USER Manual **MARWIS**

Mobil
Advanced
Road
Weather
Information
Sensor

· a passion for precision · passion pour la précision · pasión por la precisión · passione per la precisione ·

www.lufft.com

Lufft

Contents

1 Read before use

Please read this Operating Manual carefully and keep it handy for future reference. Please note that various components of the sensor and the described software may look somewhat different from those shown in the illustrations in this operating manual.

1.1 Used symbols

Important information about potential hazard to the user

Important information concerning the correct operation of the equipment

1.2 Safety instructions

- Installation and commissioning must only be carried out by suitably qualified specialist personnel.
- Never take measurements on or touch live electrical parts.
- Pay attention to the technical data, storage and operating conditions.

1.3 Designated use

- The equipment must only be operated within the range of the specified technical data.
- The equipment must only be used under the conditions and for the purpose for which it was designed.
- The equipment must not be modified or altered in its construction; otherwise, operational safety and correct functioning cannot be guaranteed.

1.4 Incorrect use

If the equipment is not correctly installed

- it may function in a limited way or not funcion at all
- it may entail a risk of injury by falling down

Note: The driver is liable for securing his vehicle's load.

If the equipment is not correctly connected

- it may not function
- it may be permanently damaged
- it may entail the risk of an electrical shock

1.5 Guarantee

The guarantee applies for 12 months from date of delivery. The guarantee will not apply if the designated use is violated.

1.6 Brand names

All brand names referred to are subject without limitation to the valid trademark and ownership rights of the respective owner.

2 Scope of delivery

The delivery contains the following components:

MARWIS-UMB	
	Illustration 1: Marwis-UMB
Cable / Plug	Connection cables and plugs have to be ordered seperately. You will find the part numbers in chapter 3.2 Accessories or on our homepage www.lufft.com
Protective housing	In order to protect the MARWIS-UMB from pollution it has to be used in any case with one of the two available protective housings. The respective protective housing has to be ordered seperately. The part numbers will be found in chapter 3.2 Accessories or on our homepage www.lufft.com.
Operating Manual	

3 Part numbers

3.1 MARWIS-UMB

8900.U01.....MARWIS-UMB for 1 m (3 ¼ ft) measuring distance to the ground

8900.U02..... MARWIS-UMB for 2 m (6 ½ ft) measuring distance to the ground

3.2 Accessories

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
Connection cable, 15 m (49 ¼ ft) 8371.UK015
Connection cable, 5 m (16 ⅜ ft) with 12V car adapter for cigarette lighter.....8900.UK05
Plug without cable[1].....8371.UST1

3.3 Spare parts

Temperature humidity sensor.....8900.UTFF

3.4 Additional documents and software

You can download the following documents and software from the internet on www.lufft.com:

- Operating Manual.....this document
- UMB-Protocol.....Communication protocol for UMB devices
- Fimware.....latest firmware for the equipment

MARWIS App can be downloaded from the iTunes

1 Communication has been tested at a maximum cable length of 15m (49 ¼ ft) with a bit rate of 115200 baud

4 Equipment description

In accordance with the demands on road traffic meteorological network sensors are mounted on vehicles. MARWIS-UMB for the detection of water, ice, snow and friction can be installed on vehicles. The distance between the sensor and the road must be either 1 m or 2 m (3 ¼ ft or 6 ½ ft)

The device works with infrared measuring. Four emitting and two receiving diodes capture the reflecting behaviour of the road surface at varying wave lengths. Due to the different spectral properties of various substances – e.g. water and ice – the road state can be deduced from the captured values.

MARWIS-UMB delivers values for road temperature, dew point temperature, relative humidity at road temperature, water film height, road state, ice percentage and friction.

With an increasing number of ice particles on the road surface the friction coefficient falls and can thus be of important help when deciding about preventive gritting.

Due to the open interface protocols, MARWIS-UMB can be easily integrated into existing winter maintenance monitoring networks. Similarly, MARWIS-UMB can communicate directly with the control system of gritting vehicles.

The measurement data output supports the following protocols: UMB binary.

4.1 Road surface temperature

The road surface temperature is measured with a non-invasive pyrometer which is fullly integrated into the sensor.

4.2 Dew point temperature

The dew point temperature is the temperature where the current partial water vapour pressure equals the saturated vapour pressure, which means that condensation sets in e.g. in the form of fog.

4.3 Relative humidity at road temperature

The calculation of the relative humidity at road temperature is based on the absolute humidity and the road temperature. It can be used as an indicator for impending formation of dew or hoarfrost.

4.4 Water film height

The water film height on the road surface is measured with a non-invasive optical spectroscopy. The water film height indicates the proportion of liquid water.

4.5 Road condition

The road condition is determined from the measurement of water film height, road surface temperature and ice percentage. The sensor deduces the road conditions of dry, damp, wet, snow / ice as well as critical and chemical wetness.[2].

The values which are supposed to be used in the calculation of the road condition can be set, e.g. highest, lowest or average road temperature of the last covered road section. For this purpose, predefined settings are available for selection.

2 The road condition model is subject to constant improvement. Please check regularly on the availability of firmware updates.

4.6 Ice percentage

With the data from the optical spectroscopy the frozen part of the aqueous solution on the road is determined and delivered as ice percentage.

4.7 Friction

Friction describes the adhesion of tyres on the road surface. This can be reduced due to ambient conditions such as rain or snow. The value of the friction is scaled between 0.1 and 1.0. High values indicate high adhesion, low values stand for low adhesion. The highest value (1.0) will be achieved when the road is dry whereas the lowest result (0.1) will come up with water on ice.

Note: The grip of a road is determined basically by the consistency of its surface. The friction value of the MARWIS-UMB indicates to which degree the maximum possible grip of a specific road is reached, respectively how much it has been reduced by ambient conditions.

Therefore, identical friction values of the MARWIS-UMB on different road surfaces mean different grip.

4.8 Sensor technology MARWIS-UMB

Illustration 2: MARWIS-UMB Components

4.9 Status-LED

The device is equipped with a status LED which indicates the current state of the MARWIS-UMB. A blinking LED in any colour means that UMB data transfer is taking place through RS485 or Bluetooth.

Meaning of the LED colours:

Colour	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 nature of the error.

Colour	Description
Magenta	Firmware update active; Don't separate sensor from power supply!
Red	Device error The status channel “device status“ provides detailed information about the nature of the error.
Blinking	Data transfer is taking place.

5 Generation of measurements

5.1 Current measurement (act)

In accordance with the specified sampling rate, the value of the last measurement is transmitted when the current measurement value is requested.

In order to suppress disturbances which can occur in a mobile operation the measured values in the MARWIS-UMB are filtered over a configurable period of time. Examples for disturbances which can influence the result are described in chapter 17.2, on page 35 of this document.

6 Operation modes

6.1 Normal operation

The MARWIS-UMB is switched on and off by connecting and disconnecting the power supply.

