Operating Manual VS20-UMB

Visibility Sensor

Order No.: 8366.U50

Version V6 (08/2007)

G. LUFFT MESS- UND
REGELTECHNIK GMBH

POSTFACH 4252
70719 FELLBACH
TEL. 49 (711) - 51822-0
FAX 49 (711) - 51822-41

Table of Contents

Version history:

Version	Date	Produced by	Comment
V1	19.05.2006	EES	First version
V2	07.06.2006	EES	Error correction
V3	14.06.2006	EES	Commissioning, service and warning instructions amended
V4	08.11.2006	EES	Commissioning; “Remove protective caps before **commissioning**”
V5	22.02.2007	EES	Calibration / adjustment / error description supplemented
V6	31.08.2007	SH	EC Certificate of Conformity supplemented

1 Please read before use

Before using the equipment, please read the operating manual carefully and follow the instructions in every detail.

1.1 Symbols used

Important information concerning potential hazards 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 and 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 purposes for which it was designed.
- The safety and operation of the equipment can no longer be guaranteed if it is modified or adapted.

1.4 Guarantee

The guarantee period is 24 months from the date of delivery. The guarantee is forfeited if the designated use is violated.

1.5 Incorrect use

If the equipment is installed incorrectly

- It may not function
- It may be permanently damaged
- Danger of injury may exist if the equipment drops down

If the equipment is not connected correctly

- It may not function
- It may be permanently damaged
- The possibility of an electrical shock may exist

2 Equipment description

The VS20 is a visibility measurement device for the determination of optical visibility in the range from 0 – 2000m, such as environmental data acquisition in traffic management equipment.

2.1 Mode of operation

Visibility is determined by measuring reflectance in accordance with the 45° forward scattering principle.

The particles in the field of measurement (e.g. fog droplets) scatter the infrared light emitted by the transmitter. The receiver measures the rate of scattered light from which the reflectance is calculated. Visibility is then computed taking account of the set border contrast.

The measurements are polled via the RS485 interface or transmitted as an analogue signal via the current output.

The device is connected by means of an 8-pole screw-in connector using the associated connection cable.

Windows PC software is available for configuration and measurement polling during commissioning.

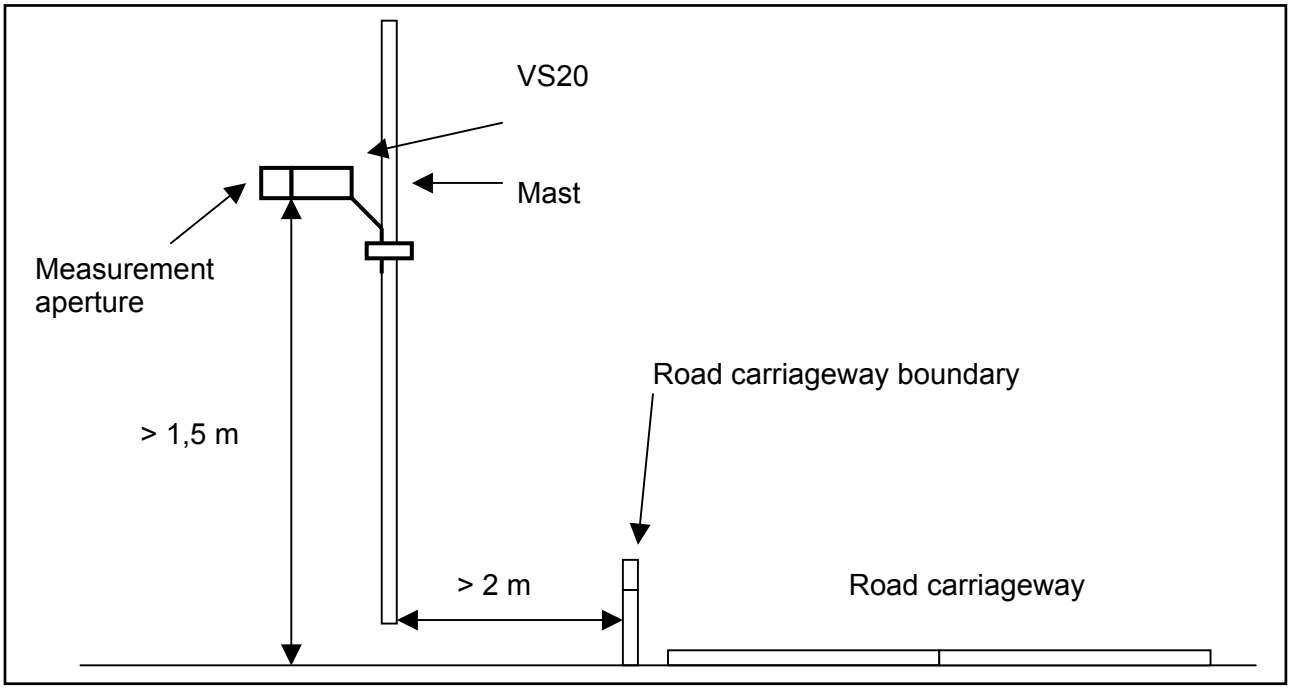
3 Installation

The device is installed on a mast (diameter 40mm ... 80mm) using the mast fitting provided.

Follow the instructions below to guarantee correct long-term operation:

- Installation height above the ground 1.5 metres
- Turn the measurement aperture away from the road carriageway
- Distance to road carriageway > 2 metres
- Do not mount any other devices above or below the VS20 within a distance of 50 cm
- There should be no objects (masts, trees, grass, bushes etc.) in front of the measurement aperture for a distance of 2 metres.

