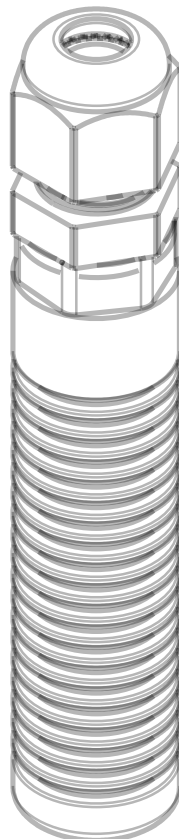# HydroTemp
Submersible Water Temperature Sensor
User Manual

v1.2.3

Starting Point

Thank you for purchasing the Geolux HydroTemp submersible water temperature sensor! We have put together the experience of our engineers, the domain knowledge of our customers, the enthusiasm of our team, and the manufacturing excellence to deliver this product to you.

You may freely rely on our field-proven technology. The use of top-quality components and advanced signal processing algorithms ensures that the Geolux HydroTemp submersible water temperature sensor can be used in various applications and environments.

We have created this User Manual to assist you in setting up and using the Geolux instrument.

Should there be any questions left unanswered, please feel free to contact us directly:

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Contents

1 *Introduction*

The Geolux HydroTemp submersible water temperature sensor enables accurate water temperature measurements. The water temperature sensor responds to Modbus requests via the RS-485 data line and can be used to measure water temperatures ranging from -20 °C to 70 °C with an accuracy of 0.1 °C and a resolution of 0.01 °C. The sensor can be used individually to measure the temperature at a single depth, or multiple sensors can be connected to measure temperatures at various depths. It is possible to connect up to 16 sensors in the multi-depth configuration with costumizable distance between the sensors.

2 Electrical Characteristics

The electrical characteristics of the Geolux HydroTemp submersible water temperature sensor are given in Table 1.

Table 1. Electrical Characteristics

Parameter	MIN	TYP	MAX	Unit
Communication interface RS-485 interface speed		9600		bps

Temperature sensor
    Measurement range
    Accuracy
	-20	0.1	+70	°C
				°C

Power supply voltage	9.0	12.0	27.0	V
Power Operational mode		15		mW
Operational temperature range	-40		+85	°C
Ingress Protection rating	IP68			
Mechanical		φ16.5 x 90		mm

3 Cable Pin-Out

The HydroTemp submersible water temperature sensor is supplied with an open end cable consisting of 5 wires coded with different colors. Table 2 gives a detailed description of each wire.

Table 2. Cable Pin-Out

Pin No.	Wire Color		Pin Name	Pin Description
1	Brown		+Vin	The power supply for the HydroTemp submersible water temperature sensor is provided on this pin. The power supply voltage must be in range of 9 VDC to 27 VDC, and the power supply must be able to provide at least 0.65 W.
2	Brown/White		GND	This pin should be connected to the ground (negative) pole of the power supply.
3	Blue		SDI-12	SDI-12 communication interface
4	Blue/White		Reserved	Reserved
5	Orange		RS-485 - D+	RS-485 data transmitter/receiver high signal.
6	Orange/White		RS-485 - D-	RS-485 data transmitter/receiver low signal

3.1. Serial RS-485 Interface

Serial RS-485 interface is implemented as standard industrial half-duplex communication interface. The communication interface is internally short-circuit and overvoltage protected. For more details please consult receiver specification.

The most common communication protocol used with RS-485 interface is Modbus-RTU, but other protocols are also available on request. Detailed description of communication protocols is given in chapter 6 of this user manual.

4 Installing the HydroTemp Sensor

In order to measure the water temperature the Geolux HydroTemp water temperature sensor must be immersed in the water. The sensor can be installed at depths up to 150 metres. It is possible to connect up to 16 sensors in the multi-depth configuration with costumizable distance between the sensors. The distance between the sensors in the multi-depth configuration must be in the range of 0.5 m and 10 m.

5 Data Interfaces

The Geolux HydroTemp submersible water temperature sensor supports both Modbus and SDI-12 communication interfaces. When Modbus is used, the device responds to Modbus requests over the RS-485 data line. The temperature measurements are not reported automatically, but are instead reported only after being requested by the master device (data logger unit). When SDI-12 is used, the device will respond to SDI-12 requests sent over dedicated SDI-12 interface.