After being switched on it takes a starting time of about 10 seconds before the first measurement values appear. Depending on the operating temperature a warm up phase of up to 5 minutes may be required before the first plausible values appear. The state of readiness is indicated by the status LED turning green or blue respectively in case the Bluetooth connection is active. The meanings of the status LED's colours are described in chapter 4.9 on page 9.

7 Measurement output

The measured values are delivered in the UMB binary protocol. You can find an example for a data retrieval and the complete overview of the UMB channels in the appendix.

7.1 Measurements

7.1.1 Road Surface Temperature

Sampling rate.....< 1 second

Units.....ºC; ºF

Channels:

UMB Channel	Measurement variable (float32)	Measuring range		
		min	max	unit
100	Road surface temperature	-40.0	70.0	ºC
105	Road surface temperature	-40.0	158.0	ºF

7.1.2 Dew point temperature

Sampling rate.....< 1 second

Units.....ºC; ºF

Channels:

UMB Channel	Measurement variable (float32)	Measuring range		
		min	max	unit
120	Dew point temperature	-50.0	60.0	ºC
125	Dew point temperature	-58.0	140.0	ºF

7.1.3 Relative humidity at road temperature

Sampling rate.....< 1 second

Units.....% r.h.

Channels:

UMB Channel	Measurement variable (float32)	Measuring range		
		min	max	unit
200	Relative humidity at road temperature	-0.0	100.0	%

7.1.4 Water film height

Sampling rate.....100 Hz

Units.....µm, mil

Channels:

UMB Channel	Measurement variable (float32)	Measuring range		
		min	max	unit
600	Water film height	0.0	6000.0	µm
605	Water film height	0.0	78.7	mil

7.1.5 Road condition[3]

Sampling rate.....100 Hz

Units.....logic coding

Channels:

UMB Channel	Measurement variable (uint8)	Coding
900	Road condition	0 dry 1 damp 2 wet 3 ice-covered 4 snow-/ice-covered 5 chemically wet 6 critically wet 8 snow-covered 99 undefined

dry:	no liquid water on the road; water film height below damp threshold
damp:	liquid water on the road; water film height below wet threshold
wet:	liquid water on the road; water film height on or above wet threshold
ice-covered:	frozen water on the road mainly in the form of ice
snow- / ice-covered:	frozen water on the road either in the form of ice or snow; a more precise differentiation is not possible
chemically wet:	the water film height is on or above the damp threshold and the road surface temperature is below 1.5°C (34.7 °F); the formation of ice is inhibited by the presence of de-icing chemicals
critically wet:	water film height is on or above the damp threshold and the road surface temperature is below 1.5°C (34.7 °F) with the formation of ice particles starting;
snow-covered:	frozen water on the road mainly in the form of snow

3 The road condition model is subject to constant improvement. Please check regularly on the availability of firmware updates.

7.1.6 Ice percentage

Sampling rate.....100 Hz

Units.....%

Channels:

UMB Channel	Measurement variable (float32)	Measuring range		
		min	max	unit
800	Ice Percentage	0.0	100.0	%

7.1.7 Friction

Sampling rate.....100 Hz

Units.....none

Channels:

UMB Channel	Measurement variable (float32)	Measuring range		
		min	max	unit
820	Friction	0.0	1.0	none

8 Mounting

8.1 Hints for mounting

The mounting of the MARWIS-UMB on the vehicle must be fit to be used on the road.

The protective housings 8900.G01 and 8900.G02 are supposed to protect the sensor from turbulences and dirt which could impair the measurement. They do not affect the measuring distance which has to be measured in any case between the sensor face and the road.

It has to be made sure that the field of view of the MARWIS-UMB is directed to the road and not interrupted by vehicle parts. The zone that would be covered if the side parts of the protective housing were extended down to the road should be free of obstacles. The inclination angle of the MARWIS-UMB towards the road must correspond to the one which is given by the protective housing (see illustrations in chapter 15.3).

The MARWIS-UMB should be installed in a way that ensures it cannot be affected by heat from the exhaust fumes of the vehicle.

It should be avoided installing the MARWIS-UMB straight above the tyres track since in this position the risk of spume soiling the glass front of the MARWIS-UMB is elevated which could in turn affect the measurement of the water film height.

8.2 Mounting height

The measuring distance of 1 m or 2 m (3¼ ft or 6½ ft) which is indicated for the 2 MARWIS-UMB types refers to the distance from the sensor front (glass) to the road. This measuring distance should be observed as exactly as possible. The tolerance which still allows for plausible measurement values amounts to -20 cm / +50 cm (-8 in / + 19¾ in) in case of instrument 8900.U01 and -40 cm / +20 cm (-15¾ in / +8 in) for instrument 8900.U02. A more detailed description will follow in the next chapters.

8.2.1 8900.U01, Mounting with short protective housing, angle 20º

Minimal height.....75 cm…(29 ½ in).....measuring distance .....80 cm. .(31 ½ in)
Ideal height.....96 cm…(37 ¾ in).....measuring distance .....100 cm. .(39 ⅜ in)
Maximum height.....141 cm…(55 ½ in).....measuring distance .....150 cm.....(59 in)

8.2.2 8900.U02, Mounting with short protective housing, angle 20º

Minimal height.....150 cm.....(59 in).....measuring distance.....160 cm.....(63 in)
Ideal height.....188 cm.....(74 in).....measuring distance .....200 cm. .(78 ¾ in)
Maximum height.....207 cm…(81 ½ in).....measuring distance .....220 cm. .(86 ⅝ in)

