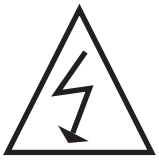
Description

The Sine Systems model CTI-2 Computer-Temperature Interface allows a computer to monitor the outside air temperature. It consists of a 2.75" x 3" x 0.75" control module with 8 screw-terminal connections. Three of these connect to the computer's RS-232 port, two are for connection to a wall-plug DC power supply (supplied), and the remaining three connect to the outdoor temperature sensor (supplied).

The CTI-2 allows a temperature range of -50°F to +199°F can be monitored with a resolution of 1°. The temperature sensor may be located up to 200 feet (or more, depending on conditions) from the control module. A weatherproofing kit is included with the sensor. The sensor is pre-calibrated to ±3° and provisions are included to allow the user to "fine-tune" the calibration of the sensor after installation is complete.

The control module communicates with the computer by means of a standard RS-232 connection. The protocol is 8 data bits, one stop bit and no parity (8N1). The baud rate is factory set to 9600, but can be changed to 4800, 2400, 1200, 600 or 300.

Installation



High Voltage!

The CTI-2 Computer-Temperature Interface should be installed only by qualified technical personnel. An attempt to install this device by a person who is not technically qualified could result in a hazardous condition to the installer or other personnel, and/or damage to the CTI-2 or other equipment. Please ensure that proper safety precautions have been made before installing this device.

Most all materials needed in the installation of the CTI-2 are included with it. The two exceptions are a length of Belden 8451 cable (or equivalent) for connecting the sensor to the control module, and an appropriate connector for the RS-232 port on the computer. In most cases, this will require a female 9 pin "D" connector. Wire strippers, a small (red) flat blade screwdriver, and a very small (green) flat blade screwdriver are the main tools required. A soldering iron and solder are needed if a solder-type "D" connector is used.

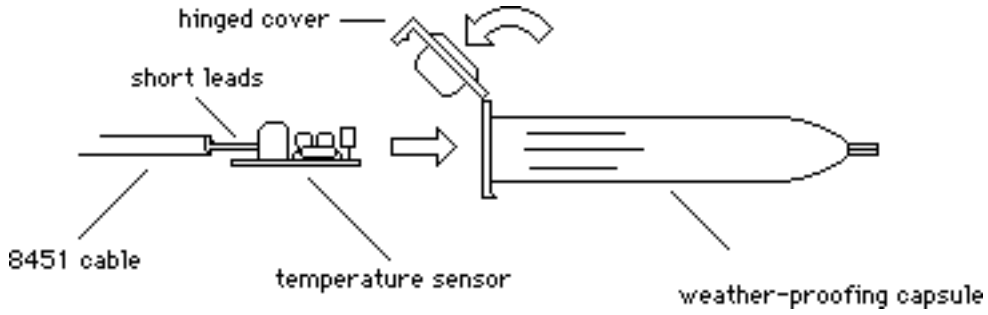
Control Module

The CTI-2 control module may be located in any convenient indoor location. It is usually most practical to place it somewhere near the computer. It is small enough that it needs no special mounting considerations. It can be rested on a horizontal surface, mounted on a vertical surface using double-stick tape, or it may be simply dangled from its connecting wires.

Temperature Sensor

The air-temperature sensor for the CTI-2 consists of a small PC board with three screw-terminals. After calibration, this sensor is capable of giving very accurate temperature readings. However, to get readings that give good correlation to readings reported by the nearest NOAA weather station, it is important to measure the temperature the same way they do. Just hanging the sensor out a window will almost surely produce disappointing results. The key to getting good temperature readings is to mount the sensor in a "standard enclosure." (Plans for a standard enclosure are provided later in this document.)

The cable for the sensor should be run up the post and through the hole in the floor of the enclosure. The sensor should be attached to the cable with the leads from the cable made as short as possible. Then, the sensor should be inserted in the open end of the included weather-proofing capsule as shown below:



The capsule contains a clear insulating gel that will protect the sensor from moisture and prevent water from seeping in the end of the cable. The gel also acts as an efficient thermal conductor to insure that the sensor will quickly track the ambient air temperature. Push the temperature sensor in the capsule as far as possible so the gel will cover it and the exposed end of the cable. A pencil or other object can be used to push the sensor in and to work the gel in behind the sensor so the end of the cable is covered. Then close the hinged cap. The cap also serves as a strain relief for the cable.