Installation sketch:



WARNING:

- Only approved and tested appliances (conductors, risers etc.) should be used to install the device on the mast.
- All relevant regulations for working at this height must be observed.
- The mast must be sized and anchored appropriately.
- The mast must be earthed in accordance with regulations.
- The corresponding safety regulations for working at road side and in the vicinity of the road carriageway must be observed.

If the equipment is installed incorrectly

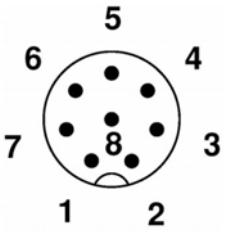
- It may not function
- It may be permanently damaged
- Danger of injury may exist if the equipment drops down

4 Connections

There is an 8-pole screw-in connector on the underside of the device. This serves to connect the power supply and the interfaces using the associated connection cable.

Connection assignment:

1	white	negative power supply
2	brown	positive power supply
3	green	RS485_A
4	yellow	RS485_B
5	grey	not assigned
6	pink	not assigned
7	blue	current output (-)
8	red	current output (+)



The cable marking is in accordance with DIN 47100.

The screening of the connection cable must not be laid to earth in the control cabinet!

If the device is not connected correctly

- It may not function
- It may be permanently damaged
- The possibility of an electrical shock may exist

4.1 Power supply

The VS20 has a 24VDC power supply. The power supply unit used must be approved for operation with equipment of protection class III (SELV).

4.2 RS485 interface

The device has a DC-isolated half-duplex 2-wire RS485 interface with the following settings:

Data bits:	8
Stop bit:	1
Parity:	none
Settable baud rates:	1200, 2400, 4800, 9600, 14400, 19200*, 28800, 57600

* = factory setting and baud rate for firmware update

4.3 Current output

The current output is DC-isolated and can be configured as follows:

off	the output transmits 0 mA
4 ... 20 mA*	the output transmits the visibility in accordance with the configuration
20 ... 4 mA	inverts the visibility output

In the event of a fault on the device the fault current indicated during configuration is transmitted.

The load resistance on the current output must be less than 300 Ohms.

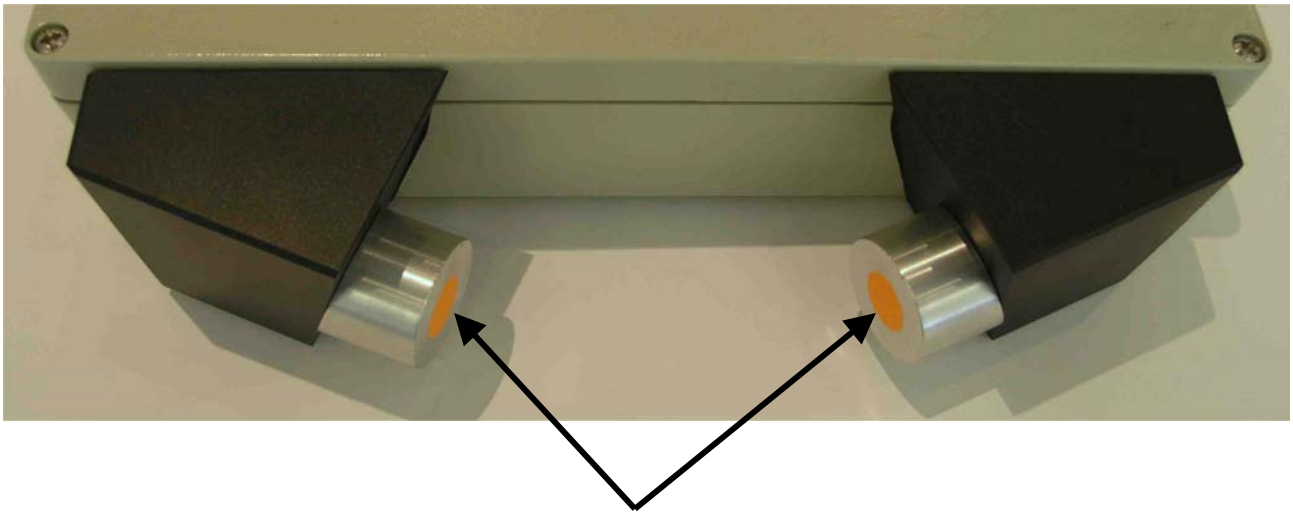
5 Commissioning

WARNING!! The protective caps must be removed from the measurement apertures after installation and prior to commissioning!!

Initialization and subsequent measurement of visibility can commence as soon as the device has been correctly installed and connected to the designated power supply.

The first valid measurement is available after 1.5 minutes. If an online request is sent to the device before this time has elapsed it responds with the status code: 'Device not ready' (28h). When the average value is requested this is calculated from the measurements available up to the time of the request.

The above mentioned times also apply after configuration via the PC software.



Remove protective caps before commissioning

6 Configuration

Lufft provides PC software for configuration purposes. The user can set up the device in accordance with his requirements with the aid of this software.

