

T-Node FR

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 Wi-Fi, 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 T-Node FR water temperature sensor utilizes an integral titanium thermistor secured in a protective housing for underwater deployments in fresh, brackish, or seawater. The sensors can be connected in series using UW underwater cables and suspended vertically in a water column or horizontally along a stream or riverbed. Double O-rings (both gland and face seals) ensure a reliable and watertight connection.

Temperature data is transmitted on the RS-485 Modbus RTU string bus. Additionally, the T-Node FR offers pass-through signals for SDI-12 and RS-232, allowing the user to connect other environmental measurement sensors along the string. This sensorBUS architecture has been designed so researchers can easily build and customize multi-point sensor strings and environmental monitoring networks.

The T-Node FR sensors feature a plug-and-play interface to NexSens SDL, SDL-V2, iSIC-CB and X2 data loggers. For connection to external data collection platforms, the T-Node FR sensor string can integrate directly with a 3rd party data collection platform via RS-485 Modbus RTU.

Figure 1: Typical T-Node FR temperature string section consisting of temperature sensors and underwater cables

What's Included

Each T-Node FR Water Temperature Sensor includes the O-rings required for a water-tight seal between sensors.

Common Accessories

Table 1: Accessories commonly used with T-Node FR temperature sensors

NOTE

The T-Node FR uses unique NexSens UW Underwater Connectors for interfacing with accessories.

Part Number	Description	Details
UW-FLxR	Underwater to flying lead cable adapter	Used to connect a T-node FR string to a data logger/SCADA system
T-Clamp	T-node FR mooring clamp	Used to secure T-node FR sensors to a mooring line
SS187-x	Stainless steel mooring line	Used for buoy and sensor string mooring
RS485-RS232	Signal adapter	RS-485 to RS-232 signal adapter
UW-Plug	UW sensor port plug	Provides a water-tight seal for the last T-node FR on string

Specifications

General

Table 2: NexSens T-Node FR temperature sensor general specifications

Length	5.3 in (134.6 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 24 VDC
Power Consumption	1.3mA active; 0.05mA sleep (per node)

Temperature

Table 3: NexSens T-Node FR temperature sensor temperature specifications

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

Getting Started

Single-Point Temperature String Assembly

Single-point strings are used to determine water temperature at one location, typically at the surface.

To assemble a single-point temperature string, first connect the male UW plug connector on the T-Node to the female UW receptacle connector on an Underwater Cable as in Figure 2.

NOTE

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



Figure 2: Underwater connection between T-node FR sensor and UW cable

Then connect the supplied UW underwater plug to the female UW receptacle connector on the T-Node FR to terminate the string as shown.



Figure 3: Underwater connection between T-node FR sensor and UW cable

NOTE

Nodes must be assembled in ascending order with the lowest Modbus address connected to the logger.

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.

During the assembly of a multi-point temperature string, the nodes must be organized by Modbus address, with the first node being placed at some known reference point (usually closest to the water's surface for vertical strings). Each node must be programmed with a unique Modbus address and the addresses within a string must be sequential.

To begin assembling a multi-point string, first gather all T-Node FRs and Underwater Cables. Set the components out on a clean table or lab bench.

Select a single underwater cable as the first component in the temperature string, and connect it to the UW plug end of the T-node FR with the lowest Modbus address. Sensors will be assigned Modbus addresses based on serial numbers from the factory, so the lowest serial number will have the lowest Modbus address.

Continue the assembly with another underwater cable. Attach the plug end of the second cable to the receptacle end of the first T-Node FR in the string.

Proceed with additional T-Node FR sensor attachments, each followed by an underwater cable. Be sure to keep track of variations in underwater cable lengths if non-uniform spacing is desired. Also make sure to terminate the string with the supplied UW underwater plug.

Connecting to an RS485 Modbus RTU Device

T-Node FR 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 T-Node FR using a UW-R FL cable. The Pass-through signals do not need to be connected if they will not be utilized.

Table 4: UW-R FL Cable

Receptacle Pin	Wire Color	T-Node FR
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

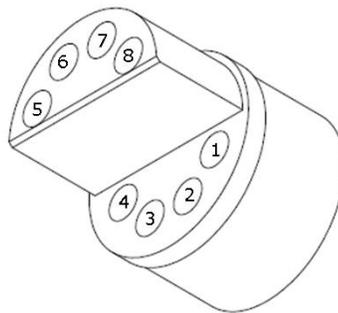


Figure 4: T-node FR UW-receptacle end

Sensor Information

The below information outlines the T-Node FR sensor's requirements.

- Protocol: Modbus-RTU
- Baud Rate: 19200
- Parity: N81
- Default Address: 1
- Universal Address: 251
- 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 5: 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 T-Node FR in Celsius

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

Requests the Celsius temperature reading of a T-Node FR from the universal Modbus address of 251.

Table 6: Write Multiple Registers

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

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

Changes a T-Node FR at the universal Modbus address of 251 to a new address of 5.

Universal Address

The T-Node FR 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.

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.

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 T-Node FR to the sensor mooring line using Thermistor String Mooring Clamps (TS-Clamp).



Figure 6: T-Node FR attached to mooring line with a TS-Clamp.



Figure 5: Stainless steel mooring line (left) and TS-Clamp (right)

Connector Signals

T-Node FR sensors require four signals for operation: +5-24 VDC, Ground, RS485A and RS485B. The sensorBUS protocol used by T-Node FR strings can also carry 5VDC, SDI-12 and RS-232 signals, which are available for connecting other sensors along a sensor string.

Table 7: UW-plug end signal pinout

Pin	Signal
1	RS485A
2	RS485B
3	SDI-12 Pass-through
4	5-24V+
5	5V Pass-through
6	RS232 RX Pass-through
7	GND
8	RS232 TX Pass-through

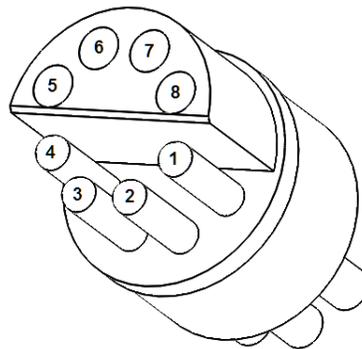


Figure 7: T-node FR UW-receptacle end

Maintenance

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

WARNING

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

Cleaning

Any bio-fouling that accumulates on T-Node FR 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

T-Nodes are capable of holding the initial factory calibration indefinitely and do not require re-calibration.

Troubleshooting

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

Table 8: T-Node FR 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	Use a DVM to verify the input power is registering 5-24VDC

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.

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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.