



1328 Parkway Court • Beaver Creek • OH • 45432
Phone: (937) 426-2703 • Fax: (937) 426-1125 • E-Mail: info@NexSens.com
Visit us on the web at <http://www.NexSens.com>

NexSens TS110
Sensor Interface Manual
Revision 07.09.20

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About NexSens Technology, Inc.

NexSens software and real-time data logging systems are designed to simplify the setup and operation of environmental monitoring networks. NexSens products automate much of the tedious programming, data collection, and manual data processing common with other systems.

iChart is an easy-to-learn, easy-to-use Windows-based software program designed to interface with the industry's most popular environmental monitoring sensors and systems. A large multi-vendor instrument library makes setup quick and easy. iChart automates much of the tedious programming, data collection and manual data processing common with other environmental data collection systems.

The NexSens iSIC (Intelligent Sensor Interface and Control) is a state-of-the-art line of data loggers that simplify the collection of real-time data from environmental sensors and monitoring instruments. The iSIC data logger supports multi-vendor sensor connections and is designed for environmental data monitoring with NexSens communication equipment and software.

How to Use This Manual

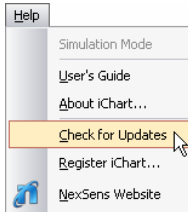
This manual is designed to provide you with detailed instructions for interfacing specific sensors to the NexSens iSIC data logger.

This manual provides you with all the information needed to interface your sensor with the iSIC data logger. For advanced system and sensor reference material:

- Review the material in the iSIC operations manual:
 - <http://www.nexsens.com/support/manuals.htm>
- Review the sensor manufacturer's operations manual. This information should have been provided with the purchase of the sensor. This material can also typically be found at the instrument manufacturer's website. If you are still having difficulty, email your technical support question to:
support@nexsens.com

Keeping iChart Up to Date

NexSens periodically releases new versions of iChart software and iSIC firmware to be downloaded free of charge. The updated versions typically add new features, improve existing features, and/or add more reliability to the system. It is important that iChart is updated to the latest version before connecting a new sensor to your iSIC data logger. Your computer will require internet access to update automatically.



To obtain the latest version of iChart software, open the program on your computer. In the **Help** menu, select **Check for Updates**.

If your software is up to date, iChart will confirm that your computer is running the current software release.

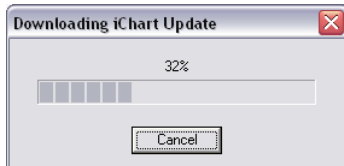


If a newer version of iChart is available, a dialog box will appear asking if you would like to upgrade to download the update.



Click **Yes**. iChart will begin downloading the update.

Note: Depending on your connection speed, this update may take a few minutes. You can continue running other applications on your computer while the download is progressing.



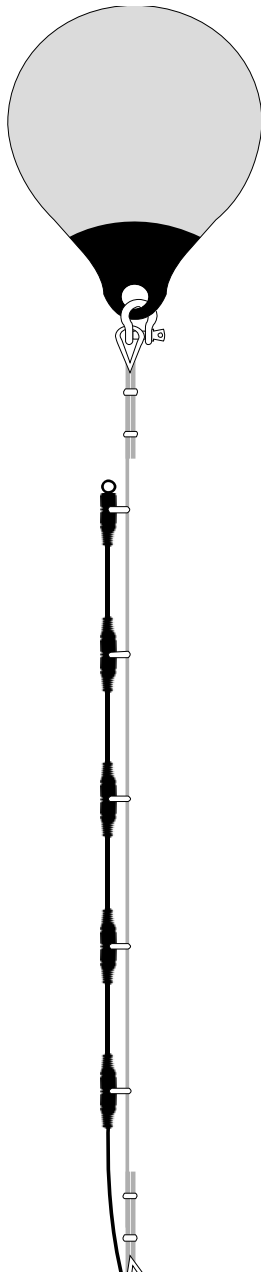
When the update has finished the downloading process, click **OK** and close iChart.

Reopen iChart. When the program opens, iChart will automatically begin the installation process. Follow the step-by-step installation windows to complete the iChart software update.

Note: If an internet connection is unavailable on the computer, iChart can be downloaded onto another computer and then moved to the computer where it needs installed. The latest version of iChart can be downloaded here:

<http://www.nexsens.com/support/downloads.htm>

Technical



The NexSens TS110 Temperature String is a multi-point water temperature monitoring system, consisting of multiple temperature sensors spaced along a cable at user-specified intervals. The system is completed when the TS110 is connected to an iSIC data logger and operated by iChart software.

The TS110 is available for configuration with up to 120 sensors that can be spaced evenly at 1/2, 1, or 2 meters apart. The user defines the number and spacing of sensors when ordering. The total length of the string, which can be up to 200 meters, is also specified. With these options, the string is capable of taking 120 water temperature readings at different depths up to 200 meters. The TS110 is built to operate in harsh conditions, such as coastal waters, rivers and stream fed reservoirs. It features a 60 second read time in fresh, brackish, or seawater.