6.1 Factory setting

The VS20 is supplied with the following settings:

Device ID:	1
Baud rate:	19200
RS485 protocol:	binary
Current output:	4 ... 20 mA corresponding to 0 ... 2000 m (linear)
Border contrast:	5 %
Averaging interval:	5 min

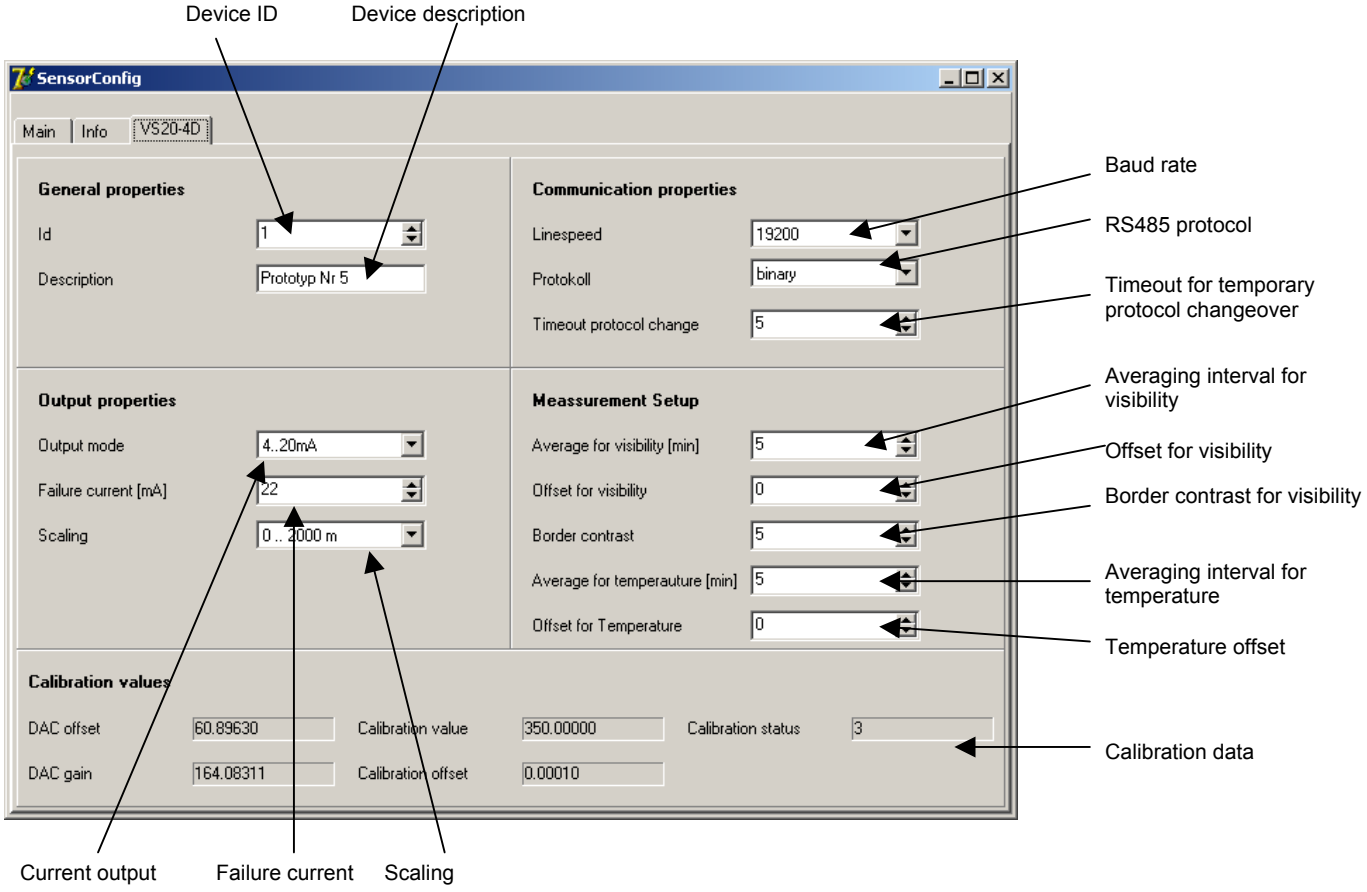
The ID must be changed if several VS20's are operated in a UMB network as each device requires a unique ID. We suggest using ID's from 1 upwards.

6.2 Configuration using PC software

The principle mode of operation of the PC software is described in detail in the Online Help. For this reason only the menus and functions specific to the VS20 are described here.

6.2.1 VS20 configuration

All relevant settings and values can be adjusted following loading of a VS20 configuration.



6.2.2 Measurement request channels

The required channel for the measurement request can be activated by clicking on the respective channel.

