

# RoadSmart 21 Road Weather Information Sensor

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Operational Manual



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# 1 Scope of supply

The following items are included with delivery:

- RoadSmart Road Weather Information Sensor

## 2 Order numbers and variant code

### 2.1 Product variants

| Variant   | Order number |
|-----------|--------------|
| RoadSmart | 8811.U55     |

### 2.2 Accessories and spare parts

| Item                        | Order number |
|-----------------------------|--------------|
| Mounting Starwis            | 8711.MHA     |
| Lufft sensor cable 15 m     | 8371.UK015   |
| Temperature humidity sensor | 8900.UTFF    |

## 3 About this manual

### 3.1 Other applicable documents and software

The following documents contain further information on installation, maintenance and calibration:

- MARWIS-App manual

The following documents and software can be downloaded at [www.otthydromet.com](http://www.otthydromet.com):

- ConfigTool.NET
- UMB protocol description
- Firmware

The following App can be downloaded from iTunes or Google Playstore:

- MARWIS-App for iOS or Android



*MARWIS Android App for Android 6-9*



*MARWIS Android App for Android 10 and newer*

### 3.2 General signs and symbols

The signs and symbols used in the operational manual have the following meaning:

#### Practical tip

-  This symbol indicates important and useful information.

#### Action

- ✓ Prerequisite that must be met before performing an action.
  - ▶ Step 1
    - ⇒ Intermediate result of an action
  - ▶ Step 2
    - ⇒ Result of a completed action

#### List

- List item, 1st level
  - List item, 2nd level

### 3.3 Explanation of warnings

To avoid personal injury and material damage, you must observe the safety information and warnings in this manual. The warnings use the following danger levels:

#### WARNING

##### WARNING

This indicates a potentially hazardous situation. If the hazardous situation is not avoided, it may result in death or serious injuries.

---

#### CAUTION

##### CAUTION

This indicates a potentially hazardous situation. If the hazardous situation is not avoided, it may result in moderately serious or minor injuries.

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#### NOTICE

##### NOTE

This indicates a situation from which damage may arise. If the situation is not avoided, products may be damaged.

---

## 4 General safety instructions

### 4.1 Intended use

The RoadSmart is used to give information about road conditions.

### 4.2 Potential misuse

Any use of the product that does not comply with the intended use, be this intentional or negligent, is forbidden by the manufacturer.

- ▶ Use the product only as described in the operational manual.

### 4.3 Personnel qualification

The equipment described in this manual must be installed, operated, maintained and repaired by qualified personnel only.

- ▶ Obtain training from OTT HydroMet if necessary.

### 4.4 Operator obligations

The installer is responsible for observing the safety regulations. Unqualified personnel working on the product can cause risks that could lead to serious injury.

- ▶ Have all activities carried out by qualified personnel.
- ▶ Ensure that everybody who works on or with the product has read and understood the operational manual.
- ▶ Ensure that safety information is observed.
- ▶ File the operational manual together with the documentation of the entire system and ensure that it is accessible at all times.

### 4.5 Personnel obligations

To avoid equipment damage and injury when handling the product, personnel are obliged to the following:

- ▶ Read the operational manual carefully before using the product for the first time.
- ▶ Pay attention to all safety information and warnings.
- ▶ If you do not understand the information and procedure explanations in this manual, stop the action and contact the service provider for assistance.
- ▶ Wear the necessary personal protective equipment.

### 4.6 Correct handling

If the product is not installed, used and maintained correctly, there is a risk of injury. The manufacturer does not accept any liability for personal injury or material damage resulting from incorrect handling.

- ▶ Install and operate the product under the technical conditions described in the operational manual.
- ▶ Do not change or convert the product in any way.
- ▶ Do not perform any repairs yourself.
- ▶ Get OTT HydroMet to examine and repair any defects.
- ▶ Ensure that the product is correctly disposed of. Do not dispose of it in household waste.

## 4.7 Health hazards

### 4.7.1 Risk of electrical shock

Live parts can cause electric shocks in the event of contact.

- ▶ Never take measurements on live electrical parts.
- ▶ Never touch live electrical parts.
- ▶ Connect the device while the power is off and then switch on.

### 4.7.2 Risk due to invisible IR radiation



The device emits invisible IR radiation and is classified into risk group 1 (low risk) according to IEC 62471:2006 "Photobiological safety of lamps and lamp systems". An exposure of more than 500 s can lead to damage to the eye.

- ▶ Do not look into the beam directly.
- ▶ Avert the eyes for at least 60 s after a long exposure to the beam.
- ▶ Do not view the IR beam or exit optics with any optical aid, such as a magnifying glass, lens, microscope, binoculars or telescope.

## 4.8 Working outdoor

### 4.8.1 Installation and maintenance at great heights

It is advised to mount the product in a certain height. Therefore, there is a risk of falling down.

- ▶ Observe and follow the local safety regulations.
- ▶ Use suitable safety equipment.
- ▶ Inspect the safety equipment before use.
- ▶ Secure the person mounting or maintaining the device against falling down.
- ▶ Secure the device against falling down.

### 4.8.2 Using long cables

Long cables are required to mount the product at longer distance. Therefore, there is a risk of strangulation.

- ▶ Use long cables properly.
- ▶ Observe manufacturer's instructions.
- ▶ Observe safety regulations.

### 4.8.3 Working at roadside

The device can be installed on a mast or on a sign gantry at the roadside. Special safety regulations apply to prevent accidents and injuries.

- ▶ Observe the safety regulations for working at the roadside and in the vicinity of the road carriageway.

## 4.9 Certification

### 4.9.1 Europe, USA and Canada

#### CE (EU)

The equipment meets the essential requirements of RED Directive 2014/53/EU.