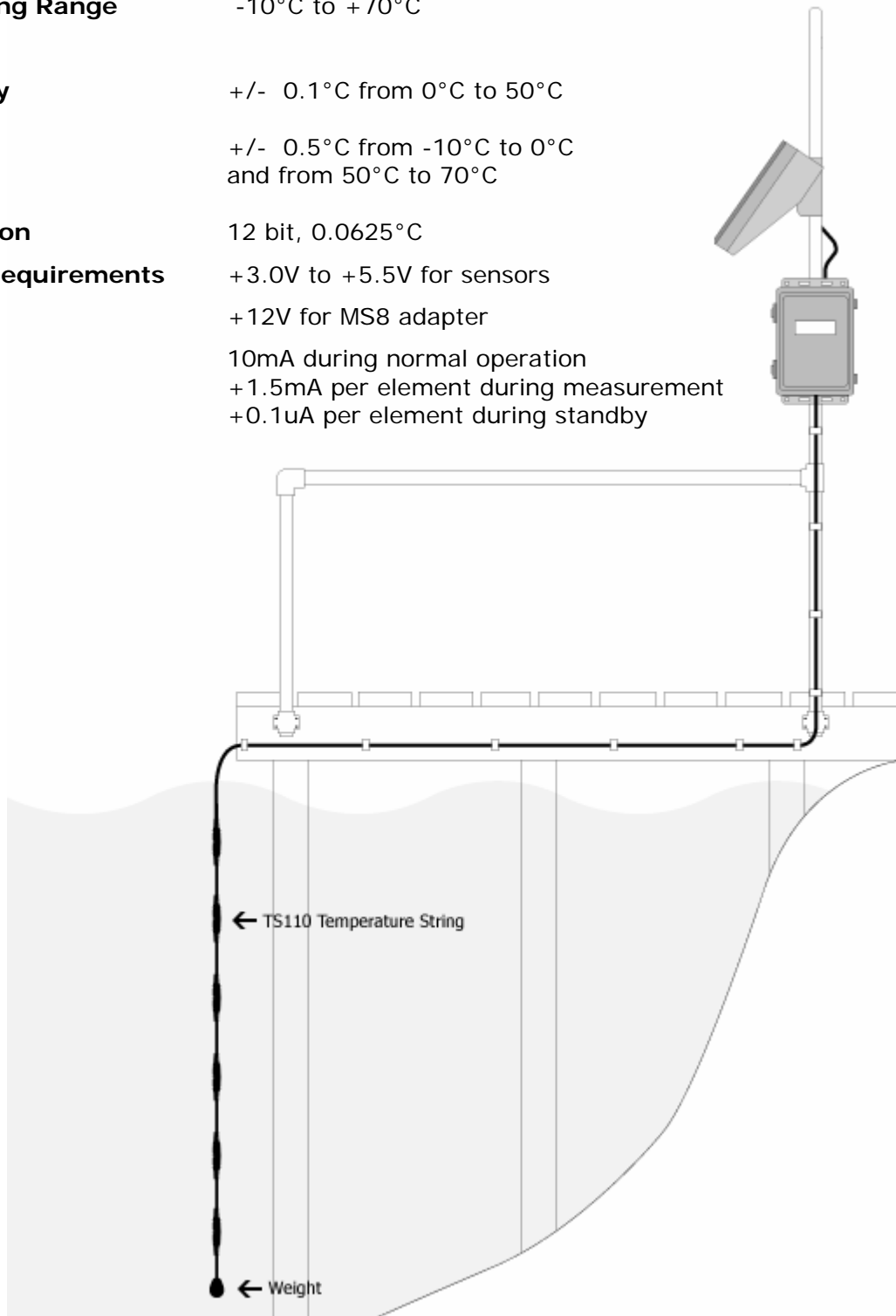
The TS110 Temperature String can be deployed as either a bottom-deployed system or surface data buoy system.

The bottom-deployed system is used to collect water temperature data that will be stored in a data logger resting on the bottom for later retrieval. In this system, the TS110 Temperature String will be fastened to a mooring cable suspended by a mooring buoy near or on the surface. At the bottom, the mooring cable is attached to a chain and anchor, while the TS110 connects to an iSIC data logger in an underwater housing. The chain and anchor system is designed to allow for water level changes. The chain will lift off the bottom during a rise in water level.

The surface data buoy system includes a surface data buoy with integral data logger and telemetry equipment. With this setup, the TS110 is suspended directly below the buoy. Two marker buoys are connected to the sides of the surface data buoy. These marker buoys are connected via mooring cable and bottom chain to anchors on the bottom. This system is also designed to accommodate changes in water level. Contact the application engineering team at NexSens for assistance in sizing your mooring system.

Specifications

Connector	MS8 connector
Interface	RS232
Measuring Range	-10°C to +70°C
Accuracy	+/- 0.1°C from 0°C to 50°C +/- 0.5°C from -10°C to 0°C and from 50°C to 70°C
Resolution	12 bit, 0.0625°C
Power Requirements	+3.0V to +5.5V for sensors +12V for MS8 adapter 10mA during normal operation +1.5mA per element during measurement +0.1uA per element during standby



Wiring

The TS110 comes with a weatherproof, MS-8 connector with housing that contains interface circuitry to the iSIC data logger from NexSens Technology, Inc. This connector is not meant to be submerged for extended periods of time. Simply plug the connector to the MS-8 connector at the bottom of the iSIC housing and run iChart to setup the Temperature String.



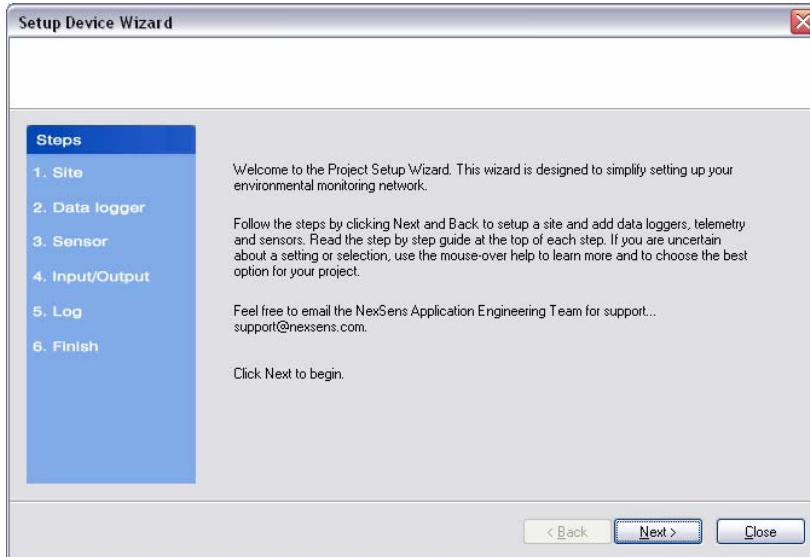
MS8 Pin	Signal
A	DTR & RTS (+12V signal)
B	Ground
C	Rx (Input Temperature String)
D	Tx (Input Temperature String)
H	+5V

Adding to iChart

Once all wiring is completed, the device is ready to be added to an iChart database. To add the device to an existing database, select **Instrument | Add Device**. To create a new database, select **File | New Project**.

