



Sensorsoft® Thermometer User's Manual

Models ST6105J, ST6105C and ST6154J

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About this Manual

This document contains information about using Sensorsoft Thermometers.

When other sections of this manual are referenced, *italics* are used.

The Sensorsoft Thermometer may be referred to as a thermometer, Soft Thermometer, Sensorsoft device, SSD (Sensorsoft Soft Device) or device throughout the manual.

Glossary of Acronyms

RWME – **Remote Watchman Enterprise** software for Windows

RWMC – **Remote Watchman Client** software for Windows

SCOM – **Serial Communications Tool** software for Linux and UNIX

SSDP – **Sensorsoft Device Protocol**

SSA – **SensorSoft Alert** appliance

SSD – **SensorSoft Device**

Overview

The **ST6105J**, **ST6105C** and **ST6154J** Soft Thermometers are RS232 compatible serial devices based on the Sensorsoft Device Protocol (SSDP). The **ST6105C** and **ST6105J** have a built-in temperature sensor and are intended for applications requiring measurement of temperature in heated or air conditioned rooms and warehouses. These products are not conformal coated and are therefore not intended for environments with high moisture or condensation.

The **ST6154J** has an external stainless steel probe for measuring temperature in the following applications or environments:

- outdoor temperature measurement
- refrigerators, freezers and cold rooms
- server rooms and data centers
- pools and saunas
- in liquids or on pipes

Only the probe portion of the **ST6154J** is suitable for exposure in the above listed environments. The plastic electronic housing must be protected from water, moisture, condensation and sunlight (UV).

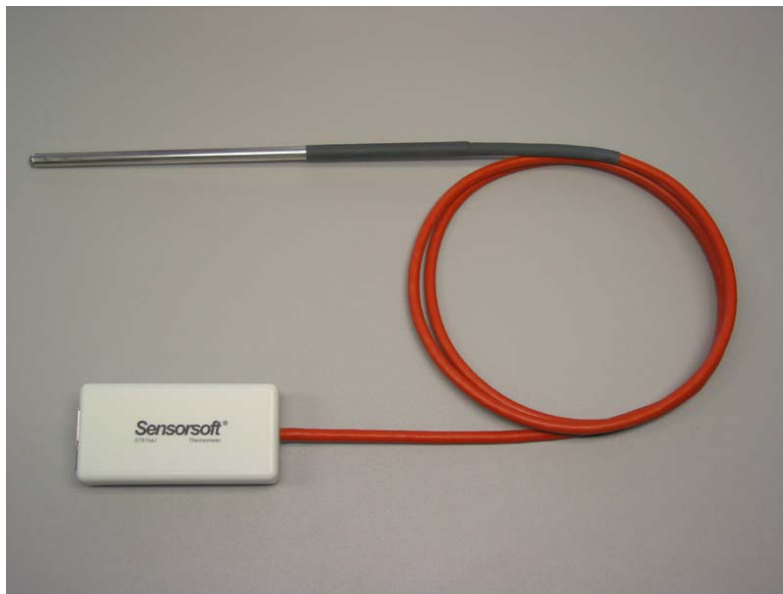


Figure 1: Photo of the ST6154J Sensorsoft Thermometer with stainless steel probe.

Sensorsoft devices offer the following benefits over other RS232 serial devices:

- Powered from the serial port (no external power or battery required)
- CRC error detection (detects transmission errors and improves reliability) (SSDP only)
- Virtually unlimited cable lengths (1000 ft) (SSDP only)
- Plug and go operation (little or no user configuration required)

Sensorsoft makes several SSDP-compliant software applications that permit you to read these thermometers, send alerts, record and (in some cases) graph data. These include:

- Sensorsoft Remote Watchman Client (RWMC) for Windows
- Sensorsoft Remote Watchman Enterprise (RWME) for Windows
- Sensorsoft Serial Communications Tool (SCOM) for Linux and UNIX
- Sensorsoft Alert Appliance (SSA)

In addition, there are many manufacturers who provide support for Sensorsoft devices within their products. Some of these include:

- ServersCheck Sensor Gateway and software
- Lantronix SecureLinx (SLC) Console Manager

As of firmware version 6.5, Sensorsoft Thermometers respond to *Simple Text Commands* when used with a text-based terminal or scripting language. Additionally, we've provided several means for customers to write software integrating Sensorsoft devices into their systems. This is discussed further in the section, *Writing custom software programs for the Sensorsoft Thermometer*.

Installing the Sensorsoft Thermometer

Installation of the Sensorsoft Thermometer requires the following steps:

- Choosing an Installation Location
- Connecting the Sensorsoft Thermometer to a serial port
- Starting the Sensorsoft software. (Please refer to the specific software manual that applies to your installation.)

Choosing an Installation Location

Model ST6105C and ST6105J

Locate the Sensorsoft Thermometer close to the equipment or airflow you're monitoring. Since the ST6105C/J Sensorsoft Thermometer isn't waterproof or weatherproof, keep the following rules in mind:

- Keep the Sensorsoft Thermometer housing out of contact with direct sunlight, UV exposure, and dripping water.
- Protect the Sensorsoft Thermometer from high traffic areas that could wear/damage the housing or cable.
- Never allow the plastic housing of the Sensorsoft Thermometer to come into contact with harsh chemicals or cleaning agents. If the housing needs to be cleaned, use a damp cloth or vacuum cleaner.

