Ultrasonic
Snow Depth Sensor

8365.00

Documentation

Snow Depth Sensor 8365.00

Issue: February 2004
From Software Version V01.32r00 Onwards

1. Functional description

1.1 Functional description and initial operation

The snow depth sensor is supplied together with a mounting and a cable connector. The connector pin-out is described in the section entitled "USH-8 pin assignment". The sensor is powered by an operating voltage of 11 to 15 V DC.

Any serial communication program (e.g. Hyperterminal; standard settings: 1200 bits/s, 8 data bits, no parity, 1 stop bit, no protocol) can be used to obtain sensor parameter setup. "USH-8 Vx.xxr-00wd" appears on the display shortly after the sensor is powered up.

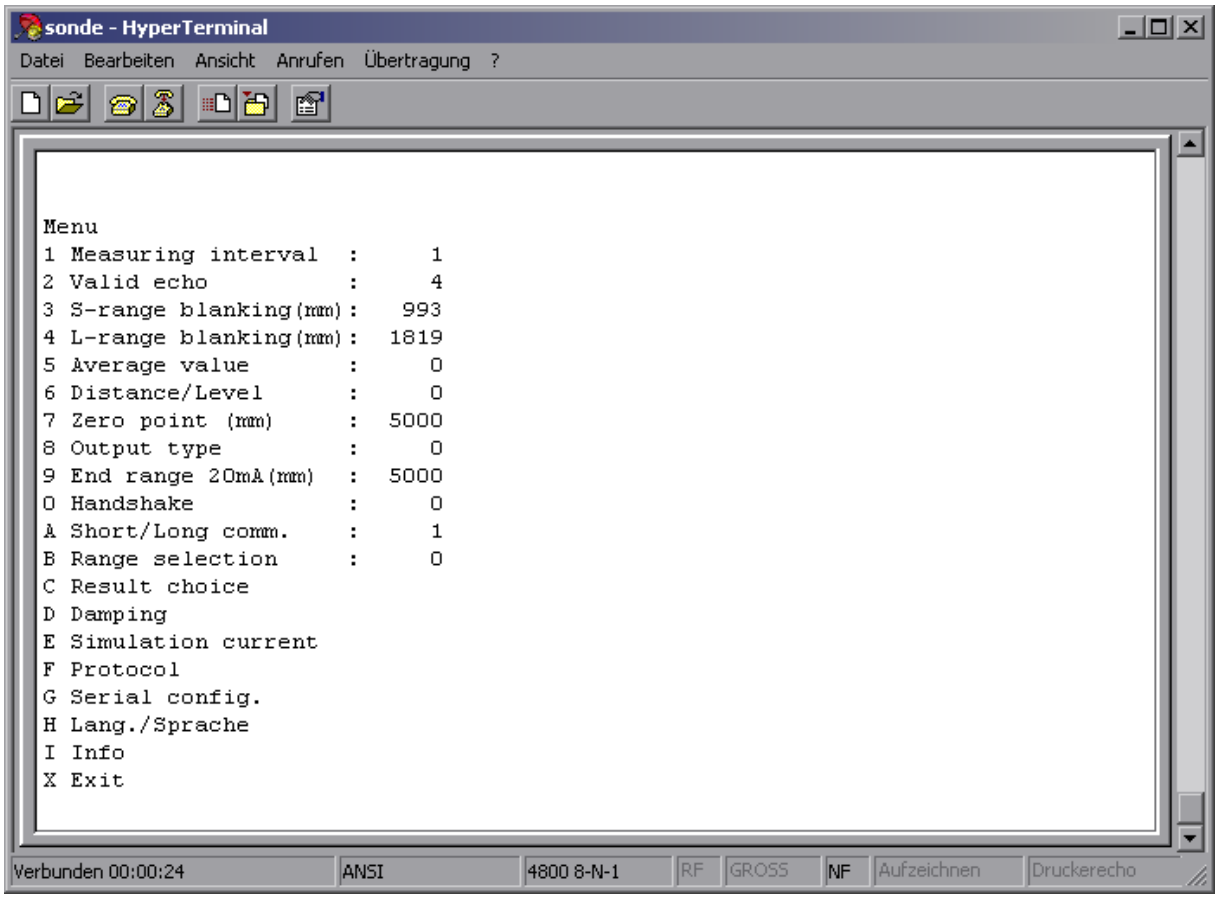


Fig. 1

A laptop with a serial interface is required in order to put the sensor into service. Commissioning takes place as follows:

- Cut to length and terminate cable
  A cable of appropriate length (shielded data cable LIYCY 12 x 0.25 mm²; length depends on local circumstances) must be connected to the supplied connector in order to put the sensor into service. The connector pin-out is defined in Section 2 (USH-8 pin assignment).

