OTT HydroMet

Lufft

an OTT HydroMet brand

MARWIS Mobile Advanced Road Weather Information Sensor

Operational Manual

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Table of contents

1 Scope of supply

The following items are included with delivery:

– Mobile Advanced Road Weather Information Sensor (MARWIS)

2 Order numbers and variant code

2.1 Product variants

Variant	Order number
MARWIS-UMB, 1 m (3 1/4 ft) distance to the ground	8900.U03
MARWIS-UMB, 2 m (6 1/2 ft) distance to the ground	8900.U04
MARWIS-UMB, 0.5 m (1 3/4 ft) distance to the ground	8900.U05

2.2 Accessories and spare parts

Item	Order number
Protective housing short (recommended for mounting on passenger car)	8900.G01
Protective housing long (recommended for mounting on lorry)	8900.G02
Assembly kit magnetic bar carrier (horizontal)	8900.G01H
Assembly kit magnetic bar carrier (vertical)	8900.G01V
Additional magnetic fastener for 8900.G01H or 8900.G01V	8900.G01M
Lufft sensor cable 15 m	8371.UK015
Connection cable 5 m (with 12 V car adapter for cigarette lighter)	8900.UK05
Connection cable 10 m (with 12 V car adapter for cigarette lighter)	8900.UK10
Connector without cable	8371.UST1
Temperature humidity sensor	8900.UTFF
MARWIS hitch carrier	8900.MHC
MARWIS cloud gate modem	8900.MOD
MARWIS cloud gate box	8900.Box-US

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:

- 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 the operating 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.

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 mobile advanced road weather information senor (MARWIS-UMB) is used to measure various values to determine the corresponding road conditions. The sensor is mounted on vehicles.

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.
- The operational manual is part of the product, forward the operational manual together with the product.

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.

4.8 Installation and maintenance on a vehicle

When the device is installed and maintained on a vehicle, special safety measures must be taken to avoid personal injury.

- Observe and follow the local safety regulations.
- Use suitable safety equipment.
- Inspect the safety equipment before use.
- Secure the device to ensure it doesn't fall during the installation process.

4.9 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.

4.10 Certification

4.10.1 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.

> 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.

> La modification ou les changements non autorisée à cet équipement de communication sans fil annuleront la droite pour I'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

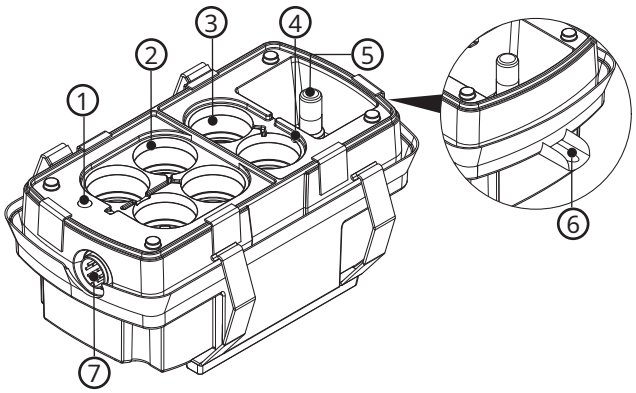
5 Product description

5.1 Design and function

The meteorological network sensors are used for road weather monitoring. The device measures the surface temperature, ambient temperature and humidity, relative humidity at surface temperature, water film height and snow height on the road by means of non-invasive optical spectroscopy and a pyrometer. Thus the device can be used for the acquisition of a variety of measurement variables to determine the corresponding road conditions relevant for winter maintenance services.