Use a Velcro fastener (P/N F1000 or F1001) to affix the Sensorsoft Thermometer to a stable surface.

Model ST6154J

This Sensorsoft Thermometer has an external stainless steel probe that may be exposed to liquids or outdoor environments. The plastic housing of the ST6154J, however, has the same restrictions as the ST6105C/J models above.

Use the F1004 adhesive fasteners if installing the stainless steel probe in a refrigerator or freezer.

Connecting the Sensorsoft Thermometer to a serial port

If you have a ST6105C (C-Suffix) Sensorsoft Thermometer, plug its molded DB-9F connector into an available RS232 serial port connector (DB-9M) on your computer or device server.

If you have an ST6105J or ST6154J (J-Suffix) Sensorsoft Thermometer, use the appropriate C200X cable to connect this device to your computer or device server. [See our listing of available C200x cables for various applications.](#)

If you intend to make a custom cable for a J-Suffix Sensorsoft device, please refer to *Making communication cables for J-Suffix Sensorsoft Devices*.

When connecting a Sensorsoft Thermometer to a serial port or device/console server, configure the port as follows:

- 1200 bps, 8 bits, no parity, 1 stop bit
- Turn off autobaud
- Flow control set to “None”
- Non-telnet binary (raw) transfer mode
- Assert RTS and DTR always

If using a device/console server, refer to its documentation for more details on the above.

Note the physical port number where you plugged the cable into your computer or device/console server. If the Sensorsoft Thermometer is being plugged into a Windows based computer that has only one COM port, the port number is usually COM1. If you are using a USB to serial adapter, you need to refer to the operating system's serial port (COM) listing. In Microsoft Windows, this is usually “Device Manager->Ports (COM&LPT).” In Linux or UNIX, refer to the /dev/tty directory.

ST6105J (v6.5) Sensorsoft Thermometer Specifications

Measurement/Operating Temperature Range: -40 °C to +60 °C (-40 °F to +140 °F)

Resolution or precision: 0.5 °C (0.9 °F) or 0.1 °C (0.18 °F)

Accuracy: +/- 0.5 °C (+/- 0.9 °F) over 0 °C to +60 °C (32 ° to 140 °F) and +/- 1 °C (1.8 °F) over remainder of temperature range

Calibration: Calibrated at the factory. Re-calibration in the field is not possible, but sensor can be replaced. NIST traceable if ordered with certificate.

Humidity: < 90% RH (non-condensing)

Maximum measurement rate: One reading every second

Housing Dimensions: 8 cm (3.1") x 4 cm (1.6") x 2 cm (0.8")

Housing Material: Injection-molded ABS thermoplastic

Housing Colour: Light gray

Sensor type: Semiconductor

Communications connector: 8 position modular jack, (accepts 8 position plug RJ45)

Power source: Port-powered (RTS and DTR, both asserted) or via External DC power connector

Power supply current drain: 1.5 mA average, 6 mA maximum when port powered (5V RS232)

External DC power connector: 2.1 mm power jack, automatic polarity correction and over-voltage protection.

External power supply voltage: 6.0 - 12.0 VDC

Communications Interface: RS232C using TX,RX,RTS,DTR and GND. One device per serial port.

Maximum communications cable length: 305 m (1000 ft.) using recommended cable type. Low capacitance shielded cable or UTP is recommended.

Firmware Version: 6.5

Communications Protocol: Sensorsoft Device Protocol (SSDP) Version 2.0 and Simple Text Commands Interface

Error control: 16 bit CRC (cyclic redundancy checking) for detection of communication errors between the device and host computer (SSDP only).

ST6105C (v6.5) Sensorsoft Thermometer Specifications

Measurement/Operating Temperature Range: -40 ° C to +60 ° C (-40 ° F to +140 ° F)

Resolution or precision: 0.5 ° C (0.9 ° F) or 0.1 ° C (0.18 ° F)

Accuracy: +/- 0.5 ° C (+/- 0.9 ° F) over 0 ° C to +60 ° C (32 ° to 140 ° F) and +/- 1 ° C (1.8 ° F) over remainder of temperature range

Humidity: < 90% RH (non-condensing)

Calibration: Calibrated at the factory. Re-calibration in the field is not possible, but sensor can be replaced. NIST traceable if ordered with certificate.

Maximum measurement rate: One reading every second

Housing Dimensions: 8 cm (3.1") x 4 cm (1.6") x 2 cm (0.8")

Housing Material: Injection-molded ABS thermoplastic

Housing Color: Light gray

Sensor type: Semiconductor

Communications cable: Integrated 6 m (20 ft.) colour matched cable with DB-9F (female) mini D-SUB connector

Power source: Port-powered (RTS and DTR, both asserted).

