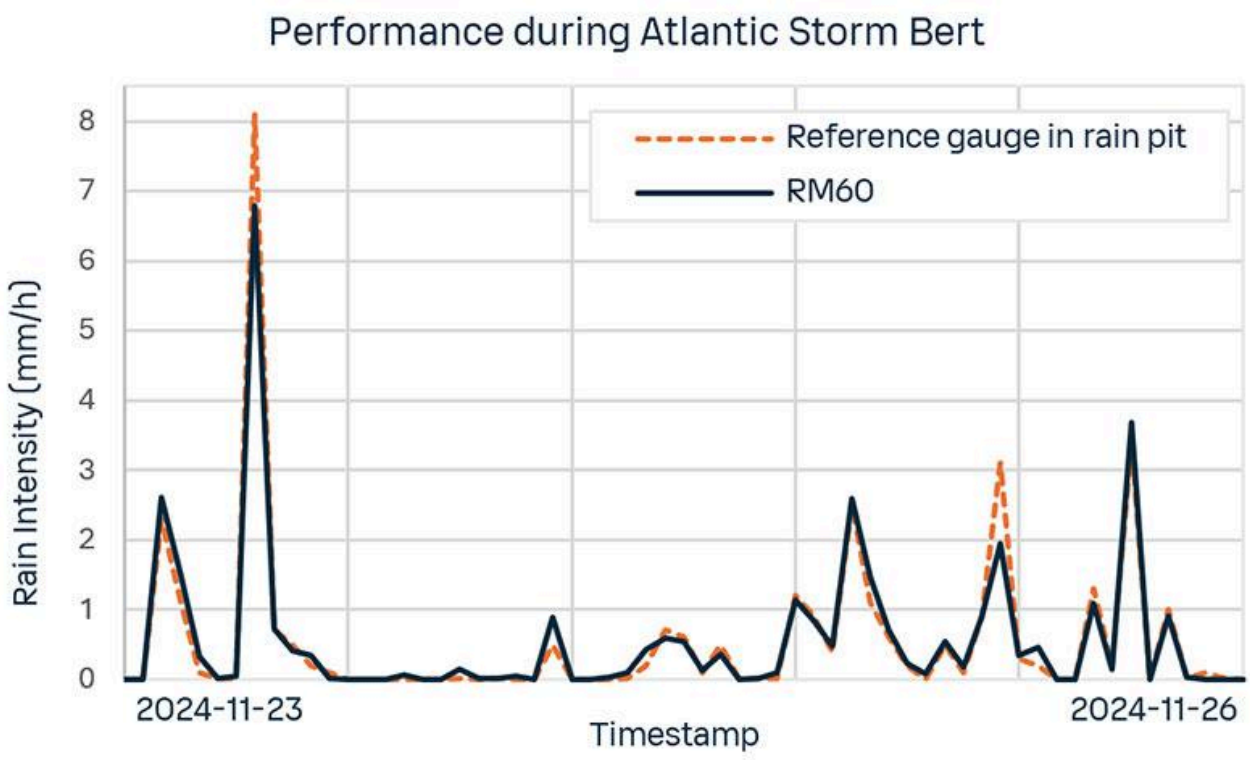
USER GUIDE

RM60

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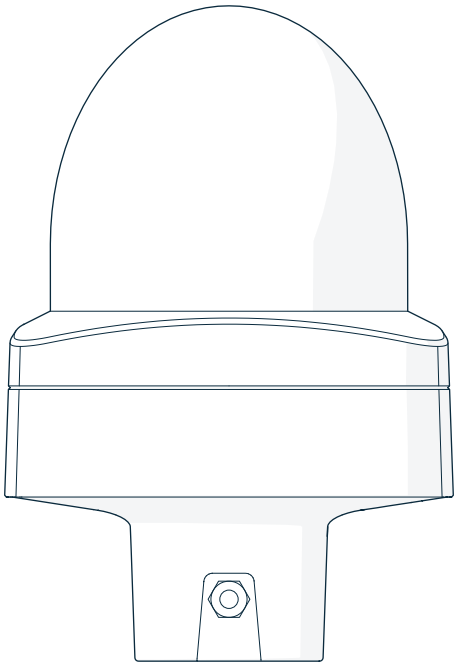


M213218EN-B

User Guide

Vaisala PRECICAP® Radar Precipitation Sensor

RM60



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1. About this document

1.1 Version information

This document provides detailed instructions for using and configuring Vaisala PRECICAP Radar Precipitation Sensor RM60.

Table 1 Document versions (English)

Document code	Date	Description
M213218EN-B	August 2026	• Updated cable options in Ordering options (page 11). • Updated default interval for autosend to 60 seconds and range to 0.25–600 seconds in Configuring data message MSG3 settings (page 36) and Modbus registers (page 68). • Updated precipitation intensity range in RM60 specifications (page 62). • Added FCC and ISED radio acceptance, RCM compliance, and updated radio compatibility standards in RM60 specifications (page 62). • Added ISED warning statement in ISED warning statement for category I equipment (page 75).
M213218EN-A	June 2026	First version.

1.2 Related manuals



For the latest versions of these documents, see docs.vaisala.com.

Table 2 Related manuals

Document code	Name
M213217EN	Vaisala PRECICAP Radar Precipitation Sensor RM60 Setup Guide
M213218EN	Vaisala PRECICAP Radar Precipitation Sensor RM60 User Guide

1.3 Documentation conventions



WARNING! Alerts you to a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION! Alerts you to a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE! Alerts you to a situation that, if not avoided, could result in the product to be damaged, or important data to be lost.

Highlights important information on using the product.

1.4 Trademarks

Vaisala® and PRECICAP® are registered trademarks of Vaisala Oyj.

Modbus® is a registered trademark of Schneider Automation Inc.

Windows® is either a registered trademark or trademark of Microsoft Corporation in the United States and other countries.

All other product or company names that may be mentioned in this publication are trade names, trademarks, or registered trademarks of their respective owners.

1.5 Patent notice

This product is protected by the following patents.

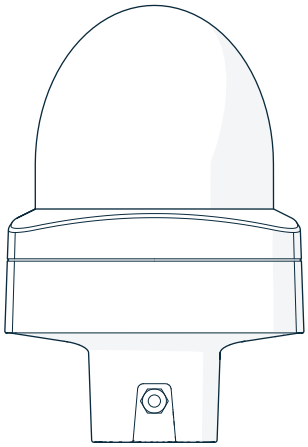
Table 3 Applicable patents

Issuing office	Patent number
European Patent Office	EP4243205
	EP4243209
United States Patent and Trademark Office	US 12481023

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2. Product overview

2.1 Vaisala PRECICAP Radar Precipitation Sensor RM60



Vaisala PRECICAP® Radar Precipitation Sensor RM60 reports precipitation intensity, accumulation, and precipitation type by measuring individual hydrometeors using 61 GHz Doppler radar. This patented breakthrough technology allows accurate measurements in all weather conditions without requiring heating or maintenance.

RM60 is built to deliver reliable precipitation data for its full operating life without scheduled maintenance. This non-catchment type of instrument has multiple advantages over conventional rain gauges: no moving parts that would get jammed or break, no container to empty or fill with anti-icing fluid, and no openings that would get clogged.

2.2 Product and part names

Table 4 Product and part names

Item	Name
RM60	Vaisala PRECICAP Radar Precipitation Sensor RM60
Insight	Vaisala Insight PC software
QSP431	Vaisala Surge Protection Unit QSP431
WSP150	Vaisala Surge Protector WSP150

2.3 Safety

If any instructions in this document conflict with your local or state legislation or regulations, always follow the local or state legislation or regulations.

Follow local and state legislation and regulations on occupational safety.

Consult local authorities on decisions that relate to aviation safety and safe installation.

Consult local authorities and electricity professionals on decisions that relate to grounding, safe installation, and power supply.

The assembler is responsible for the safety of the system into which the device is integrated.

If the product is used in a manner not specified by Vaisala, the protection provided by the product may be impaired. Follow the instructions.

Only qualified maintenance personnel may perform maintenance procedures.



Radiation hazard
The device incorporates a radio frequency (RF) transmitter. The RF radiation may affect cardiac pacemakers, insulin pumps, and other electronic life-supporting equipment. Keep a minimum distance of 20 cm (8 in) from the device in normal operation. In case of device failure, keep a minimum distance of 3 m (10 ft).



Risque lié au rayonnement RF
L'appareil intègre un émetteur à radiofréquence (RF). Le rayonnement RF peut interférer avec les stimulateurs cardiaques, les pompes à insuline et d'autres appareils électroniques de maintien en vie. Maintenez une distance minimale de 20 cm de l'appareil en fonctionnement normal. En cas de défaillance de celui-ci, maintenez une distance minimale de 3 m.



CAUTION! Modification of the product can result in injury or damage the product. Do not modify the product or substitute parts unless instructed to do so. Improper modification voids your warranty.



CAUTION! Using components that do not meet Vaisala specifications can result in injury or damage the product. Use only accessories and spare parts that meet the specifications.



Failure to comply with the warnings and cautions in these instructions violates safety standards of design, manufacture, and intended use of the product. Vaisala assumes no liability for the failure to comply with these requirements.

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The following figure shows the product markings, including regulatory markings and manufacturer information on the device.

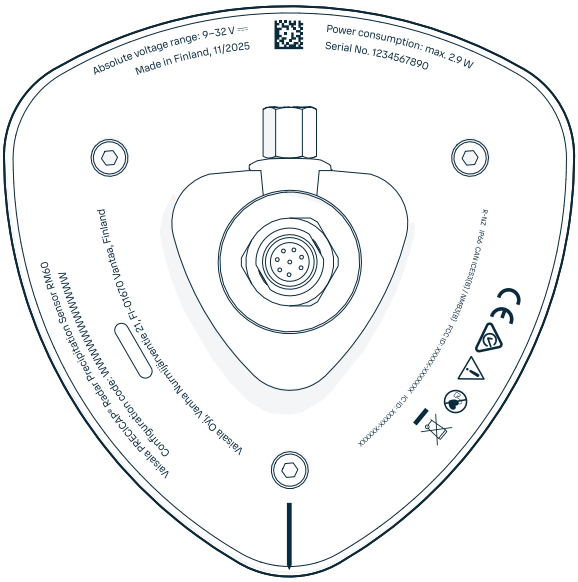


Figure 1 Type label on device

Table 5 Symbols on product

Symbol	Description
	Direct current
	Caution For instructions of use, see RM60 User Guide (M213218EN).
	Radiation hazard for users of cardiac pacemakers, insulin pumps, and other electronic life-supporting equipment.

2.4 Cybersecurity guidelines

RM60 has been designed following the industry best practices for secure product development. The development process complies with the requirements in the IEC 62443-4-1 cybersecurity standard. RM60 runs only on Vaisala-signed firmware. In case Vaisala recognizes a critical vulnerability, Vaisala provides a firmware update package or mitigation proposal.

Ensuring the security of RM60 and data is one of the key responsibilities of the organization setting up the device. The following security guidelines help protect against threats, vulnerabilities, and unauthorized access.

Understanding and following these guidelines is crucial.

Table 6 Cybersecurity guidelines

Layer	Guidelines
Human layer	The human layer focuses on the human element: the users of RM60. Make sure that all users are properly trained to use the device.
Hardware perimeter layer	The hardware perimeter layer focuses on the physical access to RM60. Make sure that only authorized personnel can access the device operating area.
Network layer	The network layer is crucial in managing and protecting the communication between applications and devices on your network. Do not expose the device interfaces to the Internet.
Application layer	The application layer focuses on keeping software and device free of threats. Vaisala software development processes comply with ISO/IEC 27001 IEC 62443-4-1 (Secure product development life cycle requirements). These standards take into account the security of the product throughout its life cycle. Vaisala follows secure coding practices. Vaisala monitors common vulnerabilities and exposures (CVE) that affect our products, evaluates their impact, and provides a new firmware version or a mitigation proposal.
Process layer	To keep your RM60 secure, update the device firmware if needed. Firmware releases might contain important security updates. You can download the latest firmware version from docs.vaisala.com. In your organization, agree who is responsible for checking for firmware updates and performing the updates. Also, agree how often the person should check for the updates. For secure decommissioning of RM60, make sure to reset the device to factory default settings to remove data.

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3. Ordering options

Table 7 Measurement options

Option	Order code
Precipitation intensity, precipitation accumulation, precipitation type, drop size distribution, and reflectivity factor	A

Table 8 Additional measurement options

Option	Order code
Air pressure	1

Table 9 Communication profile options

Option	Order code
RS-485, Modbus RTU, server, 19200 baud, 8, E, 1	1
RS-485, ASCII autosend, 19200 baud, 8, N, 1	2

Table 10 Cable options

Option	Order code
No cable	N
Shielded 2-m cable, 8-pin, M12 connector on one end	1
Shielded 5-m cable, 8-pin, M12 connector on one end	2
Shielded 10-m cable, 8-pin, M12 connector on one end	3
Shielded 3.5-m cable, 8-pin, M12 connector on one end	220496
Shielded 30-m cable, 8-pin, M12 connector on one end	220498

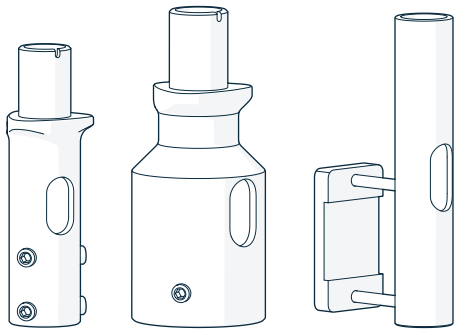


Figure 2 RM60 mounting adapter options

Table 11 Mounting adapter options

Option	Order code
No mounting adapter	N
Mounting adapter for 30-mm mast	A
Mounting adapter for 60-mm mast	B
Mounting adapter for 40 × 40 mm support arm	C

Table 12 Documentation options

Option	Order code
English Setup Guide	1

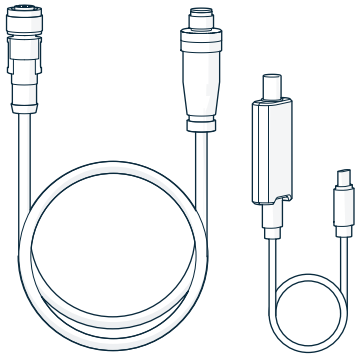


Figure 3 USB configuration cable set (service cable and USB adapter)

Table 13 Accessories

Accessory	Order code
USB configuration cable set for use with Vaisala Insight PC software (includes service cable and USB adapter with USB-C connector)	USBCONFSET

Table 14 Vaisala services

Option	Order code
Vaisala Care Enhanced Support and Extended Warranty	RM60SC

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4. Functional description

RM60 provides measurement and diagnostic data over RS-485 serial communication by means of Modbus RTU and the RM60 data message MSG3.

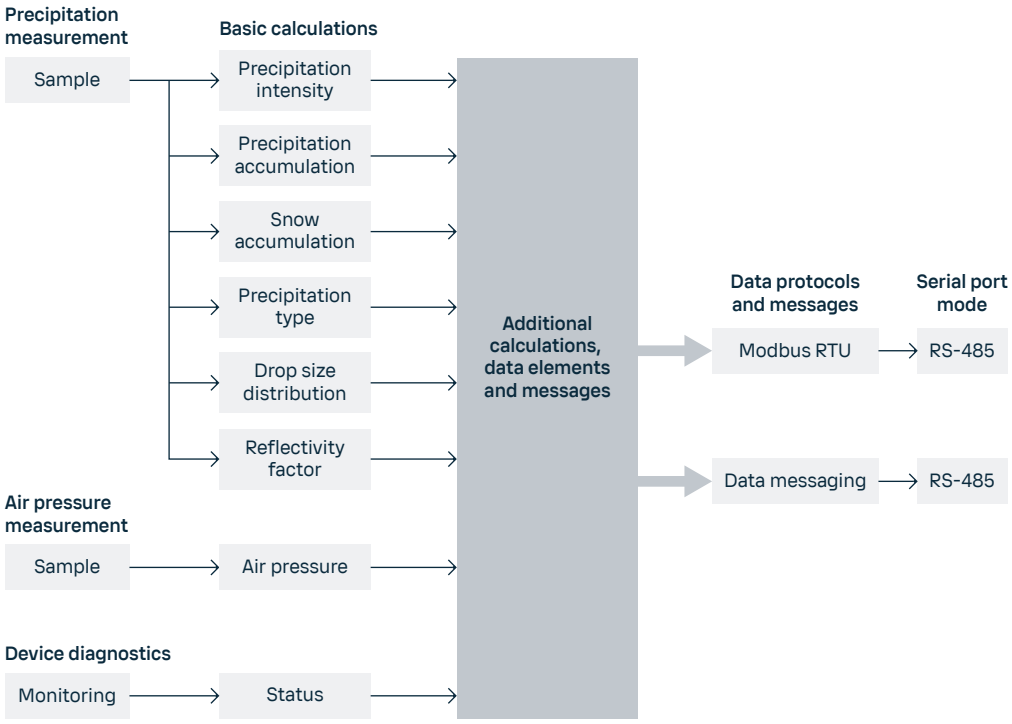


Figure 4 Functional description

To configure device settings, use Insight or Modbus RTU.

