Description

The Sine Systems model TS-1/PS Temperature Sensor allows remote monitoring of indoor or outdoor temperature with the RFC-1 Remote Facilities Controller. The TS-1 is the temperature sensor. Model TS-1/PS includes a small DC wall-plug power supply. The power supply can be any voltage in the range 5-15 VDC and one power supply will operate several temperature sensors. Additional TS-1 temperature sensors may be purchased separately.

The TS-1 Temperature Sensor produces an output of 10 millivolts per degree Fahrenheit. For example, a temperature of 72° will result in an output of approximately 0.72 volts. With an additional circuit (shown later), the TS-1 can measure temperatures below 0° F.

Installation

The TS-1 consists of a small PC board with three screw-terminals. Then sensor may be located 100 feet or more away from the monitoring system if a high quality, foil-shielded cable is used. Figure 1 shows a typical connection.

WARNING!

If the sensor is located more than 3 feet from the system, foil-shield cable such as Belden 8451 should be used for the connection. This is especially important in high RF fields. It is very important to use foil-shielded cable. Braid-shielded cable is inadequate for this installation.

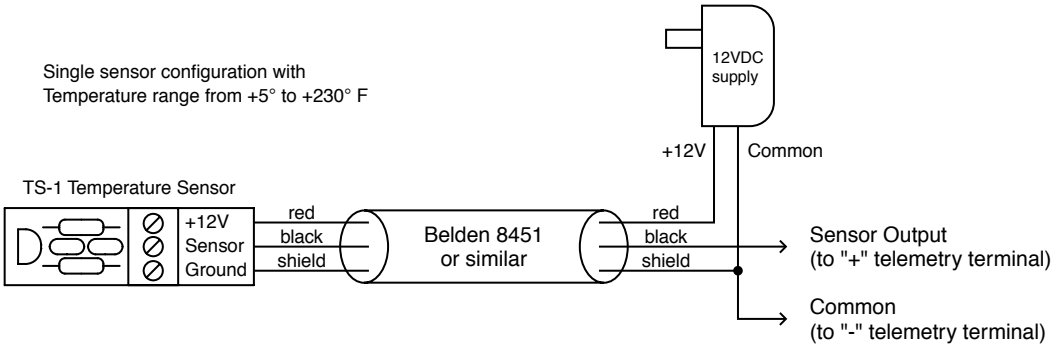

Figure 1; Single sensor with temperature range +5° to +230° F

Figure 2 shows how to connect more than one TS-1 sensor using a single supply and multiple telemetry outputs.

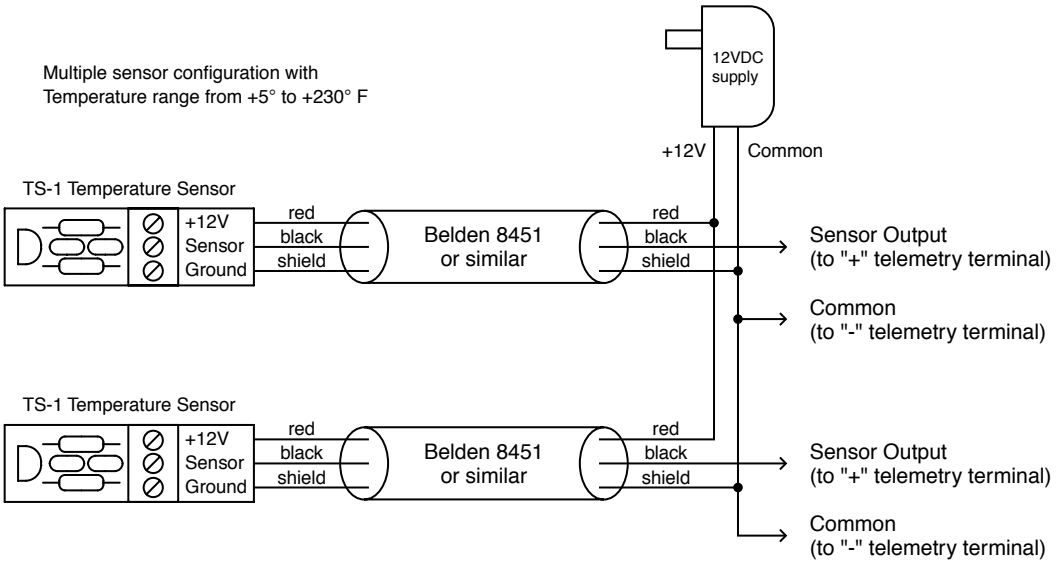

Figure 2; Multiple sensors with temperature range +5° to +230° F

If the TS-1 sensor is installed in such a way that the lower side of the PC board could come in contact with metal, a piece of insulating tubing (supplied) should be installed over the sensor. This is heat-shrinkable tubing but it should not be shrunk in order to allow good air flow over the sensor.