Power supply current drain: 2 mA average, 6 mA maximum when port powered (5V RS232)

Communications Interface: RS232C using TX,RX,RTS,DTR and GND. One device per serial port.

Maximum extension cable length: 305 m (1000 ft.) using recommended cable type. Low capacitance shielded cable or UTP is recommended.

Firmware Version: 6.5

Communications Protocol: Sensorsoft Device Protocol (SSDP) Version 2.0 and Simple Text Commands Interface

Error control: 16 bit CRC (cyclic redundancy checking) for detection of communication errors between the device and host computer (SSDP only).

ST6154J (v6.5) Sensorsoft Thermometer Specifications

Probe temperature measurement range: -55 ° C to +125 ° C (-67 ° F to +257 ° F)

Resolution or precision: 0.5 ° C (0.9 ° F) and 0.1 ° C (0.18 ° F)

Accuracy: +/- 0.5 ° C (+/- 0.9 ° F) over 0 ° C to +70 ° C (32 ° to 158 ° F) and +/- 1 ° C (1.8 ° F) over remainder of temperature range

Calibration: Calibrated at the factory. Re-calibration in the field is not possible. Sensor probe can be replaced if returned to the factory. NIST traceable if ordered with certificate.

Maximum measurement rate: One reading every second

Probe dimensions: 15.2 cm (6") long, 6 mm (1/4") diameter, stainless steel probe with 1.2 m (4 ft.) long, high-temp silicone rubber cable.

Sensor type: Semiconductor

Housing Dimensions: 8 cm (3.1") x 4 cm (1.6") x 2 cm (0.8")

Housing Material: Injection-molded ABS thermoplastic

Housing Color: Light gray

Electronics Housing Temperature Operating Range: -40 ° C to +60 ° C (-40 ° F to +140 ° F)

Electronics Housing Humidity Operating Range: < 90 % RH (non-condensing)

Communications connector: 8 position modular jack, (accepts 8 position plug RJ45)

Power source: Port-powered (RTS and DTR, both asserted) or via External DC power connector

Power supply current drain: 1.5 mA average, 6 mA maximum when port powered (5V RS232)

External DC power connector: 2.1 mm power jack, automatic polarity correction and over-voltage protection.

External power supply voltage: 6.0 - 12.0 VDC

Communications Interface: RS232C using TX,RX,RTS,DTR and GND. One device per serial port.

Maximum communications cable length: 305 m (1000 ft.) using recommended cable type. Low capacitance shielded cable or UTP is recommended.

Firmware Version: 6.5

Communications Protocol: Sensorsoft Device Protocol (SSDP) Version 2.0 and Simple Text Commands Interface

Error control: 16 bit CRC (cyclic redundancy checking) for detection of communication errors between the device and host computer (SSDP only).

Resolution, Accuracy and Calibration

The terms **resolution**, **accuracy** and **calibration** frequently cause misunderstanding for many individuals who have not been trained in metrology. We explain these terms here and how they might apply to your application of Sensorsoft devices.

Resolution or **precision** is the fineness of the measurement. It is usually specified in terms of the smallest unit that can be resolved.

Accuracy is the trueness of the measurement or how close it can be to the true value (National Standard). Accuracy is often specified as a percentage (i.e. +/- 3 %) of the reading, or a fixed value (i.e. +/- 0.5) that can vary from the true value of the reading.

Calibration is a process where accuracy is verified (and often corrected) with respect to a standard. Calibrations are routinely carried out to certify that a device has not lost its accuracy, linearity and stability. Calibrations can be carried out at a time interval that is required by your industry. In many cases, this is at least once every year.

When a calibration or verification takes place, it must always be done with equipment that has significantly better accuracy and resolution than the device under testing. When a calibration check is performed on a “Unit under Test” with an instrument traceable to the National Standards Laboratory, the “Unit under Test” is also considered to be traceable.

Avoiding invalid judgments or comparisons

Using any of the following measurement devices or situations is **unacceptable** for comparing to, or judging the accuracy of a Sensorsoft device:

- Low cost measurement device purchased from a retail store
- Digital display on HVAC or cooling/heating equipment
- Location of the active sensing element is unknown or hidden
- Measurement device has its active sensing element more than one inch (2.5 cm) away from the Sensorsoft device's sensing element
- Measurement device has lower accuracy specifications as compared to the Sensorsoft device
- Measurement device has unknown accuracy specifications
- Measurement device has not been calibrated within one year, has no calibration certificate or is not traceable to a reference standard

Appropriate measurement instruments for making comparisons

We recommend one of the following instruments (or equivalent with a recently dated traceable calibration certificate for judging the accuracy or stability of your Sensorsoft device:

- Vaisala HM40 series Hand held Humidity & Temperature Meter (approx. price \$500-1000 US)

- Vaisala HMT330 series Humidity & Temperature Transmitter and external probe (Wall mount, RS232 interface, order with 115/230 VAC power supply, approx. price \$1900-2500 US)

More details about the above instruments are available on Vaisala's web site:

<https://www.vaisala.com>

Correct method for making comparisons

Keep the following points in mind when checking the Sensorsoft device for accuracy or stability:

1. Use one of the above recommended instruments (or equivalent that has a recent calibration certificate within one year).
2. The sensing elements of Sensorsoft device and the traceable instrument must be touching or within one inch (2.5 cm).
3. Allow sufficient time (30-60 minutes) for the Sensorsoft device and the traceable measurement instrument to acclimatize to the environment.
4. Make sure you know how to get a live (up to the second) temperature reading from the Sensorsoft device through its software.
5. For reading the Sensorsoft device during the comparison use the 0.1 C resolution variable, not the 0.5 C resolution variable.
6. Have the published accuracy specifications for the Sensorsoft device and the traceable measurement instrument readily available for comparison.