For details about the outputs, see the information about data communication.

More information

- RM60 measurement data (page 15)
- RM60 data message MSG3 (page 26)
- Modbus RTU protocol (page 29)

4.1 Measurement principle

RM60 precipitation measurement uses the Vaisala PRECICAP technology, which builds on the principle of a vertically pointing Doppler radar. RM60 transmits and receives radio frequency (RF) modulated continuous waves on the 61 GHz RF band.

Using the patented Vaisala antenna system, precipitation is reconstructed as ensembles of distinct individual hydrometeors in the short ranges (approximately 2 m / 6 ft 7 in) of the optimized narrow RF beam. RM60 observations correspond to the effective catchment area of 700 cm^2, which enables precipitation measurement with good representativeness. The diameters of individual raindrops are reconstructed using their known relations with terminal fall velocities. The counts of raindrops, combined with the spectral power densities that are normalized to the counts, lead to estimates of rain intensity.

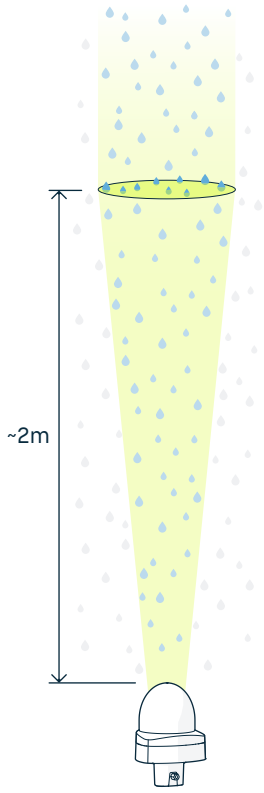


Figure 5 RM60 measurement principle

The narrow-beam characteristics eliminate the known uncertainties relating to windy weather. The narrow beam enables the accurate measurement of terminal fall velocities. The counting method eliminates the known uncertainties relating to the high intrinsic variability of the precipitating echo.

Raindrops can be accurately defined by the following physical properties:

- Sizes, shapes, and fall velocities of raindrops
- Dielectric properties of water

RM60 measures these properties through the Doppler power spectrum from the echoes of individual drops. By interpreting the full spectrum, RM60 reconstructs the complete set of known hydrometeors, such as drizzle and solid hydrometeors.

The RM60 Doppler measurement is based on a stable built-in clock system. The fall velocities are accurately measured over the operating temperature range. At factory, the echo signals are verified in controlled conditions against a perfectly conducting sphere of a known diameter. Both the frequency and diameter are traceable to SI units.

During normal operation in precipitation, RM60 autocalibrates the signals based on the physical properties of raindrops and performs adjustments if necessary.

4.2 RM60 measurement data

RM60 outputs the following measurement data.

Table 15 RM60 measurement data

Measurement value	Range	Unit	Measurement type	Description	Calculation period
Precipitation intensity	0–999.9	mm/h	Instant	Average of intensity sample values	1-minute moving average
Precipitation accumulation	0–999.99	mm	Total	Accumulation of liquid and solid precipitation	Continuous until reset
Precipitation accumulation (differential)	0–999.99	mm	Total	Accumulation of liquid and solid precipitation	Continuous until read or reset
Snow accumulation	0–999.99	mm	Total	Accumulation of snow	Continuous until reset
Snow accumulation (differential)	0–999.99	mm	Total	Accumulation of snow	Continuous until read or reset
Precipitation type	See RM60 SYNOP codes (page 16)	–	Instant	Present (dominant) precipitation type based on analysis of samples	Depends on measurement interval
Drop size distribution	See Drop size distribution (page 17)	$m^{-3}\,mm^{-1}$	Instant	–	1-minute moving average
Reflectivity factor	−60 … +65	dBZ	Instant	–	1-minute moving average
Air pressure	500.0–1100.0	hPa	Instant	–	1-minute moving average

More information

- RM60 data message MSG3 (page 26)
- Configuring precipitation measurement (page 40)
- Modbus RTU protocol (page 29)

4.2.1 RM60 SYNOP codes

RM60 outputs the precipitation type according to the World Meteorological Organization (WMO) classification, the WMO SYNOP code from table 4680.

The precipitation type is part of the RM60 data message MSG3 and the Modbus RTU output.

Table 16 Precipitation type SYNOP codes

Code	Description in WMO 4680	Identified as
0	No significant weather observed	Precipitation not detected (clear)
40	PRECIPITATION	Precipitation detected, but not identified
50	DRIZZLE	Drizzle
51	Drizzle, not freezing, slight	Drizzle with slight intensity
52	Drizzle, not freezing, moderate	Drizzle with moderate intensity
53	Drizzle, not freezing, heavy	Drizzle with heavy intensity
57	Drizzle and rain, slight	Mixed drizzle and rain with slight intensity
58	Drizzle and rain, moderate or heavy	Mixed drizzle and rain with moderate or heavy intensity
60	RAIN	Rain
61	Rain, slight	Rain with slight intensity
62	Rain, moderate	Rain with moderate intensity
63	Rain, heavy	Rain with heavy intensity
67	Rain (or drizzle) and snow, slight	Mixed liquid and snow with slight intensity
68	Rain (or drizzle) and snow, moderate or heavy	Mixed liquid and snow with moderate or heavy intensity
70	SNOW	Snow
71	Snow, slight	Snow with slight intensity
72	Snow, moderate	Snow with moderate intensity
73	Snow, heavy	Snow with heavy intensity
89	Hail	Hail

More information

- RM60 data message MSG3 (page 26)
- Modbus registers (page 68)

4.2.2 Drop size distribution

Drop size distribution (DSD) describes the drop number density in the air as a function of their diameter.

Drop sizes are categorized into bins (size classes). The measurement value of each of size bin is a 1-minute running average of the number of drops per cubic meter per unit drop diameter. The unit of measurement is $m^{-3}\,mm^{-1}$.

Table 17 Drop size distribution

Bin	Min. Ø (mm)	Max. Ø (mm)	Mean Ø (mm)	Bin width (mm)
1	0.17	0.26	0.215	0.09
2	0.26	0.35	0.305	0.09
3	0.35	0.45	0.400	0.10
4	0.45	0.54	0.495	0.09
5	0.54	0.63	0.585	0.09
6	0.63	0.73	0.680	0.10
7	0.73	0.83	0.780	0.10
8	0.83	0.94	0.885	0.11
9	0.94	1.06	1.000	0.12
10	1.06	1.19	1.125	0.13
11	1.19	1.32	1.255	0.13
12	1.32	1.47	1.395	0.15
13	1.47	1.64	1.555	0.17
14	1.64	1.82	1.730	0.18
15	1.82	2.03	1.925	0.21
16	2.03	2.26	2.145	0.23
17	2.26	2.53	2.395	0.27
18	2.53	2.86	2.695	0.33
19	2.86	3.27	3.065	0.41
20	3.27	3.80	3.535	0.53
21	3.80	4.60	4.200	0.80
22	4.60	6.20	5.400	1.60

Drop size distribution is part of the Modbus RTU output.

More information

- Modbus registers (page 68)

4.2.3 Reflectivity factor

Reflectivity factor is calculated as a sum of the drops in the unit of air volume.

$$Z = \sum_i \frac{D^6}{V_{unit}}$$

Table 18 Explanation of reflectivity factor formula

Item	Explanation
Z	Reflectivity factor
D	Drop diameter

RM60 reports the reflectivity factor in units of dBZ. The unit of the reflectivity factor Z is $mm^6\ m^{-3}$.

$$Z(dBZ) = 10 \times \log_{10}(Z)$$

Reflectivity factor is part of the RM60 data message MSG3 and the Modbus RTU output.

More information

- RM60 data message MSG3 (page 26)
- Modbus registers (page 68)

4.3 Measurement interval and power consumption

RM60 uses power during the measurement phase, data communication phase, and idle phase. The effect of the data communication phase on the power consumption is minimal.

RM60 power consumption varies depending on the measurement interval.

The following examples illustrate the changes in power consumption and measurement performance with 3 different measurement intervals.

The data output interval in these examples is always 60 seconds. The data output interval is configurable.

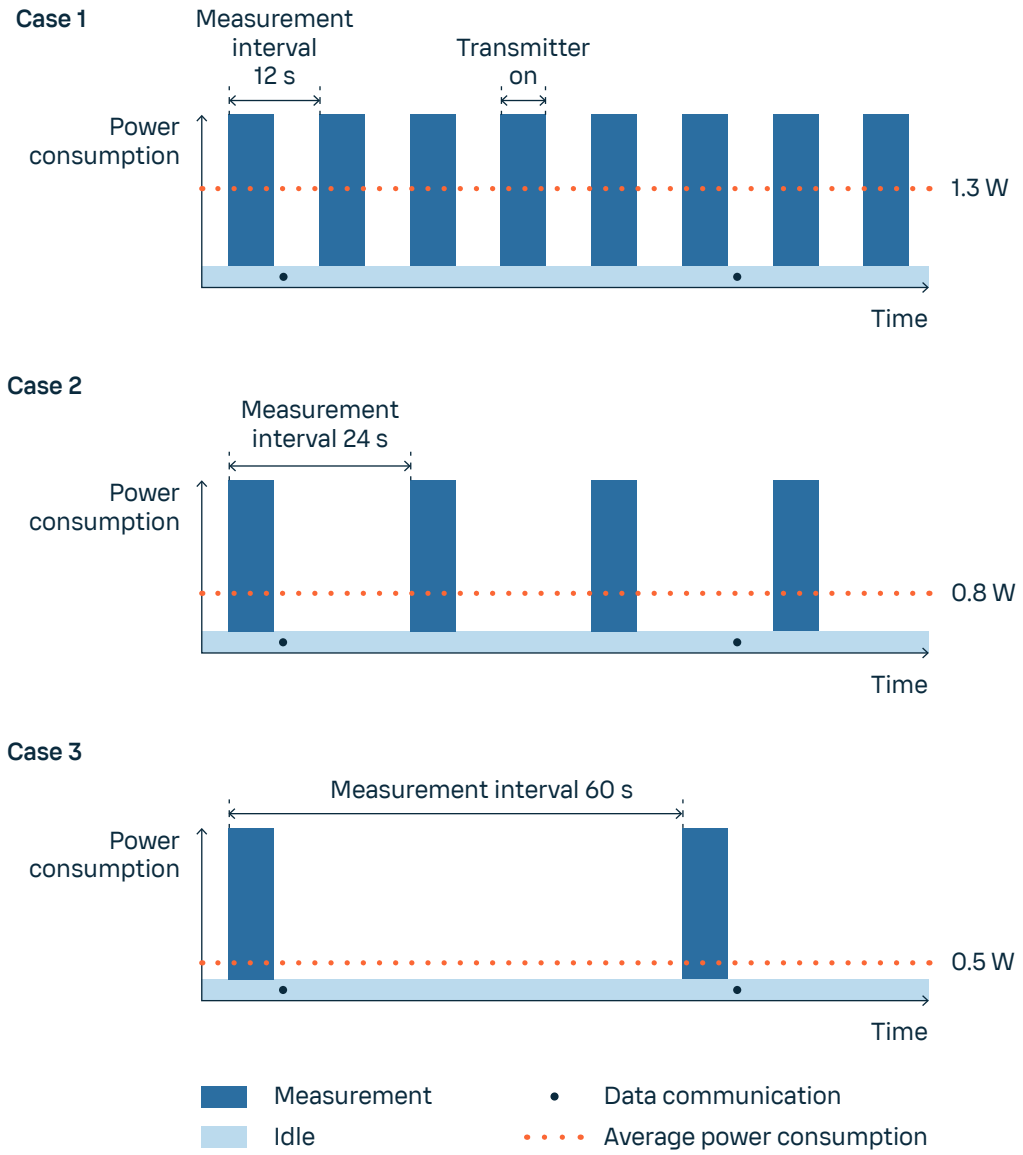


Figure 6 Effect of measurement interval on power consumption

Table 19 Effect of measurement interval on measurement performance

Condition	Property	Case 1	Case 2	Case 3	Effect
Operating mode	Measurement interval	12 s	24 s	60 s	–
	Transmitter on	6 s	6 s	6 s	–
	Average power consumption at 24 V	1.3 W	0.8 W	0.5 W	–

Condition	Property	Case 1	Case 2	Case 3	Effect
Performance in continuous precipitation	Precipitation intensity and precipitation accumulation	Excellent	Very good	Good	–
	Drop size distribution	Excellent	Very good	Good	
	Reflectivity factor	Excellent	Very good	Good	
	Precipitation type	Excellent	Very good	Good	
Performance in showery precipitation	Precipitation intensity and precipitation accumulation	Excellent	Good	Fair	Longer measurement intervals expected to increase uncertainty because of variation in precipitation intensity.
	Drop size distribution	Excellent	Good	Fair	
	Reflectivity factor	Excellent	Good	Fair	
	Precipitation type	Excellent	Good	Fair	Longer measurement intervals mean it takes longer to identify the precipitation type.

Measurement intervals longer than 60 seconds can be used to achieve even lower power consumption. This can have a significant impact on the performance, especially in showery events.

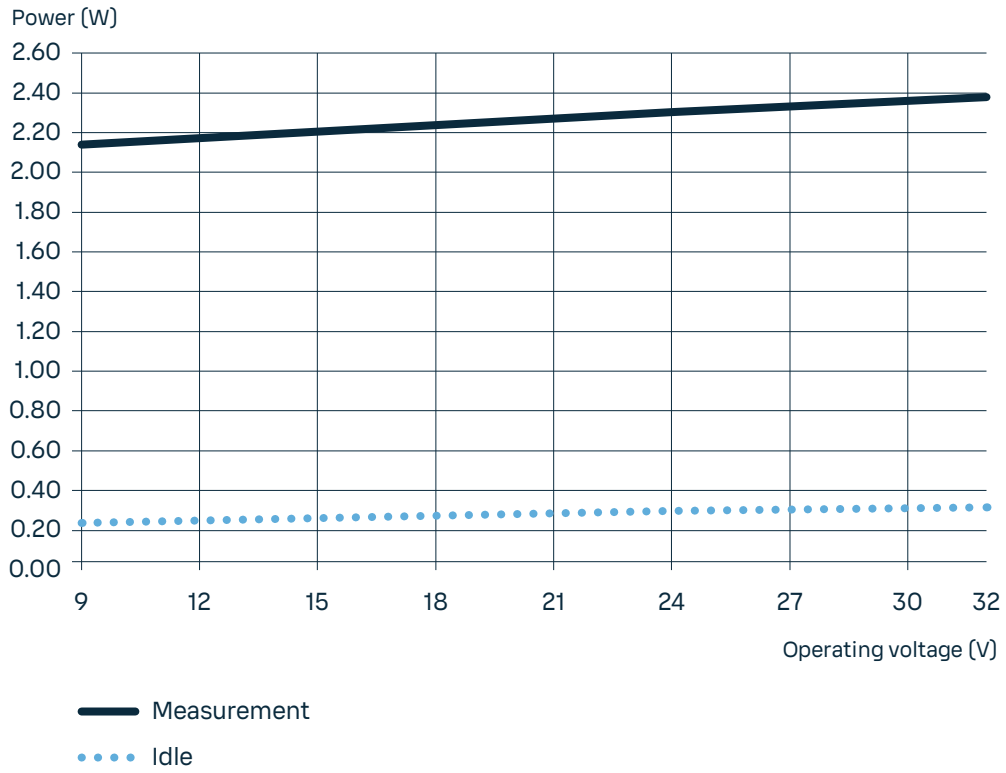


Figure 7 Typical RM60 power consumption in measurement state and idle state

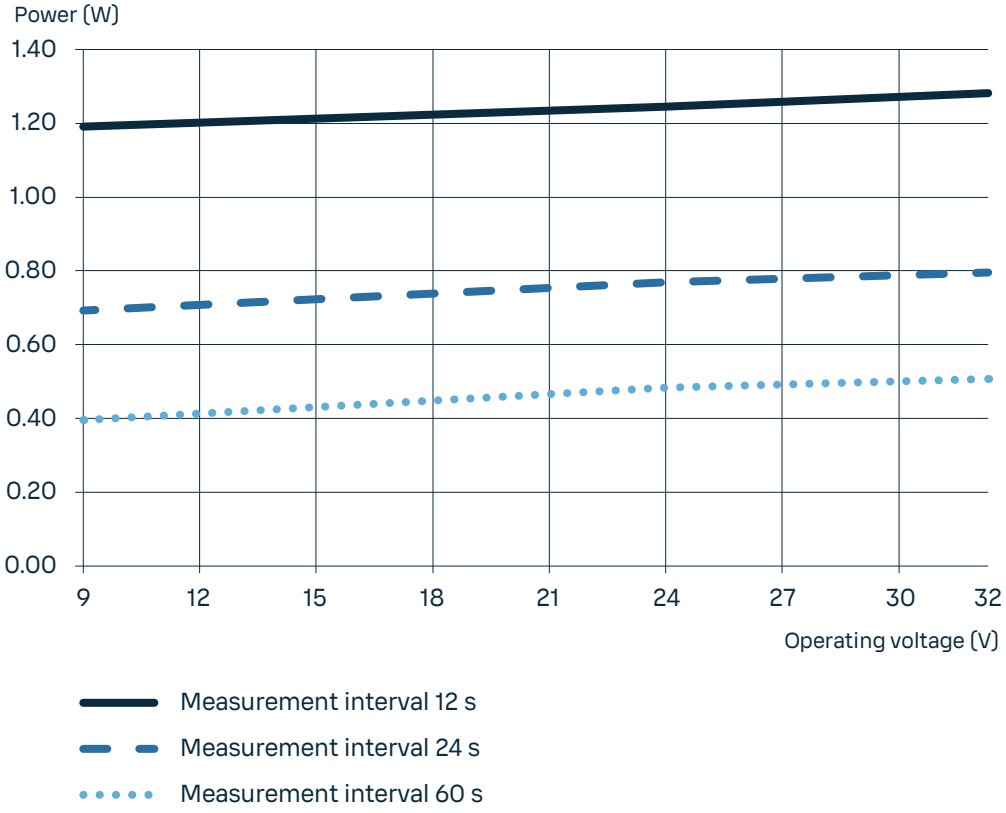


Figure 8 Typical average RM60 power consumption with 3 different measurement intervals

To adjust the measurement interval and the data output interval, see instructions about configuring the precipitation measurement and the MSG3 settings.