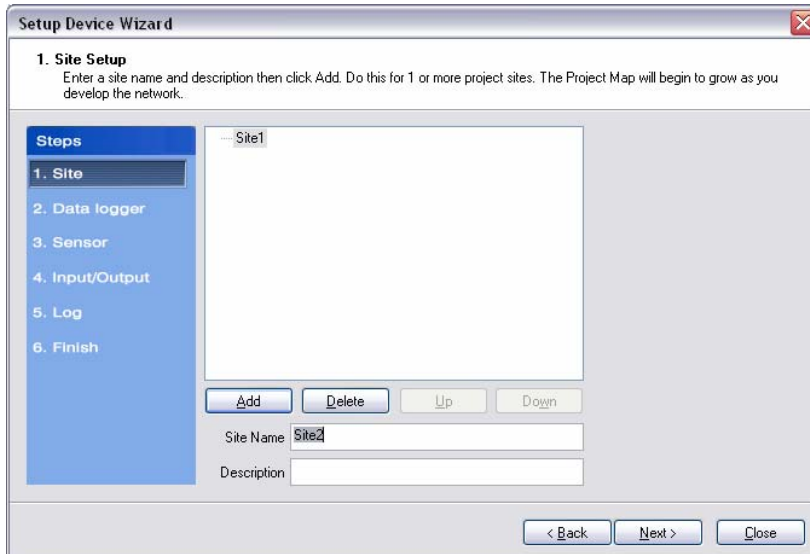
Setup Device Wizard

The Setup Device Wizard will begin. Click **Next** to continue.



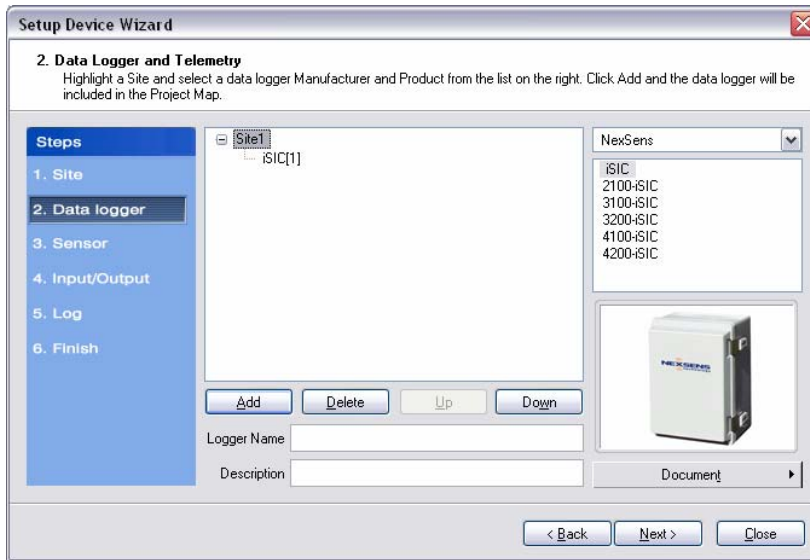
Step 1 – Site Setup

The first step is to create a site for data loggers and sensors to be located in. If this is an existing project, sites may already exist. Enter a **Site Name** and click **Add**.



Step 2 – Data Logger & Telemetry

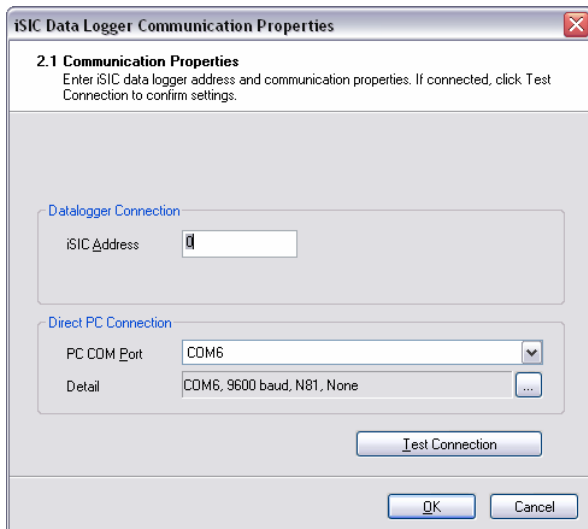
The next step is to add the data logger(s) to the sites created in the previous step. Select a site to add a data logger to. Then select the data logger model number from the list at right and click **Add**.



The **iSIC Data Logger Communication Properties** dialog box will appear. Enter the required iSIC data logger connection information (see below for model-specific instructions) to finish adding the data logger to the selected site. When complete, click **OK**.

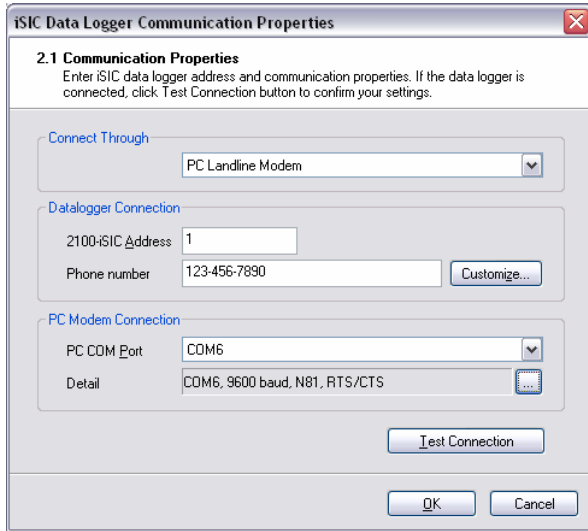
For an **iSIC** data logger, enter the iSIC address and select the PC COM Port that the data logger is connected to.

- The iSIC address is typically '1'. If unknown, enter '0' and click **Test Connection** to determine the address.
- The PC COM Port drop-down menu is the list of available COM ports iChart detected on the computer.



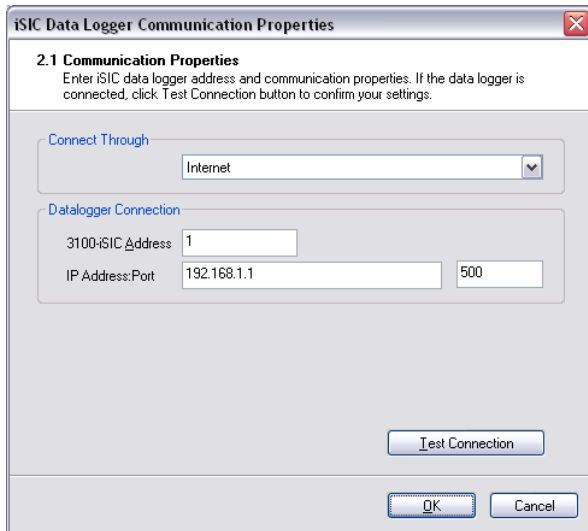
For a **2100-iSIC**, enter the 2100-iSIC address, phone number, and PC COM Port that the computer phone modem is connected to.