What to do if you believe the Sensorsoft device is reading incorrectly

If, after following the above method, you find the Sensorsoft device isn't reading within its stated specifications, you can obtain an RMA to return it to our factory for repair. See *Returns* at the end of this manual. Charges may apply if the device is out-of-warranty or if we find no evidence that it's out-of-calibration.

Making extension cables for C-Suffix Sensorsoft Devices

In some applications it's not possible to use pre-assembled cables. When installing the Sensorsoft device at a remote location it may be necessary to run cables through walls, ceilings or conduits where connectors would get jammed. In this situation it makes sense to terminate the cables on-site using hand crimp tools. The following details will assist you in this process.



NOTE - A C-suffix Sensorsoft device has a built-in cable. This includes model **ST6105C**.

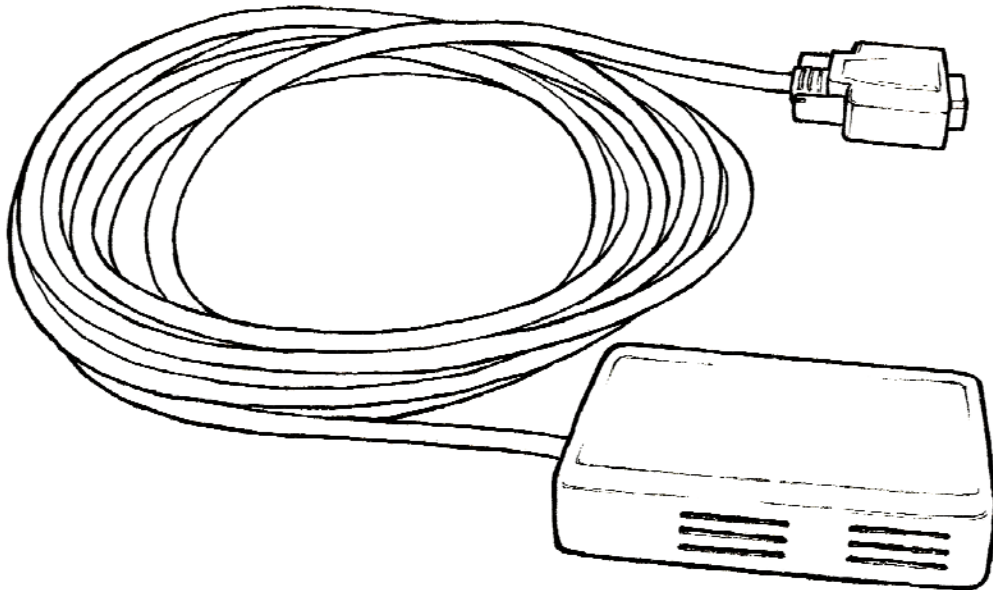


Figure 2: Illustrates a C-suffix Sensorsoft device with a built-in molded cable and DB-9F connector.



IMPORTANT - A properly made extension cable will allow your Sensorsoft device to operate reliably over long cable lengths up to 305 m (1000 ft) using SSDP-compliant software.

Sensorsoft Cable P/N C2100 Extension cable for C-Suffix model SSD's with DB-9F connector

Serial Port - DB-9F			SSD - DB-9M		
3	TX	white-green	RX	3	
2	RX	white-orange	TX	2	
4	DTR	white-brown	POWER +V	4	
7	RTS	blue	POWER +V	7	
5	SIGNAL GND	green	GND	5	

Figure 3: C2100 cable is used to extend the cable length for model ST6105C. The DB-9F end of the cable plugs into a DB-9M serial port. The DB-9M end of the cable plugs into the DB-9F connector on the SSD.