More information

- Configuring data message MSG3 settings (page 36)
- Configuring precipitation measurement (page 40)

5. Installation and setup

5.1 Device parts

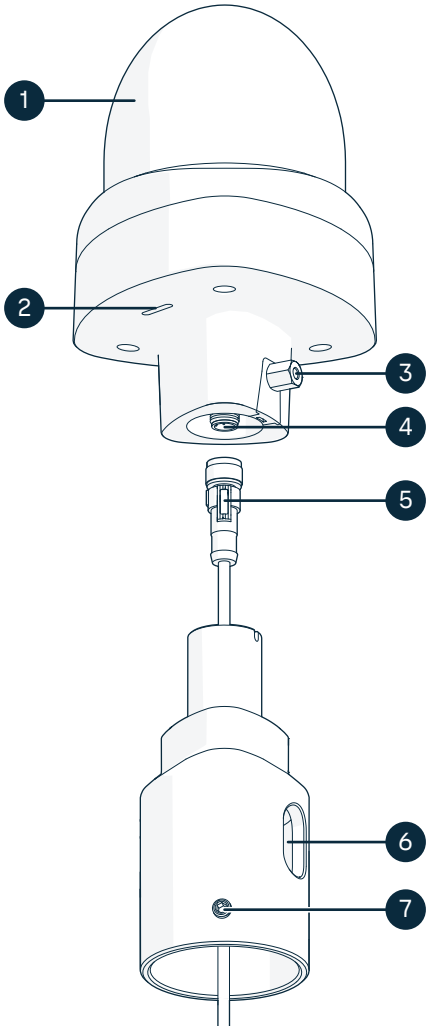


Figure 9 Device parts

1 Radar antenna
2 Device LED
3 Fixing point for mounting and grounding cable
4 Device connector for cable connection
5 Device cable for data and powering
6 Slot in mounting adapter for device cable routing in mast installations
7 Fixing point for attaching mounting adapter to pole

5.2 Installation

You can install RM60 with the 30-mm or 60-mm mounting adapter on a pole or with a mounting adapter on a 40 × 40-mm support arm. Alternatively, you can install RM60 directly on the 30-mm mast without the mounting adapter.

For site requirements and installation instructions, see RM60 Setup Guide (M213217EN).

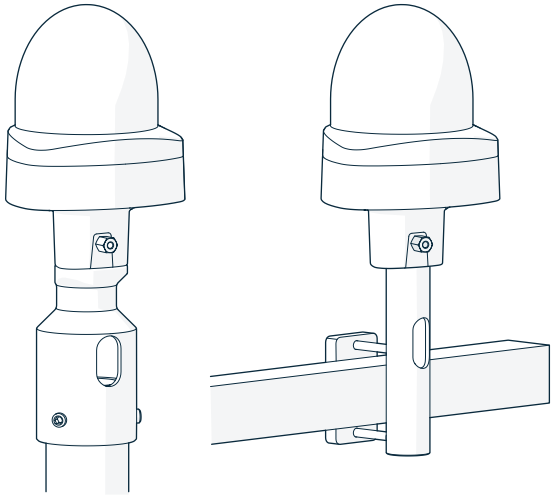


Figure 10 RM60 installation options

If you need to modify the device from the default factory settings before use, configure the device as needed. After installation, verify that the device outputs data as expected.

More information

- Connecting device to Insight (page 33)

5.3 Powering requirements

To ensure electrical safety of the device:

- Connect the device to an isolated power supply.
- Protect the device with an overcurrent protection device.
- Use the specified type of device cable.

For the requirements, see the following tables.

Table 20 Power supply requirements

Property	Description
DC output	9–32 V DC absolute range
Insulation	Double/Reinforced insulation

CAUTION! Always choose a power supply unit that conforms to the local standards and requirements.
In North America, only power the device with one of the following:

- An approved/certified Class 2 power supply. The output of the power supply may not exceed 100 VA, with operating voltage not more than 30 V_{rms}, 42.4 V_{peak}, or 60 V DC.
- An approved/certified Limited Power Source (LPS) (CAN/CSA-C22.2 No. 60950-1 or UL 60950-1).

The device requires an external overcurrent protection device. Protect the device and the cabling with a circuit breaker at operating voltage lines that has the following characteristics. The overcurrent protection device can be a fuse or a circuit breaker. Alternatively, use a power supply that provides the device a maximum of 100 W, such as a limited power supply (LPS).

Table 21 Requirements for overcurrent protection device

Property	Description
Current rating for device	1 A, with type B, C, or D tripping characteristics (according to IEC/EN 60898-1 or UL 1077)
Minimum voltage rating	32 V DC
Circuit breaker Instead of a circuit breaker you can use a cartridge fuse with class T (slow acting) tripping characteristics.	2-pole (connected on both V+ and V–) or 1-pole (connected on V+)

Vaisala recommends using a cable provided by Vaisala. If you use another cable, it must meet the following requirements.

Table 22 Cable requirements

Property	Description
Maximum cable length	50 m (164 ft)
Shield	Mandatory
Minimum wire thickness	0.25 mm^2 (24 AWG)
Connector type	A-coded 8-pin M12 connector, female, straight plug

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5.4 Grounding and surge protection

WARNING! Electricity hazard
Failure to provide proper grounding can result in injury or death from electric shock and can severely damage the product. Ground the product and verify the grounding periodically.

Consult local authorities and electricity professionals on decisions that relate to grounding, safe installation, and power supply.

Install the device as instructed in RM60 Setup Guide (M213217EN).

The device has a grounding fixing point. The device is grounded by installing it on a mast or a support arm that provides a good connection to earth ground.

If the grounding by fixing it to the mast is not sufficient, a separate grounding cable is recommended.

To protect your data logging device from surges, you can use the following options:

- Vaisala Surge Protection Unit QSP431
- Vaisala Surge Protector WSP150

QSP431 is installed in an enclosure or inside together with the data logging device. If QSP431 in installed inside, WSP150 is not needed.

WSP150 is installed next to the sensor, typically within 3 m (10 ft).

For QSP431 and WSP150 documentation, see docs.vaisala.com.

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6. Data communication

The device uses RS-485 serial communication. The measurement data output options are:

- RM60 data message MSG3
- Modbus RTU

More information

- RM60 data message MSG3 (page 26)
- Modbus RTU protocol (page 29)

6.1 Default communication settings

The default communication settings depend on the options you selected when ordering RM60. To check which default profile your product has, check the configuration code of the product with Insight or from the label on the device. The fourth character of the configuration code indicates the ordering option for the communication interface.

Table 23 RM60 default communication settings

Ordering option	Communication interface settings	Default address
1	RS-485, Modbus RTU, server, 19200 baud, 8, E, 1	Modbus address 240
2	RS-485, ASCII autosend, 19200 baud, 8, N, 1	Messaging address 0

To check and change the settings:

- In Insight, browse to the communication settings and data messaging settings.
- In Modbus, use the registers of serial port communication settings.

More information

- Configuring data message MSG3 settings (page 36)
- Configuring Modbus settings (page 39)
- Modbus registers (page 68)

6.2 RM60 data message MSG3

RM60 data message MSG3 is as follows:

```
$\#xs\xdaMSG3x,\rpa,\rpi,\rpx,\rsa,\rsx,\rpt,\rrf,\paa,\sta\#xe*\#xc\#cr\#lf
```

Table 24 RM60 data message MSG3

Name	Description	Unit
$	Start of message delimiter	–
\#xs	Start of checksum calculation	–
\xda	Messaging address Valid values are: • 0-9 • a-z • A-Z	–
MSG3x	• MGS3 = Data message MSG3 • x = Message version	–
\rpa	Precipitation accumulation	mm
\rpi	Precipitation intensity	mm/h
\rpx	Precipitation accumulation (differential)	mm
\rsa	Snow accumulation	mm
\rsx	Snow accumulation (differential)	mm
\rpt	Precipitation type	See RM60 SYNOP codes (page 16)
\rrf	Reflectivity factor	dBZ
\paa	Air pressure	hPa
\sta	Status code	–
\#xe	End of checksum calculation	–
*	Checksum delimiter	–
\#xc	2-character checksum value Hexadecimal representation Calculated as an 8-bit XOR of all characters in the sentence between, but excluding, the delimiters $ and * (between the tags \#xs and \#xe).	See Checksum calculation, data message MSG3 (page 28)
\#cr\#lf	Carriage return and line feed	–

Example of RM60 data message MSG3

```
$0MSG31,34.12,0.00,0.00,21.34,0.00,0,0.0,1024.1,00000000*5F<CR><LF>
```

Table 25 Example of RM60 data message MSG3

Name	Data
Messaging address	0
Message and message version	MSG31
Precipitation accumulation	34.12
Precipitation intensity	0.00
Precipitation accumulation (differential)	0.00
Snow accumulation	21.34
Snow accumulation (differential)	0.00
Precipitation type	0
Reflectivity factor	0.0
Air pressure	1024.1
Status code	00000000
2-character checksum value	5F

Invalid values are expressed as a truncated value of -99.000... based on the formatting of the value field.

More information

- Reflectivity factor (page 18)
- Configuring data message MSG3 settings (page 36)

6.2.1 Checksum calculation, data message MSG3

Here is an example of the checksum calculation of data message MSG3.

```
The checksum is calculated over the message payload — the bytes
between the start character '$' and the separator '*' (exclusive).

Each byte of the payload is XOR-ed together to produce a single
byte, which is appended after '*' as two uppercase hexadecimal digits.

    checksum = 0
    for each byte in payload:
        checksum = checksum XOR byte
```

6.3 Modbus RTU protocol

The device supports the Modbus RTU protocol for measurement data and for configuring the device by using holding registers. Individual 16-bit registers follow the Modbus standard big-endian byte order for 16-bit values.

See also DMU801 Modbus RTU Sensor Integration Guide.

Function codes

The device supports the following function codes.

The function code is given in hexadecimal and decimal format.

Table 26 Function codes

Function code	Subcode	Function name
0x03 (03)	–	**Read Holding Registers**
0x10 (16)	–	**Write Multiple Registers**
0x2B (43)	0x0E (14)	**Read Device Identification**

Data addressing

The device provides 2 methods for easy register addressing.

Table 27 Data addressing

Method	Description	Value range
Register address	16-bit register address in hexadecimal and decimal formats	0x0000–0xFFFF (0–65535)
Register number	Register address in decimal format + 1	1–65536

Related to addressing in decimal format, check the reference documentation of your Modbus host to verify which notation is used:

- Register address in decimal format (0–65535)
- Register number (1–65536)

Data types

The following data types are used in the device.

Table 28 Data types

Data type	Description	Register coding
int16	16-bit signed integer value	Standard Modbus big-endian byte order

Data type	Description	Register coding
int32	32-bit signed integer value	Two 16-bit registers in little-endian word order
float	32-bit floating-point value. Binary32 encoding defined in IEEE 754, (single-precision floating point format).	Two 16-bit registers in little-endian word order
text	ASCII string in linear byte order	Standard Modbus big-endian byte order
register	Holding register address as 16-bit integer	Standard Modbus big-endian byte order
date	Date as 3 int16 values (YYYY, MM, and DD)	Standard Modbus big-endian byte order

Data formats

The examples show values as read from the Modbus communication test registers.

16-bit register big-endian byte order

16-bit register contains two 8-bit bytes. Big-endian byte order means that the most significant byte (MSB) is the first 8 bits in the register. For example, integer value -12345 is read from the holding register `0x1F00`. The value -12345 in hexadecimal form is `0xCFC7` and it splits into 2 bytes `0xCF` and `0xC7`.

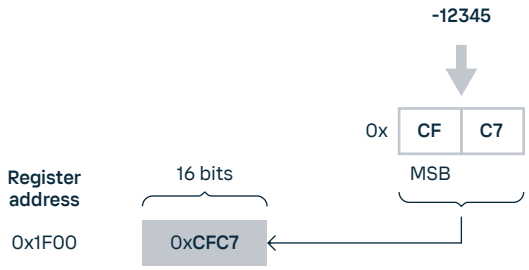


Figure 11 16-bit register big-endian byte order

32-bit value little-endian word order

32-bit value needs two 16-bit registers (2 words). Little-endian word order means that the least significant word (LSW) is in the first register and the most significant word (MSW) in the second register. Note that the 16-bit registers still follow big-endian byte order. For example, floating point value -123.45 is read from the holding register `0x1F01`. The value -123.45 in hexadecimal form is `0xC2F6E666` and it splits into 4 bytes `0xC2`, `0xF6`, `0xE6`, and `0x66`.

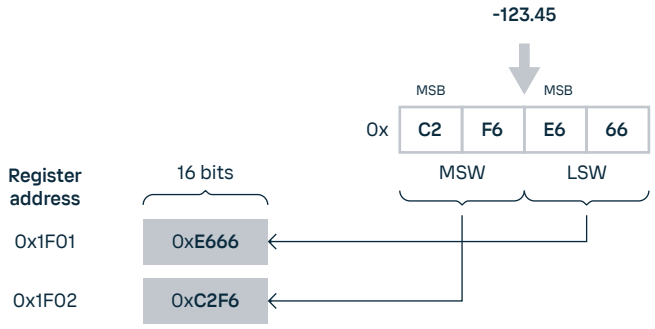


Figure 12 32-bit value little-endian word order

Text string

In the device, there are several fields that store text strings. The characters are packed into multiple 16-bit registers, 2 characters in each. For example, the text string -123.45 is read from the holding register `0x1F03`. The characters of the string -123.45 are respectively `0x2D`, `0x31`, `0x32`, `0x33`, `0x2E`, `0x34`, and `0x35`. Note that the least significant byte (LSB) of the last word is filled as NUL value `00`.

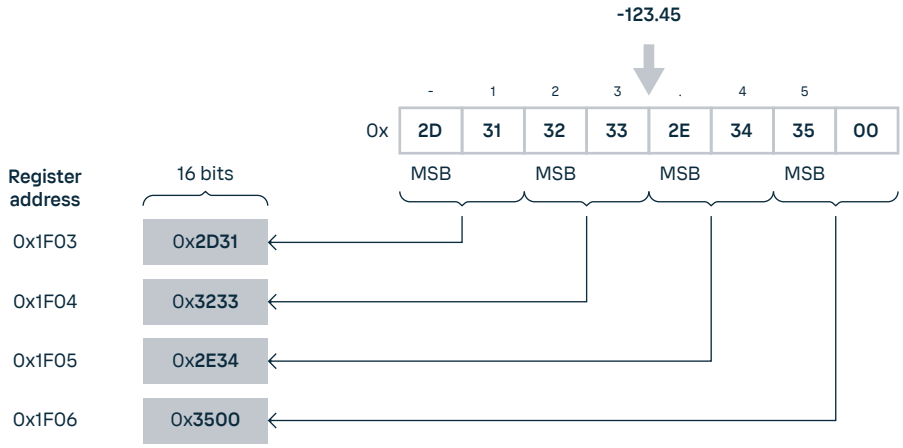


Figure 13 Text string

More information

- Modbus registers (page 68)

7. Configuration through Insight PC software

7.1 Vaisala Insight PC software

Vaisala Insight PC software is an application for connecting to and accessing your device.

With Insight you can:

- Configure the device.
- Update device firmware.
- View measurement data.
- View device information.