- Functional test
  Having connected the cable and powered up the sensor, perform a functional test. To do this, connect the sensor to the laptop's serial interface. If the sensor is to manage communication with the measuring system via the digital interface, the serial interface and desired protocol must first be configured and tested. If the sensor uses the analog interface as a communication interface, the latter must be configured. The basic settings suggested (see Section 4) can be used as a basis for the functional test. More detailed information concerning

parameters that can be set and their significance is given in the description of individual menu items. After this initial test, it is advisable to make the presettings for final installation in order to minimise the number of settings that have to be made on site.

- Installation
  Once the functional test has been completed successfully, install the sensor in its intended installation location and put it into service.

- Commissioning
  Configure the sensor on site depending on the particular requirements and circumstances. Set the interface, zero point, measuring interval, damping, end range and short-range blanking correctly depending on the operating mode. The sensor can be used once it has been configured and successfully tested.

1.2 Parameter setup

When two "??" characters (keep the Shift key pressed) are entered via the keyboard, the parameter setup menu (see Figure 1) appears on the display. There may be a delay of up to 30 s, for instance if the sensor is actually making a measurement. To edit a menu item, press the corresponding keyboard key (e.g. 7 for zero point). The parameter together with the corresponding unit appears in the menu. You can then enter a new value and store it by pressing Enter. Press ESC to quit if you do not want to modify the value. This method can be used to set every parameter shown in the menu to the desired value. Data entered in the menu via the keyboard is not case sensitive, i.e. upper case or lower case letters are irrelevant.

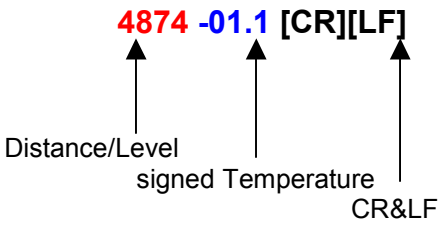
Exit the menu by pressing "X". The sensor then makes a measurement, outputs the measured value, changes to standby mode and makes another measurement after the selected interval has elapsed.

1.3 Output format of measured values

Measured values are output in different formats using one of four possible protocols. Selecting a protocol is described in Section 3.5.

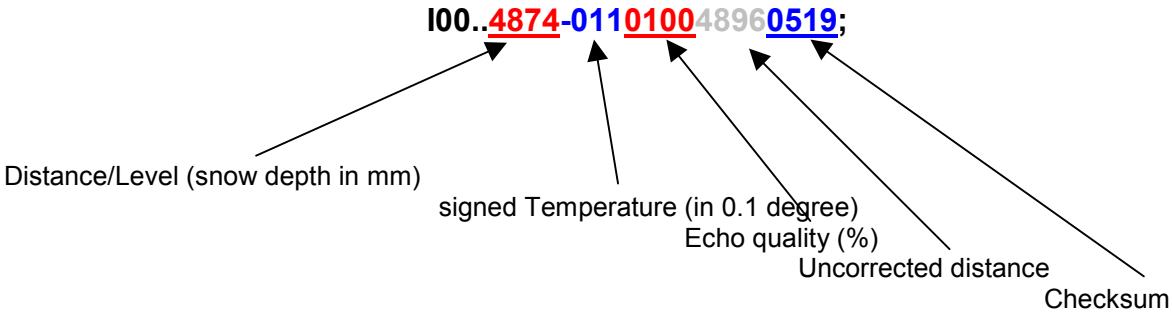
1.3.1 Standard protocol

The standard protocol is a simple easy-to-implement protocol. Measured values are output separated by spaces.