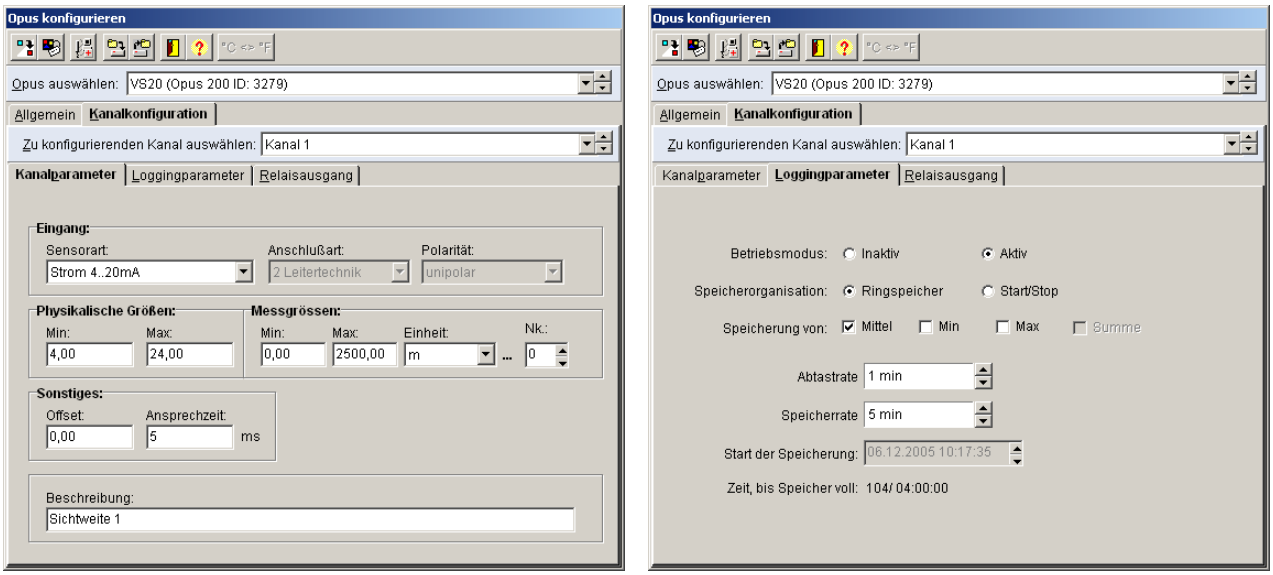
ChNr.	Measurement	Unit	Range	Active
600	Sichtweite	m	0..1000	inactive
650	m_Sichtweite	m	0..1000	inactive
601	Sichtweite	m	0..2000	active
651	m_Sichtweite	m	0..2000	active
602	Sichtweite	km	0..1,000	inactive
652	m_Sichtweite	km	0..1,000	inactive
603	Sichtweite	km	0..2,000	inactive
653	m_Sichtweite	km	0..2,000	inactive
604	Sichtweite	ft	0..3000	inactive
654	m_Sichtweite	ft	0..3000	inactive
605	Sichtweite	ft	0..6500	inactive
655	m_Sichtweite	ft	0..6500	inactive
606	Sichtweite	ls	0..0,600	inactive
656	m_Sichtweite	ls	0..0,600	inactive
607	Sichtweite	ls	0..1,200	inactive
657	m_Sichtweite	ls	0..1,200	inactive
608	Sichtweite	norm_value	0..65520	active
658	m_Sichtweite	norm_value	0..65520	active
609	Sichtweite TLS	m	10..1000	inactive
659	m_Sichtweite TLS	m	10..1000	inactive

6.3 Configuring OPUS200/300/208 for the VS20 Visibility Sensor

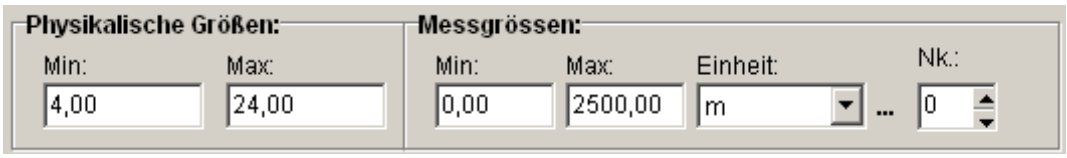
The interface in the VS20 configuration must be activated and configured before the VS20 can be operated with the OPUS instrument.

The following information is necessary for setting the OPUS channel for the 4 ... 20 mA interface:

Example of the VS20 factory setting (scaling 0 ... 2000 metres):



If the current output is scaled to a different value the setting must be adjusted accordingly:



Scaling	Max. measurement	Unit
0 – 1000 metres	1250	m
0 – 2000 metres	2500	m
0 – 1.000 km	1.25	km
0 – 2.000 km	2.5	km
0 – 3000 feet	3750	ft
0 – 6500 feet	8125	ft
0 – 0.600 miles	0.75	mi
0 – 1.200 miles	1.5	mi

6.4 Firmware update

The description of the firmware update can be found in the manual of the UMB-Config-Tool.

7 Calibration / Adjustment

Every device has a factory calibration. Recommended calibration interval is 12 months. There is an on-site-calibration device available

Pre-requisities

- Visibility must be at least 2000m
- No precipitation
- PC / Laptop with serial interface
- UMB-Config-Tool (PC-Software)
- Calibration kit (Lufft ref.no.: 8366.UKAL1)

Fixation device of the calibration disk:

7.1 Calibration

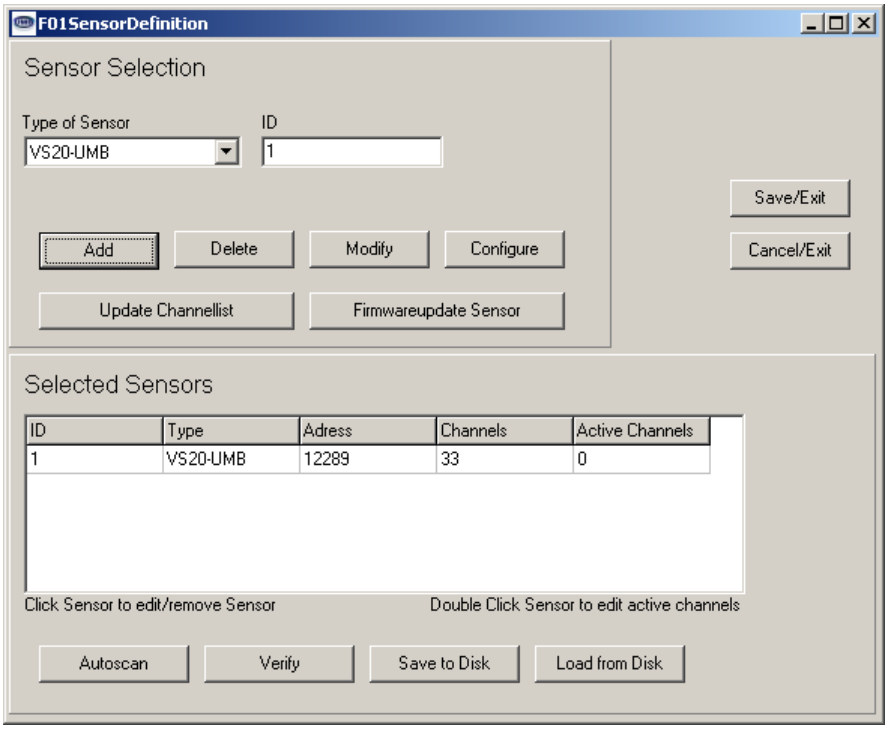
Calibration means the comparison between the device with a traceable reference, result is the accuracy of the unit.

