Mega-RTD EIGHT CHANNEL

DATA ACQUISITION CARD FOR RASPBERRY PI

USER'S GUIDE VERSION 1.1

GENERAL DESCRIPTION
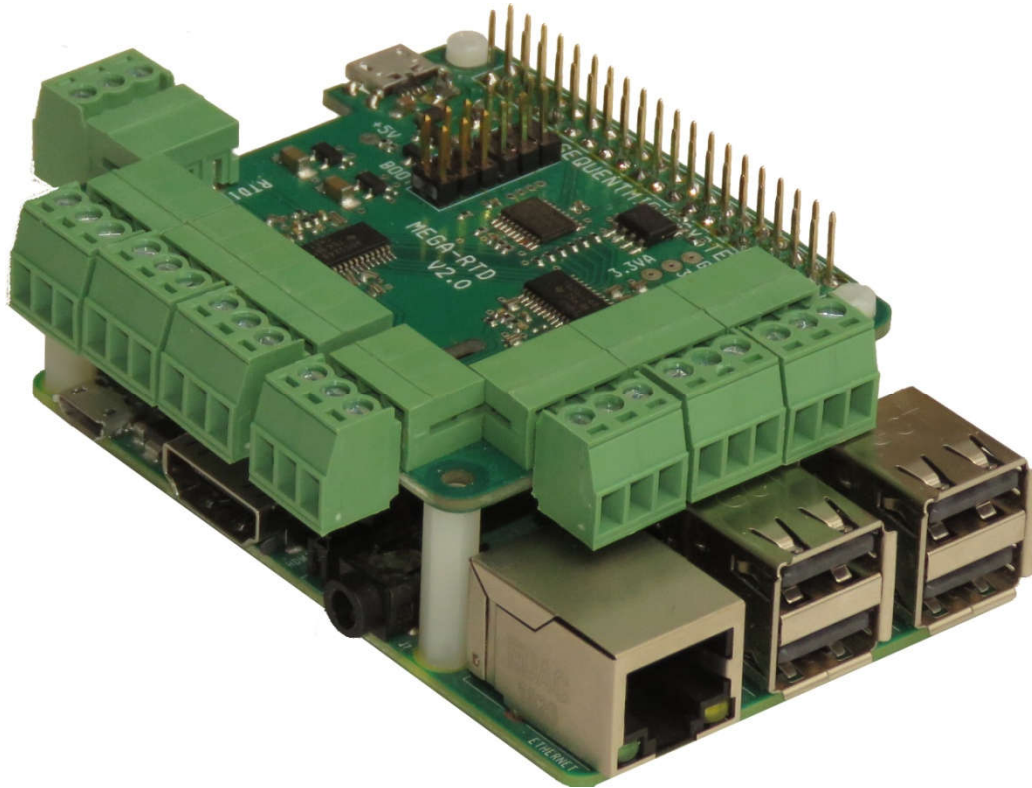
The MEGA-RTD is a stackable expansion card for Raspberry Pi. It is compatible with all Raspberry Pi versions from Zero to 4 and offers a compact and inexpensive solution for reading and storing data from up to 64 RTD-100 temperature sensors.

Since temperature measurement using RTD is based on resistance, the resistance in the lead wires and connectors must be taken into account when calculating the overall resistance in the system circuit. Using a 3-wire circuit design allows lead wire resistance to be factored out of the overall calculation.

SPECIFICATIONS

- Two ADS1248 24 bit delta-sigma converters (four channels each)
- Factory accuracy: 0.1%
- Maximum accuracy (through calibration): 0.01%
- Pluggable connectors
- On-board hardware watchdog capable of power cycling the Raspberry Pi.
- On-board resettable fuse
- Command Line and Python Drivers

Up to eight MEGA-RTD cards can be stacked on top of one Raspberry Pi. Each MEGA-RTD card is equipped with a 32-bit STM32F030 running at 48 MHz. RTD inputs are processed using two ADS1258, 24 bit Delta-Sigma converters and can achieve up to 0.01 °C accuracy.