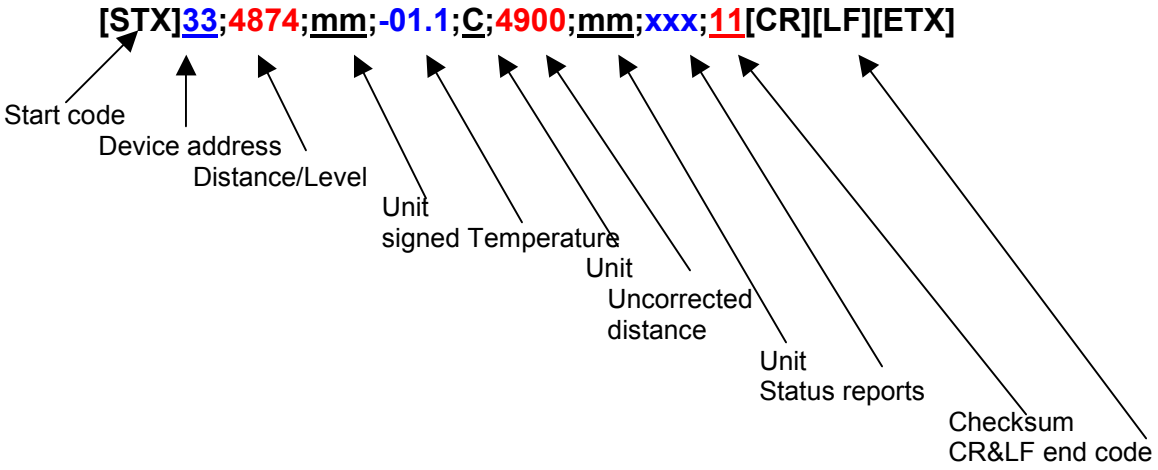
1.3.2 Protocol 1

Measured values are output to 4 decimal places using this protocol.



1.3.3 Protocol 2

If this protocol is selected, the output format is as follows:



The semicolon between individual values is interpreted as a delimiter.

Protocol 2 status messages:

000	-	OK
990	-	No echo after powering up
999	-	Erroneous measurement

1.3.4 Spectrum

This type of protocoll is an enlargement of protocoll 1. After the calculated values, each individual measurement value is diplayed without correction. Measurement values are separeted through '|'.

Example:
I00..1635022701001572042F;|1572|1569|1572|....|1572|1569|1572|

1.4 Checksums

1.4.1 Protocol 1 checksum

In protocol 1, the checksum is the total of the ordinal numbers of all the characters before the checksum (viewable in an ASCII table).
e.g.: I01..00000000000000230040B;
I is character 73, 0 is character 48, 1 is character 49, . is character 46 etc. The checksum is therefore 73+48+49+46+46+48+48+... = 1035 dec or 040B hex.

1.4.2 Protocol 2 checksum

This checksum is calculated from the total of all characters (alphanumeric characters and control codes such as STX, ETX, CR, LF but excluding checksum bytes themselves). The two's complement of this total is found and the low-order byte is taken from this. The high-order and low-order half byte, converted into readable ASCII characters, form the checksum.

1.5 Polling mode

The ultrasonic sensor can operate in automatic or polling mode. If automatic mode is set, measured values are sent using the selected protocol after every measurement. In polling mode, measured values are output within 10-20 ms after receiving the poll command.

The interval between signals sent to the sensor must not exceed 1 s, otherwise they are not accepted.

The device address can be set via the menu (see Section 3.5.2). The ultrasonic sensor can only be addressed via the device address.

1.5.1 Switch polling mode on/off

Polling mode can be set to two different modes. The first mode is obtained via the menu, see Section 3.5.5. The second mode is obtained through commands sent via the RS232 interface. The format of these commands is as follows:

Switch polling mode on:	**:DeviceaddressMP;**	
Reset to automatic mode:	**:DeviceaddressMA;**	
Example using device address 33:	**:33MP;**	Polling mode on
	:33MA;	Automatic mode

1.5.2 Poll command

The poll command has the following format:

:Deviceaddress;

The device address must consist of two ASCII characters, e.g.: **:33;**

2. Pin assignment

2.1 12-pin model

Pin	Colour	Significance	Comments
A	Brown	+12 V (11 V-15 V DC)	Supply voltage
B	Green	Impulse output	
C	Yellow	Handshake	Pin for interrogating analog interface
D	White	GND	Earth (ground) for power supply and signal
E	Pink	RX	Receive Data
F	Red	TX	Transmit Data
G	Blue	RTS	Request to Send
H	Grey	PSEN	Pin for programming the sensor
J	Violet	Analog output	4 to 20 mA
K	Grey/pink	Temp-	Connection for external temperature sensor
L	Blue/red	Temp+	Connection for external temperature sensor
M	Black	GND	Earth (ground) for power supply and signal

3. Description of parameters

3.1 Basic measurement sequence of sensor

The sensor wakes up, sends a train of 14 pulses of ultrasonic energy, receives a measurement sequence of 14 individual measurements and eliminates the 2 largest and 2 smallest measured values -> leaving 10 measured values for subsequent data processing. These measured values are then damped at the previously set damping rate (if enabled), the sliding average is generated and output via the interface. The sensor then changes to standby mode. This measurement cycle then starts again after the previously set interval has elapsed.