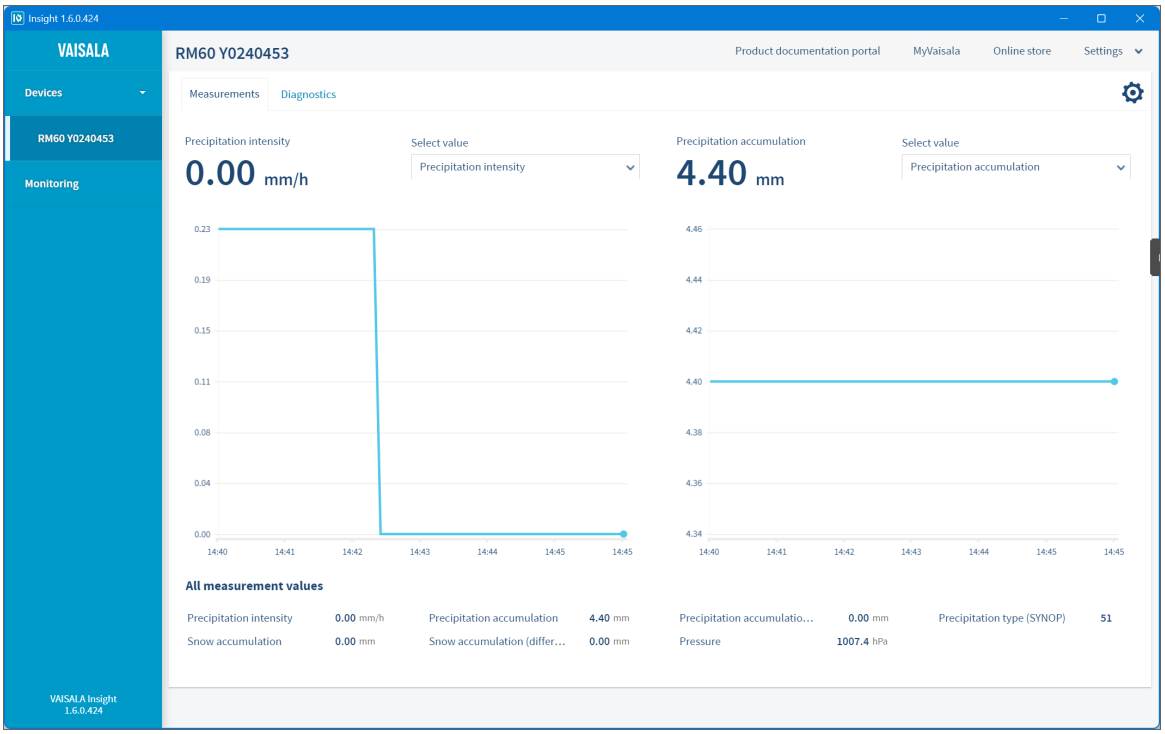


Figure 14 RM60 data on Insight

More information

- Connecting device to Insight (page 33)
- Configuring communication settings (page 36)
- Configuring precipitation measurement (page 40)

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7.2 Connecting device to Insight

- USB configuration cable set, including:
  - Service cable
  - USB adapter with USB-C connector
- Vaisala Insight PC software (download from vaisala.com/insight)
- Windows PC

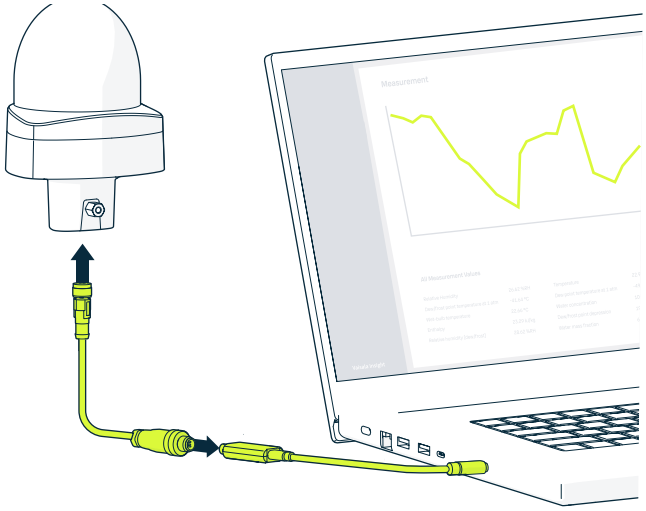


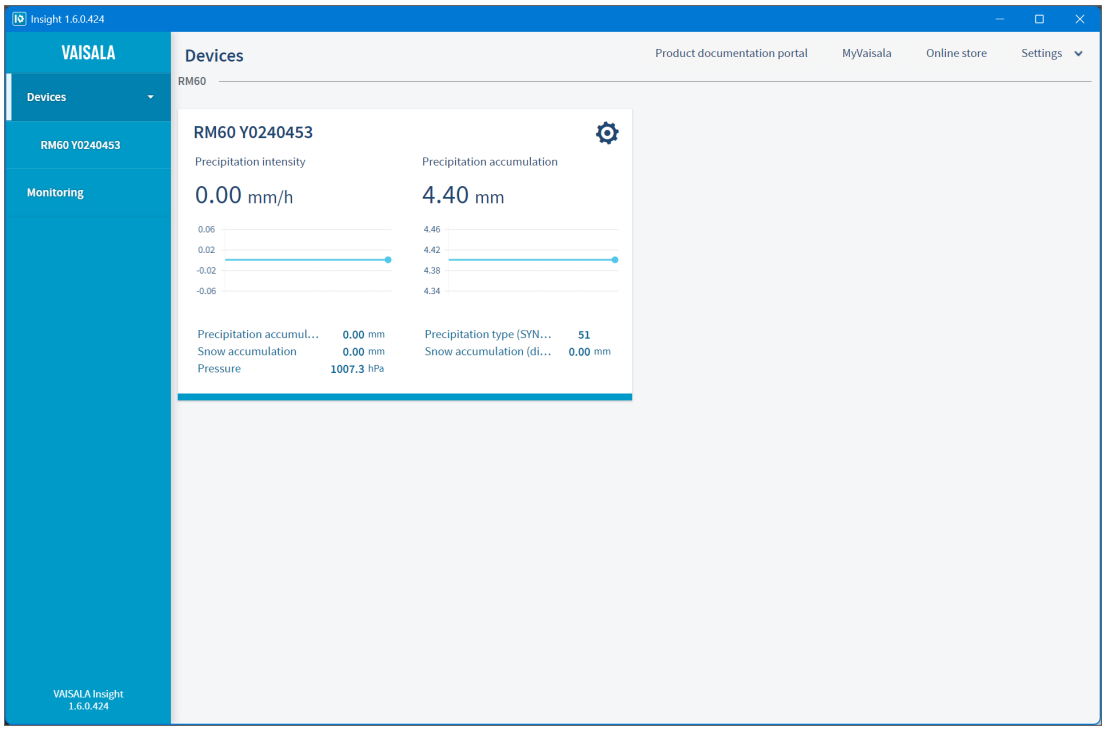
Figure 15 Connecting device to Insight

1. Start Insight PC software.
2. Connect the service cable to the USB adapter.
3. Connect the USB end of the cable to a free port on a Windows computer and the other end to the device.

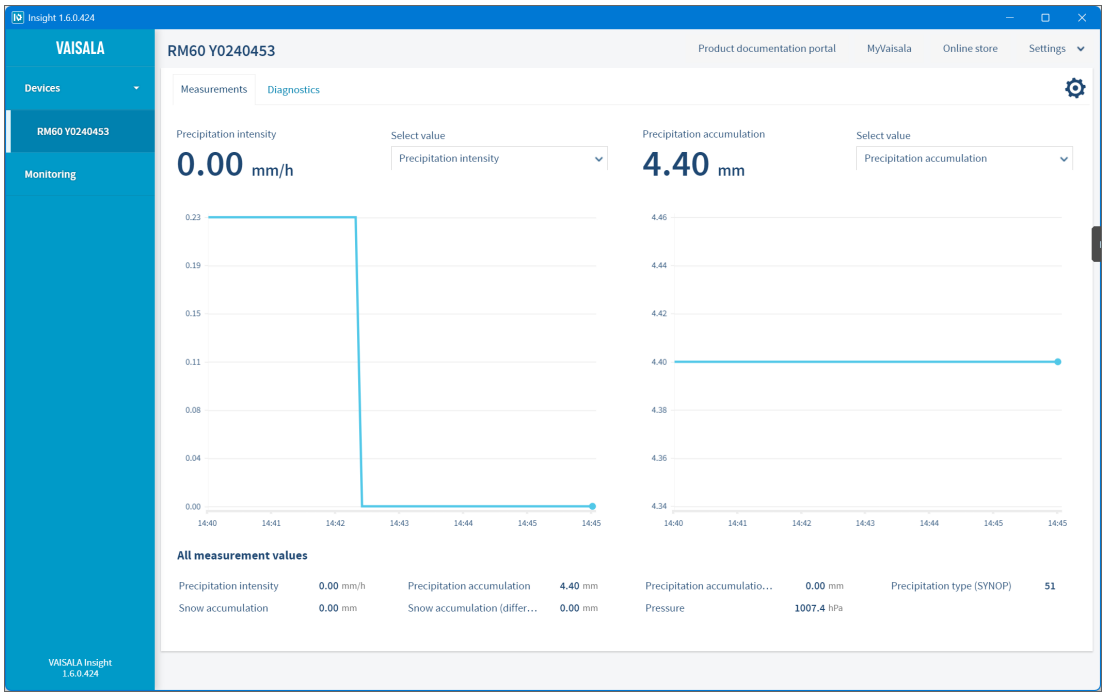
   The device LED is green for 15 minutes after device startup. After that, it blinks every 10 seconds.

4. Wait for Insight to recognize the device.

   Insight opens the **Devices** view, showing the device name and serial number.

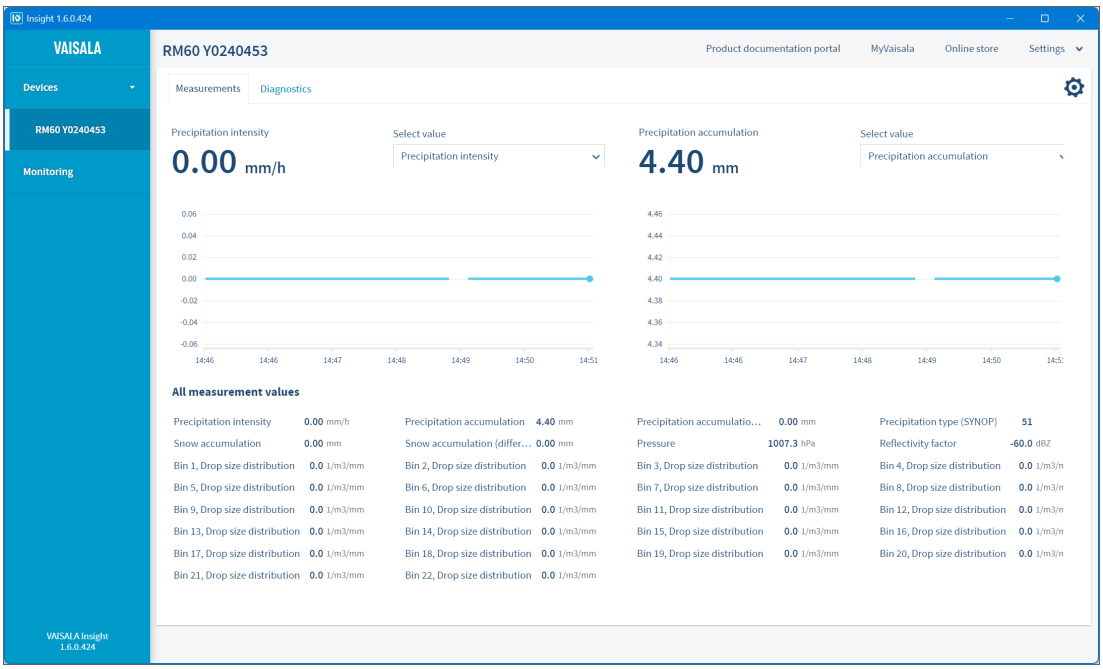


5. Select the device from the menu on the left.

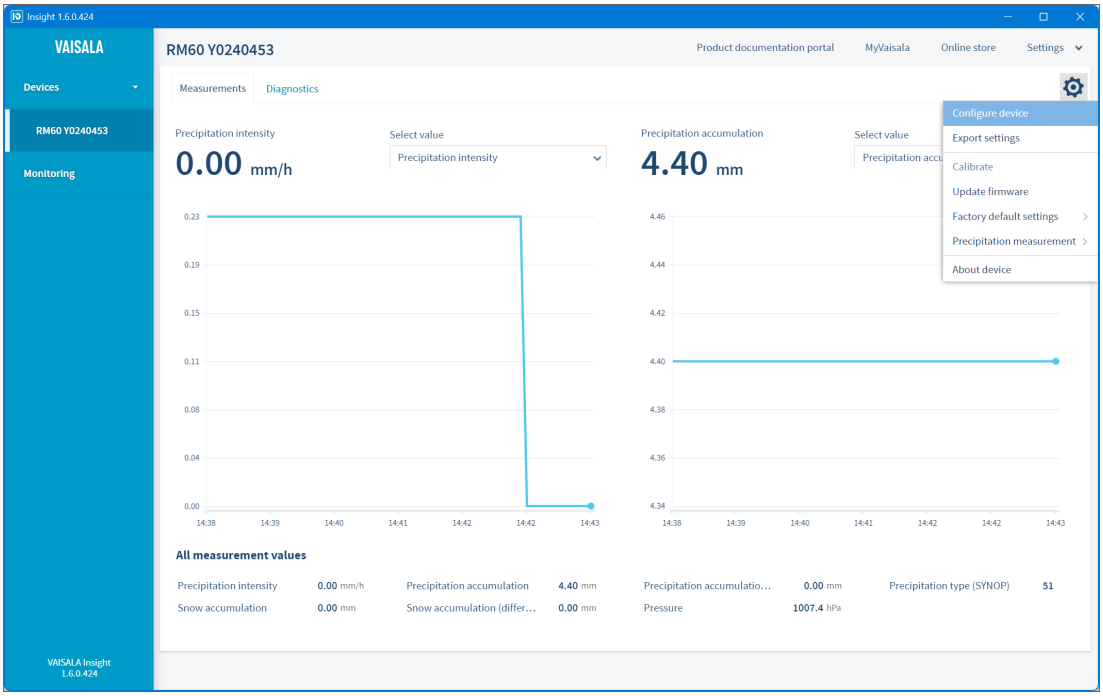


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6. To see more measurements, select **Settings > Advanced mode**.



7. Select the settings icon (⚙) and **Configure device**, and configure the communication settings and data output as needed.



If Insight does not recognize the device, try the following:

- Reboot the device by disconnecting and reconnecting the service cable.
- Check that the cables are properly connected and the cable connectors tightened.

- Download and install the USB instrument driver for cables from docs.vaisala.com and reboot the computer.
- Uninstall Insight and install it again.

7.3 Configuring communication settings

Configure the communication and data output for RM60 data message MSG3 or Modbus RTU.

More information

- Configuring data message MSG3 settings (page 36)
- Configuring Modbus settings (page 39)

7.3.1 Configuring data message MSG3 settings

- USB configuration cable set, including:
- PuTTY or other terminal program
- Vaisala Insight PC software (download from vaisala.com/insight)
- Windows PC

RM60 sends the data message MSG3 at defined intervals. Configure the communication settings, select the message type, and set the autosend interval.

1. Connect to the device. See Connecting device to Insight (page 33)
2. Select the settings icon (⚙) and **Configure device**.

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3. Select **Communication** and set the following:

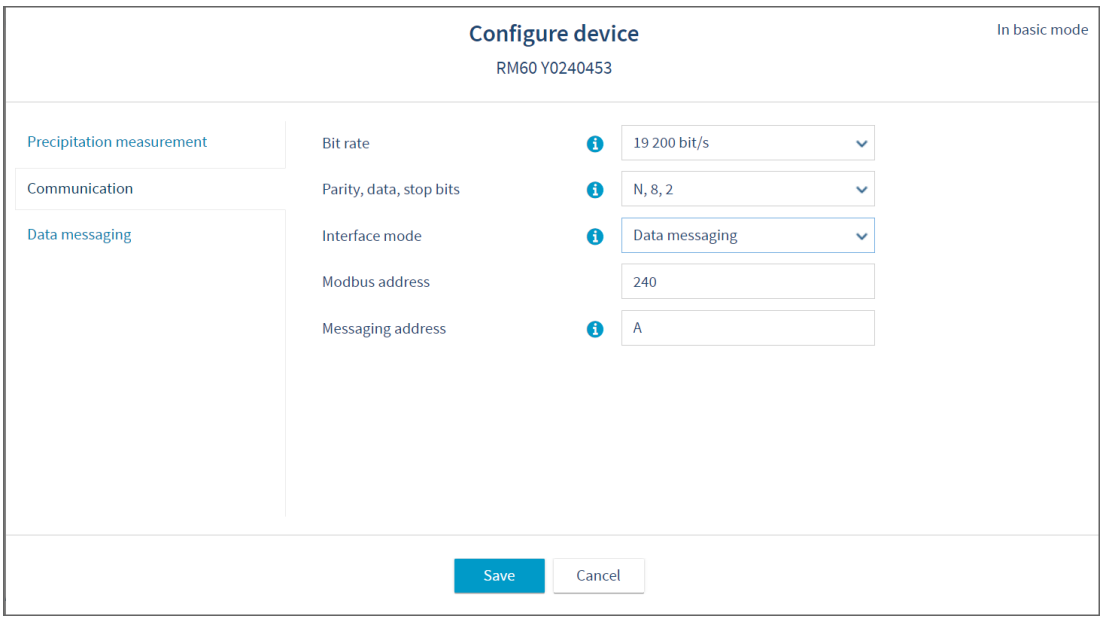
Bit rate
Select the bit rate.