When installing the TS-1 sensor at a transmitter air intake or exhaust, be sure there is no way it could fall into, or be sucked into, any portion of the transmitter where it could do harm. Nylon cable-ties are a good way to securely fasten the sensors in place.

The TS-1 sensor is capable of monitoring temperatures down to -40°F. The measurement of negative temperature readings (below 0°) requires additional components and a voltage measurement device that will measure negative voltage as well as positive voltage (e.g. -10°F produces -0.10 volts output).

Figure 3 shows a circuit that allows positive and negative temperature readings.

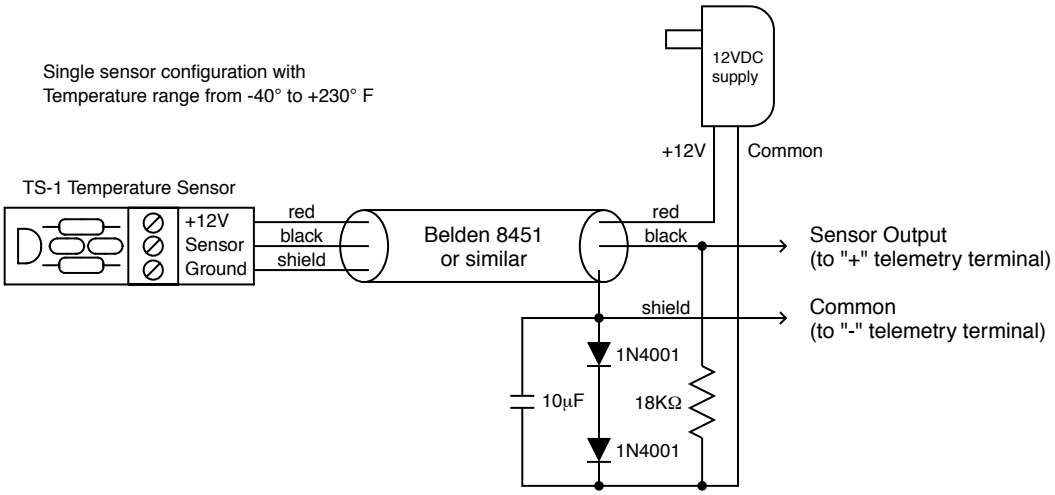

Figure 3; Single sensor with temperature range -40° to +230° F

Telemetry Channel Programming

When connecting the TS-1 as a telemetry input of an RFC-1/B Remote Facilities Controller system, the temperature reading will be more meaningful if the telemetry channel is programmed with a decimal point and unit word.

In this example we will program Channel 07 with the unit word “degrees”, a maximum reading with decimal point of “204.0” and set the channel to use a linear scale since the TS-1 voltage output is linear.

While we use channel 00 in this example, any unused telemetry input will work. The starting address for programming will change depending on the channel used; all other programming steps will be the same. Use the Programming Address Table the RFC-1/B documentation to find the address if another channel is used.

Step 1 Enter the Advanced Programming Mode: `80`
2 Enter the Advanced Programming Security Code: `4150`

3 Enter the starting address (from the Address Table) for Channel 07 telemetry units: `0028`
4 Find the word “degrees” in the Word Table and get the values V1 and V2: V1=2, V2=7
5 Enter V1 for the word “degrees”: `2`
6 Press the # key to enter this value and increment to the next address in memory
7 Enter V2 for the word “degrees”: `7`
8 Press the # key to write this value and increment to the next address in memory

9 From section 6.3.3 (Programming), find the maximum reading of “204.0” and get the value V1: V1=6
10 Enter V1 for the maximum reading of “204.0”: `6`
11 Press the # key to write this value and increment to the next address in memory

l2 From section 6.3.4 (Programming), find the setting for linear tracking and get the value V1: V1=0
l3 Enter V1 for logarithmic tracking: 0
l4 Press the # key to write this value and increment to the next address in memory

l5 Press the j key to exit the programming mode

Every channel can be setup with a unit word; the full scale reading and decimal point location can be changed; and the tracking method--linear, logarithmic or indirect--can be changed. Change the starting address the address appropriate for the channel to be programmed.

Now that the input channel has been programmed with a unit word and decimal point, the input should be calibrated so that the data given by the reading will be correct.

Calibration

Go online with the RFC-1/B. Since calibration can only be performed from the front panel, this procedure will probably be done with a local connection but a remote connection will work equally well. Select the channel to which the TS-1 is connected. Continuing from the example above, we will select channel 07. The RFC-1/B will give a reading, "Channel 07: XXX.X degrees" where XXX.X is some numeric reading.