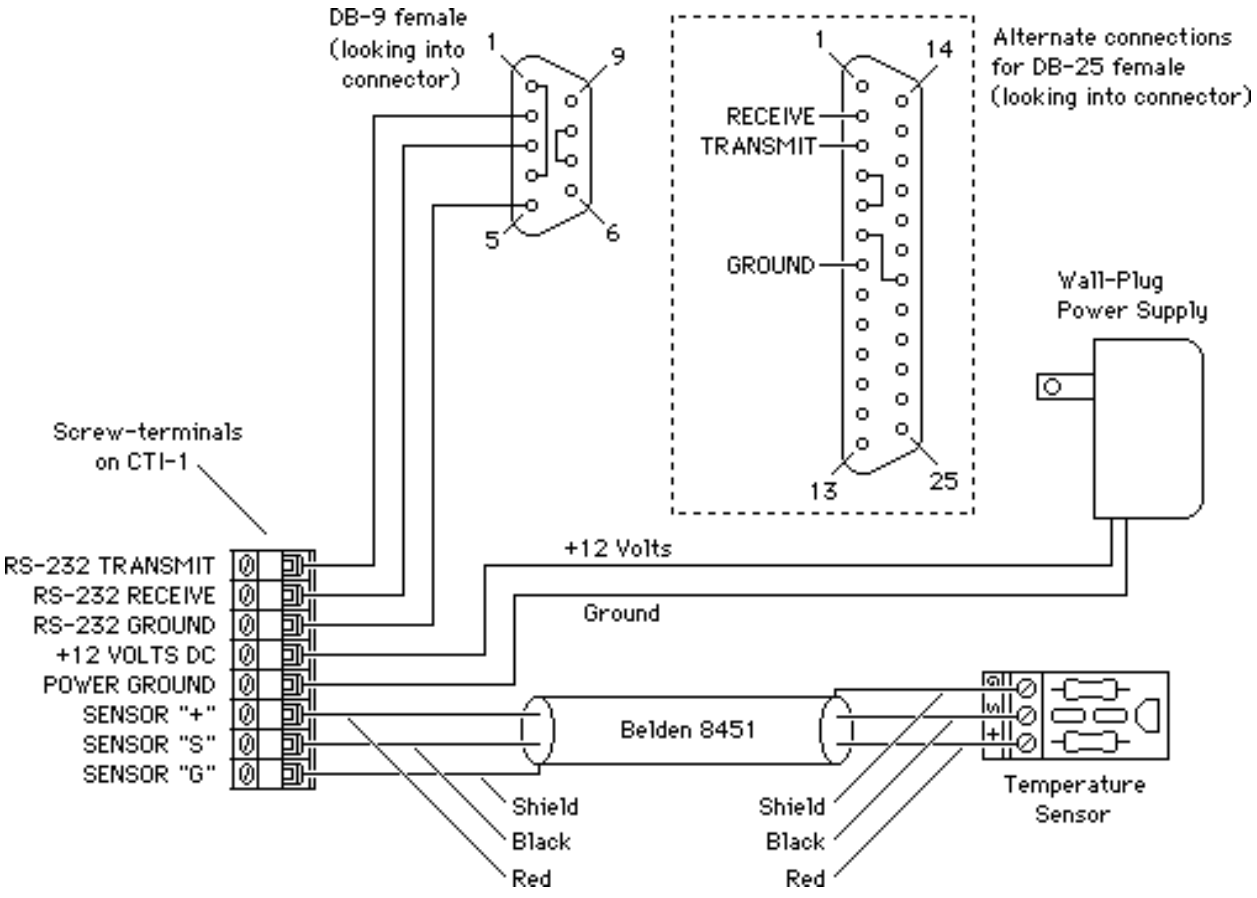
A nylon clamp is included which can be used to mount the capsule, if required. The capsule is made of non-UV resistant nylon. If it is mounted where it is exposed to direct sunlight, it is suggested that it be covered with a length of black heat-shrinkable tubing.