Parity, data, stop bits
Select the parity, data, and stop bits.

Interface mode
Select **Data messaging**.

Modbus address
Leave as is.

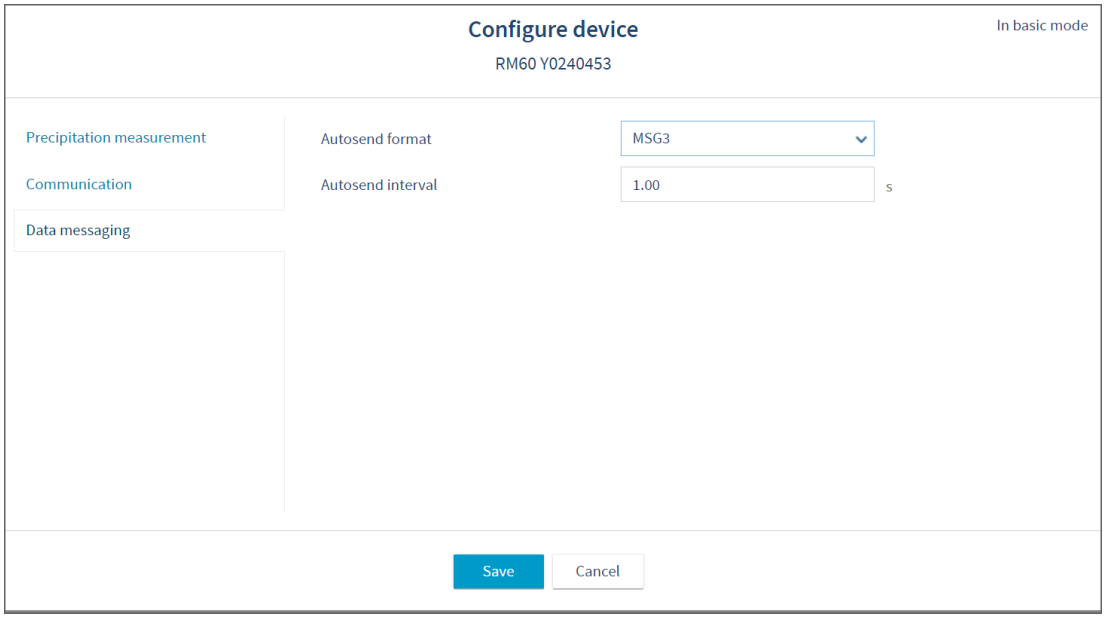
Messaging address
Use the default **0** or set a different messaging address.



4. To configure the interval at which the device sends data to your system, select **Data messaging** and set the following.

   Autosend format
   Select **MSG3**.

   Autosend interval
   Select the interval at which the device send data. The default is 60 seconds. The range is 0.25–600 seconds.



5. Select **Save**.
6. Close Insight and open a terminal software, such as PuTTY.

   The terminal software and Insight use the same COM port so make sure to have only one of them open at a time.
7. To power down the device and then power up again, disconnect the cable for 5 seconds.
8. Verify that the device starts sending data messages in the defined interval. If not, close the terminal software, open Insight, and restart the device.

To configure the measurement interval, see instructions about configuring precipitation measurements.

More information

- Default communication settings (page 26)
- Measurement interval and power consumption (page 18)
- RM60 data message MSG3 (page 26)
- Configuring precipitation measurement (page 40)
- Restarting device (page 53)

7.3.2 Configuring Modbus settings

1. Connect to the device. See Connecting device to Insight (page 33)
2. Select the settings icon (⚙) and **Configure device**.
3. Select **Communication**.
4. Select the interface mode and configure the following settings.

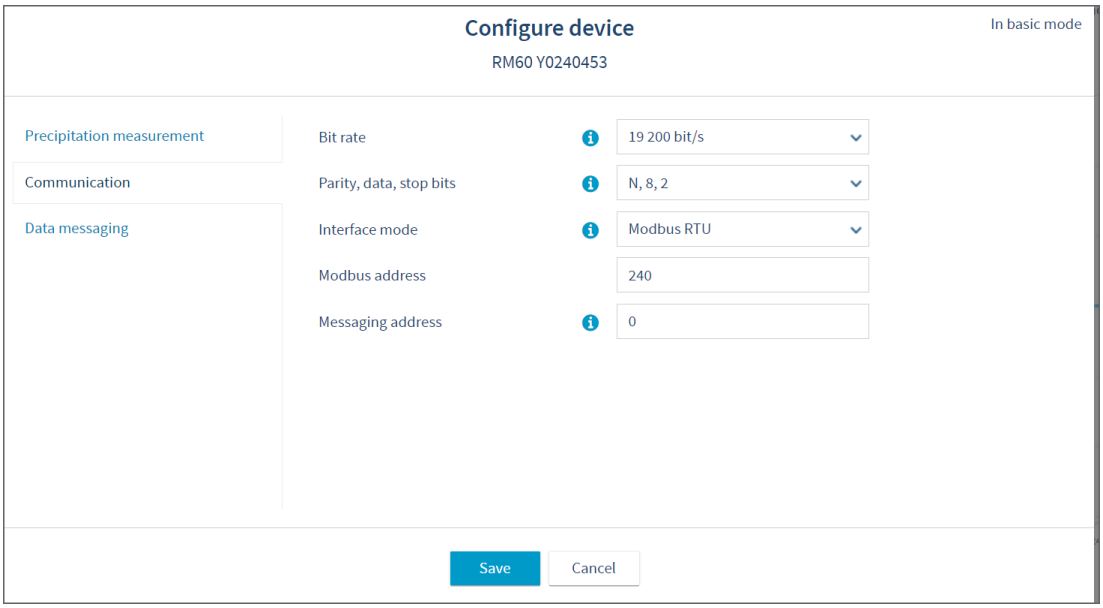
   Bit rate
   Select the bit rate.

   Parity, data, stop bits
   Select the parity, data, and stop bits.

   Interface mode
   Select **Modbus RTU**.

   Modbus address
   Type an address for the device. The default is **240**.

   Messaging address
   Leave as is.



5. Select **Save**.
6. Close Insight.
7. Connect the device to a Modbus client using the configured serial port settings.
8. To power down the device and then power up again, disconnect the cable for 5 seconds.
9. Verify device operation.

To troubleshoot, disconnect the device from the Modbus client and reconnect it to Insight and restart the device.

More information

- Modbus RTU protocol (page 29)
- Restarting device (page 53)
- Modbus registers (page 68)

7.4 Configuring precipitation measurement

1. Connect to the device. See Connecting device to Insight (page 33)
2. Select the settings icon (⚙) and **Configure device**.

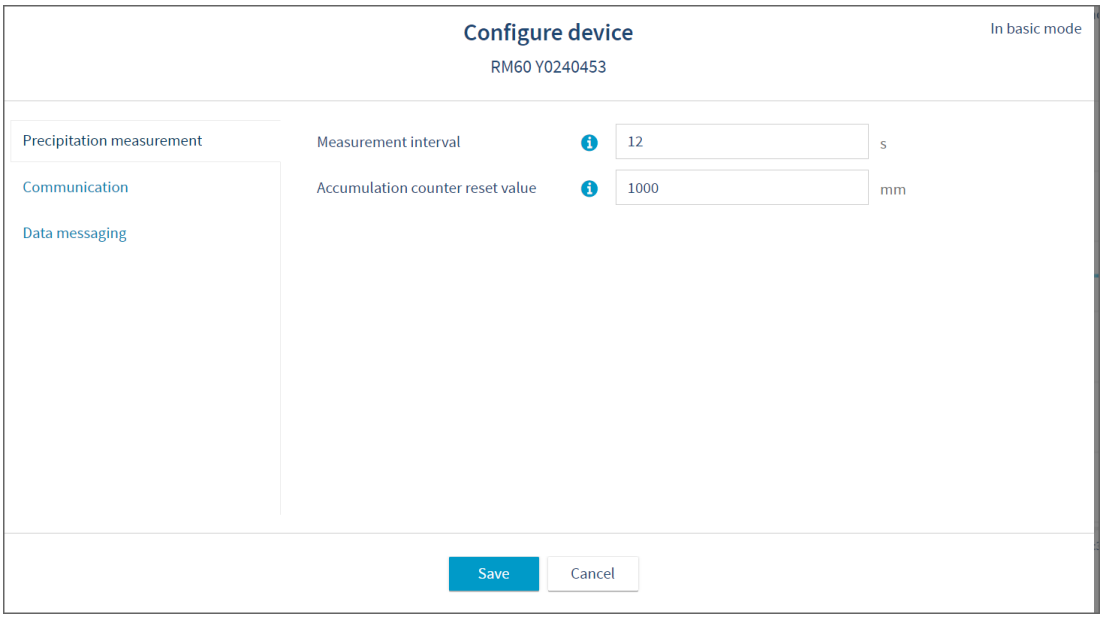
3. To configure the measurement interval, select **Precipitation measurement** and set the following:

   Measurement interval

   The default value is 12 seconds.
   The range is 12–600 seconds.
   When adjusting the measurement interval, take into account that:
   - The measurement interval affects the power consumption of the device. For details, see Measurement interval and power consumption (page 18).
   - A long measurement interval may affect data quality.

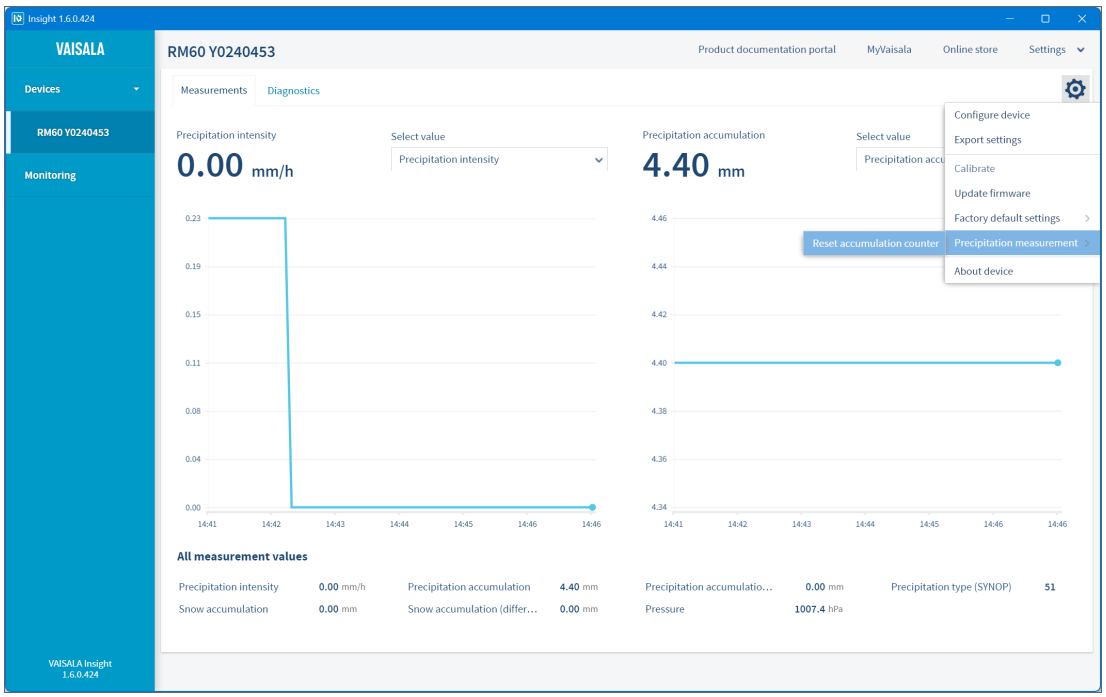
   Accumulation counter reset value

   The default value is 1000 mm.
   The range is 0–1000 mm.
   The setting is applied to precipitation accumulation and snow accumulation.
   When the accumulated precipitation reaches the configured limit, the precipitation accumulation is reset to 0 mm.



4. Select **Save**.

5. To manually reset the accumulated precipitation to 0 mm, select the settings icon ⚙ > **Precipitation measurement > Reset accumulation counter**.



To configure the data output interval, see instructions about configuring the RM60 data message MSG3.

More information

- Measurement interval and power consumption (page 18)
- Configuring data message MSG3 settings (page 36)

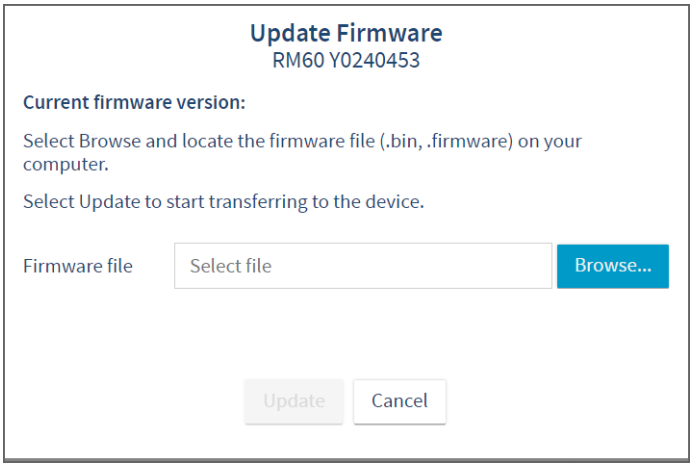
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8. Firmware update

8.1 Updating firmware

You can download the newest firmware version from docs.vaisala.com.

1. Create a connection to the device with Insight PC software.
2. To check the current firmware version, select **Devices**, select the device, and **Diagnostics**.
3. Select the settings icon (⚙) and select **Update firmware**.
4. Browse to the firmware file and follow the onscreen instructions.



   Insight shows the progress of the firmware update.
5. When the firmware update is complete, check the firmware version to verify that the firmware has been updated.
6. Verify operation.

9. Maintenance

RM60 does not require regular maintenance.

10. Troubleshooting

More information

- Troubleshooting procedure (page 45)
- Troubleshooting checklist (page 45)
- Troubleshooting RM60 (page 46)
- Device LED (page 47)
- Device status (page 48)
- Restarting device (page 53)
- Restoring factory settings (page 53)

10.1 Troubleshooting procedure

If the product does not work as it should, go through this troubleshooting procedure.

1. Depending on the problem, do one of the following.
   - Data messages are coming through, but the measurement values are invalid. Check the device status. See Checking device status (page 49).
   - Data messages are not coming through: Continue with the next step. If the device is part of a larger system, check the troubleshooting information of that system first.
2. If you cannot connect to the device, check the operation of the communication devices at the host system.
3. Check the power supply.
4. Check the device cable and connector.
5. Check the communication and message settings.
6. Restart the device. See Restarting device (page 53).
7. Restore the default factory settings. See Restoring factory settings (page 53).
8. If the failure persists, contact Vaisala technical support.

10.2 Troubleshooting checklist

When troubleshooting, check the questions listed in Technical support (page 66) before contacting Vaisala technical support.

10.3 Troubleshooting RM60

Table 29 Troubleshooting RM60

Problem	Probable cause	Actions
Device LED not on although device is powered through USB.	When the terminal software is open, Windows does not provide power to the device and the device LED is off.	Close terminal software.
Serial data output is distorted.	D+ and D- wires are the wrong way around.	Correct the wiring. See the wiring instructions in RM60 Setup Guide (M213217EN).
	Wrong serial communication settings.	Check the settings. See Configuring communication settings (page 36).
	Several devices on the same bus.	Use only 1 device on the bus or use Modbus RTU.
	A long device cable with no termination is in use.	Terminate the serial line.
No autosend data output.	Incorrect interface mode or data message type.	Select the correct interface mode (data messaging), and the correct message type in Insight. See Configuring data message MSG3 settings (page 36) or Modbus registers (page 68) for details.
	The device is not getting power.	Check the powering.
	The wires are connected incorrectly or not connected.	Correct the wiring. See the wiring instructions in RM60 Setup Guide (M213217EN).
No Modbus response.	Incorrect communication settings.	Check the settings. See Configuring communication settings (page 36).
	Incorrect Modbus address in use.	Try using the default Modbus address 240 or select the correct Modbus address to use in Insight.
	Various.	Check the probable causes and actions for *Serial data output is garbled* in this table.
Measurement values are not as expected.	Installation site is not representative of precipitation conditions.	Check the site requirements. See RM60 Setup Guide (M213217EN).
	External disturbances near the device.	Check the site and remove disturbances or move the device location. See RM60 Setup Guide (M213217EN).
	Measurement averaging periods not as expected.	Check the precipitation measurement settings.

Problem	Probable cause	Actions
Measurement values are marked as invalid.	External disturbances on the device.	Check the site and remove disturbances or move the device location. See site requirements. See RM60 Setup Guide (M213217EN).
	Device is starting up.	Wait for the startup to finish.
Unable to connect to device due to forgotten serial communication settings.	Serial communication settings lost.	Connect to the device with Insight using the USB configuration set, see Connecting device to Insight (page 33). The device remains connected to Insight when you establish the connection within 5 seconds of device power-up. Adjust the communication settings or, if needed, restore the factory settings (see Restoring factory settings (page 53)).
Unable to connect through Insight software.	Driver for the cable and adapter is missing.	Download and install the USB instrument driver for cables from www.vaisala.com/insight.
	PC unable to recognize device.	Connect cables and open Insight before connecting power or restart device. See Connecting device to Insight (page 33) .
Unable to receive data messages with terminal software.	COM port in use by Insight.	Close Insight.
	Wrong serial communication settings.	Check the settings. See Configuring communication settings (page 36).