- The 2100-iSIC address is typically '1'. If unknown, enter '0' and click **Test Connection** to determine the address.
- The PC COM Port drop-down menu is the list of available COM ports iChart detected on the computer. Internal PC phone modems are typically set to COM3.



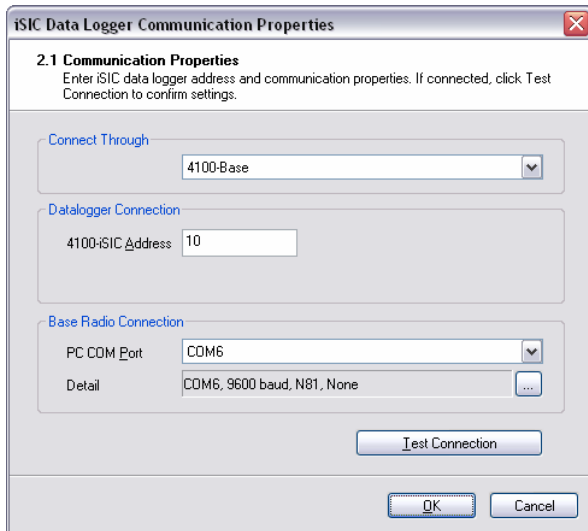
For a **3100-iSIC**, enter the 3100-iSIC address and the IP address of the data logger.

- The 3100-iSIC address is typically '1'. If unknown, enter '0' and click **Test Connection** to determine the address.
- The IP address is provided by the cellular service provider in which your cellular data account is setup. The port is set to 500 by default.



For a **4100-iSIC**, select the method in which the 4100-iSIC is connected to your PC and enter the 4100-iSIC address.

- A 4100-iSIC can connect to a PC through a 4100-BASE or a 4200-iSIC.
 - A 4100-BASE system connects to a PC via RS-232 cable.
 - A 4200-iSIC connects to a PC via landline telephone.
- The 4100-iSIC address is '1' by default.
 - If there is more than one 4100-iSIC in use, each 4100-iSIC should be programmed with different addresses (See the *4100-iSIC / iSIC Addressing* section in the iSIC manual).

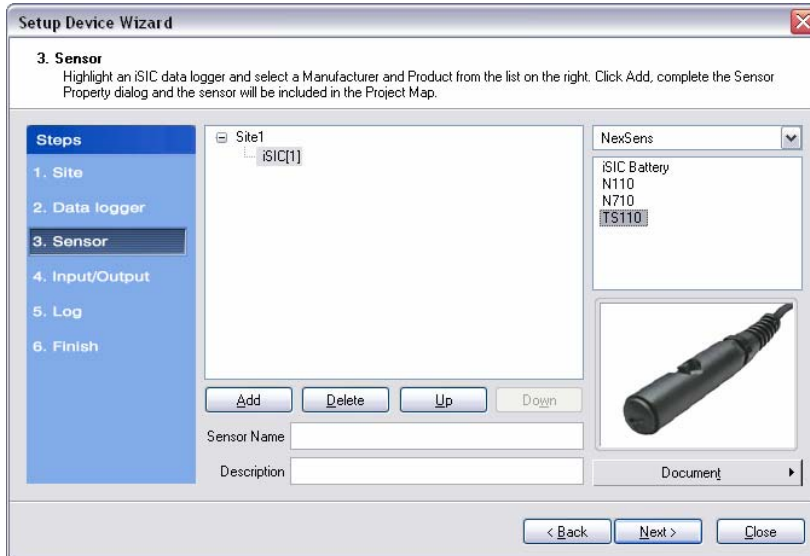


For a **4200-iSIC**, enter the iSIC address and PC COM port the data logger is connected to.

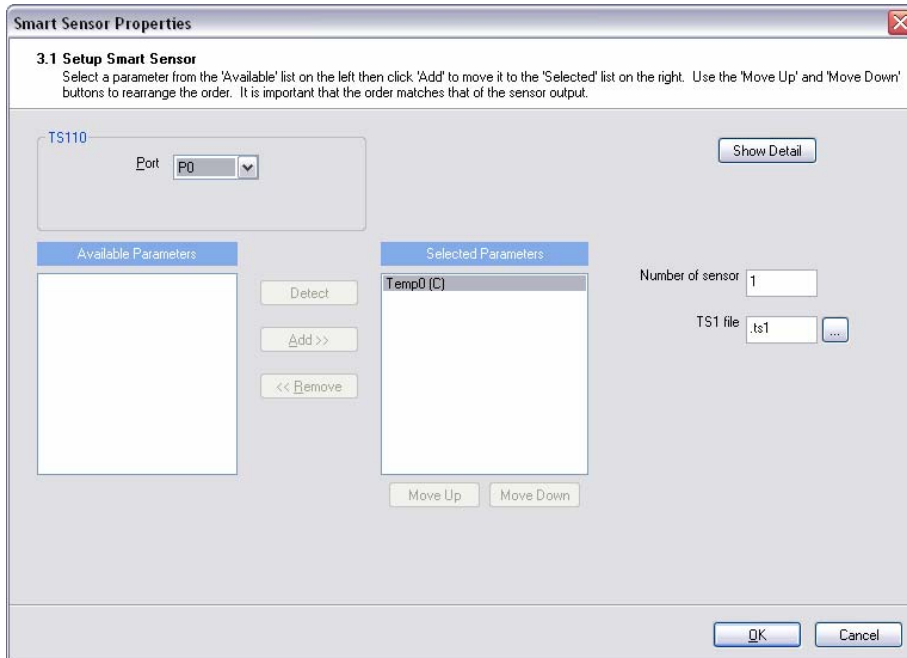
- The 4200-iSIC address is typically 250. When communicating with a 4200-iSIC, any communication using the 4200-iSIC address will be sent to the 4200-iSIC data logger.
 - Communications using any other address will be broadcast to any 4100-iSIC(s) in your radio network.
- **Note:** Do not use address '0' when communicating to a 4200-iSIC.
- The drop down menu of PC COM Port's is the list of available COM ports iChart detected on the computer. Internal phone modems are typically set to COM3.