When visiting the enclosure during the summer months you might want to take a can of wasp-and-hornet-killer with you. They just love to build nests in these things.

Calibration of the sensor is discussed in the following section.

Electrical Installation

All electrical connections to the CTI-2 are made with 8 screw-terminals located on the front panel. The following illustration gives an overview of all the connections. More detailed information about each connection is given in the subparagraphs that follow.



Temperature Sensor

The temperature sensor consists of a small PC board with three screw-terminals. It may be located up to 200 feet from the main unit. Single-pair foil-shielded cable should be used to connect the sensor to the main unit (Belden 8451 or equivalent). The shield conductor is electrically offset from ground by 0.8 volts so care should be taken that it connect only to the appropriate terminals on each end. Be particularly careful not to cut or puncture the outer insulating jacket of the cable anywhere it is outdoors except where it connects to the sensor.

Power Supply Connection

The CTI-2 includes a 12 volt DC power supply rated at 500 mA. If the power supply cord has a connector attached, cut it off and strip the leads. Use a volt meter to test for correct polarity and connect to the CTI-2 accordingly.

RS-232 Connection

The remaining three terminals on the control module are for connection to the computer's RS-232 port. The above diagram shown how to connect a standard 25 pin "D" connector and, alternately, a 9 pin "D" connector. The vast majority of RS-232 interfaces can be made with one of these two connectors.

The two jumper connections shown on the connector can provide CTS and DSR signals back to the computer for applications where this is required.

Setting Baud Rate

While the factory baud rate of the CTI-2 is set to 9600, it may be changed to any of 5 other values. To change the baud rate of the CTI-2, the host computer (or terminal) must first be set to the baud rate currently programmed for the CTI-2. To change the baud rate, one of the following commands should be sent :

9600[CR] 4800[CR] 2400[CR] 1200[CR] 0600[CR] 0300[CR]

where [CR] is an ASCII carriage return, or a line-feed/carriage return. The baud rate of the CTI-2 will switch the next time the device is powered up. The baud rate programming is stored in nonvolatile memory and will be retained even if power to the CTI-2 is disconnected for an extended period.

Sensor Calibration

The CTI-2 temperature sensor is pre-calibrated to ±3°F. The calibration can be fine tuned if an accurate thermometer is available. Place a thermometer of known accuracy as close as possible to the temperature sensor. Allow the temperature to stabilize. Read the reference thermometer and set the CTI-2 temperature with a command such as:

+072[CR]

In this example, the CTI-2 is set to 72°. Use a minus sign to set temperatures below zero. Always use three digits for the temperature. Zero degrees should be entered as +000[CR]. The sensor calibration data is stored in nonvolatile memory that is retained even if power to the CTI-2 is lost for an extended period of time.

To read the temperature calibration value, send the command CØØ2[CR]. A value from ØØØ[CR] to Ø20[CR] will be returned. Ø10 is the factory calibration value. This corresponds to a "zero" correction point--the midpoint of the calibration range. The calibration range is ±10 degrees from this value. A sensor is most likely damaged if it needs to be calibrated outside of this range. To return the CTI-2 to the factory default temperature calibration, send the command CØØ1[CR].

Accurate thermometers are available at laboratory supply companies such as Edmund Scientific. They can be reached at http://www.edmundscientific.com or 800-728-6999.

Operation

Reading the Temperature

To read the temperature, send an ASCII carriage return [CR] or a combination line-feed/carriage return [CR/LF]. The CTI-2 will respond with a plus or minus sign followed by three digits and a carriage return. For example, 72° will be reported as +072[CR]. Zero degrees will be reported as +000[CR].

Miscellaneous Commands

To read the software version contained in the CTI-2, send the string CØØØ[CR].

Enable verbose messages with the command CØØ7[CR]. In verbose mode, the CTI-2 replies with 'OK' when internal settings are changed. Previously, these commands provided no feedback. Verbose mode is enabled by default but it can be disabled for backward compatibility with the command CØØ8[CR].

