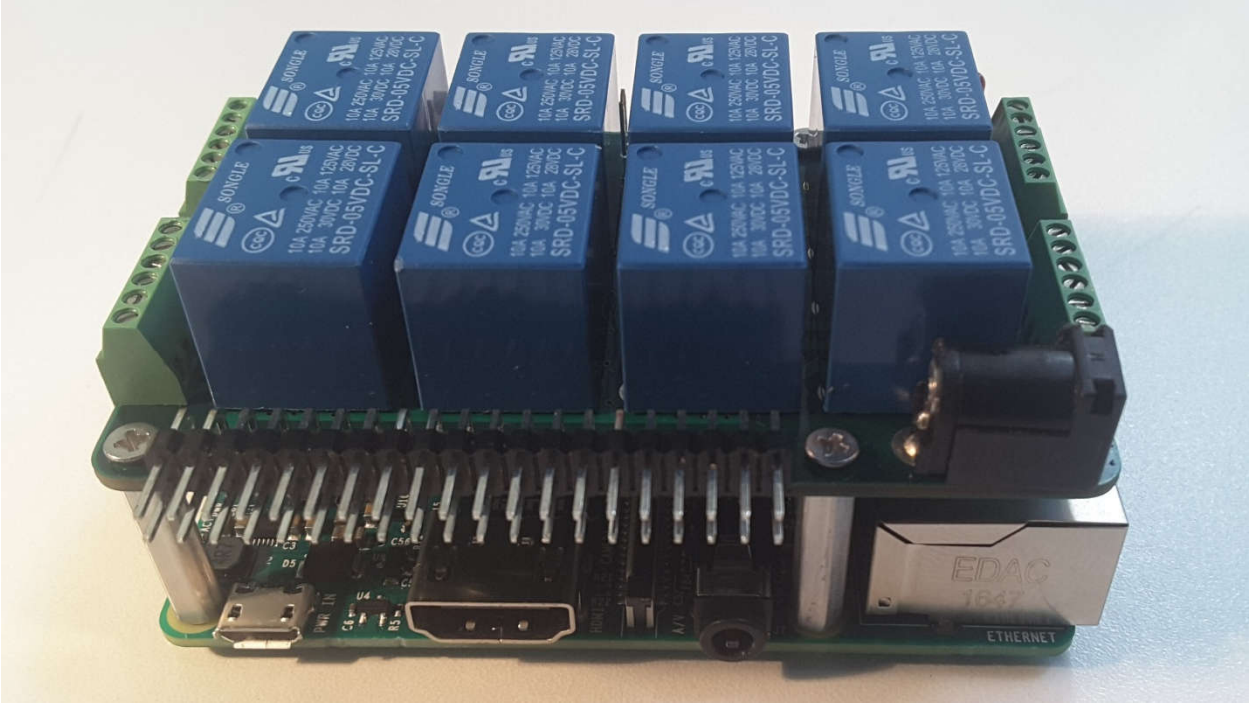
MegaIO-HOME IO CARD for Raspberry Pi

www.sequentmicrosystems.com

USER'S GUIDE VERSION 3.0

GENERAL DESCRIPTION



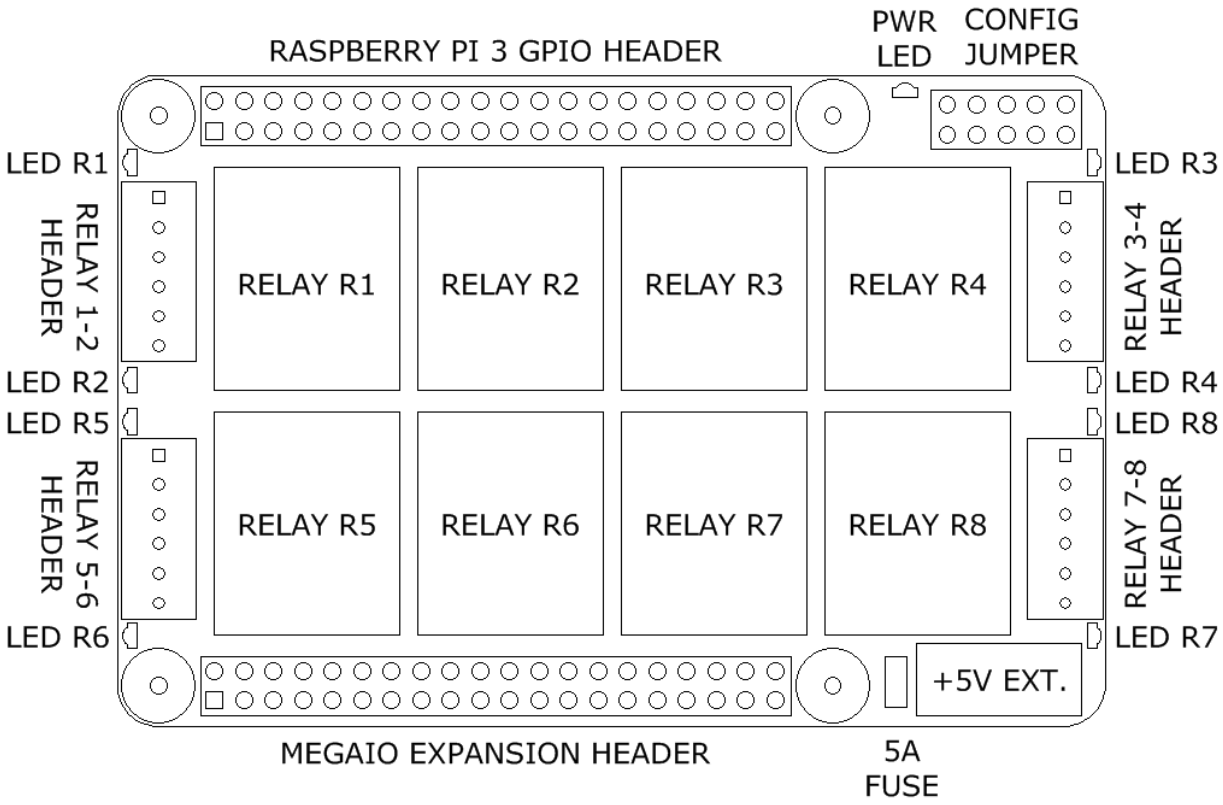
The MEGA-IO is a stackable expansion card for Raspberry Pi B+, 2, 3 and Zero. Two of the Raspberry Pi's GPIO pins (pin 3 and pin 5) are used for I2C communication. Pins 8 and 10 are used for firmware programming, but are