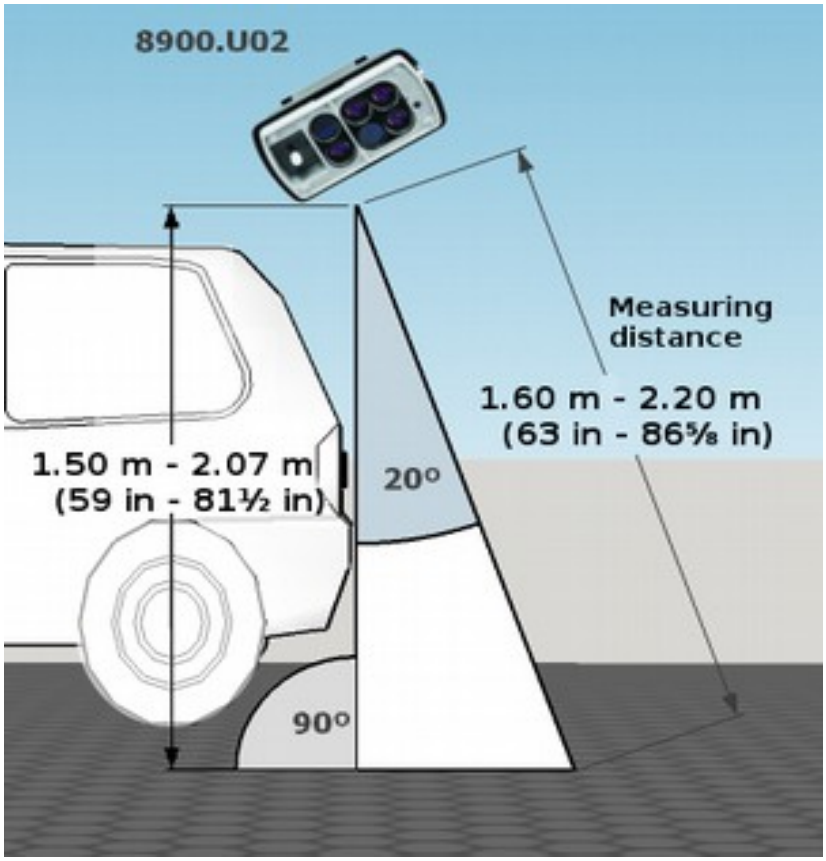


Illustration 3: 8900.U02 Mounting at an angle of 20°

8.2.3 8900.U01, Mounting with long protective housing, angle 10°

Minimal height.....79 cm…(31 ⅛ in).....measuring distance .....80 cm. .(31 ½ in)
Ideal height.....98 cm…(38 ⅝ in).....measuring distance .....100 cm. .(39 ⅜ in)
Maximum height.....148 cm…(58 ½ in).....measuring distance .....150 cm.....(59 in)

8.2.4 8900.U02, Mounting with long protective housing, angle 10°

Minimal height.....157 cm.....measuring distance .....160 cm.....(63 in)
Ideal height.....197 cm.....measuring distance .....200 cm. .(78 ¾ in)
Maximum height.....217 cm.....measuring distance .....220 cm. .(86 ⅝ in)

8.3 Protective housing

The protective housing is supposed to protect the MARWIS-UMB from dirt and turbulences. Furthermore it is equipped with a flange which can be used for fixing it.

8.3.1 Connecting the MARWIS-UMB to the protective housing

Loosen the screws on the upper side of the MARWIS-UMB and take off the plastic stripes.

Illustration 4: Loosen screws on MARWIS-UMB housing

Illustration 5: Preparation for connecting the protective housing

Illustration 6: Fixing stripes and screws

The delivery of the protective housing includes 2 clamp straps for fixing it to the MARWIS-UMB.

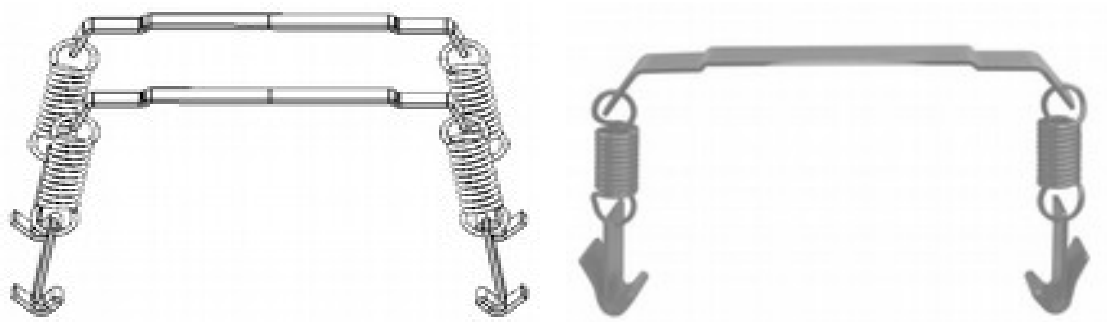


Illustration 7: clamp strap

Place the clamp straps that have come with the protective housing on the MARWIS-UMB so that the profiles of the two clamp straps fit in neatly with the dents on the upper side of the MARWIS-UMB.

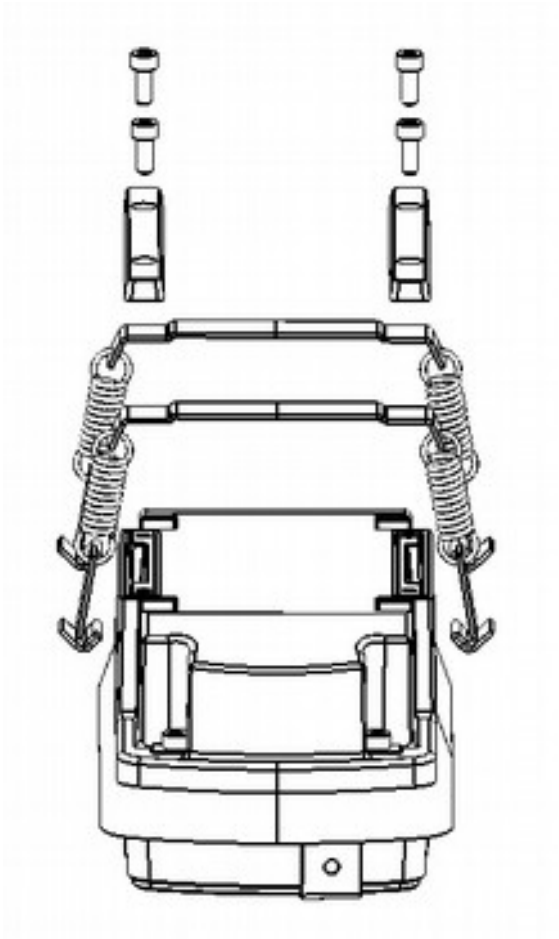


Illustration 8: Placing the clamp straps

Illustration 9: Placing the clamp straps

Mount the plastic bars of the clamping device on the MARWIS-UMB; insert the screws and tighten them.

Illustration 10: Fixing the clamp straps

Illustration 11: Insert screws

Illustration 12: Tighten screws

Put the MARWIS-UMB on the protective housing so that the ends of the clamp straps come close to the hitch of the housing.

Illustration 13: Hitch on protective housing

Illustration 14: Set MARWIS-UMB on protective housing

Press the clamp straps with a screw driver towards the protective housing until they catch the hitch. Now the MARWIS-UMB is connected to the protective housing. First fasten one clamp strap on both sides, then other one.

Illustration 15: Fasten clamp straps with a screw driver

Illustration 16: Fasten clamp straps with a screw driver

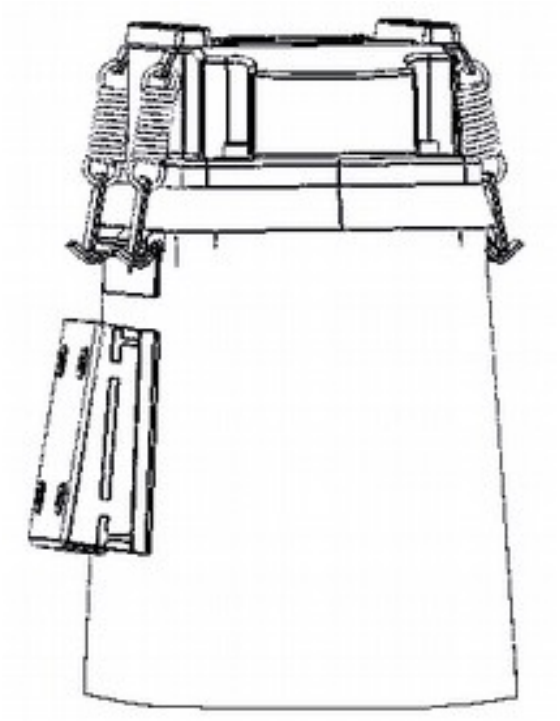


Illustration 17: Protective housing connected

Illustration 18: clamp straps latched

Removing the MARWIS-UMB from the protective housing is easily done by again inserting a

screw driver into the ears of the clamp straps. By pressing outwards downwards the connection can be opened.