Error Codes

When the CTI-2 receives an invalid command, the string EØØØ[CR] is returned. If there is a problem with the temperature sensor or associated wiring, the CTI-2 will respond with EØØ1[CR] when the temperature is requested. If an attempt is made to calibrate the sensor more than 10 degrees (F) from the original sensor calibration, the CTI-2 will return EØØ2.

Summary Of All Operating Codes

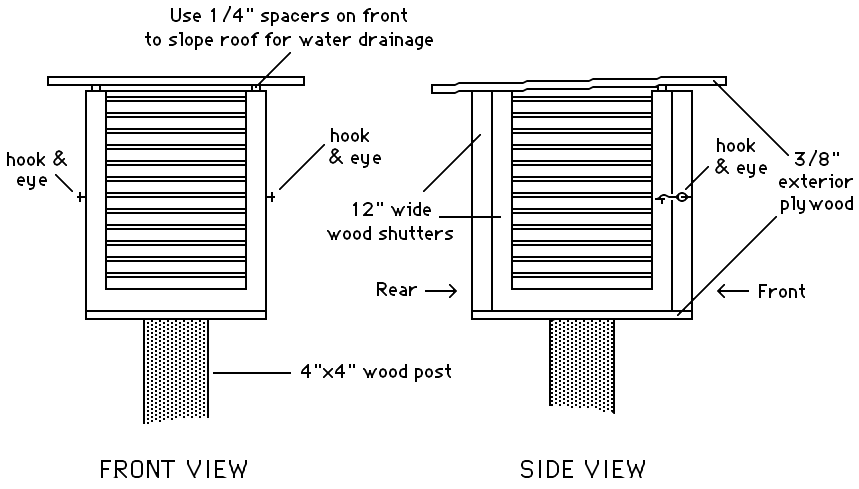
[CR]	reads temperature
+072[CR]	sets temperature
9600[CR]	sets baud rate
CØØØ[CR]	reads software version
CØØ1[CR]	sets temperature calibration to factory default
CØØ2[CR]	reads calibration value (0 to 20)
CØØ3[CR]	sets temperature output to Fahrenheit (default)
CØØ4[CR]	sets temperature output to Celsius
CØØ5[CR]	enables temperature scale identifier C/F
CØØ6[CR]	disables temperature scale identifier C/F (default)
CØØ7[CR]	enables verbose messages (default)
CØØ8[CR]	disables verbose messages

Summary Of All Error Codes

EØØØ[CR]	invalid command
EØØ1[CR]	sensor error
EØØ2[CR]	attempted calibration is out of range
EØØ3[CR]	memory programming error
EØØ4[CR]	serial data input error

Building a Standard Enclosure

An alternative to buying one is to make a standard enclosure using inexpensive, locally-available materials. The primary raw material is a couple of 12-inch-wide louvered wood shutters. These are available at any home-improvement store. Cut the shutters so you end up with four equal lengths of shutter about 13 to 16 inches long. Depending on the style, a little improvising may be required. Some shutters can be cut along a solid horizontal reinforcement piece and others will require the end louvers to be stabilized with glue or a piece of wood. In either case, you will build a box with the four pieces of shutter using them for the four walls. The floor and roof of the box should consist of 3/8 inch exterior plywood. Here is how the end result will look:



The roof should overhang about 3 inches on all sides. Nail and glue, or screw three of the four sides together and then attach this to the floor. The pieces of shutter should be oriented so the louvers will drain “out.” Attach the roof with a couple of 1/4 inch spacers near the front so that it slopes slightly to the rear. This will prevent water from standing on top. The remaining wall should be attached with two hook-and-eye sets so it can be removed. The enclosure should be mounted on a 4-inch-square wooden post. The floor of the enclosure should be 4.5 to 5 feet above the ground. Don’t forget to drill a small hole in the floor near the edge of the post for the cable to come through. Also, a 1/4 inch hole drilled in one of the walls about an inch above the floor makes an easy way to insert a dial-type calibration thermometer without removing the louvered panel (see section 5.3). When finished, the enclosure should be given at least two coats of white exterior paint inside and out.

The enclosure should be placed at least 20 feet from the nearest building, preferably on grass-covered soil. It should be as far away as possible from concrete and pavement. It should not be placed near air-conditioner compressors nor under trees.