

TS210

Water
Temperature
Sensor

User Manual



About NexSens

NexSens is a US-based company specializing in the design and manufacture of real-time environmental measurement systems. Recent data logger, sensor and web developments simplify collecting and sharing project data. Environmental measurement systems are constructed with standard components. Data is transmitted by WiFi, cellular, satellite or radio and shared on a real-time datacenter.

Planning

Component and system drawings are available online

Integration

Systems are pre-constructed, tested and documented prior to shipment

Field Services

Installation support and setup ensure successful deployments

Training

Factory or onsite training ensure successful startup and operation

Repair

Technicians inspect and recondition equipment for reliable performance

Support

Online knowledge base, phone and email support are readily available

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Overview

The NexSens TS210 Thermistor String provides high precision temperature measurements for profiling in lakes, streams, and coastal waters. It features an integral titanium thermistor secured and epoxied in a protective housing for underwater deployments. A marine-grade cable with braided Kevlar core help ensure reliability in extreme environments.

Each sensor is accurate to ± 0.075 C for high-precision measurements. The exposed titanium thermistor makes direct contact with water, allowing readings to stabilize within 60 seconds. Temperature data is transmitted on a RS-485 Modbus RTU string bus for integration with data loggers and SCADA systems. The string is powered by 4-28 VDC for operation on a 12 or 24 VDC power supply.

TS210 strings are available standard with 1m spacing or at custom intervals to meet project requirements. Cable lengths are available up to 1,219 meters (4,000 feet) with a maximum 250 nodes. Strings terminate in a NexSens UW plug and receptacle connector, allowing additional sections or sensors to be added as required. Optional accessories include a bottom pressure sensor, cable clamps, stainless steel mooring line, and communication adapters.



Figure 1:
Typical TS210
Temperature
String

What's Included

Each TS210 Water Temperature Sensor includes the UW underwater plugs required for temperature string terminations and O-rings for preventing leakage at these connections.

Common Accessories

Table 1: Accessories commonly used with TS210 temperature sensors

Part Number	Description	Details
UW-FLxR	Underwater to flying lead cable adapter	Used to connect TS210 temperature sensor string to a NexSens iSIC data logger
TS-Clamp	TS210 mooring clamp	Used to secure TTS210 strings along a mooring line
SS187-x	Stainless steel mooring line	Used for buoy and sensor mooring systems
RS485-RS232	Signal adapter	RS-485 to RS-232 signal adapter

NOTE

TS210 sensors use unique NexSens UW Underwater Connectors for interfacing with accessories.

Specifications

General

Table 2: NexSens TS210 temperature sensor general specifications

Length	3.0 in (76.2 mm)
Diameter (OD)	1.4 in (35.6 mm)
Weight	0.3 lbs
Housing	Acetal Copolymer Polyvinylchloride (PVC)
Operating Temp Range	0 to 45°C
Operating Depth Range	4000 ft
Sensor Capacity	250 nodes
Output	RS-485 Modbus RTU
sensorBUS Signals	SDI-12, RS-232
Power Requirements	Voltage: 5 to 16 VDC
Power Consumption	1.3mA active; 0.35mA sleep; 0.05mA deep sleep (per node)

Temperature

Table 3: NexSens TS210 temperature sensor temperature specifications

Range	0 to 45°C
Accuracy	±0.075°C
Resolution	0.01°C
Unit of Measure	Celsius

Getting Started

Multi-Point Temperature String Assembly

Multi-point strings are used to determine temperature at various locations. Typically of interest are temperature distributions vertically in a water column or horizontally along a stream or riverbed.

WARNING

All o-rings must be clean and dry before being used to secure watertight connections.

NOTE

Always check each mating connector for an o-ring before securing any UW underwater connection.

To add the sensors in the Sensor Properties of the iChart Setup Device Wizard, highlight the appropriate sensor in the **Available Parameters** list. TS210 strings typically begin with Temp00 as the first node. Click **Add** to add the number of TS210 devices that are included in the string. Enter the correct Modbus address of the first node under **Modbus Settings** (Default is 1). The software automatically assigns the addresses of the remaining sensors.

