I2C-TC31855DK

DIN-Rail Thermocouple to I2C-bus Interface

1 Features

- Thermocouple to I2C-bus interface
- Temperature measurement based on MAX31855
- 14-bit resolution with 0.25 Degree Celsius precision
- Integrated Cold-Junction compensation
- Detects Open Thermocouples
- Detects Thermocouple Shorts to GND or VCC
- Data interfacing via I2C bus
- Configurable I2C address (2 selectable addresses via a jumper)
- Operating voltage: 3.3Vdc to 5Vdc
- Onboard inverse polarity protection circuit
- 400KHz I2C bus frequency
- Supports up to 2 boards on a single I2C bus
- Compatible with most microcontrollers
- Supports DIN-Rail PCB mounting
- PCB size 20x72 mm

2 Description

This is an I2C-bus thermocouple board, I2C-TC31855D. The board is designed around the MAX31855, a high-precision, cold-junction compensated thermocouple to digital converter. Since the MAX31855 uses SPI interface, a microcontroller typically requires at least three pins to communicate with a single chip. Furthermore, when multiple MAX31855 chips are connected, even more pins are needed.

However, this board is designed to convert the MAX31855's SPI interface to an I2C bus, requiring only two microcontroller pins for communication. Additionally, multiple boards can be connected to the same I2C bus without increasing the number of required pins. The microcontroller can easily read temperature data via the I2C bus.

The board supports two different I2C addresses on a single bus. It also includes jumpers to enable pull-up resistors for SCL and SDA lines. The board can be mounted on a DIN-Rail PCB holder for industrial applications.

Since the MAX31855 operates at 3.3Vdc then it is not directly compatible with the 5Vdc system. However, this board is designed to function with both 3.3Vdc and 5Vdc, making it more versatile.

3 Diagram

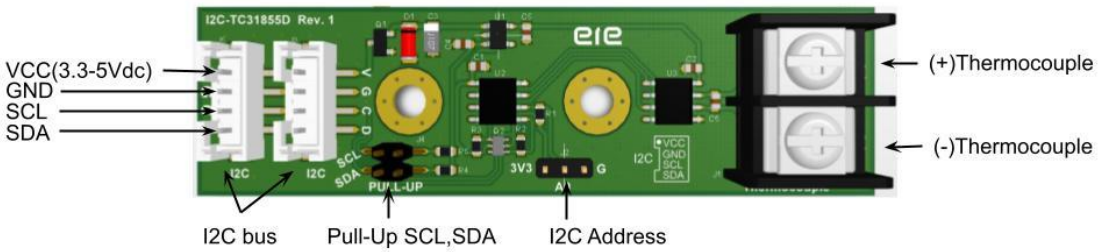

Figure 1: Board Diagram

4 Interfacing

The VCC, GND, SCL and SDA pins of the microcontroller's I2C port must connect to the corresponding VCC, GND, SCL and SDA pins on the board. The VCC voltage must be in the range of 3.3Vdc to 5Vdc.

The board supports an I2C bus clock frequency of 400KHz. It also includes onboard jumpers for enabling pull-up resistors on SCL and SDA lines.

If the microcontroller or the I2C bus already has pull-up resistors, the onboard pull-up resistors must be disabled by opening the jumpers. Additionally, a jumper is provided for setting the I2C bus addresses, which can be configured by shorting it to to GND, shorting it to VCC or leaving it open.

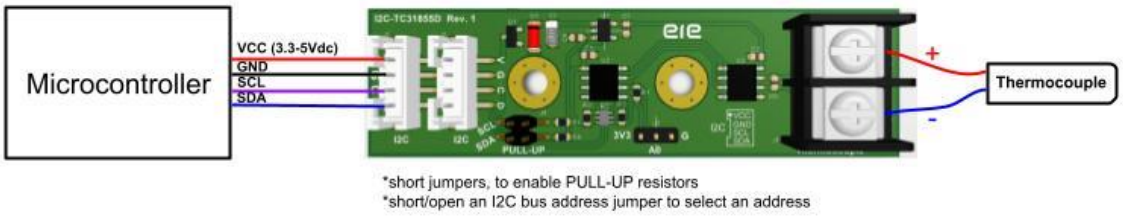

Figure 2: Interfacing

5 I2C Bus Address

The I2C bus address is set using the A0 jumper. The address is 0x18 when the A0 jumper is shorted to GND. If the A0 jumper is shorted to 3.3V or left open, the address is 0x19.

This means the board supports two different addresses, allowing up to two boards to be connected on a single I2C bus.