8.4 Example: Mounting with magnetic bar carrier for horizontal installation and short protective housing

Illustration 19: Mounting on passenger car

Illustration 20: Mounting on passenger car

8.5 Example: Mounting with magnetic bar carrier for vertical installation and long protective housing

Illustration 21: Vertical mounting (door of a van)

8.6 Mounted correctly?

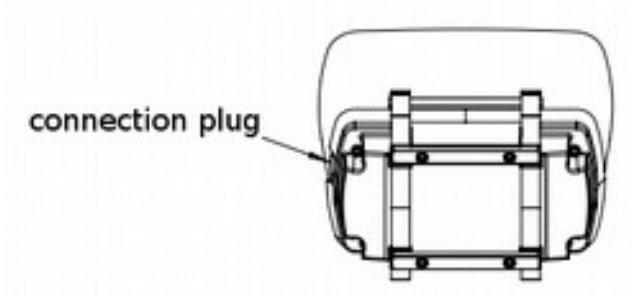
Send us a photo of your MARWIS-UMB installation to myMARWIS@lufft.com. The MARWIS-UMB team will have a look and send you feedback.

9 Connections

The MARWIS-UMB housing is equipped with an 8-pole screw plug socket which serves for connecting the supply voltage and the RS485 interface. The connection cable has to be ordered seperately in the desired length (5 or 15 meters / 49 ¼ ft or 16 ⅜ ft).

9.1 Connection plug

Ill. 22: 8-pole socket



Ill. 23: Connection plug

Ill 24: View on solder connection of the cable socket

9.2 Pin assignment

1	pink	
2	yellow	RS485_B
3	grey	
4	red	
5	green	RS485_A
6	blue	
7	white	negative supply voltage
8	brown	positive supply voltage

Note: The shielding of the MARWIS-UMB connection cable has to be connected to the chassis of the vehicle.

Note: The MARWIS-UMB has to be protected with a 5 A fuse

9.3 Supply voltage

The sensor is powered by direct current voltage of 12 – 28 VDC.

With temperatures below -10°C (14 °F) and a power supply of 12V a 12v to 24Vstep up converter should be used in order to allow for the necessary heating performance.

9.4 RS485-interface

The device is equipped with a half duplex 2 wire RS484 interface for configuration, measurement retrieval and firmware update.

The sampling rate can be adjusted in steps of 0.1 s to values between once per 0.1 s and once every 5 seconds. If the data are not retrieved more often than once per second the bit rate of 19200 baud will usually be sufficient. If the sampling rate is higher than that a baud rate of 115200 is recommended.

9.5 Bluetooth connection

For setting up a Bluetooth connection follow the instructions of the producer of the device to which you want to connect the MARWIS-UMB (iPad, Windows-PC...)

Then look for your MARWIS-UMB in the Bluetooth settings. It will register with the first two sections of its serial number.

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.

10 Commissioning

10.1 Adaption of the sensor

In order to prepare the sensor correctly for the conditions of the surface to be measured (road or tarmac), the unit has to go through an adaptation procedure prior to commissioning.

To this end, the MARWIS-UMB has to be installed on the measuring vehicle in the planned position. The adaption must take place on a dry piece of road and ist carried out on a stationary vehicle, i.e. not while moving.

The road cover which is selected for the adaption should be representative for the area in which the MARWIS-UMB is going to be used.

The ambient temperature should be lower than 20°C (68 °F). The adaption must not be carried out in artificial light.

The measurement may contain errors, if the adaption has not been carried out correctly.

The profile of the adaption can be saved in the MARWIS-UMB. Up to 10 different profiles can be stored.

During the adaption, 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. Therefore, when saving different profiles it makes sense to give them names which allow conclusions on these conditions. E.g. mentioning the vehicle in the profile name can allow conclusions about the installation height during the adaption.

10.1.1 Possible reasons why an adaption may fail

- The ambient temperature exceeds 30 °C (86 °F). In this case the LEDs may become to warm for carrying out a successful adaption.
- The MARWIS-UMB had not been switched on long enough before the adaption was started. About 5 minutes of warm-up time is necessary.
- The ground is not suitable for the adaption (too bright, too dark....)

10.2 Selecting the settings for the road condition model

While measuring MARWIS-UMB detects the ambient conditions with a frequency of up to 100 Hz, i.e. one measured value every 10 ms. Some of these values are filtered out for the suppression of disturbances (see chapter 17.2 page 35). However, at the end of each measuring cycle more values have been gathered than are actually displayed. The frequency of the measurement output can be adjusted between one value every 100 ms and one value every 5 s.

The settings for the road condition model determine if the interpretation of the current conditions is supposed to be subject to a rather optimistic, pessimistic or neutral point of view. Depending on these settings the values which are selected for the next measurement retrieval will be either the maximum, minimum or average values that have been measured on the covered distance.

Selecting the lowest measured road temperature in combination with the highest values of water film and ice percentage on a trip in winter e.g. would correspond to a rather pessimistic point of view which aims at showing the highest possible risk on a road section.

The values which are selected in the settings for the retrieval of the individual values, are also the ones which are used for calculating road condition and friction.

6 presets are available for selection:

No.	Preset	Road temperature	Water film height	Ice Percentage
0	AVG[4]	Average	Average	Average
1	Winter 1	Minimum	Maximum	Maximum
2	Winter 2	Average	Average	Maximum
3	Winter 3	Minimum	Average	Maximum
4	Summer 1	Average	Maximum	Minimum
5	Summer 2	Average	Average	Minimum