PIN-OUT OF THE DB-9F CONNECTOR ON MODEL ST6105C

Note: Only positions used in Sensorsoft device application are shown

Position	Function
2	TX (data to computer)
3	RX (data from computer)
4	POWER (connects to DTR on computer)
5	Ground
7	POWER (connects to RTS on computer)

The following are specialized tools and parts needed to make good quality extension cables:

Hand Tools:

Tyco Crimping Tool P/N 90312-1 or 90302-1, for subminiature D pin or socket contacts

Tyco PROCRIMPER P/N 58448-2, for subminiature D pin or socket contacts

Tyco Insertion/Extraction Tool P/N 91285-1, for subminiature D connector contacts

Materials:

CP Technologies CAT5E UTP stranded, P/N E-207-4P-C5-LGY, 1000 ft, light gray, RoHS
(4 pair, 8-#24 AWG wires, category 4 or better, 75 C)

Tyco DB-9 receptacle subminiature D connector (crimp-snap-in), P/N 205203-1 or -3

Tyco DB-25 receptacle subminiature D connector (crimp-snap-in), P/N 205207-1 or 207463-1

Tyco socket crimp contact for subminiature D connectors, P/N 1-66504-0

Tyco pin crimp contact for subminiature D connectors, P/N 1-66506-0

Making communication cables for J-Suffix Sensorsoft Devices

In some applications it's not possible to use pre-assembled cables. When installing the Sensorsoft device at a remote location it may be necessary to run cables through walls, ceilings or conduits where connectors would get jammed. In this situation it makes sense to terminate the cables on-site using hand crimp tools. The following details will assist you in this process.



NOTE - A J-suffix Sensorsoft Device has a RJ45 jack connector. It accepts a plug-in cable. This includes models **ST6105J** and **ST6154J**.

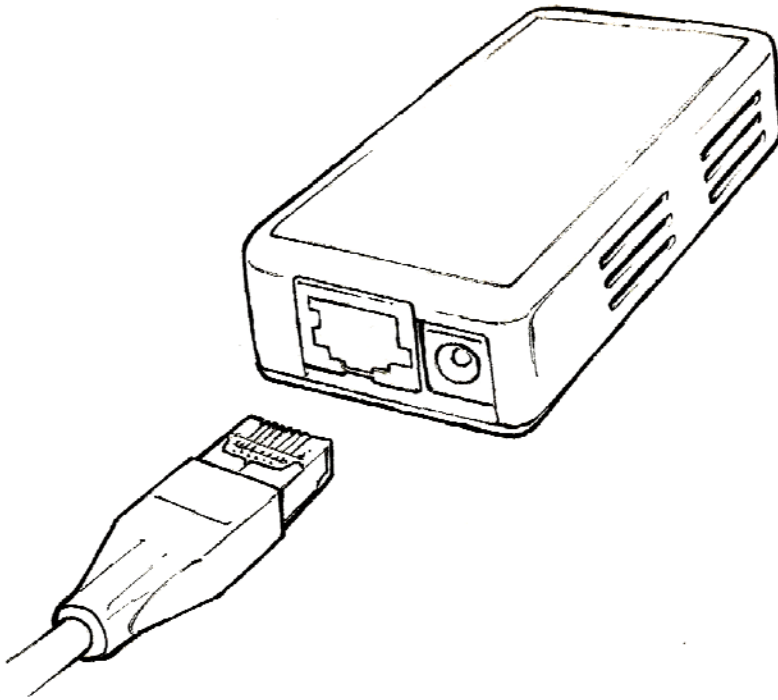


Figure 4: Illustrates a J-suffix Sensorsoft device that accepts a cable with RJ-45 plug. The 2.1 mm power jack is only used if the serial port does not have enough voltage to power the sensor.



IMPORTANT - A properly made cable will allow your Sensorsoft device to operate reliably over long cable lengths up to 305 m (1000 ft) using SSDP-compliant software.

You may connect the Sensorsoft device to the port with as little as three wires (RX, TX and GND), using inexpensive unshielded telephone wire. However, the host may need to set the

number of retries high in order to overcome the effect of occasional noise/interference and would require the use of an external power supply (PA6106 or PA6206) at the Sensorsoft device.

The Sensorsoft device modular-jack connector uses the same UTP wire map as 10-BASE-T. It is therefore possible to use this type of cabling system for Sensorsoft devices.

PIN-OUT OF THE MODULAR 8 POSITION JACK/PLUG ON A SENSORSOFT DEVICE

Note: Terminal No. 1 is the terminal to the extreme left as you face the cable opening, latch tab down.

Terminal	Function	UTP wire color
1	Receive Data	white-green
2	Ground	green
3	Transmit Data	white-orange
4	Power +V	blue
5	Ground	white-blue
6	Ground	orange
7	Power +V	white-brown
8	Ground	brown

The following are specialized tools and parts needed to make good quality cables:

Hand Tools:

- Tyco Crimping Tool P/N 1-231652-0 or 2-231652-1, for modular plugs
- Tyco 8 position modular die set P/N 853400-1
- Tyco Crimping Tool P/N 90312-1 or 90302-1, for subminiature D pin or socket contacts
- Tyco PROCRIMPER P/N 58448-2, for subminiature D pin or socket contacts
- Tyco Insertion/Extraction Tool P/N 91285-1, for subminiature D connector contacts

Materials:

- CP Technologies CAT5E UTP stranded, P/N E-207-4P-C5-LGY, 1000 ft, light gray, RoHS (4 pair, 8-#24 AWG wires, category 4 or better, 75 C)
- Tyco 8 position modular plug for round stranded wire cables, P/N 5-554169-3 (CAT4)
- Tyco 8 position modular plug for round stranded wire cables, P/N 5-557961-3 (CAT5)
- Tyco DB-9 receptacle subminiature D connector (crimp-snap-in), P/N 205203-1 or -3
- Tyco DB-25 receptacle subminiature D connector (crimp-snap-in), P/N 205207-1 or 207463-1
- Tyco socket crimp contact for subminiature D connectors, P/N 1-66504-0
- Tyco pin crimp contact for subminiature D connectors, P/N 1-66506-0