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	5	Temperature-humidity-sensor
2	Transmitters	6	Lateral temperature sensor
3	Receivers	7	Connection plug
4	Status-LED		

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	– Device status OK – Infrared measurement active
Blue	– Device status OK – Infrared measurement active, active Bluetooth connection
Yellow	– Device status OK – Error in infrared measurement (e.g. operating temperature has not yet been reached in the warm-up phase) – The status channel *measurement status* provides detailed information about the type of error
Magenta	– Firmware update active

Color	Description
	– Do not separate sensor from power supply!
Red	– Device error – The status channel *device status* provides detailed information about the type of error
Blinking (any color)	– Data transfer is currently taking place

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

- 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

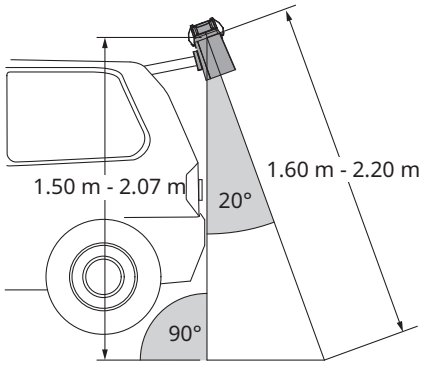
The following tools and aids are required:

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

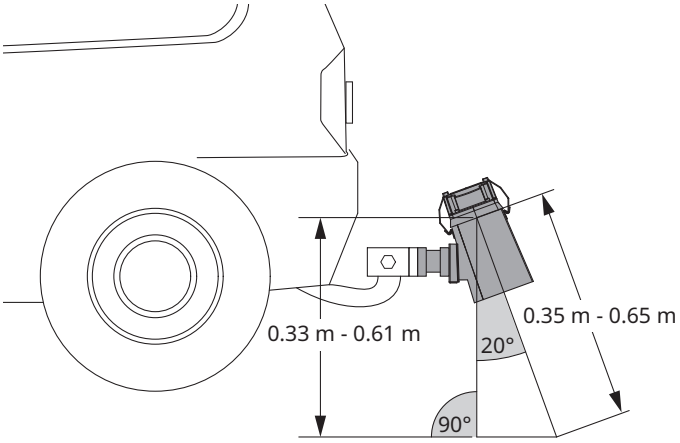
7.1.2 Preparing installation

- 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
- The device should not be affected by heat from exhaust fumes of the vehicle
- The device should not be installed straight above the tyres since the risk of spume soiling of the device's glass front is elevated which could affect the measurement of the water film height

7.1.3 Installing device



Example: Mounting 8900.U04 with short protective housing at an angle of 20°



Example: Mounting 8900.U05 on the hitch carrier

- Install the device on a vehicle, either on top or on the hitch carrier.

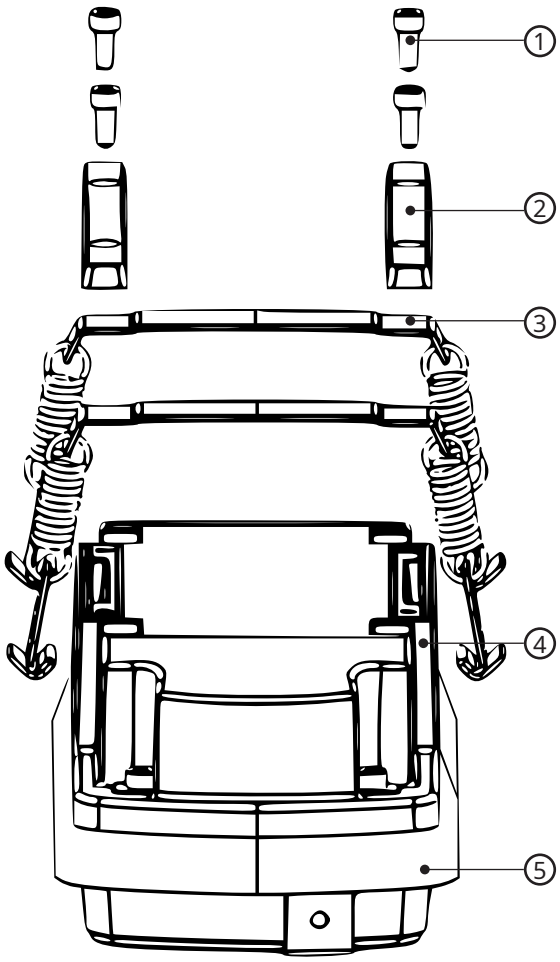
- Keep the distance between the sensor glass and the road surface in the range listed in the table below.
- Align the sensor with the road with the inclination angle of 20° or 10°, depending on the housing, see following table:

Value	8900.U03, short protective housing, angle 20°	8900.U04, short protective housing, angle 20°	8900.U05, short protective housing, angle 20°	8900.U03, long protective housing, angle 10°	8900.U04, long protective housing, angle 10°
Minimal height	75 cm (29 ½ in)	150 cm (59 in)	33 cm (13 in)	79 cm (31 ⅛ in)	157 cm (62 in)
Measuring distance minimal height	80 cm (31 ½ in)	160 cm (63 in)	35 cm (13 ¾ in)	80 cm (31 ½ in)	160 cm (63 in)
Ideal height	96 cm (37 ¾ in)	188 cm (74 in)	47 cm (18 ½ in)	98 cm (38 ⅝ in)	197 cm
Measuring distance ideal height	100 cm (39 ⅜ in)	200 cm (78 ¾ in)	50 cm (19 ¾ in)	100 cm (39 ⅜ in)	200 cm (78 ¾ in)
Maximum height	141 cm (55 ½ in)	207 cm (81 ½ in)	61 cm (24 in)	148 cm (58 ½ in)	217 cm
Measuring distance maximum height	150 cm (59 in)	220 cm (86 ⅝ in)	65 cm (25 ⅝ in)	150 cm (59 in)	220 cm (86 ⅝ in)

Note: The tolerance which still allows for plausible measurement values amounts to -20 cm / +50 cm (-8 in / + 19 ¾ in) in case of instrument 8900.U03, -40 cm / +20 cm (-15 ¾ in / +8 in) for instrument 8900.U04.

7.1.4 Mounting device

The protective housing must be connected to the device.



1	Screws	4	MARWIS-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

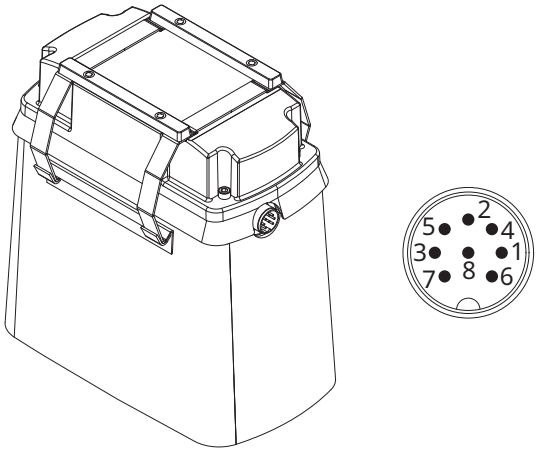
WARNING

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 cable shielding is connected to the chassis of the vehicle.
- Ensure that the MARWIS-UMB 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 ± and the maximum is 28 V DC. Operation with a supply voltage of 24 V DC is recommended.

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. If a connection cable 5 m for cigarette lighter (with 12 V) is used, it is advised to install a DC converter close to the sensor to prevent the sensor from freezing in very cold environment.

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).

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

> 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. Extented CAN-IDs (EID) are used.

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

> Further information on the CAN protocol can be found in the chapter CAN protocol [▸ 22].

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 MARWIS-App is installed on your device and connected to the MARWIS-UMB.
- ▸ In the MARWIS-App, select a road condition model when configurating your MARWIS-UMB.
- ⇨ 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 separately for each vehicle.