10.2.1 Illustration of how the road condition is determined

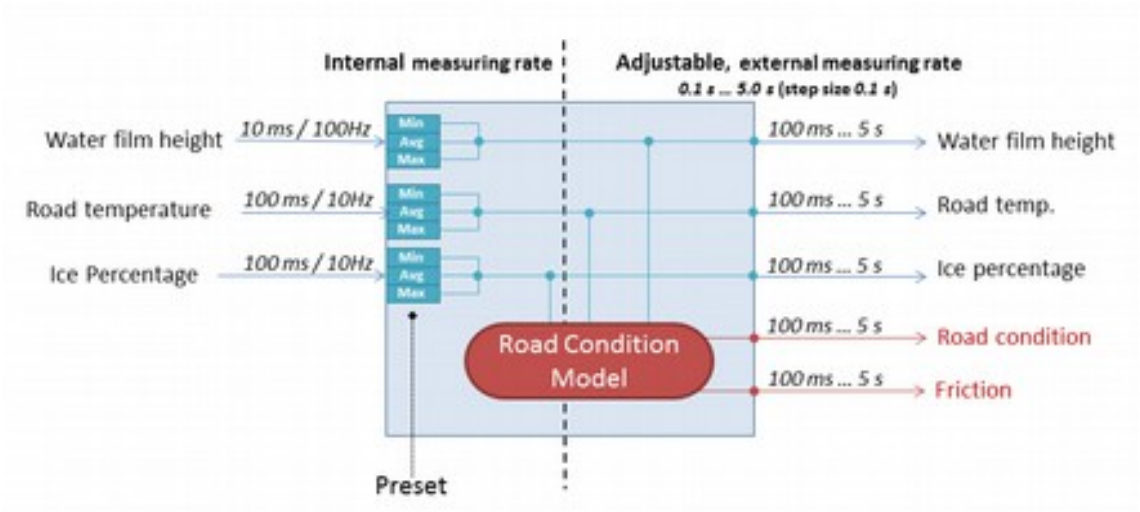


Illustration 25: Settings of the road condition model

10.3 Important hints prior to commissioning

Please adhere to the following points:

- Acquaint yourself with the functionality of the UMB Config Tool and the MARWIS-App respectively.
- Do not switch on the power supply before the installation has been completed.
- Restarting the MARWIS-UMB after the adaption will not influence the measurements. The latest used adaption profile will be reloaded automatically.
- In a vehicle with a stop-start system the cigarette lighter is usually left without power supply during the starting process. If the MARWIS-UMB receives its power supply from the cigarette lighter in such a car, it will in this case carry out a reset which may lead to data gaps.
- If several MARWIS-UMB are used in the same network, each instrument must receive its own device ID.

4 Factory setting

11 Carrying out the sensor adaption

11.1 Adaption with the iPad MARWIS-App

The adaption of the sensor can be carried out with the MARWIS-App on the iPad. The exact proceeding is described in the app manual / help.

12 Configuration and test

Lufft provides a Windows® PC software (UMB Config Tool) for configuration purposes. The sensor can also be tested and the firmware updated with the aid of this software.

12.1 Factory Settings

The sensor is deliverd with the following settings:

Class ID:.....10 (cannot be modified)

Device-ID:.....1 (gives address A001h = 40961d)

Baud rate:.....19200

RS485 protocol:.....UMB binary

Water film damp threshold:.....10 µm

Water film wet threshold:.....100 µm

Note: the device ID must be changed if several MARWIS-UMB are operated in one UMB network since each device requires a unique ID. It makes sense to start from ID 1 and continue in ascending order.

12.2 Configuration with the UMB Config Tool

The operation of the UMB Confit tool is described in detail in te operating instructions for the Windows® PC software. For this reason only the menus and functions specific to this sensors are described here.

12.2.1 Sensor selectoin

This mobile road sensor is displayed in the sensor selection as MARWIS-UMB (Class ID 10)

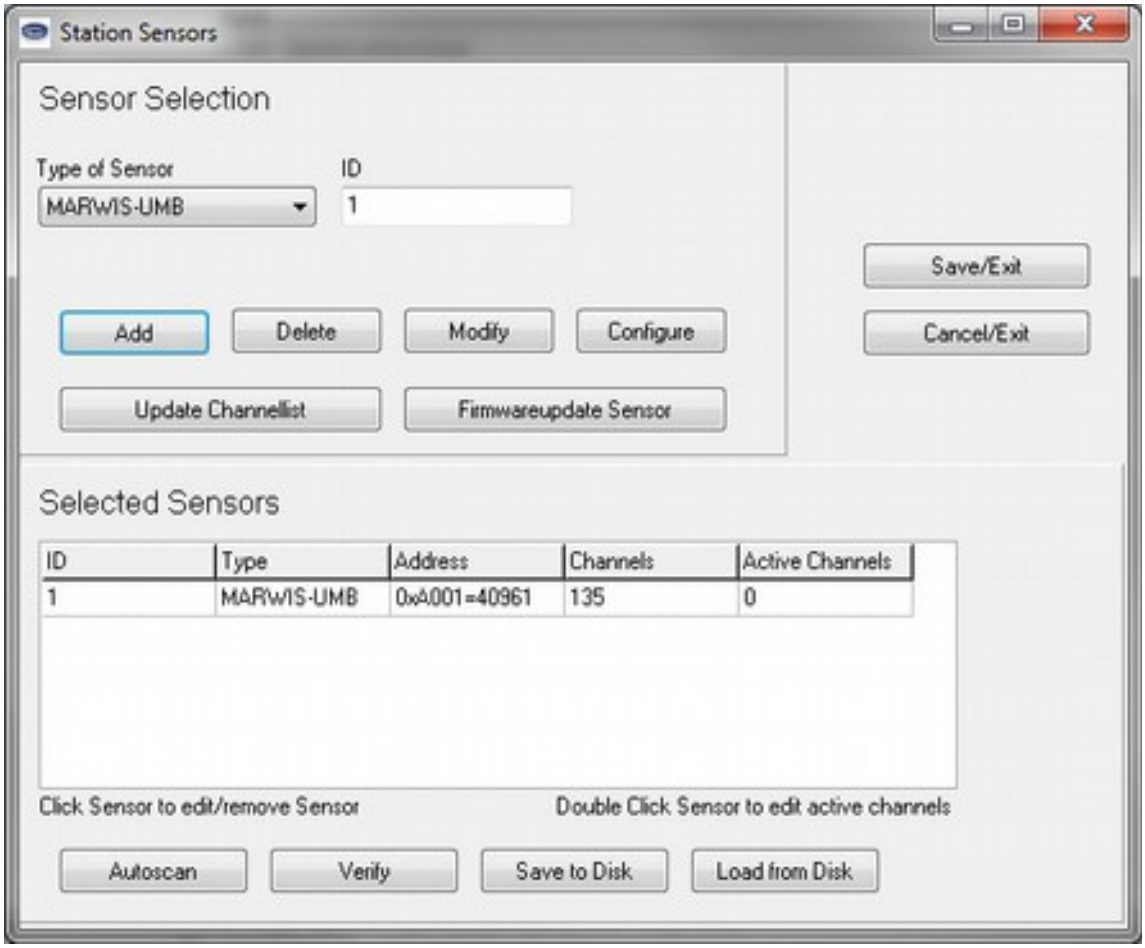


Illustration 26: Sensor Selection

Note: Due to the strict master-slave principle no other bus participant must be used as a master as long as the RS485 connection is active since the PC is taking over the master function.

12.2.2 Configuration

After loading a configuration all relevant settings and values can be adjusted.

12.2.3 General Settings

ID:	Device ID (Factory default 1; assign device Ids to additional devices in ascending order)
Description:	In order to differentiate the devices you can enter a description, e.g. location

Important note: If the baud rate is changed, after saving the configuration on the sensor, the sensor communicates at the new baud rate. Please make sure that your retrieving system supports the changed baud rate.