In order to carry out comparison testing, the calibration fixation has to be installed according to the picture:

By using software „UMB-Config-Tools“, the visibility can be displayed. Please note**:** wait at least 2 minutes to get a stable reading.

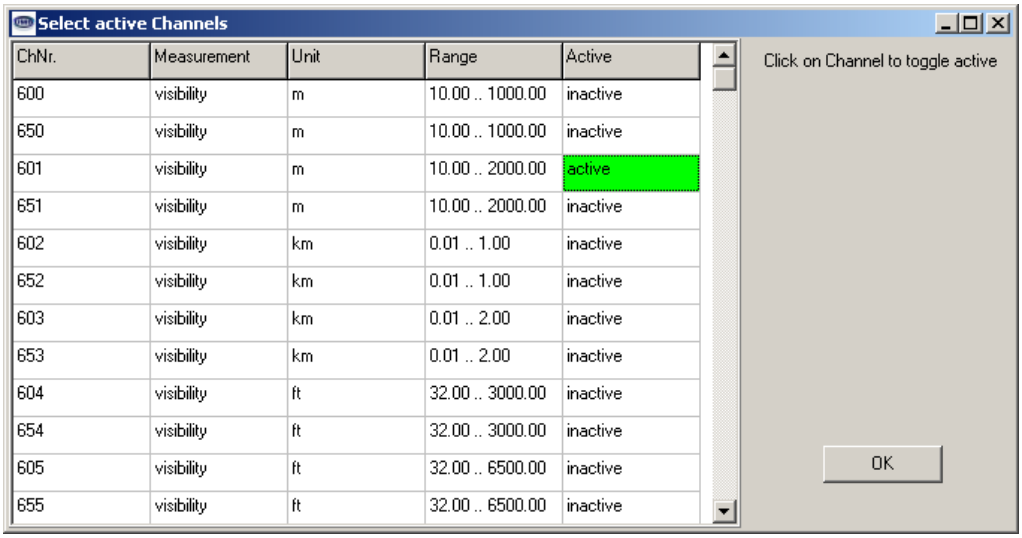
7.1.1 Add Sensor

Select ‚Edit' → ‚Sensors' as ‚Type of Sensor' select ‚VS20-UMB' and with ‚ID' please input device-ID. By ‚Add' please add the sensor to sensor list.



7.1.2 Select active channel

By double click on the sensor, the list of channels will be opened:

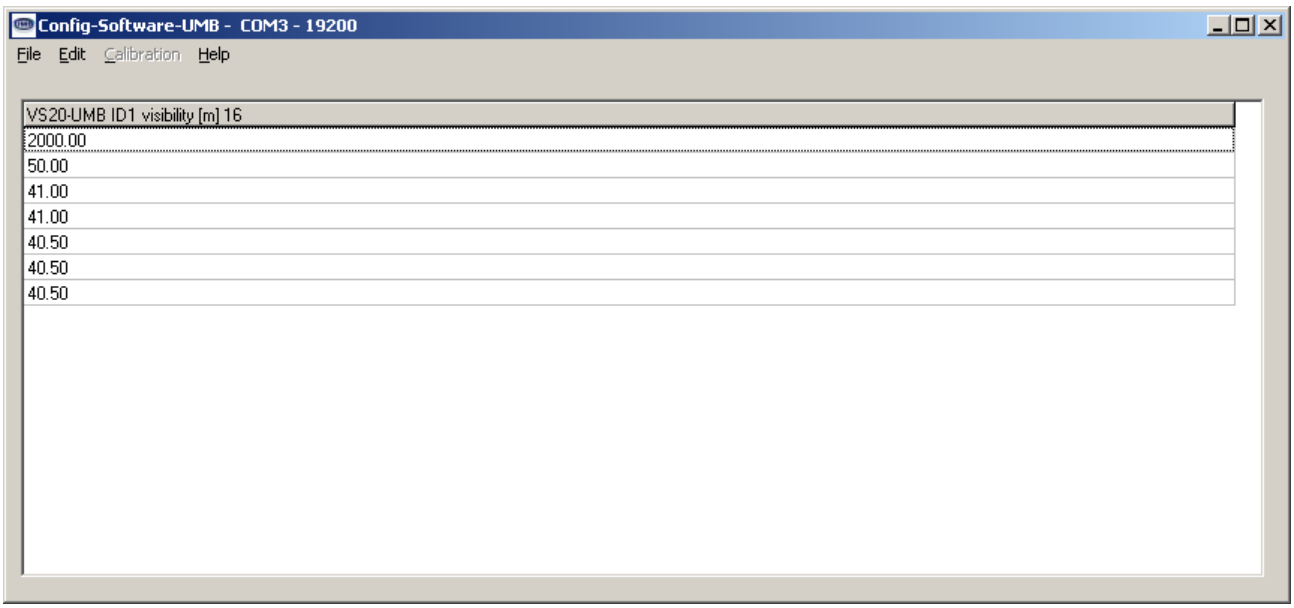


ChNr.	Measurement	Unit	Range	Active
600	visibility	m	10.00 .. 1000.00	inactive
650	visibility	m	10.00 .. 1000.00	inactive
601	visibility	m	10.00 .. 2000.00	active
651	visibility	m	10.00 .. 2000.00	inactive
602	visibility	km	0.01 .. 1.00	inactive
652	visibility	km	0.01 .. 1.00	inactive
603	visibility	km	0.01 .. 2.00	inactive
653	visibility	km	0.01 .. 2.00	inactive
604	visibility	ft	32.00 .. 3000.00	inactive
654	visibility	ft	32.00 .. 3000.00	inactive
605	visibility	ft	32.00 .. 6500.00	inactive
655	visibility	ft	32.00 .. 6500.00	inactive

Please select channel 601 (10 ... 2000m) and with ‚OK' ‚Save/Exit' close this menu.

7.1.3 Start inquiry

On menu select ‚File' → ‚Start measurement'.



Please wait at least 2 minutes to have a stabilised measurement.

Please note: after having the device switched on, it takes 90 seconds to see the first measurement. In the meanwhile, the output is ‚FC: 40'.

7.1.4 Evaluation

Please compare the measurement with the measurement value indicated on the calibration kit.

The inaccuracy has to be less than +/- 10 % of the measurement. If the inaccuracy is worse, then the device has to be cleaned and then re-calibrated again.

7.2 Adjustment

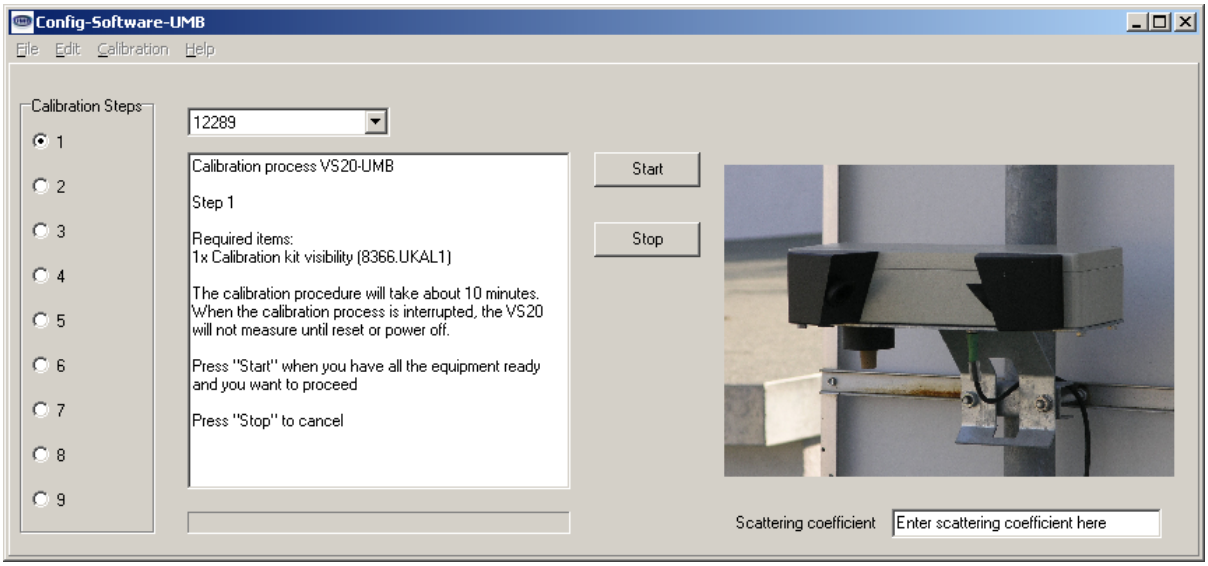
In case of adjustment, the inaccuracy will be corrected. Before this, the unit has to be cleaned.

Please make sure that you have paid attention to chapter 7.1 before adjustment takes place.

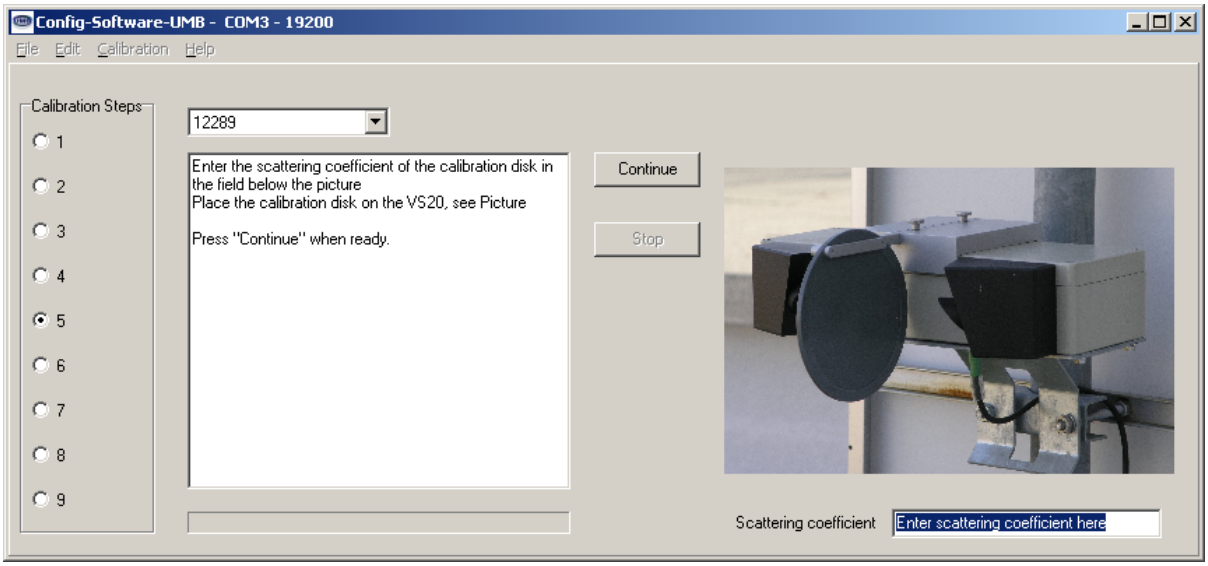
Please follow the calibration device fixation as described in 7.1