#### FCC (US)

##### FCC part 15 statement

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

**i** Unauthorized modification or changes to this wireless communication equipment will void the right to use it. Changes or modifications to this unit not expressly approved by the party responsible for compliance will void the user's authority to operate the equipment. Any change to the equipment will void the FCC grant.

Contains FCC ID: PVH0946

#### IC (CA)

##### Canadian Radio Interference-Causing Equipment Regulation, ICES-001

The device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'industrie Canada applicable aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. L'appareil ne doit pas produire de brouillage.
2. L'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

**i** La modification ou les changements non autorisée à cet équipement de communication sans fil annuleront la droite pour l'utiliser. Les changements ou les modifications à cette unité pas expressément approuvé par le parti responsable de la conformité annuleront l'autorité de l'utilisateur pour fonctionner l'équipement. N'importe quel changement à l'équipement annulera la certification de Canada d'industrie.

Contains IC: 5325A-0946

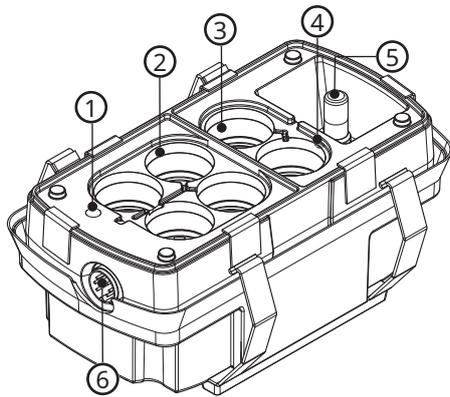
# 5 Product description

## 5.1 Design and function

The sensors are used for road weather monitoring. The device measures the surface temperature and gives an indication about the water film height, snow cover and ice conditions on the road by means of non-invasive optical spectroscopy.

The equipment is connected by way of an 8-pin plug-in terminal and associated connection cable (length 5 m or 15 m). The measured values are requested over the RS-485 interface in accordance with UMB protocol. During commissioning, configuration and verification takes place using the ConfigTool.NET software or the MARWIS-App.

## 5.2 Product overview



- |   |              |   |                             |
|---|--------------|---|-----------------------------|
| 1 | Pyrometer    | 4 | Status-LED                  |
| 2 | Transmitters | 5 | Temperature-humidity-sensor |
| 3 | Receivers    | 6 | Connection plug             |

### 5.2.1 Status LEDs

The status LEDs give information on how the device is operating. The following table describes the different colors and states of the LEDs.

| Color   | Description  |
|---------|--|
| Green   | <ul style="list-style-type: none"><li>- Device status OK</li><li>- Infrared measurement active</li></ul>   |
| Blue    | <ul style="list-style-type: none"><li>- Device status OK</li><li>- Infrared measurement active, active Bluetooth connection</li></ul>  |
| Yellow  | <ul style="list-style-type: none"><li>- Device status OK</li><li>- Error in infrared measurement (e.g. operating temperature has not yet been reached in the warm-up phase)</li><li>- The status channel <i>measurement status</i> provides detailed information about the type of error</li></ul> |
| Magenta | <ul style="list-style-type: none"><li>- Firmware update active</li><li>- Do not separate sensor from power supply!</li></ul>   |
| Red     | <ul style="list-style-type: none"><li>- Device error</li></ul>   |

| Color                | Description   |
|----------------------|---|
|                      | <ul style="list-style-type: none"><li>- The status channel <i>device status</i> provides detailed information about the type of error</li></ul> |
| Blinking (any color) | <ul style="list-style-type: none"><li>- Data transfer is currently taking place</li></ul>   |

The status of the device and the measurement can also be retrieved via UMB channels 4000 and 4001.

## 6 Transport, storage, and unpacking

### 6.1 Unpacking

- ▶ Use two people to carefully remove the product from the packaging.
- ▶ Check that the delivery is complete and undamaged.
- ▶ If you find any damage or if the delivery is incomplete, then immediately contact your supplier or manufacturer.
- ▶ Keep the original packaging for any further transportation.

### 6.2 Storage

- ▶ Store within specified temperature ranges.
- ▶ Store in dry area.
- ▶ Store in original box where possible.

# 7 Installation

## 7.1 Mechanical installation

### 7.1.1 Required tools and aids

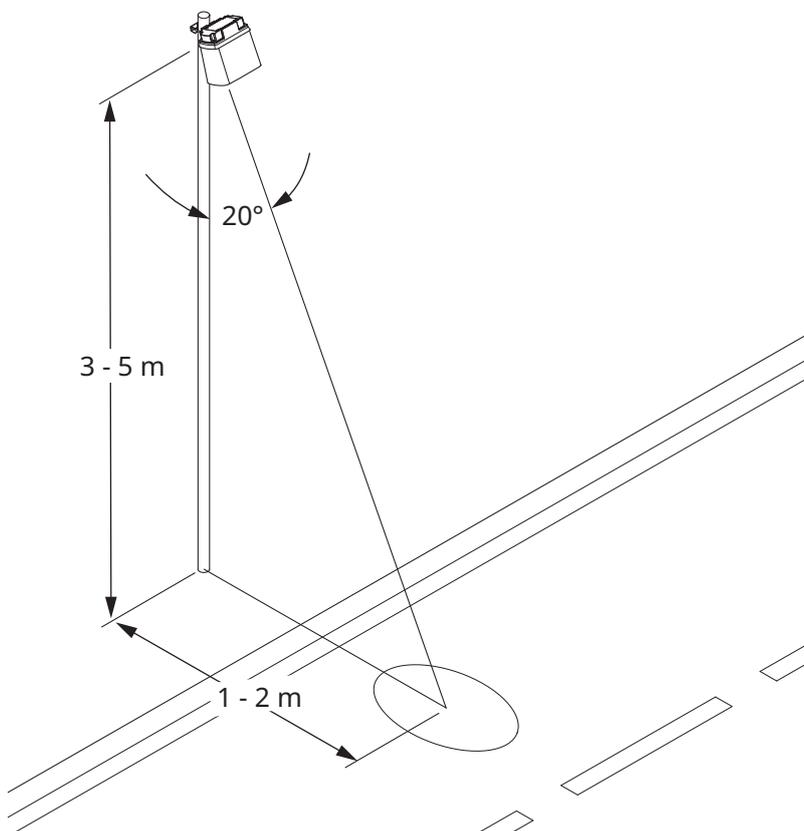
The following tools and aids are required:

- wrench, 8 mm
- Allen key, 4 mm
- screw driver

### 7.1.2 Preparing installation

- ▶ Ensure the following before installing the device on a vehicle:
  - The field of view of the device is directed to the road
  - The area between the sensor front and the road should be free of obstacles

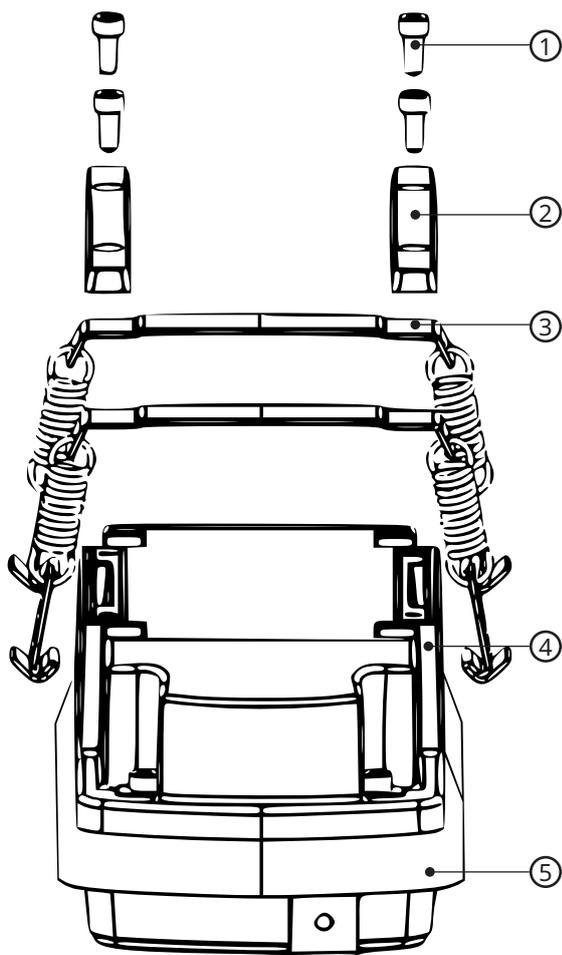
### 7.1.3 Installing device



*Example: Mounting RoadSmart at an angle of 20°*

### 7.1.4 Mounting device

The protective housing must be connected to the device.



- |   |              |   |                    |
|---|--------------|---|--------------------|
| 1 | Screws       | 4 | RoadSmart-UMB      |
| 2 | Plastic bars | 5 | Protective housing |
| 3 | Clamp straps |   |                    |

- ▶ Loosen the screws (1) on the upper side of the device and take off the plastic stripes.
- ▶ Place the clamp straps (3) so that the profiles of the two clamp straps fit in with the dents on the upper side of the device.
- ▶ Mount the plastic bars (4) of the clamping device on the device.
- ▶ Insert the screws and tighten the screws appropriately.
- ▶ Place the device (4) on the protective housing (5).
- ▶ Then the ends of the clamp straps come close to the hitch of the housing.
- ▶ Press the clamp straps towards the protective housing with a screw driver, until they catch the hitch.
  - ⇒ The device is connected to the protective housing.
- ▶ Fasten one clamp strap on both sides, then the other.

## 7.2 Electrical installation

### 7.2.1 Electrical connections

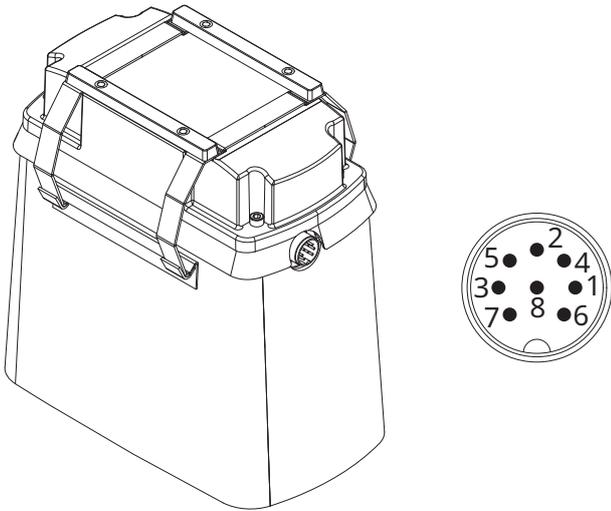


Electric shock due to incorrectly connected device!

If the device is not connected correctly, it may be permanently damaged and an electric shock may result.

- ▶ Ensure that the device is connected correctly.
- ▶ Ensure that the RoadSmart 21 is protected with a 5 A fuse.

There is an 8-pin screw plug on the front side of the protective housing. This serves to connect the supply voltage and the interface via the connection cable.