The MEGA-RTD cards share a serial I2C bus using only two of the Raspberry Pi's GPIO pins to manage all eight cards. This feature leaves the remaining 24 GPIOs available for the user.

WHAT IS IN YOUR KIT

1. MEGA-RTD add-on card for Raspberry Pi
2. Mounting hardware
    a. Four M2.5x18mm male-female nylon standoffs
    b. Four M2.5x5mm nylon screws
    c. Four M2.5 nylon nuts
3. Two jumpers. You do not need the jumpers when using only one MEGA-RTD card. See STACK LEVEL JUMPERS section if you plan to use multiple MEGA-RTD cards.
4. Eight 3-pin female mating connectors.

QUICK START-UP GUIDE

1. Plug your MEGA-RTD card on top of your Raspberry Pi and power up the system.
2. Enable I2C communication on Raspberry Pi using raspi-config.
3. Install the MEGA-RTD software from github.com:
    a. ~$ git clone https://github.com/SequentMicrosystems/megartd-rpi.git
    b. ~$ cd /home/pi/megartd-rpi
    c. ~/megartd-rpi$ sudo make install
4. ~/megartd-rpi$ megartd

    The program will respond with a list of available commands.

BOARD LAYOUT
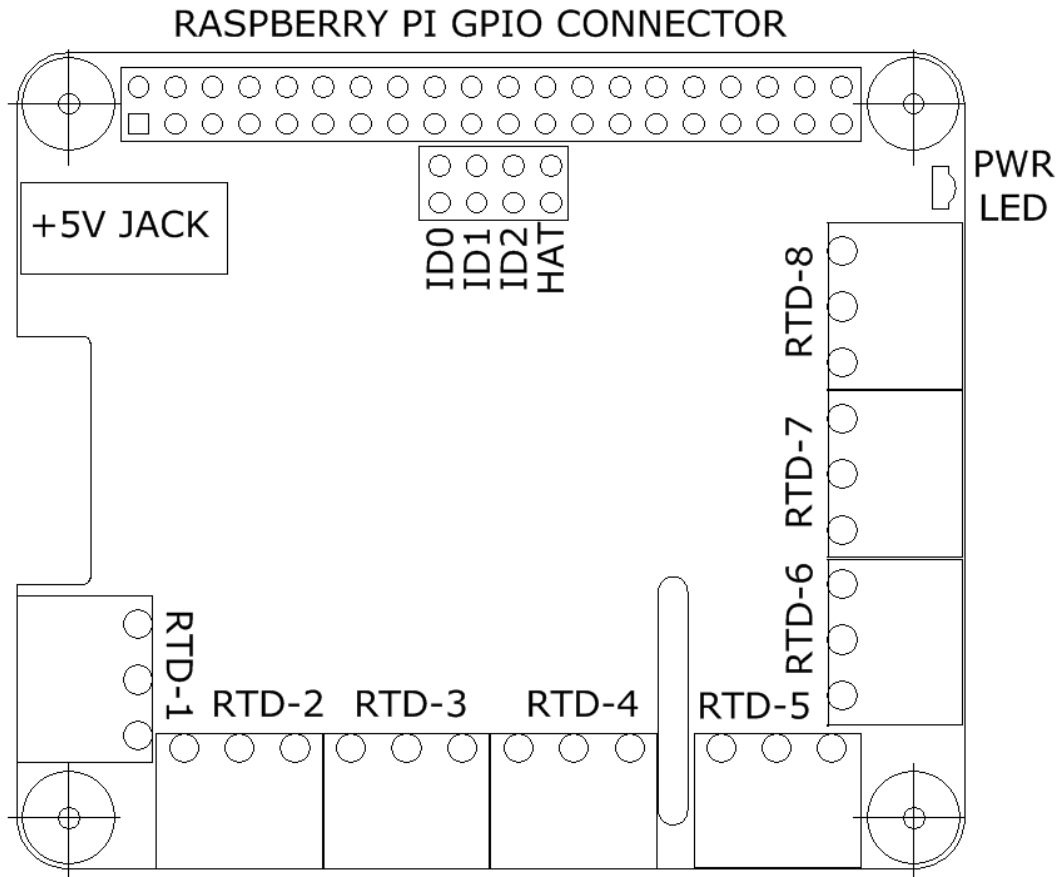
Your MEGA-RTD comes with appropriate mounting hardware. Up to eight MEGA-RTD cards can be stacked on top of one Raspberry Pi.