Please make sure that you have stable conditions during adjustment.

Please start under menu ‚Calibration' → ‚VS20-UMB' the adjustment process and follow the recommended steps.



After 3 minutes, the software allows to install the calibration disk.



Please input in ‚Scattering coefficient' the measurement which is given on the calibration disk (in km^{-1}) and ‚Continue'. After 3 more minutes and successful adjustment, finish with ‚Stop'.

Then the VS20-UMB measures according to the new adjustment.

Please check the success of the adjustment according to the steps in chapter 7.1.

8 Communication

Depending on the configuration of the device, the visibility can be requested in binary or ASCII-protocol.

8.1 Binary protocol

This operating manual only describes an example of an online data request. Please refer to the current version of the document "**UMB Protocol**" for the exact mode of operation.

8.1.1 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> Transmitter address, 2 bytes
<len> Number of data bytes between STX and ETX; 1 byte
STX Control character for the start of the payload data transmission (02h); 1 byte
<cmd> Command; 1 byte
<verc> Version number of the command; 1 byte
<payload> Data bytes; 0 – 210 byte
ETX Control character for the end of the payload data transmission (03h); 1 byte
<cs> Check sum, 16 bit CRC; 2 byte
EOT Control character for the end of the frame (04h); 1 byte

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

8.1.2 Addressing with class and device ID

Addressing takes place via a 16 bit address. This is divided into a sensor class ID and a device ID.

Address (2 bytes = 16 bBit)			
Bits 15 – 12 (upper 4 bits)		**Bits 11 – 0 (lower 12 bits)**	
Class ID (0 to 15)		**Device ID** (0 – 4095)	
0	Broadcast	0	Broadcast
3	Visibility (VS20)	1 - 4095	Available
15	Master or control devices		

ID = 0 is provided as broadcast for classes and devices respectively. Thus it is possible to transmit a broadcast on a specific class. However this is only feasible if there is only one device of this class on the bus.

8.1.3 Examples for the formation of addresses

If for example a VS20 with the device ID (serial number) 0001 is to be addressed, this takes place as follows:

The class ID for visibility is 3d = 3h
Device ID (serial number) is for example 001d = 001h

Putting the class and device ID's together gives the following address: 3001h (12289d).

8.1.4 Example of a binary protocol request

If for example a visibility sensor with the device ID (serial number) 0001 is to be polled from a PC according to the current visibility (0 – 2000m), this takes place as follows:

Sensor:

The class ID for the **visibility sensor** is 3 = 3h
The device ID (serial number) is 0001 = 0001h

Putting the class and device ID's together gives a target address of 3001h.

PC:

The class ID for the **PC (master unit)** is 15 = Fh
PC-ID is for example 22 = 016h

Putting the class and PC ID's together gives a sender address of F016h

The length <len> for the online data request command 4d = 04h,

The command for online data request is 23h,

and the version number of the command is 1.0 = 10h.

The channel number is shown under <payload>; as can be seen from the channel list, the current visibility 0 – 2000m in channel 601d = 259h

The calculated CRC is D40Dh

The request to the device:

SOH	<ver>	<to>		<from>		<len>	STX	<cmd>	<verc>	<channel>		ETX	<cs>		EOT
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
01h	10h	01h	30h	16h	F0h	04h	02h	23h	10h	59h	02h	03h	0Dh	D4h	04h

The response from the device:

SOH	<ver>	<to>		<from>		<len>	STX	<cmd>	<verc>	<status>	<channel>		<typ>
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
01h	10h	16h	F0h	01h	30h	0Ah	02h	23h	10h	00h	59h	02h	16h

<value>				ETX	<cs>		EOT
15	**16**	**17**	**18**	**19**	**20**	**21**	**22**
00h	00h	FAh	44h	03h	5Eh	11h	04h

<status> = Device o.k.

<typ> = Data type of the following value; 16h = float (4 byte, IEEE format)

<value> = 44FA0000h corresponds to the float value 2000.00

The visibility is therefore 2000m.

The correct data transmission can be checked with the aid of the check sum (115Eh).

WARNING: Little endian (Intel, lowbyte first) applies when transmitting word and float variables, of addresses or CRC for example. This means first the LowByte and then the HighByte.

8.1.5 CRC calculation

CRC is calculated according to the following rules:

Norm: CRC-CCITT

Polynomial: 1021h = $x^{16} + x^{12} + x^5 + 1$ (LSB first mode)

Start value: FFFFh

(Warning! In contrast to earlier Lufft protocols, in this case the start value for CRC calculations is not 0h but FFFFh according to CCITT!!)

Further information can be found in the description of a CRC in the UMB Protocol V1_0.

8.2 ASCII protocol

Easy communication with the devices can be carried out using the ASCII protocol.