#### Pin assignment

| Number | Color  | Assignment              |
|--------|--------|-------------------------|
| 1      | Pink   | CAN-HIGH                |
| 2      | Yellow | RS-485_B                |
| 3      | Red    | Not connected           |
| 4      | Grey   | CAN-LOW                 |
| 5      | Green  | RS-485_A (+)            |
| 6      | Blue   | Not connected           |
| 7      | White  | Negative supply voltage |
| 8      | Brown  | Positive supply voltage |

### 7.2.2 Supply voltage

The minimum supply voltage for the device is 10 V DC  $\pm$  and the maximum is 28 V DC. Operation with a supply voltage of 24 V DC is recommended.

- i** If the temperatures are below -10 °C and you are using a supply voltage of 12 V, a step-up converter from 12 V to 24 V should be used to ensure the heating capacity. The heating of the unit is optimal, when the sensor indicates yellow.

### 7.2.3 RS485 interface

The device has an electrically isolated, half-duplex, 2 wire RS485 interface for configuration, measurement polling and the firmware update. The RS485 interface has a default baud rate of 19200 (no parity, 8 data bits, 1 stop bit), but other baud rates are supported (adjustable baud rates: 1200, 2400, 4800, 9600, 14400, 28800, 57600, 115200).

**i** For sampling rates up to 1/s a bit rate of 19200 baud will usually be sufficient; for higher sampling rates please select 115200 baud.

### 7.2.4 Connecting with Bluetooth

- ▶ Switch on the RoadSmart by connecting the power supply.
- ▶ Locate the RoadSmart in the Bluetooth settings of your device.
  - ⇒ The first two sections of the serial number define the name of the connection.
- ▶ Connect the RoadSmart with your device.
  - ⇒ The default PIN of every RoadSmart is 1007.
- ▶ If you are using the UMB Config Tool, select the *COM port* for communicating with the RoadSmart that has been assigned to your Bluetooth connection during the setup.

**i** To ensure a stable Bluetooth connection, keep the distance between the sensor and the display device (tablet or smartphone) as short as possible.

### 7.2.5 CAN interface

The device can communicate over the CAN interface. The CAN interface has a bit rate of 500 kbps. Extended CAN-IDs (EID) are used.

Each end of the CAN bus should be terminated by a 120 Ohm resistance.

**i** Further information on the CAN protocol can be found in the chapter CAN protocol [▶ 21].

#### Pin assignment

| Number | Assignment |
|--------|------------|
| 1      | CAN-High   |
| 4      | CAN-Low    |

# 8 Commissioning

## 8.1 Selecting the road condition model

Before you can start the adaptation of the sensor, you must first select a road condition model. The road condition models for the RoadSmart only give indications for the road conditions above condition 2. No accuracy value for conditions can be provided.

- ✓ The MARWIS-App is installed on your device and connected to the RoadSmart .
- ▶ In the MARWIS-App, select a road condition model when configuring your RoadSmart .
- ⇒ This setting determines whether the next measurement retrieval uses the maximum, minimum, or average values recorded for the measurements road temperature, water film height and ice percentage.

There are 7 presets to choose from:

| Road condition model | Road temperature | Water film height | Ice percentage |
|----------------------|------------------|-------------------|----------------|
| AVG (default)        | Average          | Average           | Average        |
| Winter 1             | Minimum          | Maximum           | Maximum        |
| Winter 2             | Average          | Average           | Maximum        |
| Winter 3             | Minimum          | Average           | Maximum        |
| Winter 4             | Minimum          | Average           | Average        |
| Summer 1             | Average          | Maximum           | Minimum        |
| Summer 2             | Average          | Average           | Minimum        |

## 8.2 Adaption of the sensor

The sensor has to be adapted before starting the measurements.

During the adaptation of the sensor the following conditions must be met:

- ✓ The RoadSmart is installed in the planned position.
- ✓ The adaptation takes place on a dry stretch of road.
- ✓ The ambient temperature is below 30 °C (85 °F).
- ✓ The adaptation is carried out in natural light.
- ✓ The RoadSmart has been switched on for about 10 minutes before starting the adaptation to allow for warm-up.
- ✓ The yellow light is off and the status LED indicates green on the device and MARWIS-App.
- ✓ Each RoadSmart in the same network has received its own device ID.
- ✓ The selected road surface for the adaptation represents the area where the RoadSmart will be used.
  - ▶ Carry out the adaption of the sensor with the MARWIS-App on your iOS or Android device or with the program ConfigTool.Net on a Windows PC.  
Detailed instructions are given in the manual of the MARWIS-App or the ConfigTool.Net.
    - ⇒ Basic settings are configured which depend on the structure of the ground, the measuring angle and the exact measuring distance between the RoadSmart and the road.
  - ▶ Optionally, you can save your profile of the adaption in the RoadSmart . Up to 5 different profiles can be stored.



When saving different profiles, name them in a way that reflects relevant conditions.

- i Restarting the RoadSmart after adaptation has been completed, has no influence on the measurements. The last used adaption profile is automatically loaded.

### 8.3 Configuration and testing

For configuration and testing OTT HydroMet Fellbach GmbH provides the proprietary software ConfigTool.NET. ConfigTool.NET can also be used to update the firmware of the device.

- ▶ Download the ConfigTool.NET software: [www.otthydromet.com/en/software\\_firmware](http://www.otthydromet.com/en/software_firmware)
- ▶ Install the software on the computer.
- ▶ Get familiar with the software in general.
- ▶ Ensure to always use the latest version of ConfigTool.NET.
- ▶ During configuration and testing, disconnect other devices that poll the UMB-Bus, e.g. modem or LCOM.
- ▶ Ensure that the connection settings of ConfigTool.NET are conform to the settings of the device.

- i The operation of the ConfigTool.NET is described in detail in the help function of the Windows® PC software. For this reason only the menus and functions specific to the device are described below.

- i The configuration can also be carried out in the MARWIS-App on an iOS or Android device.