10.4 Device LED

RM60 has a LED for communicating about the device operation.

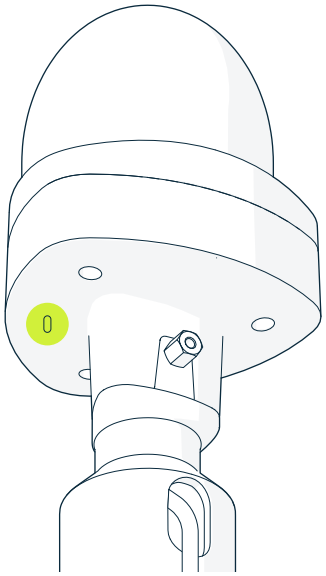


Figure 16 Device LED on RM60

Table 30 Device LED

LED	Description
Green, static	On for 15 minutes after device startup. Device powered and operating.
Green, blinking	Blinks every 10 seconds. Device powered and operating.

10.5 Device status

RM60 monitors itself on a continuous basis. Diagnostics results are output in status field of the ASCII data message and as Modbus register values. The following status categories are in use:

- Device
  - Operating voltage
  - Precipitation measurement

The device status is a high-level status that is triggered based on the lower-level statuses.

Table 31 Device status

Description	Severity	
Device is ok.	None	`0`
Device or system may need maintenance.	Warning	`W`

The device status is **W** when any of the following lower-level statuses have a value other than **0**.

Table 32 Operating voltage status

Description	Operating voltage status		Device status
Operating voltage is OK.	None	0	0
Operating voltage is too low.	Under range	U	W
Operating voltage is too high.	Over range	O	W

Table 33 Precipitation measurement status

Description	Precipitation measurement status		Device status
Measurement is OK.	None	0	0
Missing precipitation intensity sample value.	Unavailable	S	W
Missing internal temperature or air pressure value.	Unreliable	R	W
Device is out of valid autocalibration range. Check that the installation is according to the site requirements (see RM60 Setup Guide (M213217EN)). The device autocalibrates during rain events.	Calibration expired	C	W

10.5.1 Checking device status

1. Check the status with one of the following depending on your communication and message options.

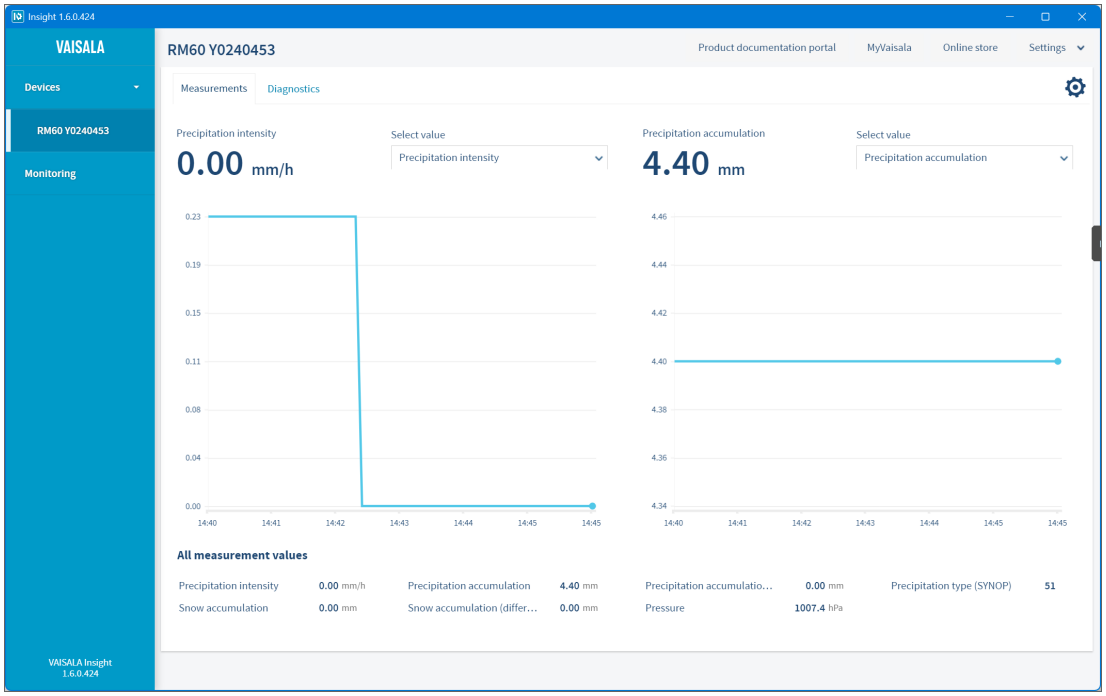
   Table 34 Checking device status

Interface	Device status and diagnostics data
Insight software	See Checking device status with Insight (page 50) for instructions.
Data message (ASCII)	Status code in data message MSG3 (**00000000** = OK). • Character 1: overall device status • Character 2: quality of operating voltage • Character 8: quality of precipitation measurement For example, **00000000** for OK. For details, see RM60 data message MSG3 (page 26) and Device status (page 48).
Modbus RTU	See the status information registers at Modbus registers (page 68). For an explanation of the status coding in Modbus, see Device status in Modbus (page 51).

10.5.2 Checking device status with Insight

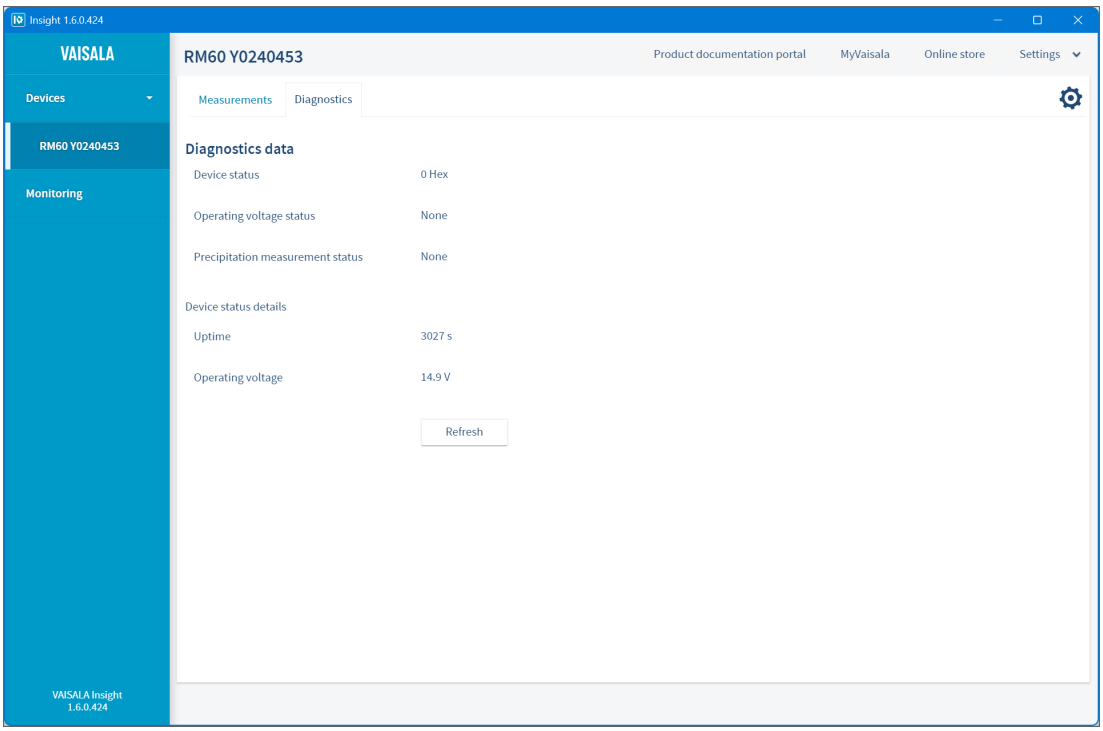
- USB configuration cable set, including:
  - Service cable
  - USB adapter with USB-C connector
- Windows PC
- Vaisala Insight PC software (download from docs.vaisala.com)

1. Connect to the device. See Connecting device to Insight (page 33)
2. Select **Devices**, select the device, and **Diagnostics**.



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3. Check **Device status**.



The following values are used.

Device status	Description
0 Hex	Device is ok.
4 Hex	Device or system may need maintenance. See Device status (page 48).

4. To see updated device status after corrective actions, select **Refresh**.
5. To see more detailed information about the device status, select **Settings > Advanced mode** and select **Refresh**.
6. To check the device data, select **Monitoring**.

   Monitoring provides options for monitoring and recording selected parameters, and exporting the monitoring data as a CSV (comma-separated values) file.

10.5.3 Device status in Modbus

RM60 applies the following coding in the Modbus bit field to represent the device status.

More than one bit can be set at a time.

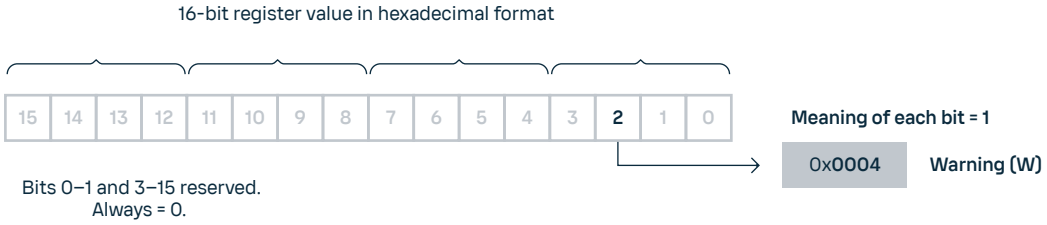


Figure 17 Device status coding in Modbus bit field

Table 35 Device status coding in Modbus bit field

Severity	Register value (hexadecimal)	Register value (bits)
Warning (W)	0x0004	`0000000000000100` (bit 2 = 1)

Bits 0–1 and 3–15 are reserved.

RM60 applies the following coding in the Modbus bit field to represent the measurement and operating voltage status.

More than one bit can be set at a time.

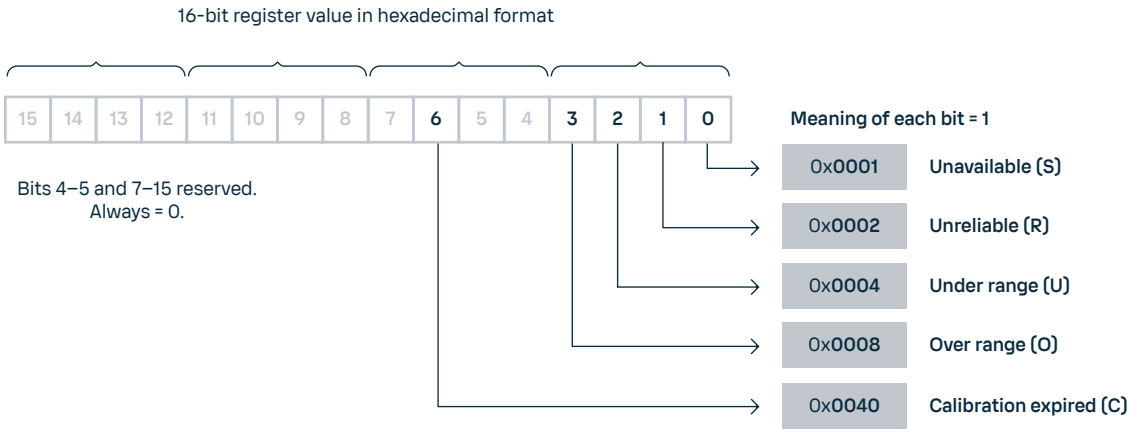


Figure 18 Measurement and operating voltage status coding in Modbus bit field

Table 36 Measurement and operating voltage status coding in Modbus bit field

Severity	Register value (hexadecimal)	Register value (bits)
None (OK)	0x0000	`0000000000000000` (all bits = 0)
Unavailable (S)	0x0001	`0000000000000001` (bit 0 = 1)
Unreliable (R)	0x0002	`0000000000000010` (bit 1 = 1)

Severity	Register value (hexadecimal)	Register value (bits)
Under range (U)	0x0004	`0000000000000100` (bit 2 = 1)
Over range (O)	0x0008	`0000000000001000` (bit 3 = 1)
Calibration expired (C)	0x0040	`0000000001000000` (bit 6 = 1)

Bits 4–5 and 7–15 are reserved.

10.6 Restarting device

You can restart the device by disconnecting power or through Vaisala Insight PC software or Modbus (register 0x0600).

A restart is needed after configuring the communication settings whether through Insight or Modbus.

1. Create a connection to the device with Insight PC software.
2. Select the settings icon (⚙) and **Restart device**.

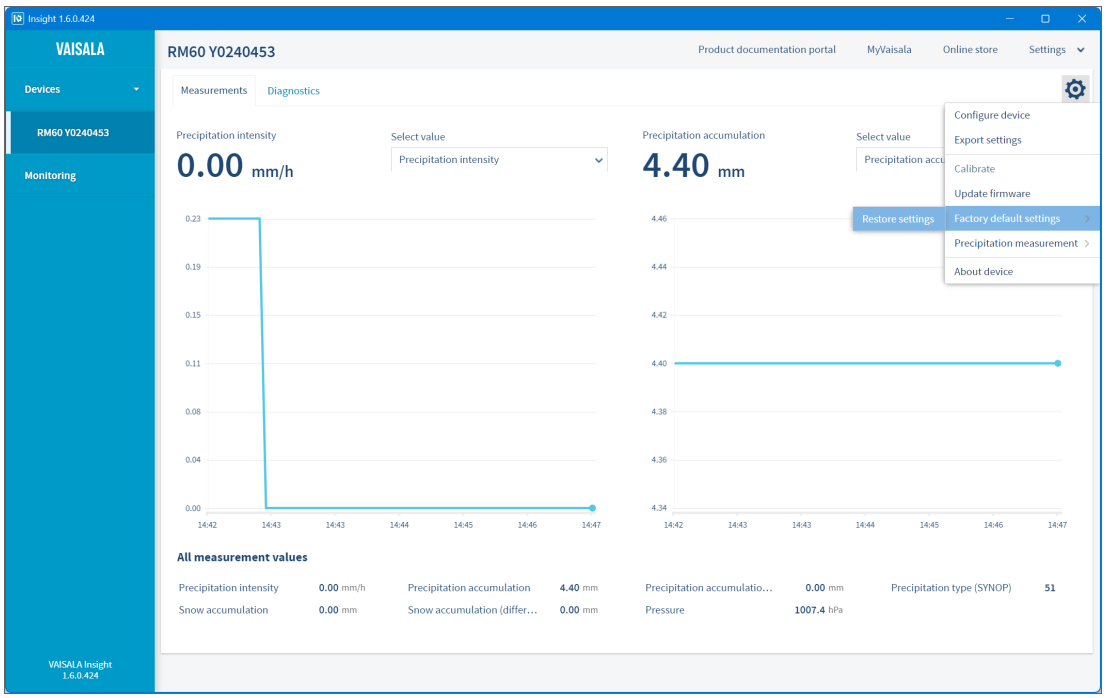
   After a restart, wait for 5 s before connecting to the device because after restart the device uses the default settings before loading the configured settings.
3. Verify device operation.

10.7 Restoring factory settings

You can restore the default factory settings through Vaisala Insight PC software or Modbus (register 0x1e00).

1. Create a connection to the device with Insight PC software.

2. Select the settings icon (⚙) and **Factory default settings > Restore settings**



This starts the factory reset. The process takes a couple of seconds.

3. Verify device operation.

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11. Repairs

11.1 Spare parts

WARNING! Electricity hazard
Incorrect electrical installation can cause serious injury or death. Only licensed experts may install electrical components.

CAUTION! Using components that do not meet Vaisala specifications can result in injury or damage the product. Use only accessories and spare parts that meet the specifications.

CAUTION! Modification of the product can result in injury or damage the product. Do not modify the product or substitute parts unless instructed to do so. Improper modification voids your warranty.

The device has no moving or consumable parts.

If you suspect a device failure, contact Vaisala technical support.

If you need a replacement mounting adapter or cable, order them as spare parts.

Table 37 Spare parts

Spare part	Order code
Shielded 2-m cable, 8-pin, M12 connector on one end	CBL211623-2M
Shielded 5-m cable, 8-pin, M12 connector on one end	223283
Shielded 10-m cable, 8-pin, M12 connector on one end	220497
Mounting adapter for 40 × 40 mm support arm	SENSORARMFIX30
Mounting adapter for 30-to-30-mm pole mast	ASM216503
Mounting adapter for 30-to-60-mm pole mast	ASM216504

More information

- Replacing device (page 56)
- Replacing cable (page 58)
- Replacing mounting adapter (page 60)

11.2 Replacing device

- 10-mm wrench



Wear personal protective equipment (PPE).

CAUTION! If you remove the device and do not mount a replacement device right away, protect the cable connector from the environment.