13 Firmware Update

To keep the sensor in accordance with the latest state-of-the-art, it is possible to carry out a firmrware update on site with no need to return the sensor to the manufacturer.

13.1 Update with the MARWIS-App

The proceeding of how to carry out a firmware update is described in the help function of the MARWIS-App.

14 Maintenance

Note: Make sure that the MARWIS-UMB is disconnected from power supply during maintenance / cleaning!

14.1 Cleaning the sensor front glass pane

If the glass pane on the sensor front is soiled, clean it with a damp, wrung out cloth. Dry the pane afterwards with a dry lint-free cloth.

Remove dust and dirt from the housing as well.

Don't use solvents like benzine, thinner, alcohol, kitchen cleaners etc. since these agents can damage the housing and the optical parts.

If you use a chemical cleaning tissue, pay attention to the corresponding instructions.

Note: By no means use a pressure washer for cleaning the MARWIS-UMB.

14.2 Checking the bolted connections

Please check regularly if all screws and the clamp straps are still fitted tightly.

15 Technical Data

15.1 Device

Power supply:	10 – 28 V DC on the sensor
Power input:	ca. 3 VA without heating heating 17 W at 12V, resp. 65 W at 24 V [5]
Protection class:	IP68
Measuring distance	8900.U01 1 m / 3 ¼ ft tolerance: 0.80 m ...1.50 m / 31 ½ in...59 in 8900.U02 2 m / 6 ½ ft tolerance: 1.60 m ... 2,20 m / 63 in...86 ⅝ in
Sensor dimensions	height ca. 110 mm / 4 ⅜ in width ca. 200 mm / 7 ⅞ in depth ca. 100 mm / 3 ⅞ in
Sensor weight	1.7 kg

Storage conditions

permissible temperature	-40…+70 °C / -40….+158 °F
permissible rel. humidity	0 … 95 % r.h. non-condensing
permissible height above sea level:	3000 m / 9,843 ft

Operating conditions

permissible ambient temperature	-40 ... +60 °C / -40...+140 °F
permissible rel. humidity	0 … 100 % r.h.

RS485 interface, 2 wire, half duplex

Data bits	8
Stop bit	1
Parity	none
Tri-state	2 bits after stop bit edge
Adjustable baud rates	1200, 2400, 4800, 9600, 14400, 19200[6], 28800, 57600, 115200
Sampling rate	100 ms.... 5 s, adjustable in steps of 0.1 s [7]

Bluetooth interface

Housing	aluminium, plastic

5 With temperatures below -10°C (14 °F) and a power supply of 12V a 12v to 24V step up converter should be used in order to allow for the necessary heating performance.
6 Default setting and baud rate for firmware update
7 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.

15.2 Measuring Range / Accuracy

15.2.1 Road Surface Temperature

Principle	optical
Measuring range	-40°C...+70°C / -40….+158 °F
Accuracy	0.8 K at 0°C / 1.44 °R at 32 °F
Resolution	0.1 K / < 1.8 °R

15.2.2 Road Condition[8]

Value	Road state
0	dry
1	damp
2	wet
3	ice-covered
4	snow / ice-covered
5	chemically wet
6	critically wet
8	snow covered
99	undefined

15.2.3 Dew point temperature

Principle	passive, calculated out of air temperature and humidity
Measuring range	-50 °C … + 60 °C / -58 °F... 140 °F
Resolution	0,1 K / < 1.8 °R

15.2.4 Water film

Principle	optical
Measuring range	0 - 6 mm / 0... 0.236 in
Resolution	0.1 µm / < 4 mil

15.2.5 Relative humidity at road temperature

Measuring principle	passive, calculated out of absolute air humidity and road surface temperature
Measuring range	0 … 100%
Resolution	0.1 %

15.2.6 Friction

Measuring range	0 … 1
Resolution	0.01

8 The road condition model is subject to constant improvement. Please check regularly on the availability of firmware updates.