#### 8.3.1 Factory settings

The device is delivered with the following settings:

| Specification                          | Value                           |
|--|---------------------------------|
| Class ID                               | 10 (cannot be modified)         |
| Device ID                              | 1 (gives address A001h = 40961) |
| Baud rate                              | 19200                           |
| RS485 protocol                         | UMB binary                      |
| Water film damp threshold              | 10 µm                           |
| Water film wetness threshold           | 100 µm                          |
| Critical temperature for ice detection | 1,5 °C                          |
| Temperature offset                     | 0 K                             |
| Surface type                           | Asphalt                         |
| Measuring interval RoadSmart 21        | 60 s                            |
| Deicer                                 | NaCl                            |
| Road condition model                   | AVG                             |

- i If several RoadSmart are operated in one UMB network, the device ID must be changed as each device requires a unique ID.
- i When connecting via the RS485 interface, ensure no other device operates as the master, as the PC takes on the master role.
- i If the baud rate is changed, the sensor communicates at the new baud rate after the configuration has been saved on the sensor. Ensure that your retrieving system supports the changed baud rate.

## 8.4 CAN protocol

All MARWIS measuring channels can communicate over the CAN interface. Each value will be sent in its own CAN telegram.

In order to transfer a measured value it is either possible to send a remote telegram which will cause the value to be transferred once or to configure a trigger so that the value is sent automatically time and time again. In this latter case the system will check once every 10 ms if a value is supposed to be transferred. The configured triggers of the CAN data transmission are stored permanently and need to be configured only once when commissioning a RoadSmart 21.

### 8.4.1 Data transmission

The data format and byte order in the communication protocol will be as follows:

|        |   |
|--------|---|
| LONG:  | LowLowByte LowHighByte HighLowByte HighHighByte |
| INT:   | LowByte HighByte                                |
| FLOAT: | Acc. to IEEE format (4 bytes)                   |

### CAN-ID

Every value will have its own CAN-ID. The default values correspond to the UMB value numbers. Since extended CAN-IDs are used, the IDE bit is set in addition.

Examples:

| Value                   | Value number (dez./hex) | 11 Bit Identifier (hex) | IDE | 18 Bit Identifier (hex) | RTR | CAN-ID (extended) |
|-------------------------|-------------------------|-------------------------|-----|-------------------------|-----|-------------------|
| Road temperature in °C  | 100d = 0x0064h          | 0x000                   | 1   | 0x00064                 | 0   | 0x00000064        |
| Water film height in µm | 600d = 0x0258h          | 0x000                   | 1   | 0x00258                 | 0   | 0x00000258        |
| Road state              | 900d = 0x0384h          | 0x000                   | 1   | 0x00384                 | 0   | 0x00000384        |

### Transmission format

The first data byte contains a status byte which indicates if a valid value is available, see Status and error codes [► 24]. If the status is not OK no more data will follow.

If the status is OK (0x00h) it will be followed by the second data byte which specifies the data type in which the value is released, see Data types [► 24].

Depending on the data type 1 – 4 byte with measured values will follow from the third data byte on.

Examples:

| 11 Bit Identifier (hex) | IDE | 18 Bit Identifier (hex) | RTR | Data Length Code | Data byte (hex)    |                   |                        | Description                      |
|-------------------------|-----|-------------------------|-----|------------------|--------------------|-------------------|------------------------|----------------------------------|
|                         |     |                         |     |                  | 1 Status           | 2 Type            | 3 - 6 Value            |                                  |
| 0x000                   | 1   | 0x00064                 | 0   | 1                | 0x54<br>Data error | -                 | -                      | Road temperature: no valid value |
| 0x000                   | 1   | 0x00258                 | 0   | 6                | 0x00               | 0x16<br>(4 Bytes) | 0x00 0x00<br>0x00 0x00 | Water film height is 0           |

| 11 Bit Identifier (hex) | IDE | 18 Bit Identifier (hex) | RTR | Data Length Code | Data byte (hex) |               |             | Description           |
|-------------------------|-----|-------------------------|-----|------------------|-----------------|---------------|-------------|-----------------------|
|                         |     |                         |     |                  | 1 Status        | 2 Type        | 3 - 6 Value |                       |
| 0x000                   | 1   | 0x00384                 | 0   | 3                | 0x00            | 0x10 (1 Byte) | 0x01        | Road state: 1 (humid) |

#### 8.4.2 Remote query

Marwis supports remote value queries. Following the CAN specifications the CAN-ID corresponds to the CAN-ID which is used for transmitting the corresponding value with additionally set RTR bit.

Examples:

| Value                   | Value number (dez./hex) | 11 Bit Identifier (hex) | IDE | 18 Bit Identifier (hex) | RTR | CAN-ID (extended) |
|-------------------------|-------------------------|-------------------------|-----|-------------------------|-----|-------------------|
| Road temperature in °C  | 100d = 0x0064h          | 0x000                   | 1   | 0x00064                 | 1   | 0x00000064        |
| Water film height in µm | 600d = 0x0258h          | 0x000                   | 1   | 0x00258                 | 1   | 0x00000258        |
| Road state              | 900d = 0x0384h          | 0x000                   | 1   | 0x00384                 | 1   | 0x00000384        |

#### 8.4.3 Trigger configuration

If a value is supposed to be transferred several times, a trigger can be configured which defines under which circumstances the value is supposed to be sent. Every value can have a trigger of its own.

In the default settings no values will be transferred.

#### CAN-ID

The configuration of every value trigger has its own CAN-ID. The default settings correspond to the CAN-IDs of the value transfer with additionally set lowest value bit of the 11 bit identifier.