5.1. Serial RS-485 Interface

Serial RS-485 interface is used for connecting multiple instruments to a single data logger. The HydroTemp water temperature sensor supports Modbus protocol over RS-485 bus. A detailed description of the protocol is given in chapter 6 of this user manual.

Default communication parameters are:

Bitrate:	9600 bps
Data bits:	8
Stop bits:	1
Parity:	Even
Device ID:	1 to N (for sensor with N probes)

The default Modbus address (Device ID) is 1. For multi-probe HydroTemp sensors, the deepest probe's address is 1, and the addresses will increase by one for shallower probes, in the order that the probes are placed on the line.

5.2. SDI-12 Interface

SDI-12 interface allows connecting Geolux HydroTemp sensor to SDI-12 compatible data logger. Details of SDI-12 protocol are given in chapter 6 of this user manual.

The default SDI-12 address is 1 (not 0). For multi-probe HydroTemp sensors the deepest probe's address is 1, and the addresses increase by one for shallower probes.

6 Data Protocols

Geolux HydroTemp water temperature sensor supports the following data protocols:

- Request-response protocol (Modbus) on RS-485 interface that allows multiple units to be used on a single RS-485 bus
- SDI-12 protocol over SDI-12 interface

6.1. Modbus Protocol (RS-485)

The unit responds to Modbus requests over RS-485 data line. 9600 bps, 1 stop bit, even parity, 8 data bits configuration is used.

Modbus registers that are accessed by Modbus protocol are 16-bit (2-byte) registers.

Modbus is a request-response protocol where a master (such as data logger) sends out requests, and slave devices (such as the HydroTemp water temperature sensor) respond. The request and response format, with examples is given in Tables 3-6.

In each request, the master can either ask the slave to retrieve the value of one or more registers, or the master can set the value of one or more registers. Each register holds one 16-bit value.

Table 3. Master Request Format

Name	Address	Fun	Data Start Address		Register Count		CRC16	
Length	1 byte	1 byte	2 bytes (H,L)		2 bytes (H,L)		2 bytes (L,H)	
Example	0x01	0x03	0x00	0x00	0x00	0x01	0x84	0x0A

Table 4. Request Example

Name	Content	Detail
Address	0x01	Slave address (Sensor id)
Function	0x03	Read holding register
Data start address	0x00	The address of the first register to read minus one (HIGH)
	0x00	The address of the first register to read minus one (LOW)
Number of regs	0x00	High
	0x01	Low (read only 1 register)
CRC16	0x84	CRC Low
	0x0A	CRC High

Table 5. Slave (sensor) Response Format

Name	Address	Fun	Byte Count	Data		CRC16	
Length	1 byte	1 byte	1 byte	2 bytes(H,L)		2 bytes(L,H)	
Example	0x01	0x03	0x02	0x01	0x79	0x84	0X0A

Table 6. Response Example

Name	Content	Detail
Address	0x01	Slave address (Sensor id)
Function	0x03	Read holding register
Data length	0x02	Data length is 2 bytes
Data	0x00	Data high byte
	0x01	Data low byte, means ID is 1
CRC16	0x79	CRC Low
	0x84	CRC High

Since the Geolux HydroTemp submersible water temperature sensor requires no configuration, all the registers used for reporting temperature are read-only.

Table 7 defines the data returned by the instrument when the master requests that the register is read. In Table 7, field *Fun* corresponds to Modbus function codes, i.e. 0x03 – *Read holding register.*

Table 7. Retrieving Data from the Sensor

Fun	Register Address	Data Length	Data Range	Details
	0x0001	2 bytes	-400 to +850	Read water temperature (value * 10)
0x03	0x0002	2 bytes	0 to 1	Read error status, 0 = no error
	0x0003	2 bytes	-4000 to +8500	Read water temperature (value * 100)