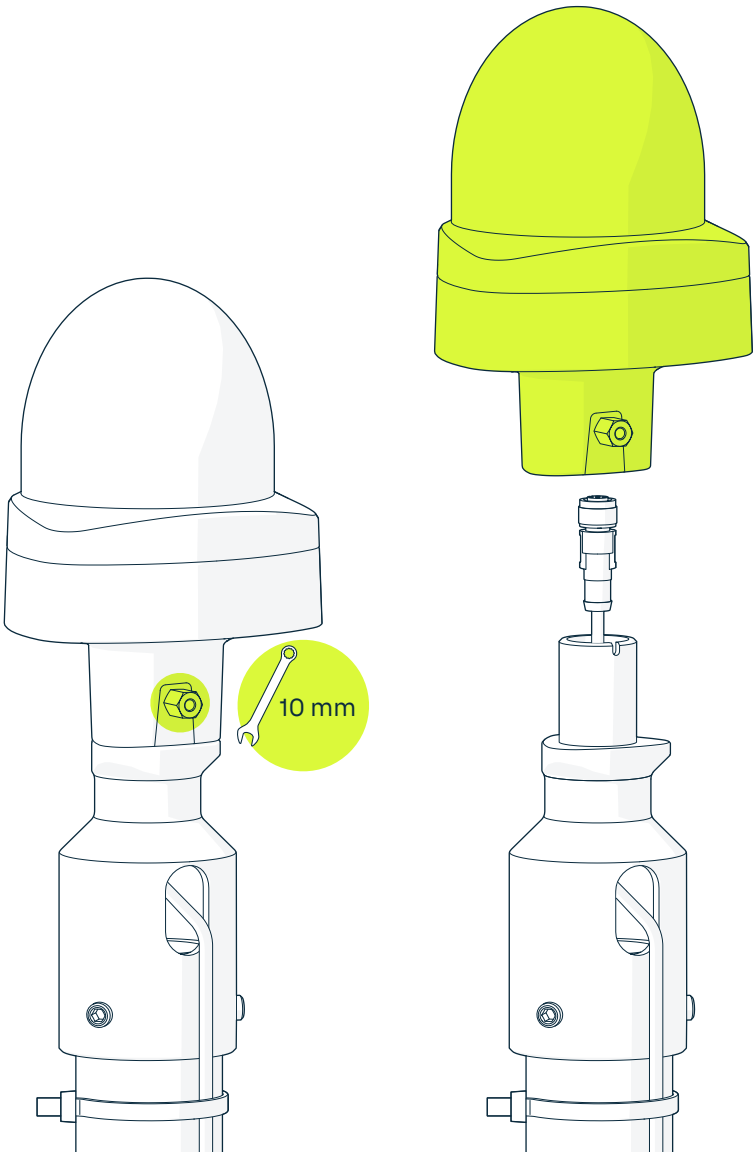


Figure 19 Replacing device

1. Switch off power supply to the device.
   Make sure that there is no power available for the system.
2. Loosen the screw that tightens the device to the mounting adapter.
3. Lift the device up and disconnect the device cable from the device.
4. Install the new device as instructed in RM60 Setup Guide (M213217EN).
5. Recycle the old device according to the recycling instructions.

11.3 Replacing cable

- 10-mm wrench



Wear personal protective equipment (PPE).

Make sure that you have the replacement spare part available.

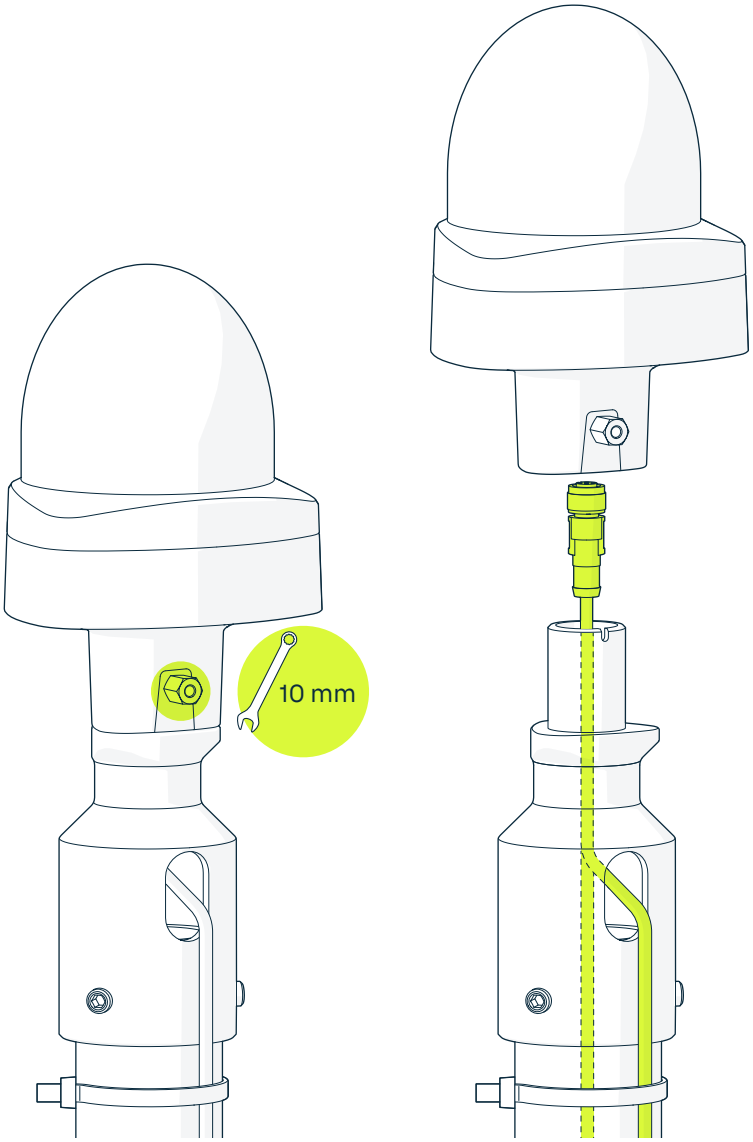


Figure 20 Replacing cable

1. Switch off power supply to the device.
   Make sure that there is no power available for the system.
2. Loosen the screw that tightens the device to the mounting adapter.
3. Lift the device up and disconnect the device cable from the device.
4. Disconnect the device cable from your system and remove the cable.
5. Route the replacement cable through the mounting adapter.
6. Install and wire the device as instructed in RM60 Setup Guide (M213217EN).
7. Recycle the old cable according to the recycling instructions.

11.4 Replacing mounting adapter

- 4-mm Allen key
- 10-mm wrench



Wear personal protective equipment (PPE).

Make sure that you have the replacement spare part available.

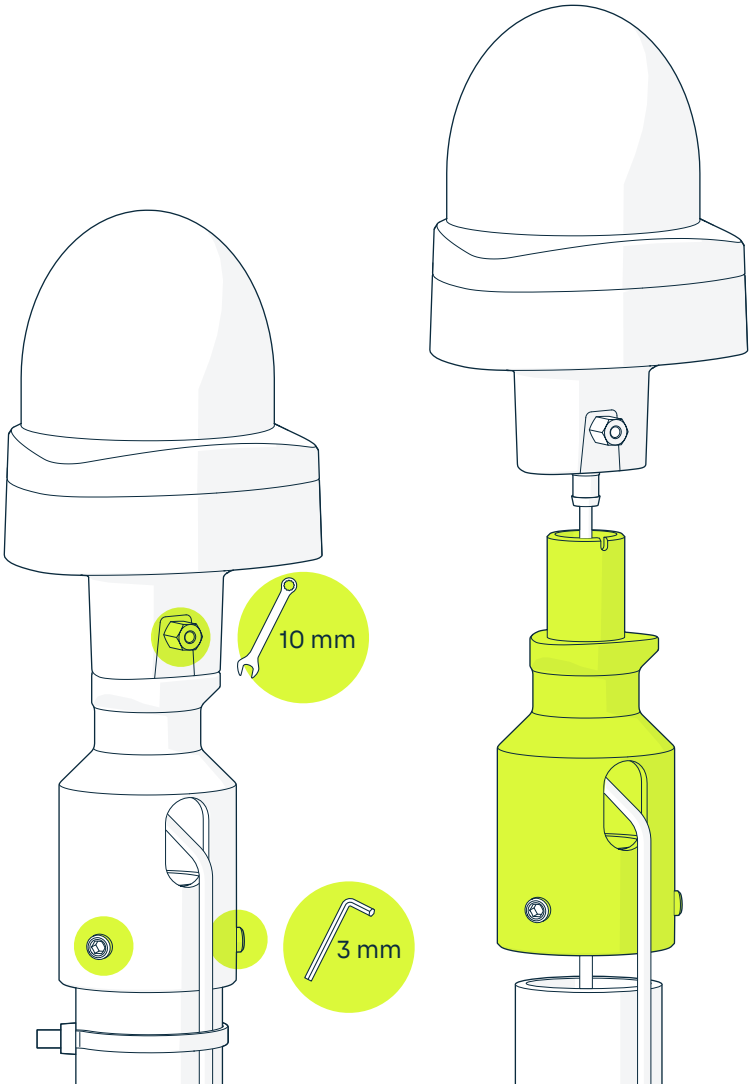


Figure 21 Replacing mounting adapter

1. Switch off power supply to the device.

   Make sure that there is no power available for the system.
2. Loosen the screw that tightens the device to the mounting adapter.
3. Loosen the screws that tighten the mounting adapter to the pole.
4. Align and install the new mounting adapter and the device as instructed in RM60 Setup Guide (M213217EN).
5. Recycle the old mounting adapter according to the recycling instructions.

12. Technical data

12.1 RM60 specifications

Table 38 Precipitation measurement performance

Property	Description/Value
Precipitation intensity	
Reporting range	0.00–999.99 mm/h (0.00–40 in/h) liquid water equivalent (LWE)
Reporting resolution	0.01 mm/h (0.0004 in/h)
Minimum intensity	0.02 mm/h (0.0008 in/h)
Precipitation accumulation	
Reporting range	0–999.99 mm (0–40 in) liquid water accumulation (LWA)
Reporting resolution	0.01 mm (0.0004 in)
Accuracy [1)]	2 %
Precipitation type [2)]	
Type identification	Precipitation, drizzle, rain, snow, hail Light, moderate, and heavy intensities 19 different SYNOP codes reported
Additional precipitation reporting	
Drop size distribution	22 size classes
Drop size measuring range	From Ø 0.2 to > 5.5 mm (from Ø 0.008 to 0.22 in)
Reflectivity factor	Reported in units of dBZ

1) *In laboratory conditions.*
2) *Based on WMO 4680 (SYNOP) codes.*

Table 39 Air pressure measurement performance

Property	Description/Value
Reporting range	500–1100 hPa
Uncertainty	±0.5 hPa at adjustment point (NTP) [1)]
Resolution	0.1 hPa

1) *Normal temperature and pressure*

Table 40 Precipitation measurement specifications

Property	Description/Value
Operating principle	Doppler radar
Operating frequency	61.0–61.5 GHz
Mean equivalent isotropic radiated power (EIRP)	< 20 dBm
Measurement area	700 cm^2
Precipitation measurement interval	User configurable

Table 41 Operating environment

Property	Description/Value
Operating environment	Outdoor use
Use in wet location	Yes
Operating temperature	−40 … +60 °C (−40 … +140 °F)
Operating humidity	0–100 %RH
Maximum operating wind speed	75 m/s (168 mph)
Maximum operating altitude	5600 m (approx. 18 300 ft)
Pollution degree	4
IP rating	IP66: Dust-tight. Protected from powerful water jets from any direction.
Storage temperature	−60 … +70 °C (−76 … +158 °F)
Storage humidity	0–100 %RH, non-condensing

Table 42 Powering

Property	Description/Value
Operating voltage	24 V DC nominal 9–32 V DC absolute range
Power consumption, maximum	2.9 W
Power consumption, average [1)]	0.5–1.3 W
Overvoltage category	CAT I

1) Depending on the measurement interval.

Table 43 Data communication

Property	Description/Value
Serial communication	RS-485

Property	Description/Value
Communication protocols	• Data messages (ASCII) • Modbus RTU
Data output interval	User configurable
Configuration interface	Vaisala Insight PC software

Table 44 Compliance

Property	Description/Value
EU directives and regulations	Radio Equipment Directive, RED (2014/53/EU) as amended by 2022/30 RoHS Directive (2011/65/EU) as amended by 2015/863
Electromagnetic compatibility (EMC)	IEC/EN 61326-1, industrial environment EN 301 489-1, EN 301 489-3
Radio compatibility	ETSI EN 305 550-1 ETSI EN 305 550-2
Radio acceptance	FCC ID: 2AO39-RM60 IC: 23830-RM60
Safety	IEC/EN/AS/UL/CSA-C22.2 61010-1
Compliance marks	CE, FCC (pending), ICES (pending), RCM, R-NZ (pending)

Table 45 Environmental compliance

Test	Applied standard or test procedure	Specification
Cold	IEC 60068-2-1	−40 °C (−40 °F)
Dry heat	IEC 60068-2-2	+60 °C (+140 °F)
Vibration (sinusoidal)	IEC 60068-2-6	Frequency range 5–200 Hz ±3 mm, 5–9 Hz 1 g, 9–200 Hz
Low air pressure	IEC 60068-2-13	5600 m (approx. 18 300 ft)
Change of temperature	IEC 60068-2-14	−40 ... +60 °C (−40 ... +140 °F) 2 cycles
Shock	IEC 60068-2-27	10 g, pulse duration 11 ms with 100 pulses in each direction
Damp heat, cyclic	IEC 60068-2-30	+55 °C (+131 °F), 93 %RH
Rough handling	IEC 60068-2-31	Drop height 120 cm (47.24 in)
Damp heat	IEC 60068-2-78	+40 °C (+104 °F), 93 %RH

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Test	Applied standard or test procedure	Specification
Corrosion and salt mist	VDA 621-415 DIN ISO 11997-1	–

Table 46 Mechanical specifications

Property	Description/Value
Dimensions (H × W × L)	180 × 123 × 123 mm (7.09 × 4.84 × 4.84 in)
Weight	0.9 kg (2 lb)
Connector	M12 8-pin male
Materials	Polycarbonate + glass fiber, polyethylene
Color	White

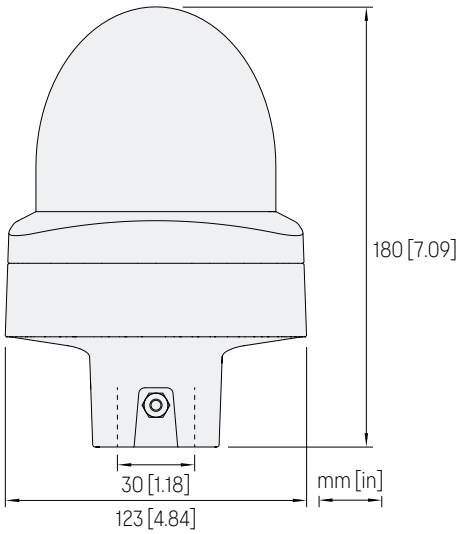


Figure 22 RM60 dimensions

13. Vaisala services

13.1 Service centers

Vaisala offers comprehensive customer care throughout the life cycle of our products. Our service centers offer maintenance, calibration, upgrade, and repair services. All the services are provided worldwide with fast deliveries. For more information, go to vaisala.com/services.

The services are available from:

- Vaisala Online Store, store.vaisala.com
- Vaisala Services, helpdesk@vaisala.com

The provided services vary product by product.

13.2 Technical support



You can contact Vaisala technical support at vaisala.my.site.com/myvaisala or helpdesk@vaisala.com. You can find all our support channels at vaisala.com/support.
When contacting technical support, provide the following 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
- Diagnostics package for the application

If applicable, also provide the following details:

- What failed (what worked / did not work)?
- Where did it fail (location and environment)?
- When did it fail (date, immediately / after a while / periodically / randomly)?
- How many failed (only one defect / other same or similar defects / several failures in one unit)?
- What was done when the failure was noticed?
- What was connected to the product and to which connectors?
- What is the input power source type, voltage, and what else (such as lighting, heaters, and motors) was connected to the same power output?
- Are all parts connected and grounded properly? Take a photo to help the troubleshooting.

13.3 Warranty

For warranty terms and conditions and the warranty claim process, see vaisala.com/warranty.

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Note that warranty coverage may not apply if the product is damaged due to normal wear and tear, exceptional operating conditions, negligent handling or installation, or unauthorized modifications. See the applicable supply contract or Conditions of Sale for details of the warranty for each product.

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Appendix A. Modbus registers

The register addresses are read only (R) or read/write (RW).

Register address and register number are defined as follows.

Table 47 Data addressing

Method	Description	Value range
Register address	16-bit register address in hexadecimal and decimal formats.	0x0000–0xFFFF (0-65535)
Register number	Register address in decimal format + 1	1–65536

Table 48 Measurement data 1 (read only)

Register address	Register number	Name	Data type	Unit	Description
0x0020 (32)	33	Air pressure	float	hPa	–
0x0022 (34)	35	Precipitation intensity	float	mm/h	–
0x0024 (36)	37	Precipitation accumulation	float	mm	The value keeps accumulating until it is reset.
0x0026 (38)	39	Precipitation accumulation (differential)	float	mm	The value keeps accumulating until it is read or reset.
0x002a (42)	43	Precipitation type	float	–	SYNOP code. See RM60 SYNOP codes (page 16).
0x002c (44)	45	Snow accumulation	float	mm	The value keeps accumulating until it is reset.
0x002e (46)	47	Snow accumulation (differential)	float	mm	The value keeps accumulating until it is read or reset.