15.2.7 Ice percentage

Measuring range	0 … 100 %
Resolution	1 %

15.3 Drawings

15.3.1 MARWIS-UMB with short protective housing

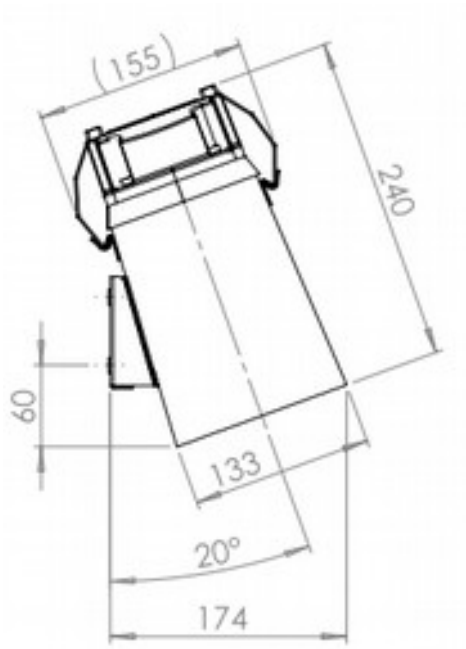


Illustration 27: MARWIS-UMB with short protective housing

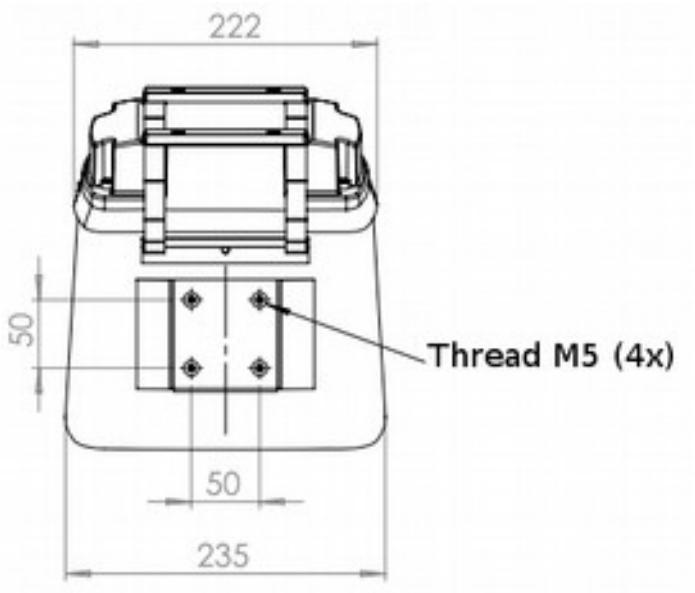


Illustration 28: MARWIS-UMB with short protective housing

15.3.2 MARWS-UMB with long protective housing

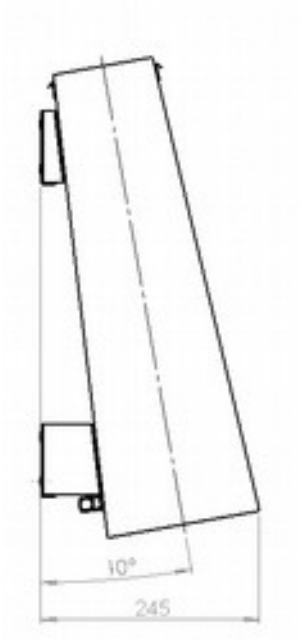


Illustration 29: Long protective housing – lateral view

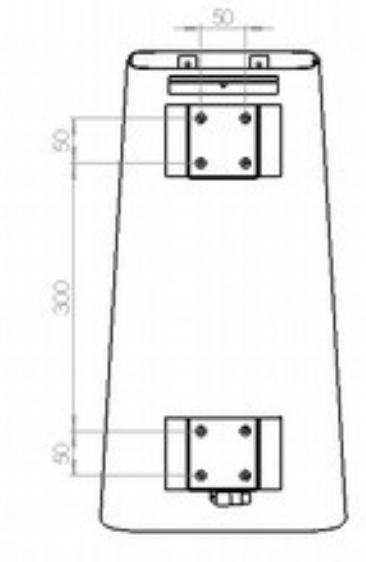


Illustration 30: Long protective housing – back view

16 EC Certificate of Conformity

Product: Mobile Road Sensor

Type MARWIS-UMB (Order No. 8900.Uxx)

We herewith certify that the above mentioned equipment complies in design and construction with the Directives of the European Union and specifically the EMC Directive in accordance with 2004/108/EC.

Applied harmonised standard:

IEC (EN) 61326-1:2012

Fellbach, Sept. 1st, 2014 Axel Schmitz-Hübsch

17 Disturbances

17.1 Possible errors occurring on the MARWIS-UMB

Error descriptions	Cause / remedy
Device does not allow polling or does not respond	• Check status-LED • Check supply voltage • Check interface connection • incorrect device-ID → check ID; devices are deliverd with ID 1.
Device delivers implausible values	• Check status-LED • Check for compliance with the sensor installation instructions • Has the device been commissioned correctly? Repeat if necessary • Has the correct adaption profile been selected?
Device transmits error value 24h (36d)	A channel was requested that is not available on this device.
Device transmits error value 28h (40d)	Device is in initialization phase after start-up → wait until first measurement is complete
Device transmits error value 50h (80d)	Device is being operated above the specified measuring range.
Device transmits error value 51h (81d)	Device is being operated below the specified measuring range.
Device transmits error value 55h (85d)	The device is unable to execute a valid measurement due to the ambient conditions.
Device transmits an error value which is not listed here.	There may be several reasons for this behaviour → contact the manufacturer's technical support team.

17.2 Interfering factors which can influence the measurement result

- Lengthwise oriented road markings, tarmac seams
  Due to their longitudinal orientation these disturbances can adopt an all but static character. Disturbances from road markings which lie crosswise towards the direction of travel are noted shorter when running over them and can therefore be filtered out for the resulting value.
- Tunnel lighting
- Longer persisting disturbances (like road markings, tarmac seams, manhole covers....) due to the vehicle not moving
- 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 front glass pane, e.g. due to spume on wet roads
- Very dark road surface (new blacktop)

18 Disposal

18.1 Within the EU

The device must be disposed of in accordance with European Directives 2002/96/EC and 2003/108/EC (waste electrical and electronic equipment). Waste equipment must not be disposed of as household waste! For environmentally sound recycling and the disposal of your waste equipment please contact a certified electronic waste disposal company.

18.2 Outside the EU

Please comply with the applicable regulations for the proper disposal of waste electrical and electronic equipment in your respective country.

19 Repair / Corrective Maintenance

Please arrange for any faulty equipment to be checked and, if necessary, repaired by the manufacturer exclusively. Do not open the equipment and do not under any circumstances attempt to carry out your own repairs.

In the event of a repair please contact:

G. Lufft Mess- und Regeltechnik GmbH

Gutenbergstraße 20
70736 Fellbach

PO Box 4252
70719 Fellbach

Germany

Phone: +49 711 51822-0

Hotline: +49 711 51822-52

Fax: +49 711 51822-41

E-Mail: info@lufft.de

Or your local distributor.

19.1 Technical Support

Our hotline is available for technical questions via the following e-mail address:

support@lufft.de

You can also consult frequently asked questions at www.lufft.com (menu header: Support → FAQs)

20 Appendix

20.1 Channel List Summary

The channel assignment described here applies to online data requests in UMB protocol

UMB Channel					Measuring Range		
act	**Min**	**Max**	**avg**	**Measurement Variable (float32)**	**Min**	**Max**	**unit**
Road surface temperature							
100				Road surface temperature	-40.0	70.0	°C
105				Road surface temperature	-40.0	158.0	°F
Dew point temperature							
120				Dew point temperature	-50.0	60.0	°C
125				Dew point temperature	-58.0	140.0	°F
Relative humidity at road temperature							
200				Relative humidity at road temperature	0.0	100.0	%
Water film height							
600				Water film height	0.0	6000.0	µm
605				Water film height	0.0	78.7	mil
Road condition							
900				Road condition (uint8)	0 dry 1 damp 2 wet 3 ice-covered 4 snow-/ice-covered 5 chemically wet 6 critically wet 8 snow-covered 99 undefined		
Ice percentage							
800				Ice percentage	0.0	100.0	%
Friction							
820				Friction	0.0	1.0	none

20.2 Communication in binary protocol

Only one example of an online data request is described in this operating manual. Please refer to the current version of the UMB protodol for all commands and the exact operation mode of the protocol (available for download at www.lufft.com)

Note: Communication with the sensor takes place in accordance with the master-slave principle, i.e. there must only be ONE requesting unit in a network.

20.2.1 Framing

The data frame is constructed as follows:

1	2	3-4	5-6	7	8	9	10	11… (8 + len) optional	9 + len	10 + len 11+ len	12 + len
SOH	<ver>	<to>	<from>	<len>	STX	<cmd>	<verc>	<payload>	ETX	<cs>	EOT

SOH	Control character for the start of a frame (01h); 1 byte
<ver>	Header version number, e.g.V 1.0 ◊<ver> = 10h = 16d; 1 byte
<to>	Receiver address , 2 bytes
<from>	Sender address, 2 bytes
<len>	Number of data bytes between STX and ETX; 1 byte
STX	Control character for the start of payload transmission (02h); 1 byte
<cmd>	Command; 1 byte
<verc>	Version number of the command; 1 byte
<payload>	data bytes; 0 – 210 bytes
ETX	Cotrol character for the end of payload transmission (03h); 1 byte
<cs>	Check sum, 16 bit CRC; 2 bytes
EOT	Control character for the end of the frame (04h); 1 byte

Control characters: SOH (01h), STX (02h), ETX (03h), EOT (04h).

20.2.2 Addressing with Class and Device ID

Addressing takes place by way of a 16 bit address. This breaks down into a Class ID and a Device ID.