Table 1: I2C bus Addresses

I2C Bus Address	Address Byte	Jumpers Setting
0x18	S 0 0 1 1 0 0 0 A0	3V3 G A0
0x19	S 0 0 1 1 0 0 1 A0	3V3 G A0
0x19	S 0 0 1 1 0 0 1 A0	3V3 G A0

6 Reading Data

A microcontroller, acting as the I2C master, can read 32-bit data from the I2C bus. The reading process begins with a START condition, followed by a slave address byte. The slave device, I2C-TC31855D, then transmits 4 bytes of data on the SDA line. The first bit is D31, and the last bit is D0.

The next section will provide a detailed explanation of the 32-bit data format.

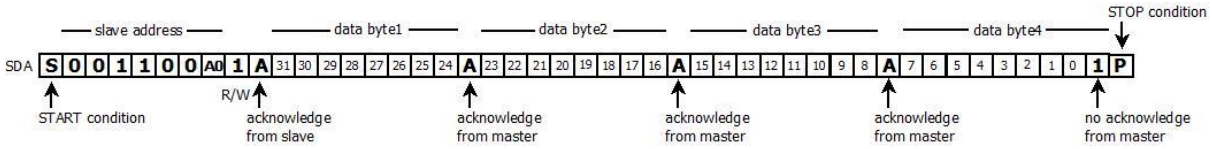

Figure 3: Read out data

7 Data Format

The data format read from the board is identical to the 32-bit format output of the MAX31855. The details of each bit in the data format are shown in the tables below.

For more information about the output data, refer to MAX31855 datasheet.

Table 2: Memory Map Bit Weights and Functions

	14-BIT THERMOCOUPLE THMPERATURE DATA				RES	FAULT BIT	12-BIT INTERNAL TEMPERATURE DATA				RES	SCV BIT	SCG BIT	OC BIT
BIT	D31	D30	...	D18	D17	D16	D15	D14	...	D4	D3	D2	D1	D0
VALUE	Sign	MSB 2^10 (1024 C)	...	LSB 2^-2 (0.25 C)	Reserved	1 = Fault	Sign	MSB 2^6 (64 C)	...	LSB 2^-4 (0.0625 C)	Reserved	1= Short to VCC	1= Short to GND	1= Open Circuit

Table 3: Memory Map Descriptions

BIT	Name	Description
D[31:18]	14-bit of thermocouple temperature data	The signed 14-bit thermocouple temperature value
D17	Reserved	This bit always reads 0
D16	Fault	This bit will be set “1” when SCV, SCG or OC are active.
D[15:4]	12-bits of on chip temperature data	The signed 12-bit of cold-junction temperature.
D3	Reserved	This bit always reads 0
D2	SCV Fault	This bit will be set “1” when the thermocouple shorts to VCC
D1	SCG Fault	This bit will be set “1” when the thermocouple shorts to GND
D0	OC Fault	This bit will be set “1” when the thermocouple is OPEN

8 Thermocouple Types

Each board model supports only one type of thermocouple. The table below lists the board models and their corresponding compatible thermocouple types.

Table 4: Thermocouple Types

Board Models	Thermocouple Types
I2C-TC31855DK	K

9 Dimensions

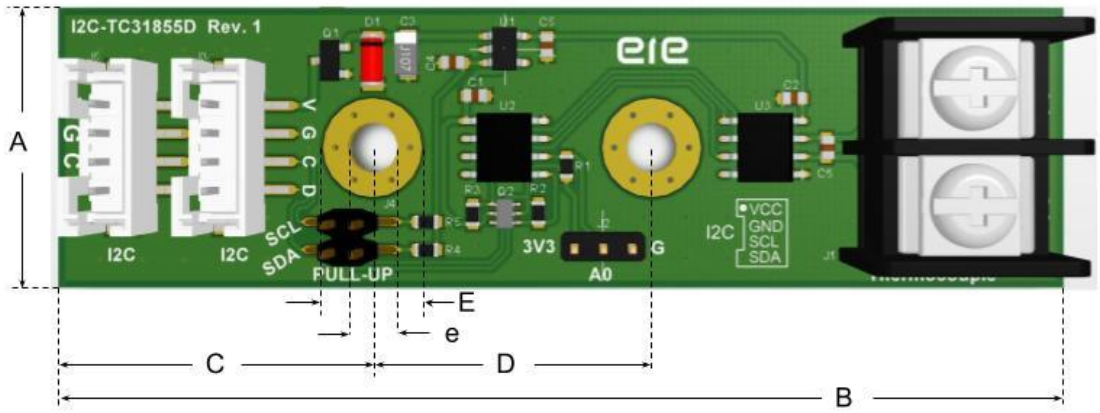

Figure 4: Dimensions

Table 5: Dimensions

Units	Inch	mm
A	0.7874	20.0
B	2.8346	72.0
C	0.8858	22.5
D	0.7874	20.0
E	0.1417	3.6
e	0.2795	7.1