3.2 Main menu

3.2.1 Menu item 1: Measuring interval

Function: The measuring interval is the time interval during which a measurement is made. A measuring interval consists of measuring and standby.

Unit: 1/10 minute

Example: 1 = 6 s

Setting range: 1 min. (6 s) to 9999 (999.9 minutes, 16.665 hours)

3.2.2 Menu item 2: Valid echo

Function: This parameter specifies how many valid individual measurements (echoes) at least must be received in order to obtain any output. If fewer valid individual measurements than specified in this parameter are returned, the measurement is ignored and the value of the last valid measurement is used (i.e. the previous measured value is retained).

Unit: -

Setting range: 1 min. to 10 max.

3.2.3 Menu item 3: S-range blanking

Function: This parameter can be used to blank short-range echoes. All echoes from objects which are less distant than the value of this parameter are blanked. The range of values entered is converted to match the internal time base of the processor and output in the menu.

Unit: mm

Setting range: 828 min. to 9000 max.

3.2.4 Menu item 4: L-range blanking

Function: All echoes from objects which are more distant than the value of this parameter are blanked. The range of values entered is converted to match the internal time base of the processor and output in the menu.

Unit: mm

Setting range: 900 min. farther than short range, 9999 max.; the value set must be at least 900 greater than the value in the S-range blanking parameter.

3.2.5 Menu item 5: Average value

Function: This parameter is used to enable or disable a sliding average output. This sliding average value is calculated over 8 measurement results and is used to smooth the measurement signal.

Unit: --

Setting range:
Average value off = 0
Average value on = 1

3.2.6 Menu item 6: Distance/Level

Function: Toggles between measurement of distance and measurement of level or snow depth.

Unit: --

Setting range:
Distance = 0
Level = 1

3.2.7 Menu item 7: Zero point

Function: This parameter can be used to define the zero point for level (snow depth) measurements. This parameter is only significant if the **Distance/Level** parameter is set to 1.

Unit: mm

Setting range: 828 min. (short range) to 9999 max.

3.2.8 Menu item 8: Output type

Function: This parameter can be used to select the type of measured-value output. 5 types are available: serial data output, analog output (4-20 mA), impulse output, analog output with serial data and impulse output with serial data.
Caution: *If Impulse output is selected, measured values are not temperature compensated!*

Unit: --

Setting range:

Serial data output	= 0
Analog output	= 1
Impulse output	= 2
Analog output + data	= 3
Impulse output + data	= 4

3.2.9 Menu item 9: End range 20mA

Function: Describes the end range for the 4-20 mA analog output. If this value is reached or exceeded as a distance, the analog output is 20 mA.

Unit: mm

Setting range: 828 min. (due to short-range blanking) up to 9999 max.

3.2.10 Menu item 0: Handshake

Function: Handshake can be used to externally enable the analog or impulse output. As soon as the Handshake input is switched ON (High, +5 – 30 V), the output is enabled. As soon as the Handshake input is switched OFF (Low), the output is disabled again.

Unit: --

Setting range:
Handshake permanent = 0
Handshake pulsed = 1

3.2.11 Menu item A: Short/Long comm.

Function: This parameter determines whether measurement is initially started in the short range or long range. The gain of the received echoes varies in the relevant ranges.

Unit: --

Setting range:
Commencement with short range = 0
Commencement with long range = 1

3.2.12 Menu item B: Range selection

Function:

- Automatic (0) If automatic mode is selected, measurement is performed in the range defined in the parameter "Short/Long comm.". If too few valid measurements are received, the sensor changes over to the other range. If there are echoes in this range, this range is used until no more echoes are obtained. Only then does the sensor change to the other range.
- Cyclic (1) In cyclic mode, range checking is performed each time the sensor wakes up, i.e. it always checks for an echo in the range defined in "Short/Long comm." initially. If there is no echo, it changes to the other range.

Unit: --

Setting range:

Automatic = 0
Cyclic = 1

3.2.13 Menu item C: Result choice

Function: Brings up the result choice menu.

3.2.14 Menu item D: Damping (ramp function)

Function: Brings up the damping menu.

3.2.15 Menu item E: Simulation current

Function: This parameter can output a value via the analog output. The desired distance is entered and this is then displayed by the 4-20 mA analog output. If the parameter End range is adjusted, the analog output also changes. The analog output remains set until the main menu is exited. If the distance entered exceeds the end range, 20 mA is output.