The ASCII protocol serves exclusively for online data requests and is not protected by a CRC. The device does not respond to unintelligible ASCII commands!

8.2.1 Construction

An ASCII command is introduced with the character '&' and ended with the character CR (0Dh). There is an empty character (20h) between the individual blocks; displayed with an underscore '_'. Characters which represent an ASCII value are in simple inverted commas.

8.2.2 Example of a ASCII request

If for example a visibility sensor with the device ID (serial number) 0001 is to be polled from a PC according to the current visibility (0 – 2000m), this takes place as follows:

A measurement value from a specific channel is polled with the command "M".

Request: '&'_<ID>^{5}_,M'_<channel>^{5} CR

Response: '$'_<ID>^{5}_,M'_<channel>^{5}_<value>^{5} CR

<ID>^{5} Device address (5-point decimal with leading noughts)

<channel>^{5} Indicates the channel number (5-point decimal with leading noughts)

<value>^{5} Measurement value (5-point decimal with leading noughts); a value scaled to 0 – 65520d. From 65521d – 65535d various error codes are defined.

Example:

Request: &_12289_M_00601

With this request, channel 601 of the device with address 12289 (VS20 with the device ID 0001) is polled.

Response: $_12289_M_00601_03456

With the scaling for visibility the following calculation then results:

0d	corresponds to 0 metres
65520d	corresponds to 32760 metres
03456d	corresponds to 32760 / 65520 * 03456 = 1728 metres

8.3 Channel assignment for data requests

The channel assignment described here applies to online data requests in binary protocol.
In the ASCII protocol all channels in the mapping standard are transmitted.

Channel		Data type	Measurement unit	Measurement range
current	average			
Visibility				
600	650	float	in metres	10 – 1000 metres
601	651	float	in metres	10 – 2000 metres
602	652	float	in kilometres	0.01 – 1.000 km
603	653	float	in kilometres	0.01 – 2.000 km
604	654	float	in feet	32 – 3000 feet
605	655	float	in feet	32 – 6500 feet
606	656	float	in miles	0.006 – 0.600 miles
607	657	float	in miles	0.006 – 1.200 miles
608	658	unsigned short	in the mapping standard	20 – 4000
Ambient temperature				
100	150	float	in °C	-40 - +80 °C
101	151		in °F	-40 - +176 °F
102	152	unsigned short	in the mapping standard	
TLS FG3				
1060		3 byte	TLS-Code FG3: Byte 1: Type of DE data (type 60) Byte 2: Measurement low byte Byte 3: Measurement high byte	10 – 1000 metres 10 = 10d = 000Ah 1000 = 1000d = 03E8h

The current value transmits the current measurement. For the average value, the measurements are averaged over the configured time period.

8.4 Mapping standard

Mapping standard	Visibility value range
0 – 65520	0 – 32760 m
	0 – 32.76 km
	0 – 107480.315 feet
	0 – 20.3561203 miles
	Ambient temperature value range
	-40 - +80 °C
	-40 - +176 °F

9 Technical data

9.1 Visibility

Measurement process:	45º forward scattering principle
Measurement:	Visibility
Measurement range:	10m - 2000 m; 32 - 6500 feet; 0.006 – 1.200 miles
Accuracy:	+/- 10% visibility

9.2 Storage conditions

Permissible storage temperature:	-40°C ... +70°C
Permissible relative humidity:	0 ... 100% RH

9.3 Operating conditions

Permissible operating temperature:	-40°C ... +60°C
Permissible relative humidity:	0 ... 100% RH
Permissible height above sea level:	N/A

9.4 Electrical data

Power supply:	20 ... 30 VDC; typically 24 VDC
Power consumption:	< 150 mA
Protection class:	III (SELV)

9.5 Interfaces

RS485 (2-wire, half-duplex) for configuration and measurement polling
Analogue output (4 – 20mA) for measurement value output

9.6 Mechanical data

Dimensions (W x H x D):	approx. 360 x 80 x 190 mm
Weight:	approx. 4.5 kg
Protection class:	IP66

Sketch:

10 EC Certificate of Conformity

Product: **Visibility Measurement Device**
Type: **VS20-UMB (Order No.: 8366.U50)**

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 89/336/EC and the Low Voltage Directive in accordance with 73/23/EC.

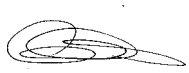
The above mentioned equipment specifically conforms to the following EMC Standards:

EN 61000-6-2:2005 Part 6-2: Generic Standards - Immunity for industrial environment

EN 61000-4-2	ESD
EN 61000-4-3	RF Field
EN 61000-4-4	Burst
EN 61000-4-5	Surge
EN 61000-4-6	Conducted RF
EN 61000-4-8	Magnetic Field 50Hz

EN 61000-6-3:2001 Part 6-3: Generic standards - Emission standard for residental, commercial and light-industrial enviroments

IEC / CISPR 22 Klasse B



Fellbach, 31.08.2007 Axel Schmitz-Hübsch

11 Fault description

To follow...

12 Service and maintenance

Service and maintenance should only be carried out by trained specialist personnel. The recommended service interval is 12 months.

The device must be disconnected from the power supply whilst service and maintenance work is being carried out.

13 Disposal

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.

14 Manufacturer

In matters of guarantee or repair please contact:

G. Lufft Mess- und Regeltechnik GmbH

Gutenbergstraße 20
D-70736 Fellbach

Postfach 4252
D-70719 Fellbach

Tel: +49(0)711-51822-0
Fax: +49(0)711-51822-41

Mail: info@lufft.de

www.lufft.de

or your local distributor.