If the sensors are to be connected to Port P1, P2 or T (See Connecting to an SDL Data Logger below) click **Show Detail**. Under Switch Power, select **SW.A (12V,200mA)**. Enter 10 in the Duration (sec) box.

Click **OK** to finish.

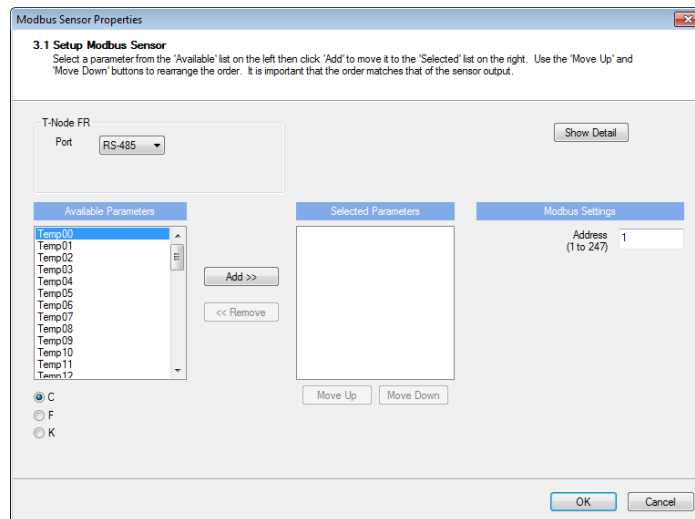
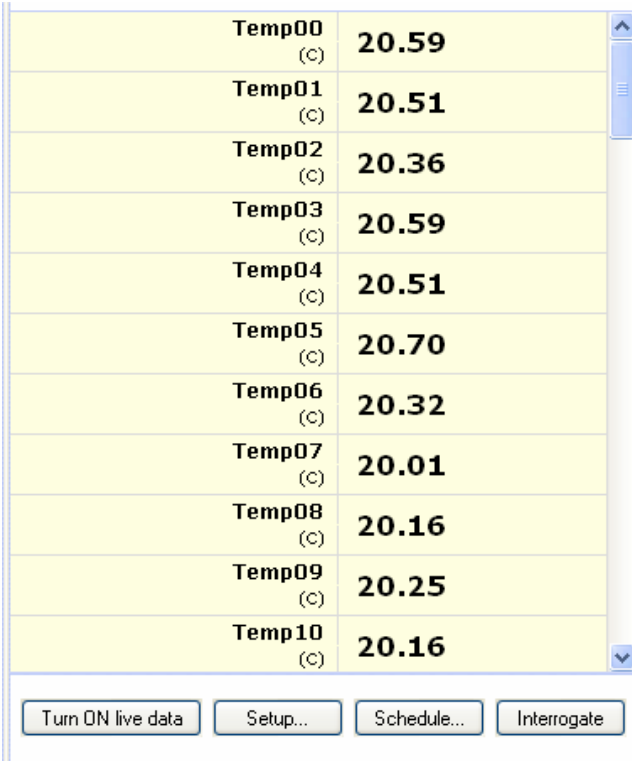


Figure 2: TS210 sensors must be added individually

Getting Started



The screenshot displays a software interface for monitoring temperature data. It features a table with 11 rows, each representing a temperature sensor. The table has two columns: the sensor ID (e.g., Temp00) and the current temperature value in degrees Celsius. Below the table, there are four buttons: 'Turn ON live data', 'Setup...', 'Schedule...', and 'Interrogate'. The table is styled with a light yellow background and a blue border. A vertical scrollbar is visible on the right side of the table.

Temp00 (C)	20.59
Temp01 (C)	20.51
Temp02 (C)	20.36
Temp03 (C)	20.59
Temp04 (C)	20.51
Temp05 (C)	20.70
Temp06 (C)	20.32
Temp07 (C)	20.01
Temp08 (C)	20.16
Temp09 (C)	20.25
Temp10 (C)	20.16

Turn ON live data Setup... Schedule... Interrogate

Figure 3: Typical temperature data display in iChart

Connecting to an SDL500 Data Logger

UW underwater connectors provide a plug-and-play interface for connection to NexSens SDL500 Submersible Data Loggers.

