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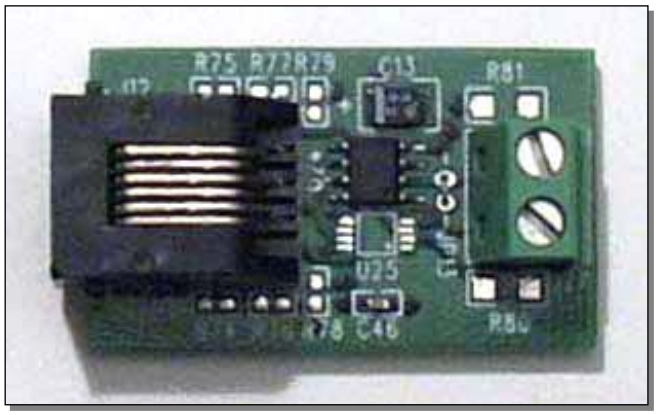
SPI Temperature Sensor Board

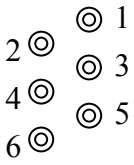


The temperature sensor board allows a SPI master device such as TNG-4 or TNG-5 to read out temperature. The temperature sensor board comes in two basic versions: thermistor and thermocouple.

The thermistor version is populated with a Maxim MAX6682 thermistor-to-digital converter IC (http://pdfserv.maxim-ic.com/arpdf/MAX6682.pdf). The MAX6682 digitizes a 10k ohm @ 25°C thermistor (Thermometrics C100Y103J, www.thermometrics.com). Other thermistors may be used, but may require a different value of R80. The device is most linear over the +10 to +40° C range. The temperature is digitized to 10 bits plus sign.

The thermocouple version is populated with a Maxim MAX6674 cold-junction-compensated K-thermocouple-to-digital converter IC (http://pdfserv.maxim-ic.com/arpdf/MAX6674.pdf). The temperature is digitized to 10 bits—each bit represents 0.125°C—over the 0-128°C operating range of the device. The board can be optionally populated with a MAX6675. The MAX6675 provides 0.25°C resolution over a 0-1024°C range.

The temperature sensor board normally has a RJ12 modular jack for connecting to the host device. The connector layout and pin connections are detailed at right. All signals are TTL-level signals. Vcc may be either 3.3 or 5 volts. Line termination resistors can be installed if required. The clock rate should be less than 4 MHz.



Connector hole pattern (component side view)

RJ12 Pin Connections:

1 = Ground
2 = NC
3 = Data Out from board
4 = SPI data clock
5 = Chip Select (active low)
6 = Vcc (3.3 or 5.0 V)

The height of the board is dictated by the RJ12 modular connector: 0.6 inches (15.25 mm). The board is 0.9 inches (23 mm) wide by 1.5 inches (38 mm) long.

The temperature sensor devices are read only. All the devices start a new temperature conversion on the low-to-high transition of the chip select line. The MAX6682 takes 80 milliseconds to do a conversion. The MAX6674 requires 180 milliseconds for a conversion, and the MAX6675 takes 220 milliseconds. All the devices require that 16 bits be read. The following TNG-4 command-mode sequence covers all three devices: 99 82 00 00 (each pair of hexadecimal digits represents one byte sent to TNG-4). The sequence means this: do an SPI operation reading 2 bytes using the SPI port chip select line. The zero bytes are simply dummy bytes, as TNG-4 must send a byte for every byte received. Sending this four-byte sequence to TNG-4 repeatedly with a device-appropriate delay between sequences will continuously read temperature from a device.

If the device is only read every so often, we recommend a two sequence operation. First read the device, wait the appropriate delay, and then read the device again. Keep only the last reading
The two bytes returned by the MAX6682 are interpreted as follows:

1. The first byte returned is the high byte.
2. The second byte returned is the low byte.
3. The 11-bit (10 bits plus sign) result is left-justified in the word. Treat the combined bytes as a signed 16-bit integer.
4. Multiply the result by 0.00390625 (0.125/32).

Process the two bytes read from a MAX6674 thermocouple device as follows:

1. The first byte returned is the high byte.
2. The second byte returned is the low byte.
3. Treat the combined bytes as an unsigned 16-bit word.
4. Mask with 10h. The result is nonzero if the thermocouple is open.
5. Mask original word from step 3 with 7FE0h (32736).
6. Multiply the result of step 5 by 0.00390625 (0.125/32).

Process the two bytes read from a MAX6675 thermocouple device as follows:

1. The first byte returned is the high byte.
2. The second byte returned is the low byte.
3. Treat the combined bytes as an unsigned 16-bit word.
4. Mask with 04h. The result is nonzero if the thermocouple is open.
5. Mask original word from step 3 with 7FF8h (32760).
6. Multiply the result of step 5 by 0.03125 (0.250/8).