the opaque glass. Damaged calibrators have a negative effect on the calibration.

2. Establish a maintenance connection to FD70.
3. Type the following commands:

```
level 2
```

```
mode adjust
```

For the side receiver, type the following command:

```
mode adjust 2
```

Follow the onscreen instructions.

4. When prompted, do the following.
   a. Using low pressure, spray 50 % isopropyl alcohol on the glass windows. Spray enough solution to dissolve and loosen any dirt.
   b. Wipe the window with a soft, lint-free cloth until the window is clean.
   c. Take a new cloth and wipe the window until it is clean.
   d. Wait until the windows are dry.



During window cleaning, keep the interface unit door closed.



CAUTION! Do not use pressure washers.



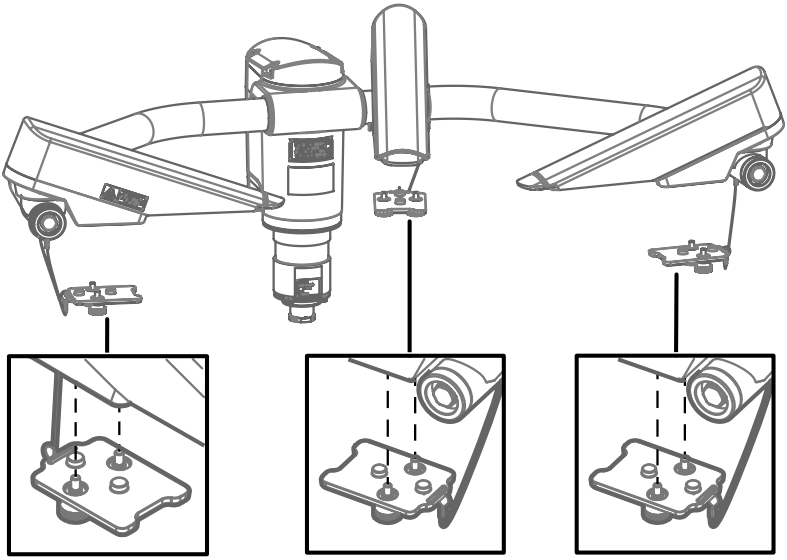
CAUTION! Be careful not to scratch the window surfaces or touch the measurement unit windows with bare hands.

- If the clean window check passes after window cleaning, the current clean window reference is not changed and adjustment can continue to calibration check.
- If the clean window check fails after 2 successive cleaning attempts, follow the onscreen prompts and either choose to set a new clean window reference and continue (type **Y**), or cancel the adjustment (type **N**).

5. When prompted for **Calibrator Signal Value**, type the 4-digit value.

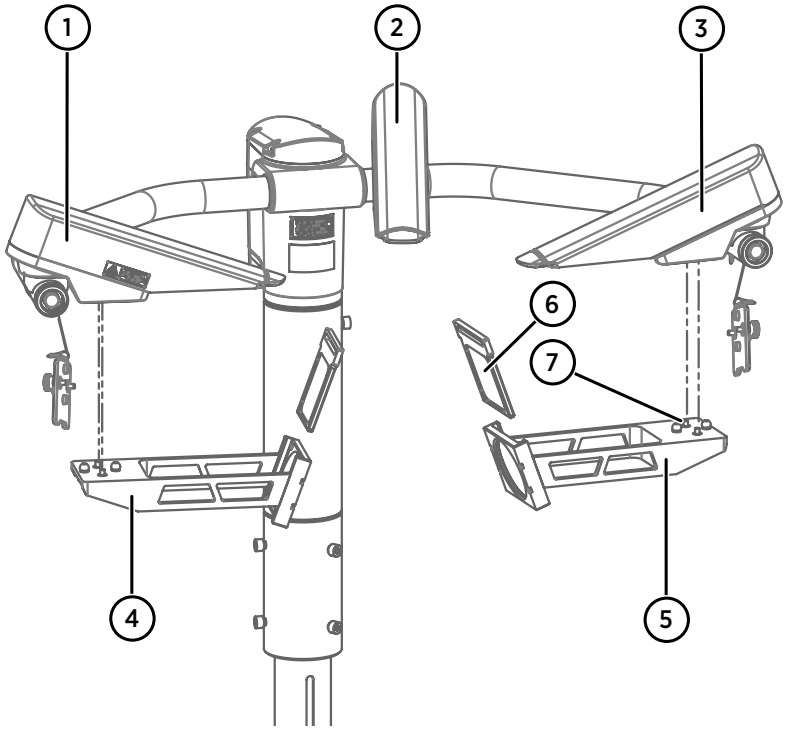
   The same value is printed on the calibrator certificate, on the calibrator labels, and the calibrator case.

6. When prompted to install the calibrators with zero signal plates, remove the protection caps from the transmitter and receivers.