Step 3 – Sensor

After selecting a data logger, click **Next** and select **NexSens** from the drop-down list of manufacturers. Then select the **TS110** model number and click **Add**.

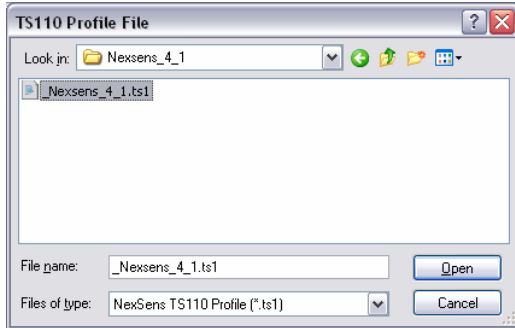


The **Sensor Properties** dialog box will come on the screen.



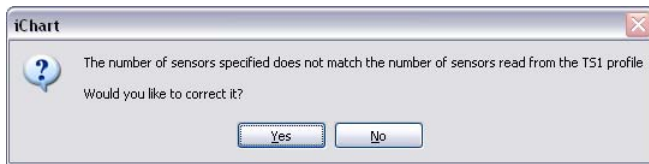
Click on the '...' next to the TS1 file text box.

This will open the **TS110 Profile File** dialog box. This file is located on the TS110 profile CD that came with your TS110 temperature string. If you can no longer have the CD or are otherwise unable to find the ts1 file, contact NexSens for the original file.



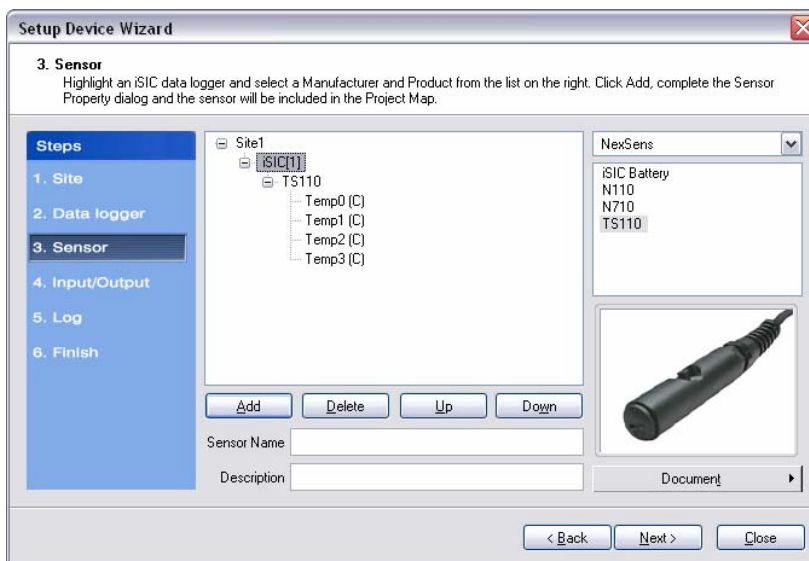
This file calibrates the sensor readings as well as provides the sensor order for the software. This file is required for proper operation. See “Temperate Calibrations” section for more information.

After clicking open, iChart will adjust the number of temperature readings on the **Available Parameters** to match the ts1 file.



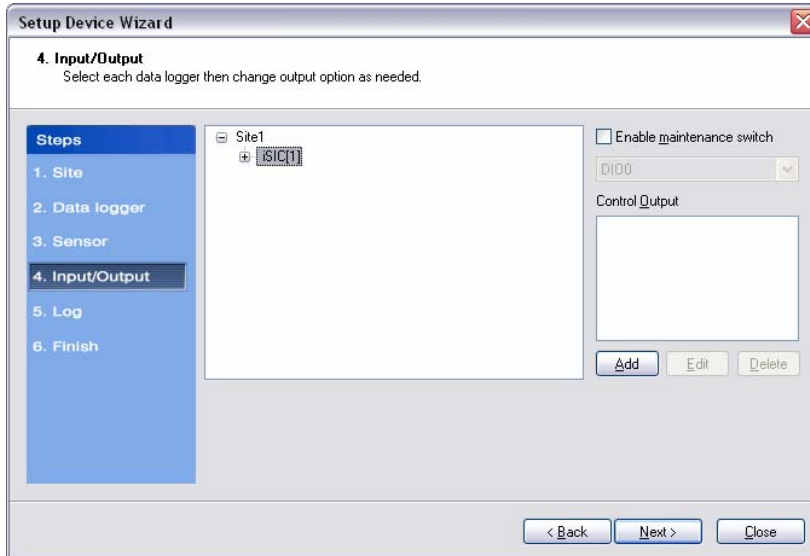
Click **Yes** to continue.

Back on the main screen, click **OK** and the sensor will be added to the selected data logger. More sensors can be added at this time by selecting the sensor manufacturer and then sensor model number from the drop down menu on the right. Click **Next** when finished adding sensors.



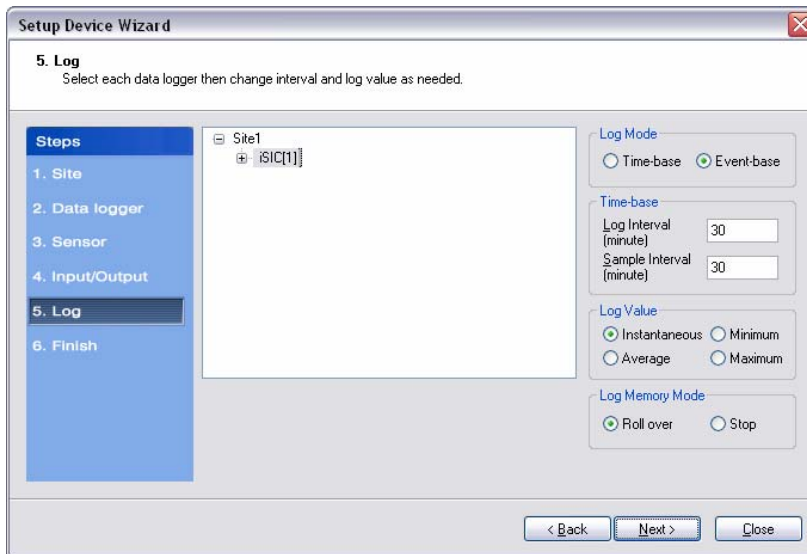
Step 4 – Input/Output

Enable any output and control features of the data logger. See the iSIC manual, section **4.4.2 iSIC Controls** for more information on this functionality.