Examples:

| Value                   | Value number (dez./hex) | 11 Bit Identifier (hex) | IDE | 18 Bit Identifier (hex) | RTR | CAN-ID (extended) |
|-------------------------|-------------------------|-------------------------|-----|-------------------------|-----|-------------------|
| Road temperature in °C  | 100d = 0x0064h          | 0x001                   | 1   | 0x00064                 | 0   | 0x00040064        |
| Water film height in µm | 600d = 0x0258h          | 0x001                   | 1   | 0x00258                 | 0   | 0x00040258        |
| Road state              | 900d = 0x0384h          | 0x001                   | 1   | 0x00384                 | 0   | 0x00040384        |

To get the CAN-ID:

The CAN-ID is set together by 18 bit + 11 bit identifier.

Example road temperature:

|             | 11 Bit         | 18 Bit                |
|-------------|----------------|-----------------------|
| binär       | 0 0000 0000 01 | 000000 0000 0110 0100 |
| hexadezimal | 0x00 0x04      | 0x00 0x64             |

### Trigger format

The first data byte of the trigger telegram indicates the trigger type. Depending on the type there will be possible parameters that are indicated from the 2nd data byte on.

| Trigger    | Data Length Code | Data byte (hex) |                 | Parameter     |                 |
|------------|------------------|-----------------|-----------------|---------------|-----------------|
|            |                  | 1 Trigger type  | 2 - 5 Parameter | Data type     | Description     |
| none       | 1                | 0x00            | -               | -             | -               |
| time       | 5                | 0x01            | 4 Byte          | unsigned long | Intervall in ms |
| difference | 1                | 0x02            | -               | -             | -               |
| minimum    | 2 - 5            | 0x03            | 1 - 4 Byte      | Same as value | Limit value     |
| maximum    | 2 - 5            | 0x04            | 1 - 4 Byte      | Same as value | Limit value     |

#### trigger type = 0

In case no trigger is specified the corresponding value will not be transferred.

#### trigger type = 1

The time trigger will have the value transferred in the specified interval. Take into account that the trigger check takes place only once every 10 ms so that it makes sense to specify an interval which is a multiple of 10 ms. Other intervals will be brought up to a round figure, e.g. a specified interval of 111 ms will lead to a value transfer every 120 ms.

#### trigger type = 2

The trigger "difference" will have the value transferred each time the current value differs from the previous one. The trigger only makes sense for measuring data whose value changes rarely, e.g. system status.

#### trigger type = 3

The triggers "minimum" will have the corresponding value transferred only if it falls below the specified limit value. The limit value has to be described in the same data format and with the same units that are used for the transfer of the measured value.

#### trigger type = 4

The triggers "maximum" will have the corresponding value transferred only if it exceeds the specified limit value. The limit value has to be described in the same data format and with the same units that are used for the transfer of the measured value.

Examples:

| 11 Bit Identifier (hex) | IDE | 18 Bit Identifier (hex) | RTR | Data Length Code | Data byte (hex) |                        | Description   |
|-------------------------|-----|-------------------------|-----|------------------|-----------------|------------------------|---|
|                         |     |                         |     |                  | 1 Trigger type  | 2 - 5 Parameter        |   |
| 0x001                   | 1   | 0x00064                 | 0   | 1                | 0x00            | -                      | The road temperature is not transmitted (any more).                   |
| 0x001                   | 1   | 0x00258                 | 0   | 5                | 0x01            | 0x64 0x00<br>0x00 0x00 | The water film height is transmitted once every 100 ms (100d = 0x64h) |

| 11 Bit Identifier (hex) | IDE | 18 Bit Identifier (hex) | RTR | Data Length Code | Data byte (hex) |                 | Description   |
|-------------------------|-----|-------------------------|-----|------------------|-----------------|-----------------|---|
|                         |     |                         |     |                  | 1 Trigger type  | 2 - 5 Parameter |   |
| 0x001                   | 1   | 0x00384                 | 0   | 1                | 0x02            | –               | The road state is transmitted each time its value changes |

#### 8.4.4 Status and error codes

Each value telegram contains a status byte which indicates if the transmitted value is ok or which error in the device prevents the value from being detected / transmitted.

Codes:

| <status>   | Define             | Description   |
|------------|--------------------|---|
| 00h (0d)   | OK                 | Commando successful, no error   |
| 24h (36d)  | UNGLTG_KANAL       | Invalid channel; CAN-ID not assigned to any channel                             |
| 28h (40d)  | BUSY               | Device not ready, e.g. initializing, calibrating                                |
| 29h (41d)  | LOW_VOLTAGE        | Undervoltage  |
| 2Ah (42d)  | HW_ERROR           | Hardware error  |
| 2Bh (43d)  | MEAS_ERROR         | Error in the measurement  |
| 2Ch (44d)  | INIT_ERROR         | Error in the device initialization  |
| 2Dh (45d)  | RTOS_ERROR         | Error in the operating system   |
| 30h (48d)  | E2_DEFAULT_KONF    | Error in the configuration. Default configuration was loaded.                   |
| 31h (49d)  | E2_CAL_ERROR       | Error in the adjustment / the adjustment is invalid. No measurement possible.   |
| 32h (50d)  | E2_CRC_KONF_ERR    | CRC error when loading the configuration. Default configuration was loaded.     |
| 33h (51d)  | E2_CRC_KAL_ERR     | CRC error when load the adjustment data; no measurement possible.               |
| 34h (52d)  | ADJ_STEP1          | Adjustment step 1   |
| 35h (53d)  | ADJ_OK             | Adjustment OK   |
| 36h (54d)  | KANAL_AUS          | Channel deactivated   |
| 50h (80d)  | VALUE_OVERFLOW     | Measured value (+Offset) is out of the specified range.                         |
| 51h (81d)  | VALUE_UNDERFLOW    |   |
| 52h (82d)  | CHANNEL_OVERRANGE  | Measured value (physically) is out of the measuring range (e.g. ADC overrange). |
| 53h (83d)  | CHANNEL_UNDERRANGE |   |
| 54h (84d)  | DATA_ERROR         | Data error in the measured values or no valid data available.                   |
| 55h (85d)  | MEAS_UNABLE        | Device / sensor cannot carry out a valid measurement due to ambient conditions. |
| F0h - FEh  | Do not use!!       | Reserved range e.g. for LCOM  |
| FFh (255d) | UNBEK_ERR          | Unknown error   |