Sensorsoft Cable P/N C2000 DB9M Serial Port to Sensorsoft Device (SSD)

Serial Port - DB-9F			SSD - RJ45 plug	
3	TX	white-green	RX	1
2	RX	white-orange	TX	3
4	DTR	white-brown	POWER +V	7
7	RTS	blue	POWER +V	4
5	SIGNAL GND	green	GND	2

Figure 5: The C2000 cable is used to connect a J-suffix Sensorsoft device to most computers or devices that have a DB-9M serial port. The DB-9F end of the cable plugs into a DB-9M serial port. The RJ-45 end of cable plugs into the SSD. M indicates male/pin type connector. F indicates female/socket type connector.

Sensorsoft Cable P/N C2012A DB25F DCE Serial Port to Sensorsoft Device (SSD)

DCE Port - DB25-M			SSD - RJ45 plug	
3	TX	white-green	RX	1
2	RX	white-orange	TX	3
6	DSR	white-brown	POWER +V	7
7	SIGNAL GND	green	GND	2

Figure 6: The C2012A cable is used to connect a J-suffix Sensorsoft device to multi-port serial cards or device servers (UDS1100, EDS1100) which have a DB-25F connector with DCE pin-out. The DB-25M end of the cable plugs into a DB-25F serial port. The RJ-45 end of cable plugs into the SSD. M indicates male/pin type connector. F indicates female/socket type connector.

Writing custom software programs for the Sensorsoft Thermometer

Sensorsoft provides three methods for allowing your custom software programs to communicate with Sensorsoft Thermometers, outlined here:

Simple Text Commands Interface

The **Simple Text Commands Interface** can be used interactively with a terminal program (HyperTerminal, TeraTerm, Putty, Telnet, Screen, etc.) or by user-written programs and language scripts. These commands make it possible to read Sensorsoft devices in many systems including Linux, UNIX and embedded applications. The following single letter (lower case) commands should be ended with a carriage return and or line feed character:

```
r    read temperature
m    read model number
v    read firmware version
```

This interface outputs temperature readings in Celsius and only supports 0.5 C resolution measurements. If you need temperatures in Fahrenheit (F), you will need to do a conversion in your software (i.e. $F = 9/5C + 32$).

Using this method, we recommend keeping the cabling short (<100 ft) as the **Simple Text Commands Interface** does not support the built-in CRC error detection.

Sensorsoft Device Monitoring .NET Component for Windows

This method involves use of the Sensorsoft Device Monitoring.NET Component for creating software on Windows based systems. It provides a high-level Windows .NET-based API to implement the Sensorsoft Device Protocol. You can download and learn more about this free software at: <https://www.sensorsoft.com/developers.html>

Sensorsoft Device Protocol (SSDP) for Advanced Programmers

This software method is the most advanced way of supporting Sensorsoft devices. It has several advantages over the Simple Text Commands Interface discussed above. These include:

- CRC error detection for use over long serial cables (1000 ft)
- higher resolution measurements (0.1)
- auto-discovery by reading device ID record

The Sensorsoft Device Protocol uses a binary, packet-formatted, master-slave protocol. Your host computer (master) must send commands to, and receive responses back from, the Sensorsoft device (slave). All data is represented in the **little endian format** - least significant byte first and the most significant byte last.

Use the following parameters when programming the serial port where the Sensorsoft device is connected:

Bit rate: 1200 bps
Bits: 8
Parity: none
Stop bits: 1
Flow control: none
Null discard: do not strip NULL bytes

In order to make use of the port-powered feature of the Sensorsoft device, you must enable serial port lines DTR and RTS when the port is opened. A delay of 1-2 seconds is required after opening the serial port before any commands are sent to the Sensorsoft device. This delay allows the Sensorsoft device to power-up correctly and prevents incorrect readings.

You should also be aware that the Sensorsoft device has an inter-packet retry time-out delay. This delay is one (1) second and is encoded into the Sensorsoft device's firmware. If your program sends a command to the Sensorsoft device without a response, your program must wait at least one (1) second before re-sending that command. Possible reasons that a Sensorsoft device may ignore your commands can be due to data transmission (CRC) errors or improper power-up delay during hot-plugging.

Sending SSDP commands to the Sensorsoft device

Each command packet your host sends to the Sensorsoft device must be in the following format:

<CMD-byte> <PACKETlength-bytes> <ADDRESS-bytes> <ARGUMENT-byte> <CRC-bytes>

CMD-byte

A single byte command indicating the desired action you want the Sensorsoft device to perform.

PACKETlength-bytes

Two bytes indicating the total length of the packet from start to finish (includes CRC bytes).