Step 5 – Log

Select each data logger from the site list and enter the desired **Log Interval** and **Sample Interval** for the data logger in the **Interval** section. In the **Log Value** section, select how the data logger should log data points.



Log Mode

The Log Mode controls when data is logged by an iSIC. In **Time-base** (the default and most common), data is logged at a specified interval, controlled in the **Time-base** section. In **Event-base** log mode, data is only logged when a ground pulse is sent to the Rain input pin on the iSIC digital terminal strip (such as from the contact closure of a tipping bucket rain gauge).

Log Value

By default, the **Sample Interval** and **Log Interval** are equal. When a sampling interval is different than the log interval, all the sampled measurements for the iSIC are used to calculate the average, minimum, or maximum of that logging interval (based on the log type selected, only one can be selected at a time). The individual data points that comprise the samples are not saved; only the final, average, minimum or maximum data point is saved at the specified log interval.

Log Memory Mode

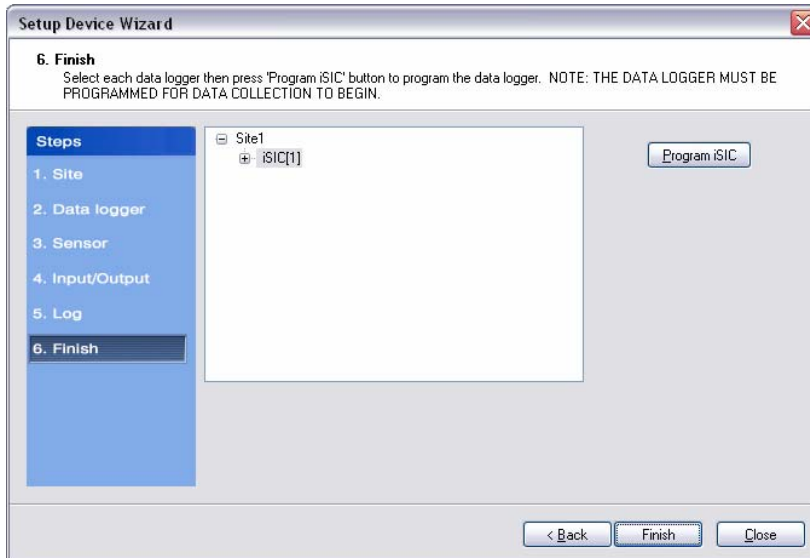
The default memory mode is **Roll over**, and is the recommended operating mode. In this mode, the last ~150K readings (when using 512K flash) will be stored in iSIC memory. When the iSIC memory has filled with readings it will “roll over” the original readings and keep logging. This is ideal for real time applications, where data is being uploaded to a PC as

In **Stop** memory mode, the first ~150K readings (when using 512K flash) will be stored in the iSIC memory. When the iSIC memory has filled with readings, it will stop logging until memory is cleared. When operating in this mode, it is recommended that memory is cleared every time data is uploaded.

Step 6 – Finish

All data loggers and sensors must be programmed before data collection can begin.

- Select an iSIC data logger and click the '**Program iSIC**' button. Before programming an iSIC:
 - The iSIC must be powered and connected to the computer.
 - The 2100-iSIC must be powered and connected to a phone line.
 - The 3100-iSIC must be powered and have a cellular data account.
 - The 4100-iSIC must be powered and be able to communicate to the computer through a 4100-base or 4200-iSIC
 - The 5100-iSIC must be powered and be able to communicate to the computer over Ethernet.
- Click **Finish** when programming is complete.



This wizard can always be revisited by selecting **Project | Setup Device Wizard** if you would like to program an iSIC at a later time or need to setup other sites, data loggers, and sensors.

Step 7 – Retrieve an Initial Data Set and Use the Instrument Within iChart

After your sensor has been added to the database, the main instrument control screen will appear.

Important: All parameters are initially displayed with blank values until after the first log interval has passed and data has been interrogated. Once data has been retrieved from the iSIC, these fields will show the most recent data set recorded by the instrument. By default, iChart will automatically interrogate devices five minutes after every hour.

Configurations, Options, and Accessories

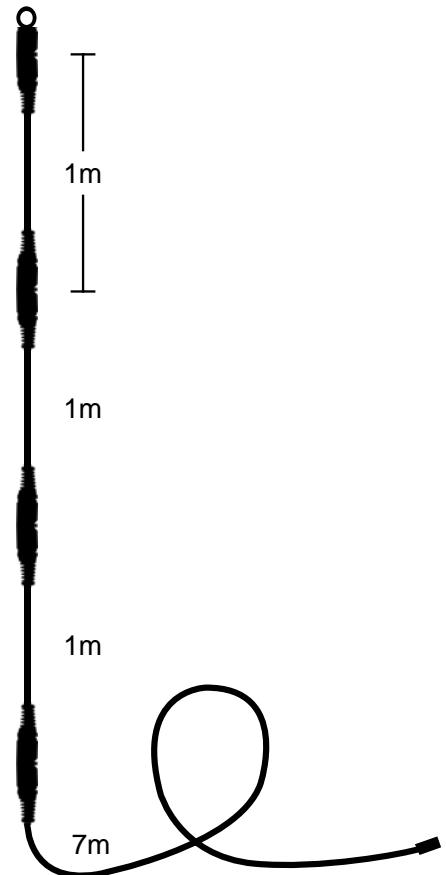
Specifying TS110 Temperature Strings

The NexSens TS110 Temperature String is a configured-to-order product. There are unlimited options for the number of sensors, spacing, and interface configurations. For quick delivery, NexSens recommends selecting from the below chart:

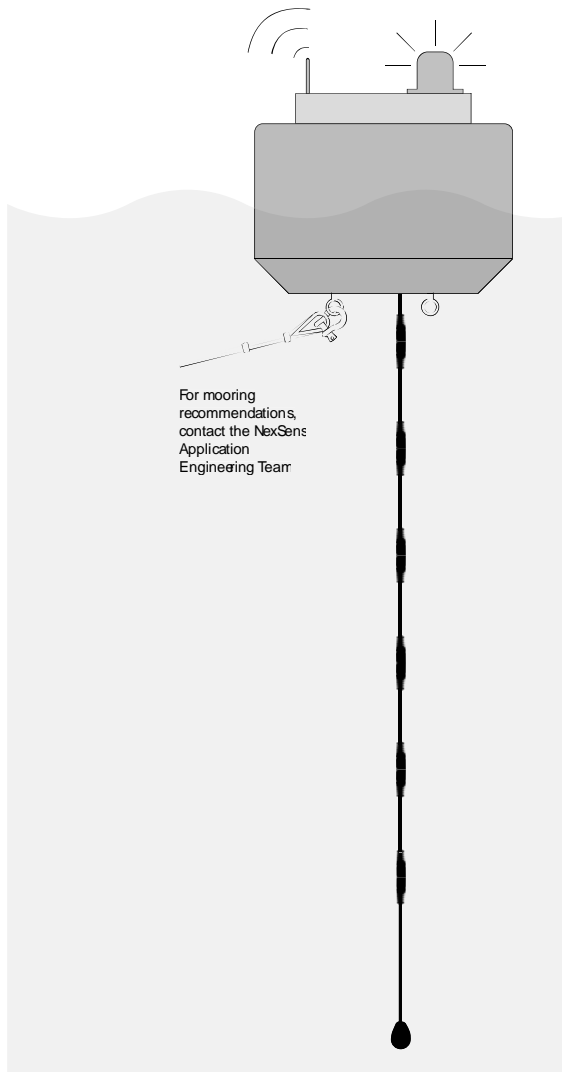
TS110 – N – S – L	
N = number of sensors	0...120
S = spacing between sensors	½, 1, or 2 meters
L = total length of string	0...200 meters

For example, TS100 – 4 – 1 – 10:

This temperature string includes 4 sensors, evenly spaced at 1 meter, with a total length of 10 meters. The string will have a 7-meter extension cable to the first temperature sensor.

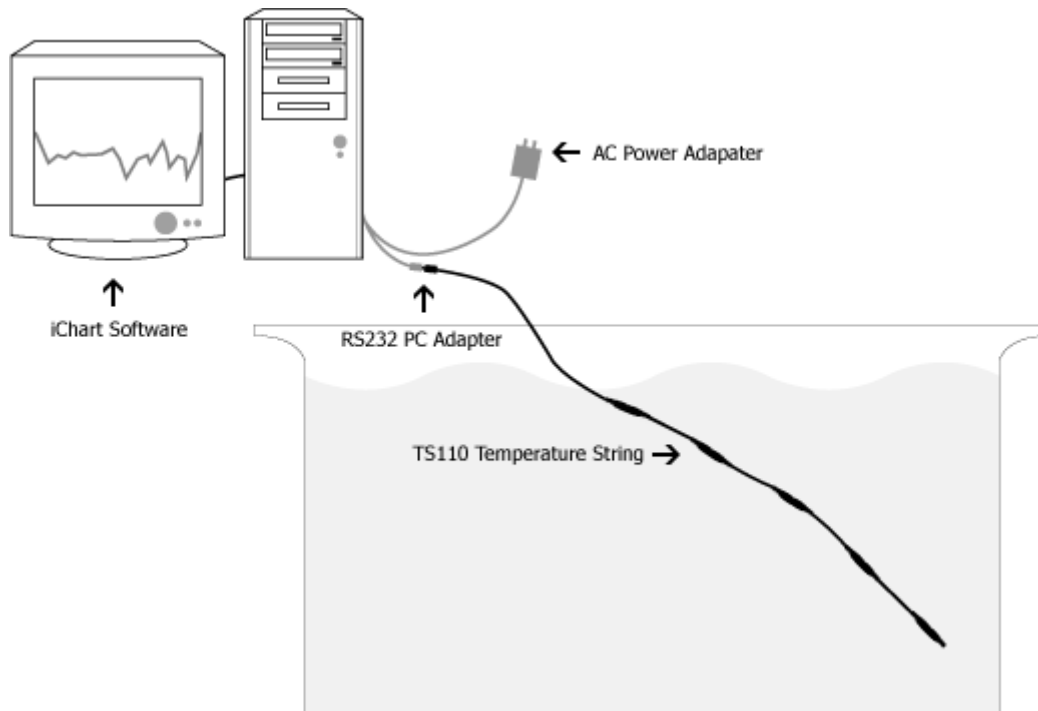


Deployment Accessories



Part No.	Description
SSPA375	3/8 screw pin shackle, 316 stainless steel
SSPA500	1/2 screw pin shackle, 316 stainless steel
SSPA625	5/8 screw pin shackle, 316 stainless steel
SSPA750	3/4 screw pin shackle, 316 stainless steel
SWIV375	3/8 swivel, 316 stainless steel
SWIV500	1/2 swivel, 316 stainless steel
SWIV625	5/8 swivel, 316 stainless steel
SWIV750	3/4 swivel, 316 stainless steel
GCH375	3/8 galvanized chain
GCH500	1/2 galvanized chain
GCH625	5/8 galvanized chain
GCH750	3/4 galvanized chain
DOR15	15 lb. pyramid anchor
DOR35	30 lb. pyramid anchor
DOR70	70 lb. pyramid anchor
DOR135	135 lb. pyramid anchor
SS187-L	3/16 stainless steel mooring, line terminated with loop thimbles on each end. Specify length (L) in meters.
TS-MCLP	Mooring clamp

TS110 with Direct to PC interface



MS8 Pin	Color	PC Adapter Pin	Signal
A	Blue	DB9 pin 4 DB9 pin 7	DTR RTS
B	Black	DB9 pin 5 Ground	Ground
C	Yellow	DB9 pin 3	Rx (Input Temperature String)
D	Orange	DB9 pin 2	Tx (Input Temperature String)
H	Red	5V Power	+5V