The SDL500 sensor bulkhead includes sensor connection ports identified as T, P1, P0, A and D.

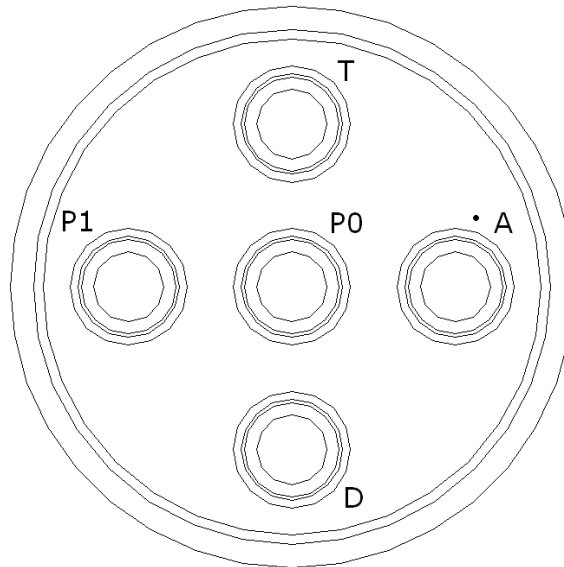


Figure 4: SDL500 sensor bulkhead

TS210 sensors and strings can be connected to Ports P0, P1, T, or D. It is recommended to connect to port P1 or T to allow for power to be removed from the TS210 sensors between readings. If this is done, ensure Switch Power is setup correctly in iChart (See [Multi-Point Temperature String Assembly](#) above).

Connecting to an iSIC Data Logger

TS210 sensors can be connected to any iSIC data logger using a UW receptacle to flying lead cable assembly.



Figure 5: UW Receptacle to Flying Lead Cable

First, plug the temperature string into the adapter’s UW connector. Run the cable through a gland fitting on the bottom of the iSIC enclosure. Then, wire flying lead end of the cable into the iSIC digital terminal strip per the wiring diagram shown in **Table 4**.

Table 4: iSIC Digital Terminal Strip Wiring Table

Wire	Signal	Pin
Brown	SDI-12	1. SDI
Red	5-16V+	2. SW.A
Black	Ground	4. GND
Yellow	Rx	5. P1.Rx
Orange	Tx	6. P1.Tx
Green	485-A	11. P3.Rx
Blue	485-B	12. P3.Tx

Connecting to an RS485 Modbus RTU Device

TS210 devices can also be connected to any device capable of reading RS485 Modbus RTU by utilizing a UW-R FL Cable.

UW-R FL Cable Connections

The following shows the necessary connections for the TS210 using a UW-R FL cable. The Pass-through signals do not need to be connected if they will not be utilized.

Table 5: UW-R FL Cable

Receptacle Pin	Wire Color	TS210
1	Green	RS485A
2	Blue	RS485B
3	Brown	SDI-12 Pass-through
4	Red	12VDC
5	White	5VDC Pass-through
6	Yellow	RS232 RX Pass-through
7	Black	GND
8	Orange	RS232 TX Pass-through

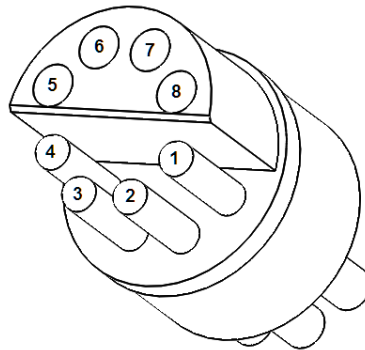


Figure 6: T-node UW-receptacle end

Sensor Information

The below information outlines the TS210 sensor’s requirements.