The 3-wire connection to the RTD-100 sensors is clearly indicated on the board's silkscreen. The board can be powered either from Raspberry Pi or from its own +5V, 2.1mm power jack. Only one 5V power supply is required for a system. The power supply must have the tip connected to the positive side.

The HAT jumper had to be ON for the board to be recognized as a HAT. At this time we do not have any software support for the HAT function.

STACK LEVEL JUMPERS

Up to eight MEGA-RTD cards may be stacked on your Raspberry Pi module. Each card is identified by jumpers you install to indicate the level in the stack. Cards can be installed on Raspberry Pi in any order. The three positions jumper is selecting the stack level of the card, as follows:

ID JUMPER

STACK LEVEL   0   1   2   3   4   5   6   7

POWER REQUIREMENTS

The MEGA-RTD card requires +5V power, supplied either from the Raspberry Pi expansion bus, or from its own 2.1mm power jack. A local 3.3V regulator powers the rest of the circuits (See Schematic 9).

<div style="border:1px solid black; padding:1em; text-align:center; color:red; font-weight:bold;">
We recommend using only one +5V source to power
both the Raspberry Pi and the MEGA-RTD card.
</div>

Raspberry Pi 3 current consumption: 250 mA @ +5V (could be as high as 2A)

 MEGA-RTD current consumption: 50 mA @ +5V

The jack which powers the MEGA-RTD card can handle up to 3A and is protected by a 3A resettable fuse We recommend using this jack with a 5V regulated power supply rated at 3A or higher. The tip is +5V and the ring is ground. (see Schematic 1).

The MEGA-RTD card can be stacked up to eight levels. A multi-stack configuration can be powered from any of the cards.

MECHANICAL SPECIFICATIONS

The MEGA-RTD card has the mechanical specifications of the Raspberry Pi HAT. It has the on-board EEPROM required, but at this time no software support is available.
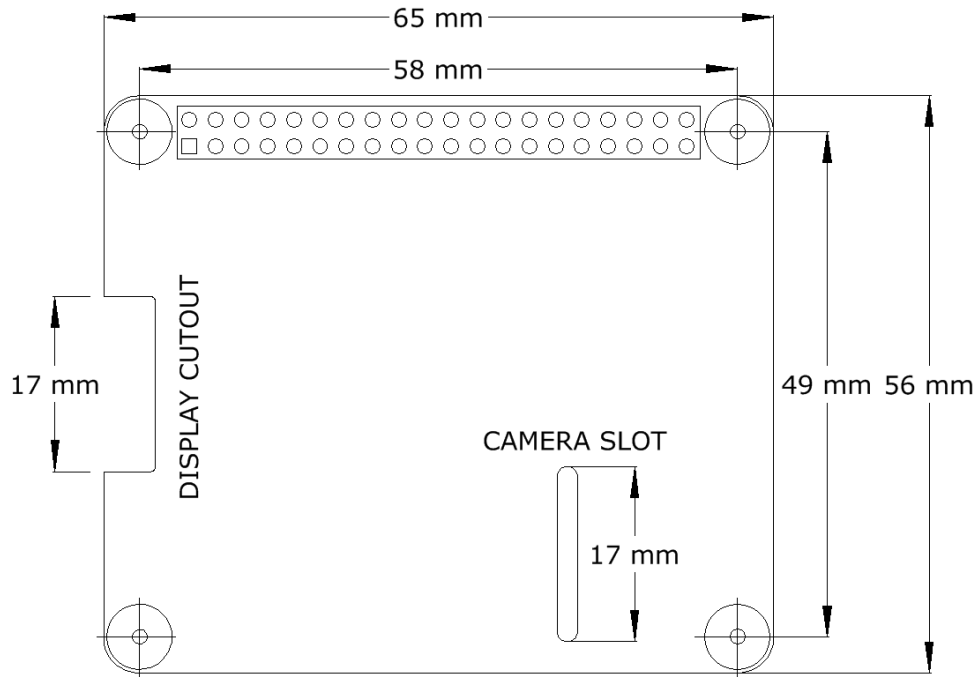
 MEGA-RTD is compatible with any card manufactured by Sequent Microsystems and can be mounted in any order. You may also intermix cards from other vendors, assuming they do not use the same I2C address (see STACK LEVEL JUMPERS section on page 6). It is recommended that you power the Raspberry Pi and the MEGA-RTD cards from the same supply, and that the MEGA-RTD card being powered is the card nearest the Raspberry Pi.