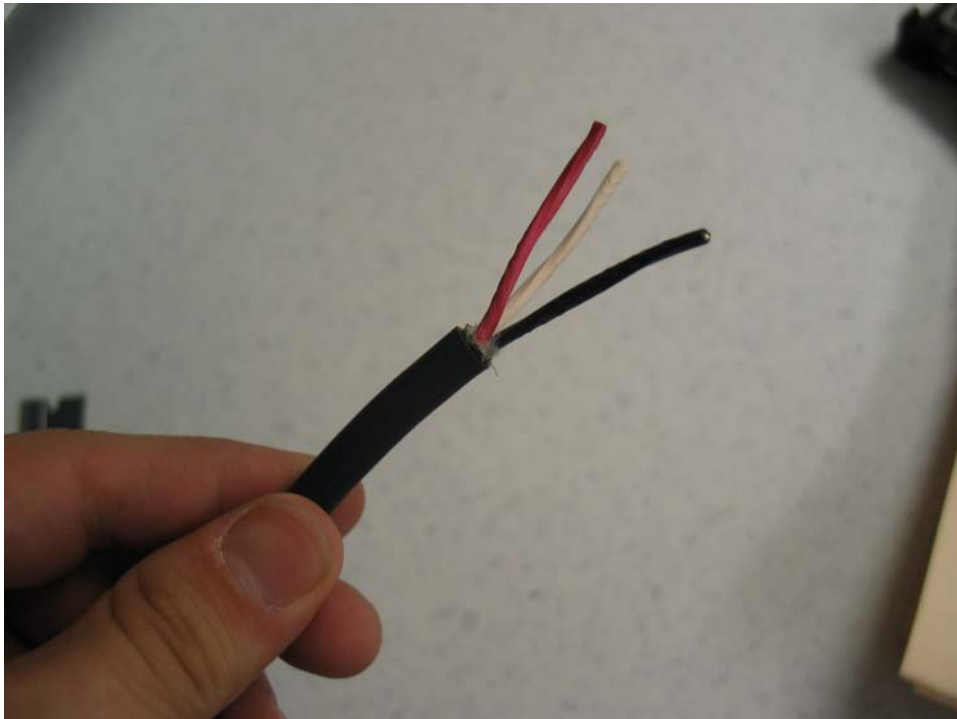
The simplest way to use the TS110 Temperature String is in the "Direct Connect to PC" configuration. In this setup, a TS110 is directly connected to a PC's serial port through a special RS232 adapter cable ordered with the temperature sensors.

It should be noted, that the TS110 Adapter cable can be used to connect a temperature string to a data logger or other device that can communicate via RS232. In such cases, the DTR signal may not be available. A 4.75V-16V signal referenced to ground can be used as a replacement.

TS110 with OEM output

To use the NexSens temperature string with your own data logger and software, NexSens can supply the temperature string with a flying lead.

- Red: +5V power
- Black: Ground
- White: Data



Contact NexSens for more information regarding this option.

Note: Every OEM string comes with a TS1 characterization file. This file calibrates the sensor readings as well as provides the sensor order for the software. This file is required for proper operation. Contact NexSens for a sample TS1 file for integration into your data logging or software package. See “Temperature Calibrations” section for more information.

TS110 with SDI-12 Output

The NexSens TS110 can come with a controller to convert the temperature readings into a fully SDI-12 v1.3 compliant output.

For more information see the TS110-SDI12 manual located here:

http://www.nexsens.com/pdf/manuals/nexsens_ts110-sdi12_manual.pdf



SDI-12 Specifications:

SDI-12 Compliance	v1.3
Interface	Flying lead cable
Default SDI-12 Address	0
Power Requirements	10.7 V to 16 VDC 20mA during reading +1.5mA per element during measurement +3mA per element during standby

TS110 with Modbus Output

The NexSens TS110 can come with a controller to convert the temperature readings into a RS232 or RS485 Modbus RTU output.

For more information see the TS110-SDI12 manual located here:

http://www.nexsens.com/pdf/manuals/nexsens_ts110-modbus_manual.pdf



Implementation:

- Modbus RTU over RS232 or RS485.
- Baud rates: 19200 or 9600 at No Parity, 8 Data Bits, and 1 Stop Bit
- Modbus address: same as the controller address (1-249 possible).
- Input registers 0 to n-1 for data where n = the number of temperature elements.
- Each input register holds the corresponding parameter reading scaled up 100. So for example 74.52 degrees Fahrenheit would be stored as 7452.
- 32 bit IEEE floating point number format are also supported. It is requested though registers 0x2000 to n-1 for data where n = the number of temperature elements. The output is in big endian format (most significant word is on the low register). Each parameter value occupies 2 modbus registers.

Supported commands:

0x04 - read input register, reads and returns result in the requested registers.

Power Requirements

10.7 V to 16 VDC
20mA during reading
+1.5mA per element during measurement
+3mA per element during standby

Temperature Calibrations

The TS110 temperature string uses temperature sensors with a bandgap-based thermal circuit. As with these kinds of digital temperature sensors, the sensor should stay stable over time. NexSens characterizes each sensor over a 0 to 50 C range, and provides each string with its characterization file on CD.



For quality assurance, we do provide characterization services to verify the stability and accuracy of the string, and recommend, if nothing else, you verify the integrity of the readings at least once a year.

Characterization file information:

The ts1 file is used to calibrate and position the ts110 sensor locations. NexSens characterizes every sensor element and the characterization is stored on that file. When setting the sensor up in the software it will ask you for the ts1 file.

Each file contains sensor information at the top and is tab delimited. This file is automatically parsed by iChart software. For OEM customers, source code is provided for parsing and applying the characterization file to the sensor outputs.

```

_Nexsens_4_1.ts1 - Notepad
File Edit Format View Help
-----
File: _Nexsens_4_1.ts1
      Sensor=<n> <a> <b> <c> <trim1> <trim2> <id>
      where err = ax^2 + bx + c
                n=sensor number counted from top of string (flying leads)
                id=individual sensor unique id
Desc: 4-sensor-tempstring custom profile for Nexsens
-----
Revision Log:
06/1/04      - Created
-----
FileVersion=1
ProgVersion=100

NumSensor=4
Sensor=2      2.9273E-04      -3.5094E-02      2.2858E+00      470000003ED94428
Sensor=3      2.0761E-04      -2.9308E-02      2.5849E+00      440000003EDDB628
Sensor=0      2.2432E-04      -2.3457E-02      1.6240E+00      000000003E963728
Sensor=1      2.4420E-04      -3.4270E-02      4.0286E+00      E50000003EC5FF28

```