ADDRESS-bytes

The six-byte (48-bit) address of the device you are sending the command to. This is always "decimal 1."

ARGUMENT-byte

The number of the Sensorsoft Thermometer's internal register or variable you want to read or write. This byte is required for commands that request temperature readings. This byte is not required for the status command.

CRC-bytes

A two byte (16 bit) Cyclic Redundancy Check that is calculated on the entire packet from the CMD byte to the last ARGUMENT byte or ADDRESS byte. In the examples below, the last two bytes in each command string are CRC bytes that were pre-calculated.

Send the following bytes to request a status reading:

<C1h><0Bh><00h><01h><00h><00h><00h><00h><00h><47h><98h>

Send the following bytes to request a temperature reading in Celsius (0.5 C resolution):

<C5h><0Ch><00h><01h><00h><00h><00h><00h><00h><01h><0Eh><49h>

Send the following bytes to request a temperature reading in Celsius (0.1 C resolution):

<C5h><0Ch><00h><01h><00h><00h><00h><00h><00h><02h><6Dh><79h>

Receiving SSDP responses from the Sensorsoft device

Each response packet the Sensorsoft device returns is in the following format:

<RESPONSE-byte> <PACKETlength-bytes> <DATA-byte(s)> <CRC-bytes>

RESPONSE-byte

A single byte response code indicating the type of response. Valid codes are 90 hex or 94 hex.

PACKETlength-bytes

Two bytes indicating the total length of the packet from start to finish (includes CRC bytes).

DATA-byte(s)

Most responses return additional data in the form of byte(s). In response to a temperature command, two bytes are returned for DATA-byte(s). In response to a status command, one byte is returned for DATA-byte(s). See *SENSORSOFT DEVICE STATUS BYTE FORMAT* chart.

CRC-bytes

A two byte (16 bit) Cyclic Redundancy Check. This placeholder is filled with CRC bytes calculated by the Sensorsoft device on the entire packet from the RESPONSE byte to the last DATA-byte. These bytes allow the host to verify the integrity of the response packet. You may choose to use or ignore these bytes depending on your programming skill or application.

The Sensorsoft device returns a normal RESPONSE-byte (**90 hex**) in acknowledgement that the previous host command was received and executed without errors. The Sensorsoft device only acknowledges correctly received commands that have no CRC errors. If the Sensorsoft device detects a CRC error in a received command packet, it does not respond to the command. It is considered the job of the host to time-out and re-transmit that command packet.

When an internal problem occurs inside the Sensorsoft device, it sends out an abnormal response byte (**94 hex**) to any command from the host. If the host receives this response byte, it must immediately read and interpret the Sensorsoft device's status to determine the problem. See *SENSORSOFT DEVICE STATUS BYTE FORMAT* chart.

The generator polynomial used for the CRC is hexadecimal 1021. The following references provide information for readers who wish to use the CRC capability;

- Calculating CRC's by Bits and Bytes, Greg Morse, Byte Magazine, September 1986, Pg. 115-124
- Implementing CRC's, Jack Crenshaw, Embedded Systems Programming Magazine, January 1992, Pg. 18-45
- Technical Aspects of Data Communication, John McNamara, Digital Equipment Press 1982, Pg. 110-122
- Data and Computer Communications, 2nd edition, William Stallings, Macmillan Publishing, Pg. 107-112
- The modem reference: the complete guide to selection, installation, and applications, 2nd edition, Michael A Banks, Brady Publishing 1991, Pg. 27-42

SENSORSOFT DEVICE STATUS BYTE FORMAT

BIT	NAME	DESCRIPTION
0	Low power supply	Voltage is unacceptable for reliable operation
1	IRQ enable	N/A
2	IRQ pending	N/A
3	Power-up	Sensorsoft device just powered-up
4	Tamper	Sensor element is disconnected or broken
5	NV option	N/A
6	EEPROM fail	N/A
7	Future use	N/A

A “logic one” condition on any of these bits indicates the condition is set or active. Otherwise, they are reset to “logic zero”. It’s a good practice for the host to check the status of the Sensorsoft device regularly in case a bit status changes.

If bit 0 is set, the Sensorsoft device power supply voltage is too low.

If bit 3 is set, the Sensorsoft device has just powered-up. This bit gets reset after the status is read.

If bit 4 is set, the sensor element has become damaged, disconnected, or is being subjected to a high level of RFI (Radio Frequency Interference) or EMI (Electro Magnetic Interference).

Bits 1,2,5,6 and 7 can be ignored - they are not used.

Converting SSDP DATA-byte(s) to temperature readings

Recent Sensorsoft temperature measuring devices can output temperature readings in two different formats.

The first format is common to all Sensorsoft temperature measuring devices and is easiest for programmers to support. It provides a resolution of 0.5 degree Celsius. Commands that query register or variable <01h> in the Sensorsoft Thermometer will receive a two byte response in the DATA-byte(s) placeholder, as described below.