Table 49 Measurement data 2 (read only)

Register address	Register number	Name	Data type	Description
0x8800 (34816)	34817	Autocalibration	int16	Autocalibration status • 0 = Up to date • 1 = In progress
0x8801 (34817)	34818	Reflectivity factor	float	dBZ
0x8803 (34819)	34820	DSD bin 1	float	$m^{-3}\,mm^{-1}$
0x8805 (34821)	34822	DSD bin 2	float	$m^{-3}\,mm^{-1}$

Register address	Register number	Name	Data type	Description
0x8807 (34823)	34824	DSD bin 3	float	$m^{-3}\,mm^{-1}$
0x8809 (34825)	34826	DSD bin 4	float	$m^{-3}\,mm^{-1}$
0x880b (34827)	34828	DSD bin 5	float	$m^{-3}\,mm^{-1}$
0x880d (34829)	34830	DSD bin 6	float	$m^{-3}\,mm^{-1}$
0x880f (34831)	34832	DSD bin 7	float	$m^{-3}\,mm^{-1}$
0x8811 (34833)	34834	DSD bin 8	float	$m^{-3}\,mm^{-1}$
0x8813 (34835)	34836	DSD bin 9	float	$m^{-3}\,mm^{-1}$
0x8815 (34837)	34838	DSD bin 10	float	$m^{-3}\,mm^{-1}$
0x8817 (34839)	34840	DSD bin 11	float	$m^{-3}\,mm^{-1}$
0x8819 (34841)	34842	DSD bin 12	float	$m^{-3}\,mm^{-1}$
0x881b (34843)	34844	DSD bin 13	float	$m^{-3}\,mm^{-1}$
0x881d (34845)	34846	DSD bin 14	float	$m^{-3}\,mm^{-1}$
0x881f (34847)	34848	DSD bin 15	float	$m^{-3}\,mm^{-1}$
0x8821 (34849)	34850	DSD bin 16	float	$m^{-3}\,mm^{-1}$
0x8823 (34851)	34852	DSD bin 17	float	$m^{-3}\,mm^{-1}$
0x8825 (34853)	34854	DSD bin 18	float	$m^{-3}\,mm^{-1}$
0x8827 (34855)	34856	DSD bin 19	float	$m^{-3}\,mm^{-1}$
0x8829 (34857)	34858	DSD bin 20	float	$m^{-3}\,mm^{-1}$
0x882b (34859)	34860	DSD bin 21	float	$m^{-3}\,mm^{-1}$
0x882d (34861)	34862	DSD bin 22	float	$m^{-3}\,mm^{-1}$

Table 50 Precipitation measurement configuration (read and write)

Register address	Register number	Name	Data type	Description
0x0316 (790)	791	Measurement interval	float	Time between 2 consecutive measurements in seconds (s). Range is 12–600. Default is 12.
0x2500 (9472)	9473	Reset accumulation counter	int16	Write **1** to reset. Resets accumulation registers 0x0024, 0x0026, 0x002c, and 0x002e to 0.

Register address	Register number	Name	Data type	Description
0x2501 (9473)	9474	Accumulation counter reset value	int16	Value in millimeters (mm) at which precipitation accumulation is reset. The value in this register is never reached. Instead, the accumulation registers reset to 0. Range is 0–1000. Default is 1000.

Table 51 Serial port communication settings (read and write)

Register address	Register number	Name	Data type	Description
0x0600 (1536)	1537	Restart device	int16	Write **1** to restart.
0x0602 (1538)	1539	Bit rate	int16	Bit rate in bits/s. • 0 = 1200 • 1 = 2400 • 2 = 4800 • 3 = 9600 • 4 = 19 200 • 5 = 38 400 • 6 = 57 600 • 7 = 115 200
0x0603 (1539)	1540	Parity, data, stop bits	int16	• 0 = N81 • 1 = N82 • 2 = E81 • 3 = E82 • 4 = O81 • 5 = O82 • 6 = N71 • 7 = N72 • 8 = E71 • 9 = E72 • 10 = O71 • 11 = O72
0x0605 (1541)	1542	Interface mode	int16	Communication mode and interface settings. • 0 = Modbus RTU • 1 = Data messaging
0x0606 (1542)	1543	Modbus address	int16	Modbus address of device. Range is 1–247. Default is 240.
0x0608 (1544)	1545	Messaging address	text[1]	Device address for data messages. Valid values are 0-9, a-z, and A-Z.
0x060d (1549)	1550	Autosend message	int16	• 0 = None • 1 = RM60 data message MSG3

Register address	Register number	Name	Data type	Description
0x060e (1550)	1551	Autosend interval	float	Automatic sending interval in seconds (s). Range is 0.25–600. Default is 60.

Table 52 Factory reset (read and write)

Register address	Register number	Name	Data type	Description
0x1e00 (7680)	7681	Restore factory default settings	int16	Write **1** to start process. See Restoring factory settings (page 53).

Table 53 Status information (read only)

Register address	Register number	Name	Data type	Description
0x0200 (512)	513	Device status	int16	• Value = 0: Device OK • Bit 2 = 1: Warning (W) For details, see Checking device status (page 49) and Device status in Modbus (page 51).
0x0201 (513)	514	Device diagnostic code	int32	Diagnostic code related to device status.
0x0203 (515)	516	Operating voltage status	int16	• Value = 0: Operating voltage OK • Bit 2 = 1: Operating voltage too low (U) • Bit 3 = 1: Operating voltage too high (O)
0x0204 (516)	517	Operating voltage diagnostic code	int32	Diagnostic code related to operating voltage status.
0x0218 (536)	537	Precipitation measurement status	int16	• Value = 0: Measurement OK • Bit 0 = 1: Unavailable (S) • Bit 1 = 1: Unreliable (R) • Bit 6 = 1: Calibration expired (C)
0x0219 (537)	538	Precipitation measurement diagnostic code	int32	Diagnostic code related to precipitation measurement status.

Table 54 Device monitoring (read only)

Register address	Register number	Name	Data type	Description
0x8000 (32768)	32769	Uptime	int32	Seconds (s) since last boot.

Register address	Register number	Name	Data type	Description
0x8002 (32770)	32771	Operating voltage	float	V
0x8004 (32772)	32773	Digital 3.3 V	float	V
0x8006 (32774)	32775	Digital 5 V	float	V
0x800c (32780)	32781	Device tilt angle	float	deg

Table 55 Device identification (read only)

Register address	Register number	Name	Data type	Description
0x1d00 (7424)	7425	Vendor name	text[16]	`Vaisala`
0x1d08 (7432)	7433	Product code	text[16]	`RM60`
0x1d10 (7440)	7441	Product serial number	text[16]	Appears also on the device type label.
0x1d28 (7464)	7465	Configuration code	text[32]	Appears also on the device type label.
0x1d38 (7480)	7481	Product manufacturing date	date	Format YYYY-MM-DD
0x1d3b (7483)	7484	Product name	text[32]	Vaisala PRECICAP Radar Precipitation Sensor RM60

Table 56 Base module identification (read only)

Register address	Register number	Name	Data type
0x7000 (28672)	28673	Item code	text[16]
0x7008 (28680)	28681	Serial number	text[16]
0x7010 (28688)	28689	Firmware version	text[32]
0x7020 (28704)	28705	Hardware version	text[8]

Table 57 PRECICAP module identification (read only)

Register address	Register number	Name	Data type
0x7300 (29440)	29441	Item code	text[16]
0x7308 (29448)	29449	Serial number	text[16]
0x7310 (29456)	29457	Firmware version	text[32]
0x7320 (29472)	29473	Hardware version	text[8]
0x7324 (29476)	29477	Secondary firmware version	text[132

Table 58 Communication testing (read only)

Register address	Register number	Name	Data type	Description
0x1f00 (7936)	7937	Signed integer	int16	Byte order verification. Reading this register returns constant signed integer value `-12345`.
0x1f01 (7937)	7938	Floating point	float	Word order verification. Reading these 2 registers returns constant floating point value `-123.45`.
0x1f03 (7939)	7940	Text string	text[8]	String verification. Reading these 4 registers returns constant string value `-123.45`

More information

- Reflectivity factor (page 18)
- Modbus RTU protocol (page 29)

Appendix B. Regulatory statements

B.1 FCC/ISED regulatory notices

Modification statement

Vaisala Oyj has not approved any changes or modifications to this device by the user. Any changes or modifications could void the user's authority to operate the equipment.

Vaisala Oyj n'approuve aucune modification apportée à l'appareil par l'utilisateur, quelle qu'en soit la nature. Tout changement ou modification peuvent annuler le droit d'utilisation de l'appareil par l'utilisateur.

Interference statement

This device complies with Part 15 of the FCC Rules and Innovation, Science and Economic Development Canada (ISED) licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR Innovation, Sciences et Développement économique Canada (ISDE) applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

FCC Class B digital device notice

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that the interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

CAN ICES-3 (B) / NMB-3 (B)

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de classe B est conforme à la norme canadienne NMB-003.

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B.2 ISED warning statement for category I equipment

The devices certified under this annex are not permitted to be used on satellites. Devices used on aircraft are permitted under the following conditions:

a. Except as allowed in J.2(b), devices are only to be used when the aircraft is on the ground.

b. Devices used in-flight are subject to the following restrictions:

i. they shall be used within closed, exclusive on-board, communication networks within the aircraft

ii. they shall not be used in wireless avionics intra-communication (WAIC) applications where external structural sensors or external cameras are mounted on the outside of the aircraft structure

iii. they shall not be used on aircraft equipped with a body/fuselage that provides little or no RF attenuation except when installed on unmanned air vehicles (UAVs) and complying with J.2(d)

iv. devices operating in the 59.3-71.0 GHz band shall not be used except if they meet all of the following conditions:

1. they are FDS
2. they are installed within personal portable electronic devices
3. they comply with the relevant requirements in J.3.2(a), J.3.2(b) and J.3.2(c)

Les appareils certifiés dans le cadre de la présente annexe ne sont pas autorisés à être utilisés sur des satellites. Les appareils utilisés à bord d'aéronefs sont autorisés dans les conditions suivantes:

a. Sauf pour ceux permis au paragraphe J.2(b), les dispositifs doivent être utilisés seulement lorsque l'aéronef se trouve au sol.

b. Les dispositifs utilisés en vol sont assujettis aux restrictions suivantes :

i. ils doivent seulement être utilisés sur des réseaux de communications de bord fermés et exclusifs au sein de l'aéronef;

ii. ils ne doivent pas servir pour des applications de type communications internes aéroélectroniques (WAIC) si des capteurs structurels ou des caméras sont montés à l'extérieur de la structure de l'aéronef;

iii. ils ne doivent pas être utilisés à bord d'aéronefs équipés d'un fuselage offrant peu ou pas d'atténuation des signaux RF, sauf lorsqu'ils sont installés sur des aéronefs sans pilote (ASP) et qu'ils sont conformes au paragraphe J.2(d);

iv. les dispositifs fonctionnant dans la bande de 59,3 à 71,0 GHz ne peuvent être utilisés que s'ils remplissent toutes les conditions suivantes :

1. Ils sont des CPC;
2. Ils sont installés dans des appareils électroniques personnels portatifs;
3. Ils doivent être conformes aux exigences pertinentes des sections J.3.2(a), J.3.2(b) et J.3.2(c).

Appendix C. Open source software (OSS) licenses

This section contains the licenses and notices for the open source software used in this product. If you have any questions about the open source software, please contact us at opensourcesw@vaisala.com.

You may request a copy of certain open-source code as required by certain applicable OSS licenses by sending an email to opensourcesw@vaisala.com with the following subject line: *OSS source code request*.

Table 59 RM60 OSS licenses

Library	Version	License
nanopb	0.4.9.1	zlib
CMSIS	6.1.0	Apache-2.0
Mbed-TLS	3.6.2	
littlefs	2.11.1	BSD-3-Clause
Renesas FSP	5.7.0	
TI XDC Tools	3.50.08.24	Eclipse Distribution License 1.0
TI RadarSS Firmware	6.3.2.6	TI TEXT LICENSE

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OSS license texts

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nanopb 0.4.9.1
https://jpa.kapsi.fi/nanopb/download/nanopb-0.4.9.1.tar.gz

The zlib license:

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Arm CMSIS6: 6.1.0 (both in Common 6 FSP)
https://github.com/ARM-software/CMSIS_6/releases/tag/v6.1.0

mbedtls 3.6.2+renesas.1
https://github.com/renesas/mbedtls/releases/tag/3.6.2%2Brenesas.1

Apache License Version 2.0, January 2004
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RA MCU BSP, RA Board BSP and RA MCU HAL Drivers 5.7.0
https://github.com/renesas/fsp/releases/tag/v5.7.0

littlefs 2.11.1
https://github.com/littlefs-project/littlefs

TI mmWave SDK 03.06.02.00-LTS,
TI SYS/BIOS 6.73.01.01,
TI DSPlib 3.4.0.0,
TI MathLib 3.1.2.1
https://dr-download.ti.com/software-development/software-development-kit-sdk/MD-PIrUeCYr3X/03.06.02.00-LTS/mmwave_sdk_03_06_02_00-LTS-Linux-x86-Install.bin
https://dr-download.ti.com/software-development/software-development-kit-sdk/MD-PIrUeCYr3X/03.06.02.00-LTS/mmwave_sdk_03_06_02_00-LTS-Windows-x86-Install.exe

TI ARM Compiler Tools 16.9.6 LTS — runtime support (RTS) library only
https://www.ti.com/tool/download/ARM-CGT/16.9.6.LTS

TI C6000 Compiler Tools 8.3.3 — runtime support (RTS) library only

https://www.ti.com/tool/download/C6000-CGT/8.3.3

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TI XDC Tools 3.50.08.24 — target/runtime portion only
https://dr-download.ti.com/software-development/software-development-kit-sdk/MD-PIrUeCYr3X/03.06.02.00-LTS/mmwave_sdk_03_06_02_00-LTS-Linux-x86-Install.bin
https://dr-download.ti.com/software-development/software-development-kit-sdk/MD-PIrUeCYr3X/03.06.02.00-LTS/mmwave_sdk_03_06_02_00-LTS-Windows-x86-Install.exe

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TI RadarSS Firmware 6.3.2.6
https://dr-download.ti.com/software-development/software-development-kit-sdk/MD-PIrUeCYr3X/03.06.02.00-LTS/mmwave_sdk_03_06_02_00-LTS-Linux-x86-Install.bin
https://dr-download.ti.com/software-development/software-development-kit-sdk/MD-PIrUeCYr3X/03.06.02.00-LTS/mmwave_sdk_03_06_02_00-LTS-Windows-x86-Install.exe

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Appendix D. Recycling instructions

These recycling instructions guide you on the end-of-life treatment of this Vaisala product. As waste regulations and infrastructure vary in each country, these instructions only indicate the different components to be separated and common ways to handle them. Always follow local requirements when disposing of the product. Vaisala encourages to use the best available recycling practices to minimize related environmental impacts.

Vaisala is committed to meeting the requirements of the EU Waste Electrical and Electronic Equipment (WEEE) Directive. This directive aims to minimize the impact of electrical and electronic goods on the environment, by increasing reuse and recycling, and reducing the amount of WEEE going to landfill. This symbol indicates that the product should be collected separately from other waste streams and treated appropriately.

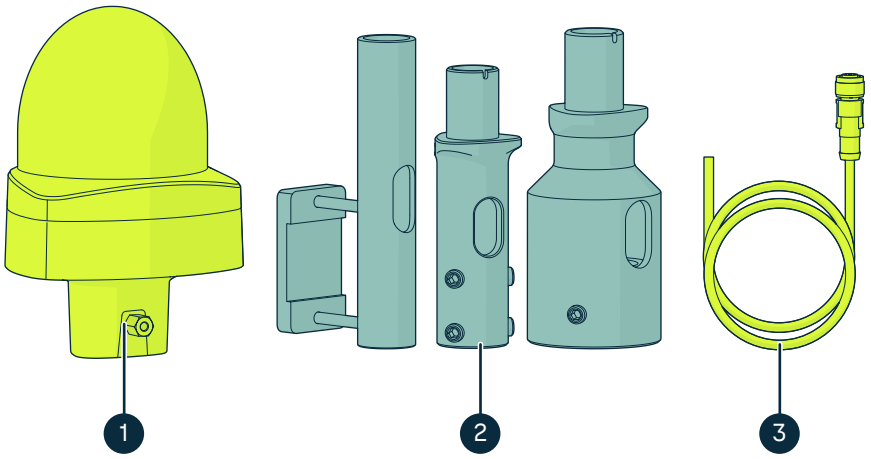


Table 60 Materials for recycling

Recycling	Part	Material
Electrical and electronic waste	1, 3	Various
Metal waste	2	Aluminum

Online store

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