available to the user as GPIO. Pin 7 is allocated for the interrupt handler, leaving 23 GPIO pins available for the user. MEGA-IO adds the following I/O functions:

- Eight on-board relays
- Eight 12 bit A/D inputs
- Eight optically isolated inputs
- One 12 bit DAC Output
- Four open collector outputs
- Six GPIO's

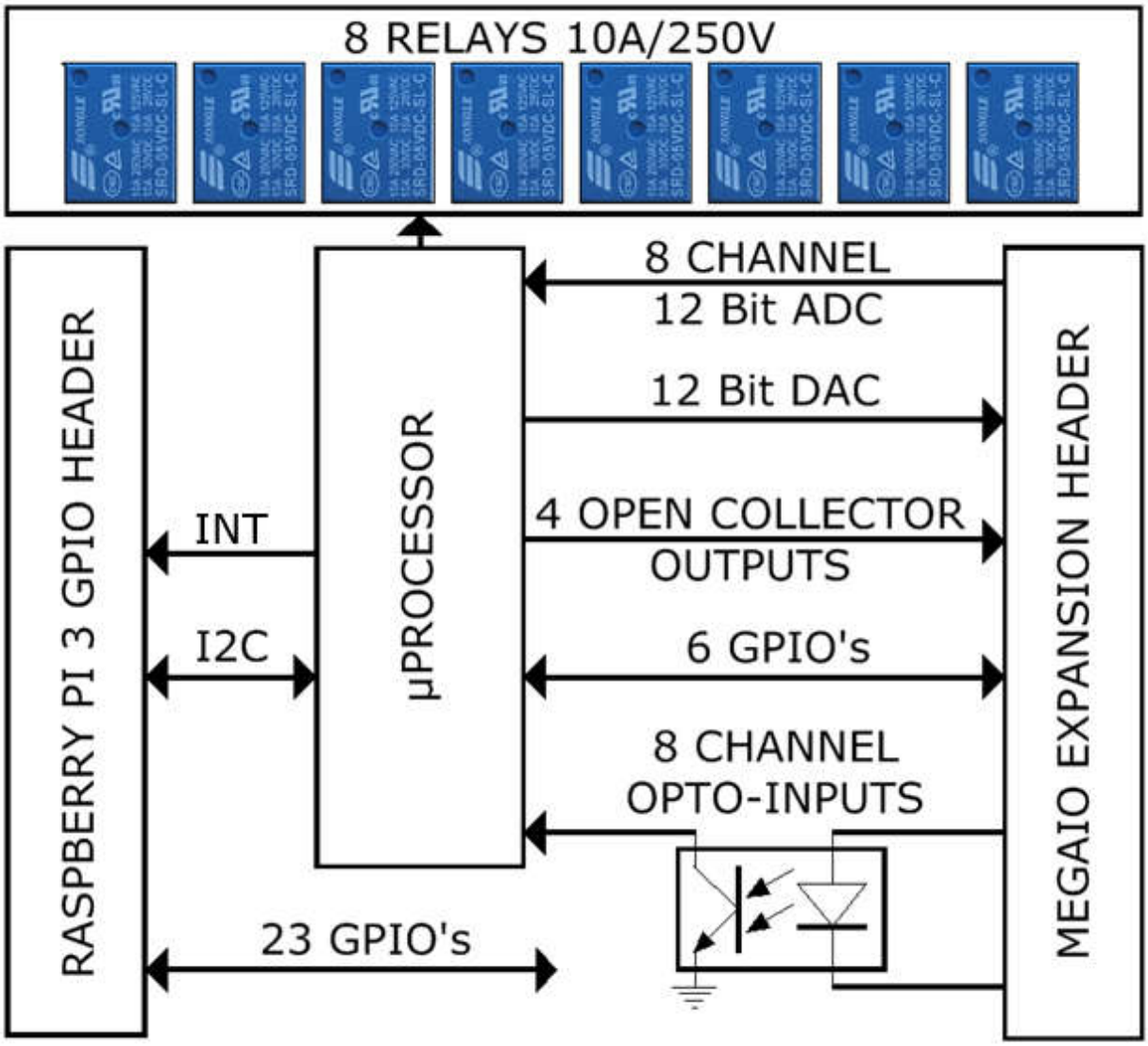
Up to four MEGA-IO cards can be stacked on top of a Raspberry Pi.