It is the job of the host software to convert the DATA-byte(s) to a floating-point number. It is then possible to display readings in Celsius or Fahrenheit scale. The following procedure explains the required steps:

1. Check the value of the most significant DATA-byte. If it is FFh, the number is negative and requires processing by steps 2,3,4 and 5. If it is 00h, the number is positive and requires processing by steps 3 and 5.
2. Invert the bits of the least significant DATA-byte, then add 1 to it.
3. Convert the least significant DATA-byte to a floating-point number.
4. Multiply the previous by -1 to get the negative result.

5. To obtain a temperature in Celsius, divide the previous result by 2. For Fahrenheit, multiply the Celsius value by 9, divide by 5, and add 32 ($F = 9/5 C + 32$).

SENSORSOFT TEMPERATURE DATA-byte(s) FORMAT

Temperature	Binary		Hex
	MSB	LSB	
+ 125 °C	00000000	11111010	00FAh
+ 85 °C	00000000	10101010	00AAh
+ 70 °C	00000000	10001100	008Ch
+ 25 °C	00000000	00110010	0032h
+ 0.5 °C	00000000	00000001	0001h
0 °C	00000000	00000000	0000h
- 0.5 °C	11111111	11111111	FFFFh
- 25 °C	11111111	11001110	FFCEh
- 40 °C	11111111	10110000	FFB0h
- 55 °C	11111111	10010010	FF92h

Please note that the least significant temperature DATA-byte is in terms of a 0.5 ° C. The sign bit is duplicated into all of the bits of the most significant DATA-byte.

The second format provided by this device for temperature is in IEEE 754 Floating-Point Standard (single precision) and has a useable resolution of 0.1 degree Celsius. Commands that query register or variable <02h> in the Sensorsoft Thermometer will receive a four byte response in the DATA-byte(s) placeholder. Decoding these IEEE 754 Floating-Point bytes is beyond the scope of this document.

Reading the SSDP ID Record

Every Sensorsoft device (SSD) accepts an identification (ID) command in order to uniquely identify the type of SSD currently connected. The model number and description can be extracted from the SSD's ID response, allowing application software to determine the specific model of the SSD and to configure the software appropriately.

The format of the ID command is identical to the format of all other commands, described earlier.

Send the following bytes to the SSD to request the ID:

```
<C3h><0Bh><00h><01h><00h><00h><00h><00h><00h><20h><5Eh>
```

The ID response contains four variable-length, null-terminated strings. The sequence of four strings begins at the 10th byte in the response packet.

To read the SSD's description, count to the 10th byte in the ID response and extract the subsequent ASCII null-terminated string.

Following this is the manufacturer's name - a null-terminated string.

The third null-terminated string is the SSD's model number. The model number can be used to uniquely identify the type of SSD, so your software can configure itself appropriately for different models of SSDs.

The fourth and final null-terminated string is the SSD's firmware version.

Structure of the ID response packet

Byte	Description of field
1	Response byte
2-3	Packet length
4-9	Not used
10	Device name or description (null-terminated)
~	Manufacturer (null-terminated)
~	Model Number (null-terminated)
~	Firmware Version (null-terminated)
~	Record Terminator (FFh)
~	CRC bytes (2)

Sample ID response packet from a ST6105J Sensorsoft Thermometer

Byte	Contents
1	<90h>
2	<4Fh>
3	<00h>
4-9	<01h> <00h> <00h> <03h> <03h> <07h>
10	Sensorsoft (R) Thermometer<00h>
~	Sensorsoft Corp.<00h>
~	ST6105J<00h>
~	4.00<00h>
~	<FFh>
~	<CEh> <CBh>

Getting Help

Limited Warranty

Sensorsoft Corporation warrants Sensorsoft products to be free from manufacturing defects for a period of two years. This includes parts and labor. All shipping and brokerage fees are your responsibility when returning a Sensorsoft product for warranty claims. The following will void the warranty:

- signs of water or chemical damage
- cracks to the housing
- lightning or electrical storm damage
- signs of tampering or reverse engineering

Technical Support

In the unlikely event you should have problems installing or using your Sensorsoft product and the previous sections of this manual have failed to provide a solution, we offer technical support to help you overcome your difficulties (see web site address below). Sensorsoft Corporation **does not** provide free support to those wishing to write their own software, although this is available on a charge-per-incident basis. Please contact our sales department for current rates.

World Wide Web: <https://www.sensorsoft.com>

30 Day Money Back Guarantee

If for any reason you want to return a Sensorsoft product for a refund, you can do so within 30 days (calendar days) of your purchase. The refund does not include shipping or brokerage fees you may have incurred.

Returns

If returning a product or item, please observe the following guidelines:

- Contact Sensorsoft for an RMA number (Return Material Authorization).
- Provide an explanation or reason for returning the product.
- Return shipments that bear no RMA number (on the outside of the package) or are not prepaid for shipping/clearing charges, will be refused.

FCC Compliance and Advisory Statement

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against such interference when operating in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with this guide, may cause harmful interference to radio communications. Operation of this equipment in a residential area may cause interference that requires the user to take measures to correct at his or her expense.

Warning: Changes or modifications to this device not explicitly approved by Sensorsoft Corporation will void the user's authority to operate this device.