Address (2 bytes = 16 bit)				
bits 15 – 12 (upper 4 bits)		**bits 11 – 8 (middle 4 bits)**	**bits 7 – 0 (lower 8 bits)**	
Klassen-ID (0 bis 15)		**Reserve**	**Geräte-ID** (0 - 255)	
0	Broadcast		0	Broadcast
10	Mobile road sensor		1 – 255	Available
15	Master or control devices			

ID = 0 is provided as broadcast for classes and devices. Thus it is possible to transmit a broadcast on a specific class. However, this only makes sense if there is only one device of the respective class on the bus, or in case of a command, e.g. reset.

20.2.3 Example for creating addresses

If e.g. a MARWIS-UMB shall be addressed with Device ID 001 this works as follows:

Class ID for MARWIS-UMB is 10d = Ah

Device ID is e.g. 001d = 01h

By putting together the class ID and the device ID the resulting address is A001h = (40961d)

20.2.4 Example online data query

Recording of a binary request with “online data query” (**23h**) as an example for retrieving the current road surface temperature (channel **100**)

Request	$23h_{10h}$[<**channel**>²]
<**channel**>²	designates the channel number
Response	$23h_{10h}$[00h, <**channel**>², <**type**>,<**value**>ⁿ]
<**type**>	designates the data type of the output; the length of <value> depends on it
<**value**>ⁿ	the requested value

Comment: The specifications of the channel numbers, which are needed for transmission as well as the transferred value and its format can be found in the device description.

Request

01 10 01 A0 01 F0 04 02 **23 10** **64 00** 03 BE F8 04

Response

01 10 01 F0 01 A0 0A 02 **23 10 00** **64 00** **16** **C3 D8 C2 41** 03 BA 2C 04

Interpretation of the response:

<status>	= 00h device ok. (≠ 00h is an error code)
<**channel**>²	0064h = 100d = road surface temperature
<**type**>	= 16h = float (4 byes, IEEE format)
<**value**>ⁿ	= 41C2D8C3h = 2.43558406829834E+0001 = 24,36°C

20.2.5 Example online data query multiple channels

Recording of a binary request with “online data query multiple channels” (**2Fh**) for reading the current road surface temperature (channel **100**) and road condition (channel **900**) = **2** channels

Request	$2Fh_{10h}$[<number>,<channel>$^{2\ x\ <number>}$]
<number>	number of the requested channels
<channel>^{2}	designates the channel numbers; channel **100** and channel **900**
Response	$2Fh_{10h}$[00h, <number>, {<sub-len>, 00h, <channel>^{2}, <type>, <value>$^{n<number>}$}]
<sub-len>	designates the number of bytes following in this sub-telegram; if the subsequent status byte displays, for example 'Value Overflow', <type> and <value>^{n} are omitted and the next channel follows
<type>	designates the data type of the output; the length of <value> depends on it
<value>^{n}	the requested value

Comment: The specifications of the channel numbers, which are needed for transmission as well as the transferred values and their formats can be found in the device description. A maximum of 20 channels can be requested.

Request

01 10 01 A0 01 F0 07 02 **2F 10** 02 **64 00** **84 03** 03 C1 26 04

Response

01 10 01 F0 01 A0 13 02 **2F 10 00** 02 08 **00** **64 00** 16 CB 3D A5 41 05 **00** **84 03** 10 01 03 3F 77 04

20.2.6 Example online data query multiple channels V1.1

Description: This command allows to poll several channels with one call. For each channel one sub-telegram is delivered. A new feature is that there are 2 request telegrams for this call. In the first one (1st call) the requested channels are defined and stored internally, with the other one (from the 2nd call on) the channels which were requested in the first call are delivered again. The answers are identical on both calls. The second call is recommended if the same values are requested again and again at a high measuring frecuency.

1st Call

Request	$2Fh_{11h}$ [<number>, <channel>$^{2\ x\ <number>}$]
<number>	number of the requested channels
<channel>^{2}	gibt die Kanalnummern an

From 2nd call on:

Request	$2Fh_{11h}$ 00h
Response:	**$2Fh_{11h}$ [00h, <number>, {<sub-len>, 00h, <channel>², <type>, <value>^{n}}$^{<number>}$]**
<number>	number of channels requested in the 1st call
<sub-len>	designates the number of bytes following in this sub-telegram; if the subsequent status byte displays, for example 'Value Overflow', <type> and <value>^{n} are omitted and the next channel follows
<type>	designates the data type of the output; the length of <value> depends on it

<value>n requested value

Example: Retrieval of 3 measurement values

Channel 100 (0064h): Road temperature in °C

Channel 600 (0258h): water film height in µm

Channel 900 (0384h): Road condition

1st Request:

```
01 10 01 A0 00 F0 09 02 2F 11 03 64 00 58 02 84 03 03 69 24 04
```

Response:

```
01 10 00 F0 01 A0 1C 02 2F 11 00 03 08 00 64 00 16 8F BB AA 41 08 00 58
02 16 57 97 E1 42 05 00 84 03 10 00 03 D8 1A 04
```

Subsequent requests:

```
01 10 01 A0 00 F0 03 02 2F 11 00 03 24 29 04
```

Response:

```
01 10 00 F0 01 A0 1C 02 2F 11 00 03 08 00 64 00 16 5D 67 AD 41 08 00 58
02 16 D1 D1 E1 42 05 00 84 03 10 00 03 BD 25 04
```

Subject index

G. LUFFT Mess- und Regeltechnik GmbH

Lufft Germany:
Fellbach Office:
Postal Address:
Gutenbergstrasse 20
D-70736 Fellbach
Address:
P.O. Box 4252
D-70719 Fellbach
Tel.: +49 (0)711 51822-0
Fax: +49 (0)711 51822-41
www.lufft.com
info@lufft.de

Berlin Office:
Oderstr. 59
D-14513 Teltow
Tel.: +49 (0)711 51822-831
Fax: +49 (0)711 51822-944

a passion for precision · passion pour la précision · pasión por la precisión · passione per la precisione

Lufft North America:
Lufft USA, Inc.
820 E Mason St #A
Santa Barbara, CA 93103
Tel.: +01 919 556 0818
Fax: +01 805 845 4275
E-Mail: sales@lufftusainc.com
www.lufft.com

Lufft China:
Shanghai Office:
Lufft (Shanghai)
Measurement & Control
Technology Co., Ltd.
Room 507 & 509, Building No.3,
Shanghai Yinshi Science and
Business Park,
No. 2568 Gudai Road,
Minhang District,
201199 Shanghai, CHINA
Tel: +86 21 5437 0890
Fax: +86 21 5437 0910
E-Mail: china@lufft.com
www.lufft.cn

Beijing Office:
B501 Jiatai International Mansion
No. 41 East 4th Ring Road,
Chaoyang District,
100025 Beijing, CHINA
Tel: +86 10 65202779
Fax: +86 10 65202789
E-Mail: china@lufft.com