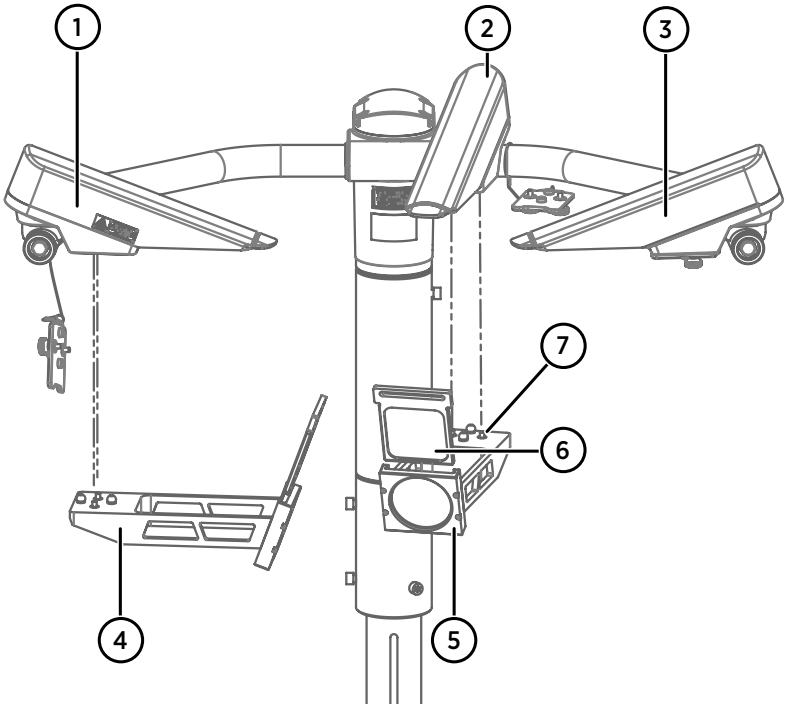


7. Attach the calibrators with zero signal plates on the transmitter and receiver.

   There is a dedicated calibrator for the transmitter and one for the receivers. Check the labels on the calibrators to make sure that you attach them correctly. The following figures show the calibrator attachment process for the main receiver and the side receiver.



1 Transmitter
2 Side receiver
3 Main receiver
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5 Calibrator for receivers (labeled)
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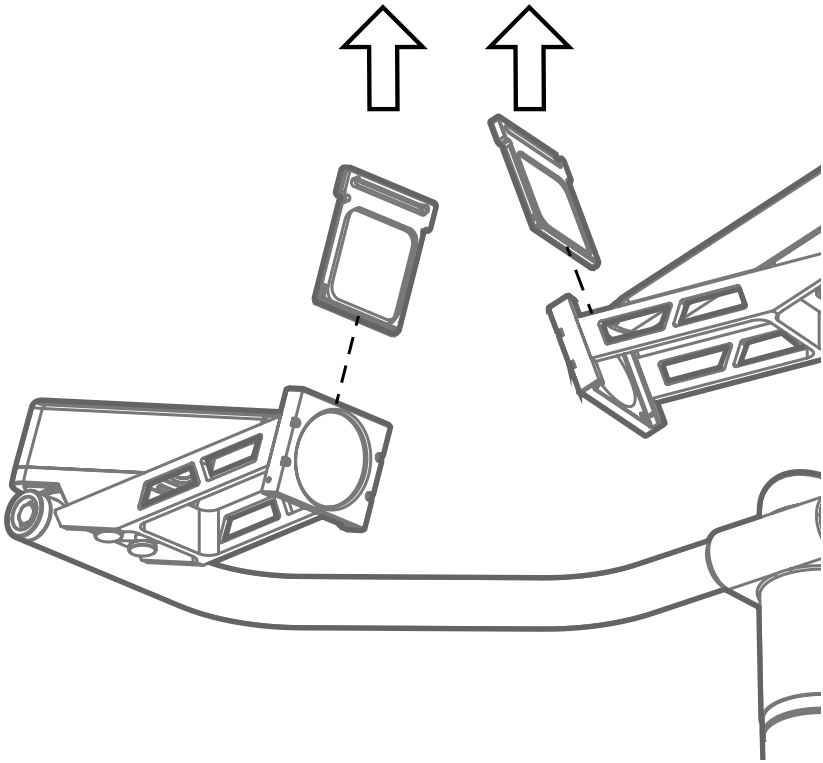


1 Transmitter
2 Side receiver
3 Main receiver
4 Calibrator for transmitter (labeled)
5 Calibrator for receivers (labeled)
6 Zero signal plate (2 pcs)
7 Thumb screw (2 pcs / calibrator)

The system performs zero signal measurement.

- The limit is ±0.012 for the main receiver and ±0.04 for the side receiver.
- If the zero signal measurement fails, eliminate all possible reflections and external light sources.

8. When prompted, remove the zero signal plates.



   The system performs scatter signal measurement.

9. Adjust the scatter measurement.
10. Verify the scatter measurement.
    - The scatter measurement passes if the scatter signal value is within 3 % of the calibrator signal value.
    - If the signal measurement fails, try calibration adjustment again (**`mode adjust`**, **`mode adjust 2`**). If measurement fails several times, contact Vaisala.
11. After completing the calibration adjustment for the main receiver, repeat the process for the side receiver.
12. When done, remove the calibrators, reattach the protection caps on the transmitter and receivers, and close the maintenance connection.

```
close
```

The calibration adjustment date is stored in the system as metadata.

Warranty

For standard warranty terms and conditions, see vaisala.com/warranty.
Please observe that any such warranty may not be valid in case of damage due to normal wear and tear, exceptional operating conditions, negligent handling or installation, or unauthorized modifications. Please see the applicable supply contract or Conditions of Sale for details of the warranty for each product.

Technical support



Contact Vaisala technical support at helpdesk@vaisala.com. Provide at least the following supporting information as applicable:

- Product name, model, and serial number
- Software/Firmware version
- Name and location of the installation site
- Name and contact information of a technical person who can provide further information on the problem

For more information, see vaisala.com/support.

Recycling



Recycle all applicable material according to local regulations.

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