Our goal is to dial the calibration pot on channel 07 up or down until the reading XXX.X is the same as the temperature where the TS-1 sensor is located. The accuracy of our reading depends on how accurately we can determine the temperature at that point. Good methods to do this are described below. However, an educated guess is sometimes the best one can do given the tools at hand. Use the best method available at the time of installation.

To very accurately calibrate the reading produced by the TS-1, a thermometer of known accuracy should be placed as close as possible to the temperature sensor. Give it a few minutes for the temperature to stabilize. Then calibrate the temperature reading with the appropriate telemetry adjustment trimmer for the selected channel.

If an accurate thermometer is not readily available, the TS-1 can be calibrated with a fair degree of accuracy using a digital multimeter. The output voltage of the TS-1 is 10.00 millivolts per degree Fahrenheit. Probe the DC voltage at the telemetry input of the selected channel. Calibrate the channel reading to the voltage reading (x 100). For example, if the voltage across the TS-1 output terminals is 0.7231 volts, the temperature should be calibrated to (0.7231 x 100) or 72.3°. This technique will typically yield a calibration within ±2° of actual temperature.

Placing the Temperature Sensor

The TS-1 temperature sensor can be placed up to 150 feet from the main unit. Single pair foil-shielded cable should be used to connect the sensor to the main unit. The shield conductor is electrically offset from ground by 0.7 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.

Standard Enclosure

To get readings that correspond to those 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 temperatures that fluctuate wildly. The key measuring the temperature accurately is to mount the sensor in a standard enclosure. It provides very accurate air-temperature readings.

An alternative to buying a standard enclosure is to make one using inexpensive materials. The primary raw material is two 12 inch wide louvered wood shutters—louvered doors might also work. Cut the shutters so you end up with four equal lengths of shutter about 13 to 16 inches long. A little improvising may be required depending on the style of shutter or door. Some 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 are made of 3/8 inch exterior grade plywood.

Attach three of the four sides together with glue and nails or screws. The pieces of shutter should be oriented so the louvers will drain outside of the enclosure. Attach this assembly to the floor. The roof should overhang about 3 inches on all sides. 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.

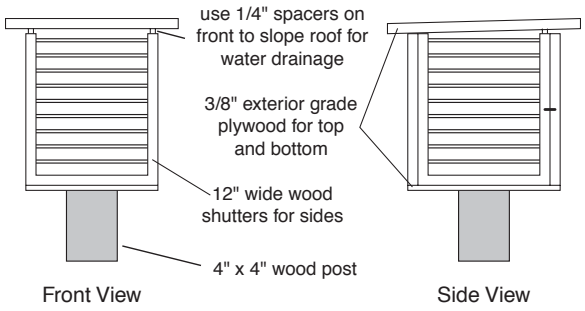

Figure 3.4; Standard enclosure for temperature sensor

Mount the enclosure on a 4 inch square wooden post. The floor of the enclosure should be 4 feet above the ground. Drill a small hole in the floor near the edge of the post for the sensor cable to come through. A 1/4 inch hole drilled in one of the walls about an inch above the floor makes an easy way to insert a calibration thermometer without removing the louvered panel. The enclosure should be given at least two coats of white exterior paint inside and out.

Place the enclosure 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. Do not place the enclosure near air-conditioner compressors or under trees.

Run the cable for the sensor up the post and through the hole in the floor. Lay the sensor in the center of the floor of the enclosure. Be careful not to cut or puncture the outer insulating jacket of the cable. The inner conductors must be protected from the weather. If an extension cable is used, wrap electrical tape around the connectors to seal out moisture.

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

WPC-1 Weather Proofing Capsule

The TS-1 should be installed in such a way that it is protected from the elements. The WPC-1 weather proofing capsule may be used in addition to the mounting enclosure.

Attach the sensor to the cable with the leads from the cable as short as possible. Insert the sensor into the open end of the weather proofing capsule as shown in Figure 5.

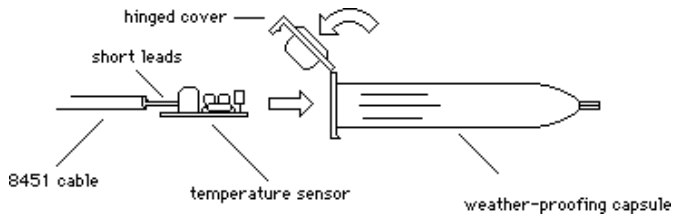

Figure 5; Temperature sensor in weather proofing capsule

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 the sensor and the exposed end of the cable. Close the hinged cover--this also serves as a strain relief for the cable.

The capsule is made of non-UV resistant nylon. Cover it with black heat shrink tubing if it will be exposed to direct sunlight when it is mounted.