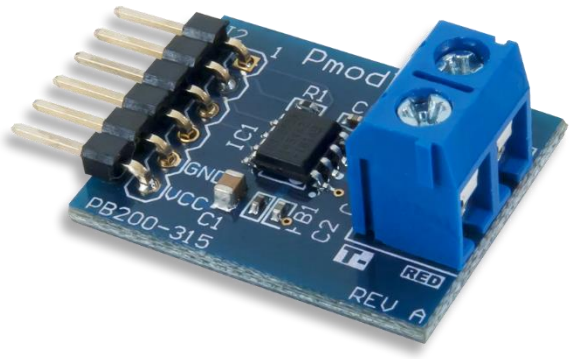
1300 Henley Court
Pullman, WA 99163
509.334.6306
www.digilentinc.com

PmodTC1™ Board Reference Manual

Revised April 12, 2016
This manual applies to the PmodTC1 rev. A

Overview

The Digilent PmodTC1 is a cold-junction thermocouple-to-digital converter module designed for a classic K-Type thermocouple wire. With Maxim Integrated's MAX31855, this module reports the measured temperature in 14-bits with 0.25°C resolution.



The PmodTC1.

Features include:

- K-type thermocouple-to-digital converter
- Wide temperature range of -73°C to 482°C with provided wire
- ±2°C accuracy from -200°C to 700°C
- 14-bit with 0.25°C resolution
- Cold-junction temperature compensation
- Small PCB size for flexible designs 1.0 in × 0.8 in (2.5 cm × 2.0 cm)
- 6-pin Pmod port with SPI interface
- Follows Digilent Pmod Interface Specification Type 2
- Library and example code available in resource center

1 Functional Description

The PmodTC1 utilizes a K-Type thermocouple wire to measure a wide range of temperatures. The wire provided with the PmodTC1 is capable of measuring temperatures ranging from -73^0 C to 482^0 C, although the module itself is capable of measuring temperatures ranging from -270^0 C up to 1800^0 C.

A thermocouple wire needs to be attached onto the screw terminal. The polarity of the thermocouple matters, therefore it is required to have the wires screwed down into the right orientation for accurate temperature readings. The device measures the difference in temperature between the two ends of the thermocouple, of which one is the internal temperature and serves as the reference junction. Once a temperature reading is established, the data passes onto a 14-bit ADC and then passed out through SPI.

2 Interfacing with the Pmod

The PmodTC1 communicates with the host board via the SPI protocol. The module sends a variety of information to the host board in 32 clock cycles, including the temperature measured by the thermocouple, the temperature of the "cold junction, as well as signals indicating if there is a fault with the thermocouple. The PmodTC1 uses a 6-pin port to connect to the host board.

To read data, the host board drives the slave select (SS) pin low and drives a clock to the slave device, the PmodTC1. The first bit (and the sign bit) of the 14-bits of data is loaded onto the master-in-slave-out (MISO) line on the falling edge of the chip select (CS) and can be read by the host board on the rising edge of the serial clock (SCLK) line. Similarly, each consecutive bit of data, starting with the most significant bit (MSB), are placed onto the data line on each falling edge of SCLK and is read on the subsequent rising edge of SCLK. Users can then choose to stop reading information from the PmodTC1 by driving the CS line high.

Temperature data is updated only when the chip select (CS) pin is held high, therefore it is recommended to drive CS high after reading. A complete temperature reading of the thermocouple requires 14 clock cycles. 32 clock cycles are required to read both the thermocouple and reference junction temperatures. Table 1 below shows the bit memory map of the thermocouple temperature data.

	14-Bit Thermocouple Temperature Data			
Bit	D31	D30	…	D18
Value	Sign	MSB 2^{10} (1024^0C)	…	LSB 2^{-2} (0.25^0C)

Table 1. Bit memory map of thermocouple temperature data.

	12-Bit Internal Temperature Data						Res	SCV Bit	SCG Bit	OC Bit
Bit	D15	D14	D13	…	D5	D4	D3	D2	D1	D0
Value	Sign Bit	MSB 2^6(64°C)	2^5(32°C)	…	2^{-3}(0.125°C)	2^{-4}(0.0625°C)	Reserved	1 = Short to Vcc	1 = Short to GND	1 = Open Circuit

Table 2. Incoming data example.

Note 1* Table information modified from Table 2 in the MAX31855 datasheet.

Note 2* Bits D2, D1, and D0 refer to the thermocouple is shorted to VCC, shorted to GND, and the thermocouple has an open connection, respectively.