#### 8.4.5 Data types

This protocol uses the following data types for the measured values:

| <type>    | Type Name      | Define         | Bytes | Range   |
|-----------|----------------|----------------|-------|---|
| 10h (16d) | unsigned char  | UNSIGNED_CHAR  | 1     | 0 ... 255   |
| 11h (17d) | signed char    | SIGNED_CHAR    | 1     | -128 ... 127  |
| 12h (18d) | unsigned short | UNSIGNED_SHORT | 2     | 0 ... 65.535  |
| 13h (19d) | signed short   | SIGNED_SHORT   | 2     | -32.768 ... 32.767  |
| 14h (20d) | unsigned long  | UNSIGNED_LONG  | 4     | 0 ... 4.294.967.295   |
| 15h (21d) | signed long    | SIGNED_LONG    | 4     | -2.147.483.648 ... 2.147.483.647                              |
| 16h (22d) | float          | FLOAT*         | 4     | $\pm 1.18\text{E-}38$ ... $\pm 3.39\text{E}+38$ (7 digits)    |
| 17h (23d) | double         | DOUBLE*        | 8     | $\pm 2.23\text{E-}308$ ... $\pm 1.79\text{E}+308$ (15 digits) |

\*Float and double type in IEEE format.

## 9 Maintenance

### 9.1 Cleaning the sensor front glass pane

#### NOTICE

#### Damage due to solvents!

Solvents like benzene, thinner, alcohol, kitchen cleaners etc. can damage the housing and the optical parts.

- ▶ Only use solvent-free agents to clean the optical parts and the housing.
- ▶ If you use a chemical cleaning cloth, pay attention to the corresponding instructions.

- ▶ Ensure that the device is disconnected from power supply.
- ▶ Clean the glass pane on the sensor front with a damp, wrung out cloth.
- ▶ Dry the pane with a dry lint-free cloth.
- ▶ Remove dust and dirt from the housing.

### 9.2 Checking the bolted connections

Check all screws and the clamp straps regularly to ensure they are still fitted tightly.

### 9.3 Updating firmware

The firmware can be updated with the ConfigTool.NET software. The firmware is valid for all types of the device. The description of the update can be found in the ConfigTool.NET software.

- ▶ Download the latest version of the firmware and the ConfigTool.NET software:  
[www.otthydromet.com/en/software\\_firmware](http://www.otthydromet.com/en/software_firmware).
- ▶ Install the update on a Windows® PC.

**i** The firmware update can also be carried out in the MARWIS-App on an iOS or Android device. The description of the update can be found in the MARWIS-App.

### 9.4 Replacing temperature/humidity sensor

The temperature/humidity sensor should be replaced once a year to ensure that the temperature and humidity are recorded as accurately as possible.

# 10 Troubleshooting

## 10.1 Error elimination

| Error   | Possible cause  | Corrective action   |
|---|---|---|
| Device does not allow polling or does not respond | Incorrect device ID is applied  | ▶ Check if the correct device ID is assigned. Devices are delivered with ID 1.            |
| Device does not allow polling or does not respond | Device does not work properly   | ▶ Check the status-LED.<br>▶ Check the power supply.<br>▶ Check the interface connection. |
| Device delivers implausible values                | Adaptation not suitable for installation location   | ▶ Repeat the adaptation using the UMB-Config-Tool.  |
| Device delivers implausible values                | –   | ▶ Check the status-LED.<br>▶ Check if the sensor installation instructions are met.       |
| Device transmits error value 2Bh (43d)            | Error in measurement, value cannot be determined  | –   |
| Device transmits error value 24h (36d)            | A channel is being polled that is not available on this device type   | –   |
| Device transmits error value 28h (40d)            | Device is in the initialization phase following startup   | ▶ Wait until the first measurement is complete.   |
| Device transmits error value 31h (49d)            | Faulty adaption   | ▶ Carry out an adaption on representative dry ground.                                     |
| Device transmits error value 50h (80d)            | Device is being operated above the limit of the specified measuring range   | –   |
| Device transmits error value 51h (81d)            | Device is being operated below the limit of the specified measuring range   | –   |
| Device transmits error value 55h (85d)            | Device is unable to execute a valid measurement due to ambient conditions, e.g. the measurement field is blocked by a vehicle | –   |
| Device transmits an unknown error value           | –   | ▶ Report any malfunction to the representative of OTT HydroMet.                           |

### 10.1.1 Interfering factors

The following interfering factors can influence the measurement result:

- Lengthwise oriented road markings, tarmac seams
- Tunnel lighting
- Extreme rainfall
- Cast shadow (in sunny weather, shadow e.g. from trees, quick alternation between sunny and shady locations)
- Dirt on the RoadSmart glass pane, e.g. from spray on wet roads
- Very dark road surface (select surface type *new blacktop* in the RoadSmart )