- Protocol: Modbus-RTU
- Baud Rate: 19200
- Parity: N81
- Default Address: 1 to n
- Format: Big Endian
- Timeout: 500ms

Register Information

Once connected the following registers can be used to collect data and change the sensor’s Modbus address.

Table 6: Read Input Registers

Function 0x04 (Read input registers)			
Registers	Data Type	Data Size	Purpose
0x0006, 0x0007	Float	2 registers	Requests the temperature recorded by the TS210 in Celsius

Ex. FB, 04, 00, 06, 00, 02, 85, 90

Requests the Celsius temperature reading of a TS210 from the universal Modbus address of 251.

Table 7: Write Multiple Registers

Function 0x10 (Write multiple registers)			
Register	Data Type	Data Size	Purpose
0x1000	Integer	1 register	Changes the Modbus Address of the TS210 to the send data

Ex. FB, 10, 10, 00, 00, 01, 02, 00, 05, 0D, 36

Changes a TS210 at the universal Modbus address of 251 to a new address of 5.

Universal Address

The TS210 is programmed such that any sensor will respond to Modbus address 251. This is implemented for the event that the sensor's current address is unknown. This address should only be queried with one sensor connected to the data line. If more than one sensor is connected, both will respond and a bad message is likely.

Universal Address should not be used with TS210 sensors that have more than one node. Only use address 251 if there is a single sensor connected.

Pre-Deployment Check

It is recommended that field deployments be carefully planned, and it is best to completely configure the system on a lab bench and test it for a period of time prior to taking it to the field. This will ensure a successful deployment and quality data collection. Additionally, it is much easier to troubleshoot problems in the lab than in the field.

For *SDL500 Submersible Data Logger* applications, connect the data logger to a PC via the SDL500's supplied USB interface cable.

For *iSIC Data Logger* applications, first ensure that power is supplied to the device. Then connect to the PC via the direct connect serial cable.

With iChart software running, select **File | New Project**. Name the project and follow the step-by-step procedure in the **Setup Device Wizard**. Refer to the iChart manual for additional information.

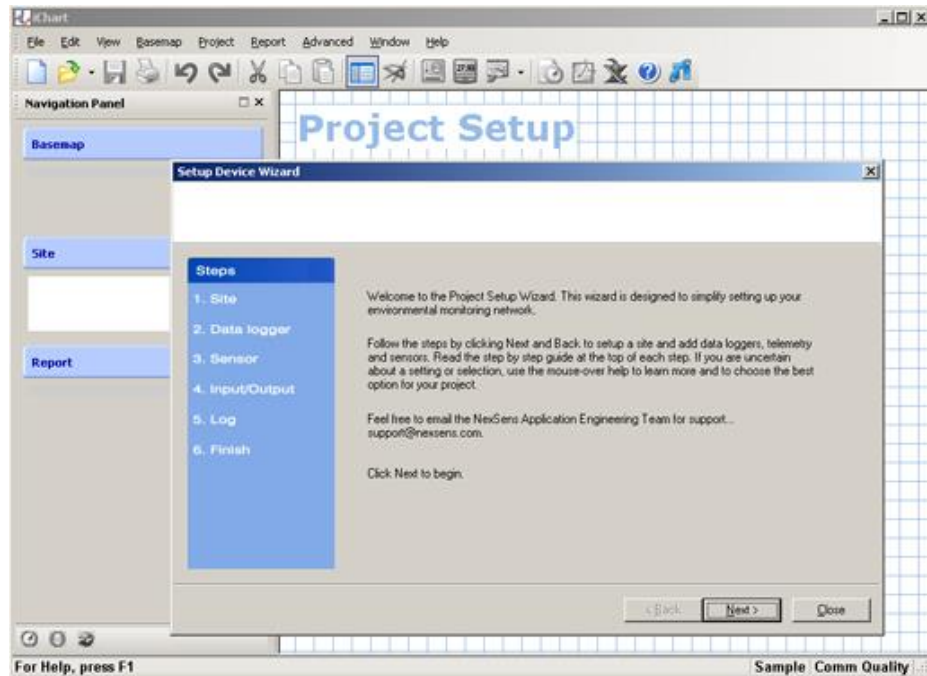


Figure 7: iChart software setup device wizard

Setting Up a Sensor Mooring Line

Temperature strings are frequently attached to a mooring line to keep them fixed in place vertically within a water column. This technique helps to ensure that temperature data is consistently being monitored at the desired depths.