Unit: mm

Setting range: 0 to 9999

3.2.16 Menu item F: Protocol

Function: Brings up the protocol menu (see Protocol menu, Section 3.5).

3.2.17 Menu item G: Serial config.

Function: Menu for configuring the RS232 interface (see Serial configuration menu Section 3.6).

3.2.18 Menu item H: Lang./Sprache

Function: Toggles the menu language, choice of German or English.

3.2.19 Menu item I: Info

When this menu item is selected, the device name, software version and serial number are output.

3.2.20 Menu item X: Exit

The parameter menu is exited and the sensor starts its measurement cycle (measurement followed by standby).

3.3 Result choice

3.3.1 Menu item 1: Array

Function: This parameter specifies if the internal calculation is done by using 10 measurement values or if the measurement values are stored in a buffer (capacity 100 measurement values). If the buffer is choosen the calculation is done by using the average values from the buffer values within the defined limits.

Unit: --

Setting range:
Small array = 0
Big array = 1

3.3.2 Menu item 2: Limit

Function: This parameter specifies the spread of the measurement values that are stored in the buffer. E.g. if the limit is set to 5 mm, the current value can vary ±5 mm from the previous value to be stored in the array.

Unit: mm

Setting range: 1 – 100 mm

3.4 Damping menu

Defines the maximum rate of increase or decrease in distance or level/snow depth per minute. This ramp is also applied to the impulse and analog output.

3.4.1 Menu item 1: Increasing damping (0,1/10 mm/min)

Function: Specifies the maximum value by which a measured value can change in one minute. Increasing damping is responsible for decreasing distance and increasing level.

Unit: 0,1/10 mm/min

Setting range: 0 (off) to 1000 mm/min

3.4.2 Menu item 2: Decreasing damping (0,1/10 mm/min)

Function: Same as above but for increasing distance and decreasing level.

Unit: 0,1/10 mm/min

Setting range: 0 (off) to 1000 mm/min

3.5 Protocol menu

The standard protocol, protocol 1 or protocol 2 can be selected in this menu. Settings can also be made for protocol 2. A description of the protocols can be found in Section 1.3.

3.5.1 Menu item 1: Standard, Protocol1, Protocol2, Spectrum

Function: The type of protocol is selected here; see Section 1.3 for details of the various protocols.

Unit: --

Setting range:
Standard protocol = 0
Protocol1 = 1
Protocol2 = 2
Spectrum = 3

3.5.2 Menu item 2: Device address

Function: To set the device address in protocol 2. The device address is used as a device identifier in protocol 1.

Unit: --

Setting range: 00 to 99 - 00 is the default setting

3.5.3 Menu item 3: Station number

Function: In protocol 1, a 2-digit number can be specified instead of two dots. The dots become visible again with this protocol if 00 is entered.

Unit: --

Setting range: 00 to 99, 00 is interpreted as ..

3.5.4 Menu item 4: mm/cm output

Function: Distance/level output in mm or cm, only valid in protocol 2.

Unit: --

Setting range:
mm = 0
cm = 1

3.5.5 Menu item 5: Auto./Polling

Function: Output of the measured values can be set here. In automatic mode, measured values are output after every measurement. In polling mode, the last measured values stored are output whenever the poll command is received (see 1.5.2).

Unit: --

Setting range:
Auto. = 0
Polling = 1

3.6 Serial configuration menu

The settings for the RS232 interface can be made in this menu. The standard settings are:
9600 bauds, 8 bits, no parity, 1 stop bit, no protocol.

3.6.1 Menu item 1: Baud rate

Function: To set the baud rate. 1200, 2400, 4800, 9600 and 19200 bauds are possible.

Unit: --

Setting range:
1200 = 0
2400 = 1
4800 = 2
9600 = 3 Default
19200 = 4

3.6.2 Menu item 2: Data bits

Function: 7 or 8 bits can be selected. If 7-bit mode is selected, the parity must also be set.

Unit: --

Setting range:
7 data bits = 0
8 data bits = 1

3.6.3 Menu item 3: Stop bits

Function: The number of stop bits can be set here. If 8-bit mode + parity is used, only one stop bit is possible.

Unit: --

Setting range:
1 stop bit = 0
2 stop bits = 1

3.6.4 Menu item 4: Parity

Function: To set the parity. None, even and odd parity are possible.