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

- ✓ The MARWIS-UMB is installed in the planned position on the measuring vehicle.
- ✓ The adaptation takes place on a dry stretch of road.
- ✓ The vehicle is stationary during the adaptation.
- ✓ The ambient temperature is below 30 °C (85 °F).
- ✓ The adaptation is carried out in natural light.
- ✓ The MARWIS-UMB has been switched on for about 5 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 MARWIS-UMB in the same network has received its own device ID.
- ✓ The selected road surface for the adaptation represents the area where the MARWIS-UMB 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 MARWIS-UMB and the road.
- ▸ Optionally, you can save your profile of the adaption in the MARWIS-UMB. Up to 5 different profiles can be stored.

When saving different profiles, name them in a way that reflects relevant conditions. For example, including the vehicle name or licence plate in the profile can provide insights into the installation height during the adaptation.

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

In vehicles with a stop-start system, the cigarette lighter loses power during startup. If the MARWIS-UMB is powered from the cigarette lighter, this may cause a reset and lead to data gaps.

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
- 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.

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.

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 MARWIS-UMB	0,1 s
Deicer	NaCl
Road condition model	AVG

If several MARWIS-UMB 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 MARWIS-UMB.

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 [▶ 25]. 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 [▶ 26].

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 Data error	–	–	Road temperature: no valid value
0x000	1	0x00258	0	6	0x00	0x16 (4 Bytes)	0x00 0x00 0x00 0x00	Water film height is 0
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**	**00**0000 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 0x00 0x00	The water film height is transmitted once every 100 ms (100d = 0x64h)
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.

<status>	Define	Description
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	±1.18E-38 ... ±3.39E+38 (7 digits)
17h (23d)	double	DOUBLE*	8	±2.23E-308 ... ±1.79E+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.

NOTICE

Damage due to leaving sensor attached while washing your car!

If you leave the MARWIS-UMB attached to your car while using a car wash or a pressure washer, it may cause damage to the housing or the optical parts.

- Don't pressure wash the MARWIS-UMB.

- 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 regulary 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.
- Install the update on a Windows® PC.

> 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. ▸ Check the power supply. ▸ 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. ▸ 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
- Prolonged disruptions (such as markings, tar joints, manhole covers, etc.) caused by the vehicle being stationary
- Extreme rainfall
- Cast shadow (in sunny weather, shadow e.g. from trees, quick alternation between sunny and shady locations)

– Heat from exhaust fumes
– Dirt on the MARWIS-UMB glass pane, e.g. from spray on wet roads
– Very dark road surface (select surface type *new blacktop* in the MARWIS-UMB)

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
- Include the following information:

– instrument model
– instrument serial number
– details of the fault or problem
– examples of data files
– readout device or data acquistion system
– interfaces and power supplies
– history of any previous repairs or modifications
– pictures of the installation
– overview of the local environment conditions

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	8900.U03: 1 m, tolerance: 0.80 to 1.50 m 8900.U04: 2 m, tolerance: 1.6 to 2.20 m 8900.U05: 0.5 m, tolerance: 0.35 to 0.65 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 Electrical data

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

13.3 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^2 (MARWIS-UMB)

13.4 Dimensions and weight

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

13.5 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

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
Measuring range	0 to 6 mm
Resolution	0.1 µm
Accuracy	+/-20 % 0 to 6 mm water film height on sleek ground*
Sampling rate	0.01 second

*Tests for checking water film height can be conducted on even ground made from sleek, non-water absorbent material with at least 50% reflectivity. The test area should be at least 25 x 25 cm, with a distance of 1-2 m from the MARWIS-UMB.

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 % at 40 km/h
Sampling rate	1.0 second

Ambient temperature

Specification	Value
Measurement process	NTC
Measuring range	-40 °C to + 70 °C
Resolution	0,1 K
Accuracy	+/-0,5 °C from 40 km/h on
Sampling rate	1.0 second

Friction

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

Ice percentage

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

Snow height

Specification	Value
Measurement process	Optical
Measuring range	0 to 50 mm

Specification	Value
Resolution	0.01 mm
Sampling rate	0.1 second

OTT HydroMet

Contact Information