With the temperature string laid out on a flat surface, secure each TS210 to the sensor mooring line using TS-Clamp sensor mooring clamps.



Figure 8: T-Node string on sensor mooring line



Figure 9: Stainless steel mooring line



Figure 10: TS-clamp mooring clamp

Connector Signals

TS210 sensors require four signals for operation: +5-16 VDC, Ground, RS485A and RS485B. The sensorBUS protocol used by TS210 strings can also carry 5VDC, SDI-12 and RS-232 signals, which are available for connecting other sensors along a sensor string.

WARNING

Never allow moisture to enter any of the UW connectors during cleaning.

Table 8: UW-plug end signal pinout

Pin	Signal
1	RS485A
2	RS485B
3	SDI-12 Pass-through
4	5-16V+
5	5V Pass-through
6	RS232 RX Pass-through
7	GND
8	RS232 TX Pass-through

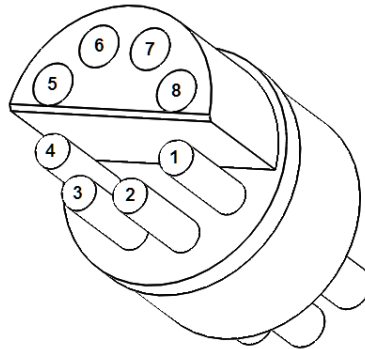


Figure 11: T-node UW-receptacle end

Maintenance

There is very little maintenance required for TS210 temperature strings because they are designed for long-term deployments in submersible applications.

Cleaning

Any bio-fouling that accumulates on T-Node temperature strings during deployments should be cleaned using a soft cloth or soft-bristled brush along with soap and water.

Storage

T-Nodes should be stored in a cool, dry place.

Calibration

Although T-Nodes are capable of holding the initial factory calibration indefinitely, NexSens recommends that temperature strings be sent in for a factory recalibration every two years to ensure maximum sensor performance.

Troubleshooting

Follow the procedure below to isolate and resolve sensor interface problems.

Table 9: TS210 temperature sensor troubleshooting guide

Symptom	Possible Cause	Corrective Action
Temperature data is displayed as a value between -99999 and -100001	Leakage into a connector	Check each underwater connection for flooding
	String disconnected (or severed cable)	Check the physical setup and condition of the temp string
	No Power	If connected to port P1 or T ensure switch power is setup in iChart.

If the issue persists, visit www.NexSens.com/Knowledgebase to search the Knowledge Base for Articles, FAQs and troubleshooting guides; otherwise please contact NexSens technical support.

Warranty and Service

NexSens Technology, Inc. warrants products against defects in materials or workmanship for a period of 12 months from the date of delivery to the original customer. This warranty is limited to the replacement or repair of such defects, without charge, when the product is returned to NexSens Technology, Inc. Damage due to accidents, misuse, tampering, lack of reasonable care, loss of parts, failure to perform prescribed maintenance, or accidents of nature are not covered. This warranty excludes all other warranties, express or implied, and is limited to a value not exceeding the purchase price of the instrument.

Limitation of Warranty

This warranty is not applicable to any NexSens Technology, Inc. product damage or failure caused by (i) failure to install, operate or use the product in accordance with NexSens Technology, Inc. written instructions, (ii) abuse or misuse of the product, (iii) failure to maintain the product in accordance with NexSens Technology, Inc. written instructions, (iv) any improper repairs to the product, (v) use by you of defective or improper components or parts in servicing or repairing the product, or (vi) modification of the product in any way not expressly authorized by NexSens Technology, Inc.

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WARNING

NexSens Technology, Inc. products are not authorized for use as critical components in any life support system where failure of the product may affect its safety or effectiveness.