# 11 Repair

## 11.1 Customer support

- ▶ Have repairs carried out by OTT HydroMet service personnel.
- ▶ Only carry out repairs yourself, if you have first consulted OTT HydroMet.
- ▶ Contact your local representative: [www.otthydromet.com/en/contact-us](http://www.otthydromet.com/en/contact-us)
- ▶ Include the following information:
  - instrument model
  - instrument serial number
  - details of the fault or problem
  - examples of data files
  - readout device or data acquisition system
  - interfaces and power supplies
  - history of any previous repairs or modifications
  - pictures of the installation
  - overview of the local environment conditions



*OTT HydroMet repair service*

# 12 Notes on disposing of old devices

## Member States of the European Union

In accordance with the German Electrical and Electronic Equipment Act (ElektroG; national implementation of EU Directive 2012/19/EU), OTT HydroMet takes back old devices in the Member States of the European Union and disposes of them in the proper manner. The devices that this concerns are labeled with the following symbol:



- ▶ For further information on the take-back procedure contact OTT HydroMet:

OTT HydroMet Fellbach GmbH

Service & Technical Support

Gutenbergstraße 20

70736 Fellbach

Germany

phone: +49 711 518 22 0

email: met-support@otthydromet.com

## All other countries

- ▶ Dispose of the product in the proper manner following decommissioning.
- ▶ Observe the country-specific regulations on disposing of electronic equipment.
- ▶ Do NOT dispose of the product in household waste.

# 13 Technical data

## 13.1 General technical data

| Specification                                   | Value              |
|---|--------------------|
| Housing   | Aluminium, plastic |
| Protection type                                 | IP68               |
| Measuring distance                              | 3.5 to 5.5 m       |
| Operating temperature range                     | -40 to +60 °C      |
| Humidity range                                  | 0 to 100 %         |
| Storage temperature range                       | -40 to +70 °C      |
| Humidity range (non-condensing, during storage) | 0 to 95 %          |
| Permissible height above sea level              | 3000 m             |

## 13.2 Installation data

| Specification  | Value        |
|--|--------------|
| Recommended distance range between RoadSmart and surface | 3.5 to 5.5 m |
| Tilt angle (fixed)                                       | 20°          |
| Installation height                                      | 3 to 5 m     |

## 13.3 Electrical data

| Specification | Value  |
|---------------|--|
| Power supply  | 10 to 28 V DC on the sensor                        |
| Power input   | Approx. 3 VA without heating<br>50 VA with heating |

## 13.4 Data transfer

| Specification         | Value   |
|-----------------------|---|
| Interfaces/ protocols | RS485 half-duplex, two-wire interface (UMB protocol); Bluetooth         |
| Data bits             | 8   |
| Stop bit              | 1   |
| Parity                | None  |
| Tri-state             | 2 bits after stop bit edge  |
| Baud rate             | 19200   |
| Adjustable baud rates | 1200, 2400, 4800, 9600, 14400, 19200, 28800, 57600, 115200              |
| Sampling rate         | 100 ms to 5 s, adjustable in steps of 0.1 s <sup>2</sup> (RoadSmart 21) |

### 13.5 Dimensions and weight

| Specification                       | Value              |
|-------------------------------------|--------------------|
| Dimensions (height x width x depth) | 110 x 200 x 100 mm |
| Weight RoadSmart                    | Approx. 1700 g     |

### 13.6 Measuring range and accuracy

#### Road surface temperature

| Specification       | Value            |
|---------------------|------------------|
| Measurement process | Optical          |
| Measuring range     | -40 °C to +70 °C |
| Resolution          | 0.1 °C           |
| Accuracy            | +/-0.8 K at 0 °C |
| Sampling rate       | 0.1 second       |
| Units               | °C; °F           |

#### Road condition

| Value | Road state         |
|-------|--------------------|
| 0     | Dry                |
| 1     | Damp               |
| 2     | Wet                |
| 3*    | Ice-covered        |
| 4*    | Snow / ice-covered |
| 5*    | Chemically wet     |
| 6*    | Water + ice        |
| 8*    | Snow covered       |
| 99    | Undefined          |

\*Only indication of road condition.

#### Dew point temperature

| Specification       | Value   |
|---------------------|---|
| Measurement process | Passive, calculated out of air temperature and humidity |
| Measuring range     | -50 °C to + 60 °C                                       |
| Resolution          | 0,1 K   |

#### Water film height

| Specification       | Value   |
|---------------------|---------|
| Measurement process | Optical |

| Specification   | Value        |
|-----------------|--------------|
| Measuring range | 0 to 500 µm* |
| Resolution      | 0.1 µm       |
| Sampling rate   | 0.01 second  |

\*All displayed values above 500 µm are only indications of higher water films. The maximum reported range is 6 mm.

### Relative humidity at road temperature

| Specification       | Value   |
|---------------------|---|
| Measurement process | Passive, calculated out of absolute air humidity and road surface temperature |
| Measuring range     | 0 to 100 %  |
| Accuracy            | 0.1 %   |
| Sampling rate       | 1.0 second  |

### Relative humidity

| Specification       | Value      |
|---------------------|------------|
| Measurement process | Capacitive |
| Measuring range     | 0 to 100 % |
| Resolution          | 0.1 %      |
| Accuracy            | 3 %        |
| Sampling rate       | 1.0 second |

### Friction

| Specification   | Value       |
|-----------------|-------------|
| Measuring range | 0 to 1 µ    |
| Resolution      | 0.01        |
| Sampling rate   | 0.01 second |

The friction value is based on an internal model. The values are only indicators and can not replace e.g. grip tester values.

### Ice percentage

| Specification   | Value      |
|-----------------|------------|
| Measuring range | 0 to 100 % |
| Resolution      | 1 %        |
| Sampling rate   | 0.1 second |

The ice percentage is only an indication of ice.

## Snow height

| Specification       | Value   |
|---------------------|---------|
| Measurement process | Optical |

The values of the snow height are only indicators with an undefined uncertainty.



Contact Information