See the following document for the latest map of I2C addresses used by Sequent Microsystems

https://sequentmicrosystems.com/Sequent-I2C-Address-Map.pdf

HARDWARE WATCHDOG

The MEGA-RTD card contains a built-in hardware watchdog which will guarantee that your mission-critical project will recover and continue running even if Raspberry Pi software hangs up. After power up the watchdog is disabled, and becomes active after it receives the first reset.

The default timeout is 120 seconds. Once activated, if it does not receive a subsequent reset from Raspberry Pi within 2 minutes, the watchdog cuts the power and restores it after 10 seconds.

Raspberry Pi needs to issue a reset command on the I2C port before the timer on the watchdog expires. The timer period after power up and the active timer period can be set from the command line. The number of resets is stored in flash and can be accessed or cleared from the command line. All the watchdog commands are described by the online help function.

SOFTWARE SETUP

1. Have your Raspberry Pi ready with the latest OS.

2. Enable I2C communication:

~$ sudo raspi-config

1. Change User Password	Change password for default user
2. Network Options	Configure network settings
3. Boot Options	Configure options for start-up
4. Localisation Options	Set up language and regional settings to match..
5. Interfacing Options	Configure connections to peripherals
6. Overclock	Configure overclocking for your Pi
7. Advanced Options	Configure advanced settings
8. Update	Update this tool to the latest version
9. About raspi-config	Information about this configuration

P1	Camera	Enable/Disable connection to the Raspberry Pi Camera
P2	SSH	Enable/Disable remote command line access to your Pi
P3	VNC	Enable/Disable graphical remote access to your Pi using...
P4	SPI	Enable/Disable automatic loading of SPI kernel module
P5	I2C	Enable/Disable automatic loading of I2C kernel module
P6	Serial	Enable/Disable shell and kernel messages to the serial port
P7	1-Wire	Enable/Disable one-wire interface
P8	Remote GPIO	Enable/Disable remote access to GPIO pins

4. Install the megartd software from github.com:

~$ git clone https://github.com/SequentMicrosystems/megartd.git

5. ~$ cd /home/pi/megartd

6. ~/megartd-rpi$ sudo make install

7. ~/megartd-rpi$ megartd

The program will respond with a list of available commands.

Type "megartd -h" for online help.

After installing the software, you can update it to the latest version with the commands:

1. ~$ cd /home/pi/megartd-rpi

2. ~/megartd-rpi$ git pull

3. ~/megartd-rpi$ sudo make install

CALIBRATION

The A/D converter measures the temperature by sending a 1mA current through the RTD-100 sensors and measuring the voltage. The current generator is using a 820 Ohms, 0.1% resistor. Thus, the accuracy of an un-calibrated device is limited to 0.1%.

The user can further calibrate the board using the command line and a precision, 100 Ohms resistor. First, short the input to be calibrated and issue the command:

megartd <id> c[alibrate] <channel> 0

Next, connect to the input to be calibrated a precision 0.01% 100 ohms resistor and issue the command:

megartd <id> c[alibrate] <channel> 100

Any resistor between 0 and 100 ohms can be used, but to achieve best results we recommend using a value as close as possible to the 100 ohms end of scale.

To reset the calibration to the factory value, issue the command

megarts <id> rc[alibrate]