Register addresses start at 1 according to Modbus specification. Internally the Modbus protocol will increase them by 1 when sending them over the data line, so in Modbus packet the register 0x0001 will be represented by 0x0000.
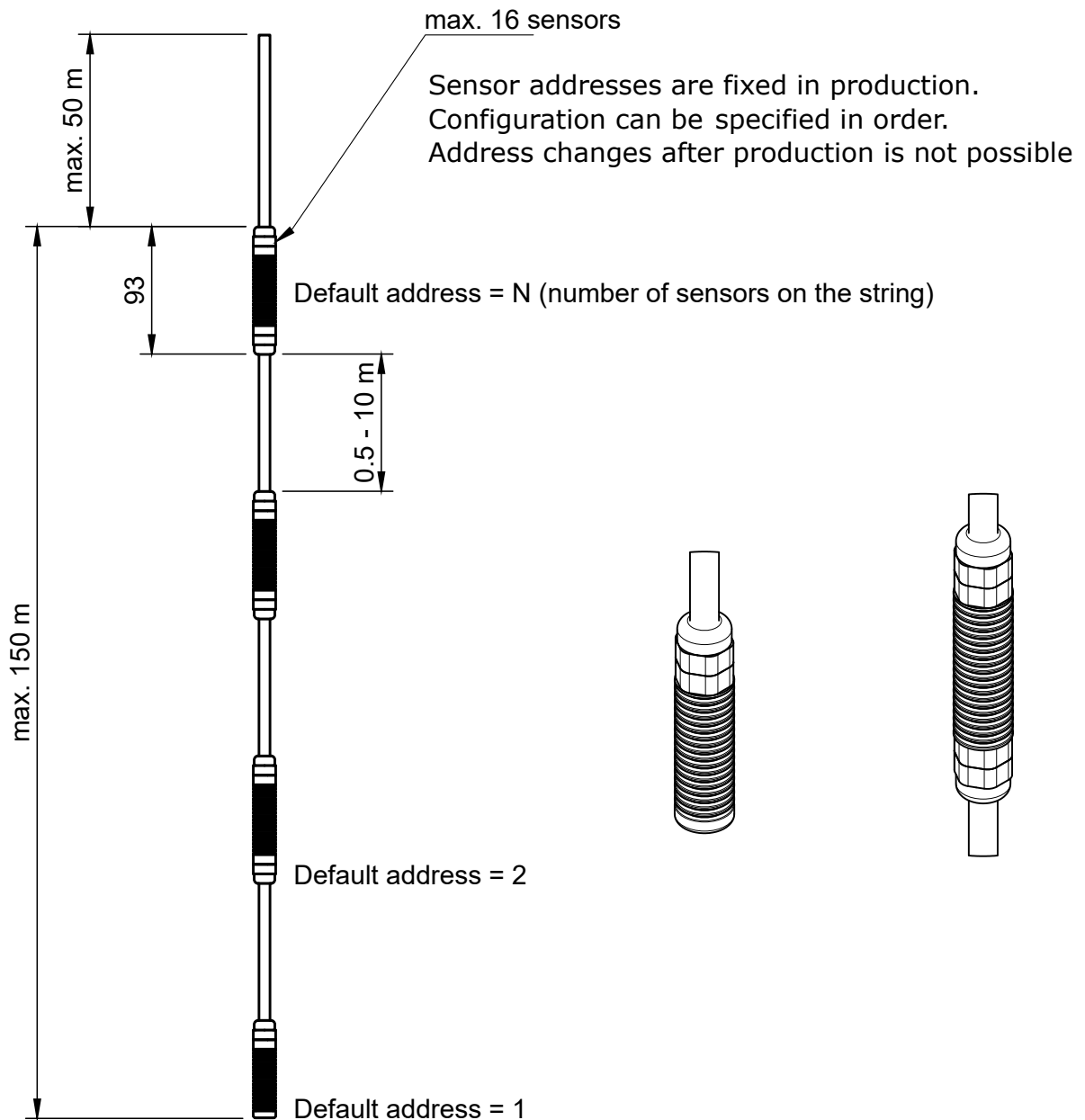
6.2. SDI-12 Protocol

In all commands, 'a' represents the device address. Supported SDI-12 commands are given in Table 8.

Table 8. SDI-12 commands

Name	Command	Response	Details
Send identification	aI!	a13GEOLUXHydTmp fff000000<CR><LF>	a – address SDI-12 version – 1.3 vendor identification – GEOLUX sensor model – HydTmp sensor version – fff, where fff is firmware version
Start measurement	aM!	ammm1<CR><LF>	1 value is ready within mmm seconds
Send data	aD0!	a+f<CR><LF>	+f – temperautre in °C

7 Appendix A - Mechanical Assembly

max. 16 sensors

Sensor addresses are fixed in production.
Configuration can be specified in order.
Address changes after production is not possible

Default address = N (number of sensors on the string)

max. 50 m

93

0.5 - 10 m

max. 150 m

Default address = 2

Default address = 1

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