Unit: --

Setting range:
None = 0
Even = 1
Odd = 2

3.6.5 Menu item 5: RTS on time

Function: RTS on time can be used to clock the RTS signal. RTS on time specifies how soon the RTS signal is switched on before sending the data. Once the data has been sent, the RTS line remains active for 10 ms. If a time of 0 is entered, the RTS line clocks the data on the TX line.

Unit: ms

Setting range: 0 to 600 ms

3.6.6 Menu item 6: Immediately confirmation

Function: Here the user can set whether interface settings are to be accepted immediately or only after a reset. If settings are accepted immediately, modified settings become valid on exiting the menu. The settings of the terminal program must then be modified.

Unit: --

Setting range:
After reset = 0
Immediately valid = 1

4. Basic settings

The following settings are recommended for initial commissioning:

Menu
1 Measuring interval : 1
2 Valid echo : 4
3 S-range blanking(mm) : 828
4 L-range blanking(mm) : 5129
5 Average value : 1
6 Distance/Level : 1
7 Zero point (mm) : 5000
8 Output type : 0
9 End range 20mA (mm) : 5000
0 Handshake : 0
A Short/Long comm. : 1
B Range selection : 1
C Result choice
D Damping
E Simulation current
F Protocol
G Serial config.
H Lang./Sprache
I Info
X Exit

Result choice
Array : 1
Limit : 10

Damping
1 Increasing (1/10 mm/min): 20
2 Decreasing (1/10 mm/min): 20
X Exit

Protocol
1 Strd, 1, 2, Spc : 1
2 Device address : 0
3 Station number : 0
4 mm/cm output : 0
5 Auto./Polling : 0
X Exit

Serial configuration
1 Baud rate : 9600
2 Data bits : 8
3 Stop bits : 1
4 Parity : 0
5 RTS on time : 0
6 Immediately confirmation: 1
X Exit

5. Parameter setup table

You can enter the parameters you have set for the sensor in this table.

Date:_____

Location:_____

Serial number:_____

Software version:_____

Main menu parameters	
Measuring interval 1/10min	
Number of valid echoes	
S-range blanking mm	
L-range blanking mm	
Average value	o on o off
Distance/Level	o Distance o Level
Zero point mm	
Output type	o RS232 o Analog o Impulse o Analog + RS232 o Impulse + RS232
End range 20 mA mm	
Start with	o Short range o Long range
Range selection	o Automatic o Cyclical
Handshake	o off o on
Protocol menu parameters	
Protocol	o Standard o Protocol 1 o Protocol 2 o Spectrum
Device address	
Station number	
Unit output	o mm o cm
Auto./Polling	o Auto. o Polling

Serial configuration menu parameters	
Baud rate	o 1200 o 2400 o 4800 o 9600 o 19200
Data bits	o 7 o 8
Stop bits	o 1 o 2
Parity	o none o even o odd
RTS on time ms	
Immediately confirmation	o yes o no
Damping menu parameters	
Decreasing damping	
Increasing damping	
Result choice menu parameters	
Array	o small o big
Limit	

6. Technical specifications

Measurement range – snow depth	Measurement range: 0 to 8 m; resolution: 1 mm; accuracy: 0.1 % (FS) Measurement principle / sensor: ultrasonic (Frequency 50 kHz; beam width 12°)
Measurement range – temperature	Measurement range: -35 °C to +60 °C; resolution: 0.1 °C; non-linearity: ≤0.15 % Measurement principle / sensor: semiconductor (external sensor in air-cooled radiation shield)
Functions	Distance or depth measurement (configurable)
Interface – analog	Distance / snow level Signal: 4 to 20 mA (configurable); resolution: 12 bit; max. load 100 Ω
Interface – digital	Distance / snow level and air temperature Interface: RS 232; data transfer rate: 1.2 to 19.2 kBd Protocol: various ASCII protocols
Supply	Supply voltage: 11 to 15 V DC Current consumption: 200 mA max. (measurement phase, approx. 3 s); 5 mA (standby) Power consumption: 0.5 Ah / day (with 1-minute measuring interval)
Lightning protection	Discharge capacity: built-in lightning protection with 0.6 kA discharge capacity
Range of application	Operating temperature: -35 °C to +60 °C
Housing	Basic dimensions: diameter: 80 mm; length: 230 mm Thermal shield dimensions: diameter: 110 mm; length: 120 mm Material: anodised aluminium, natural finish Total weight: 2 kg
Protection rating	IP 66
Installation	Mast-mounting device for 61 mm (2") pipe