Any of the inputs of the MEGA-IO can be configured as interrupt inputs.

BOARD LAYOUT

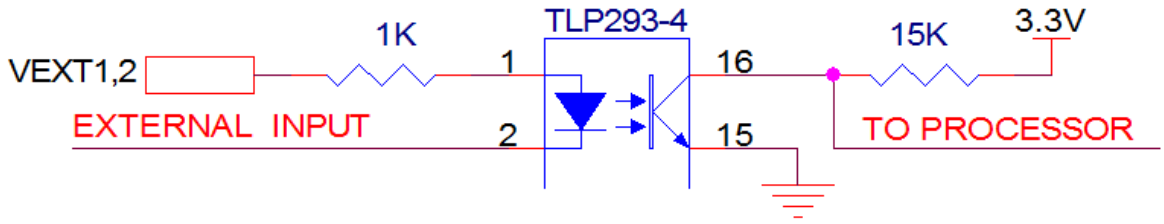


BLOCK DIAGRAM



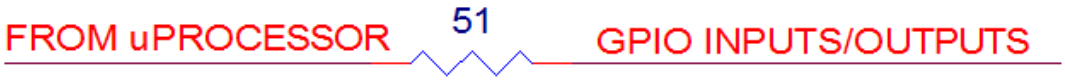
SCHEMATICS

OPTO-ISOLATED INPUTS, 1 of 8

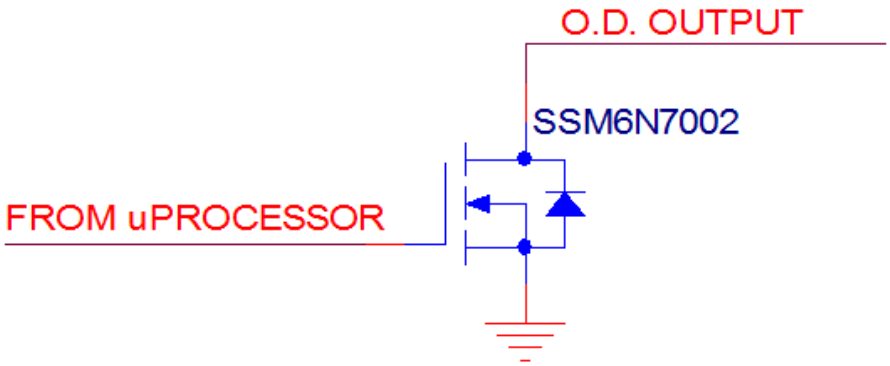


Inputs 0-3 are powered by VEXT1, inputs 4-7 by VEXT2. You must supply 5V - 24V on the VEXT pins.

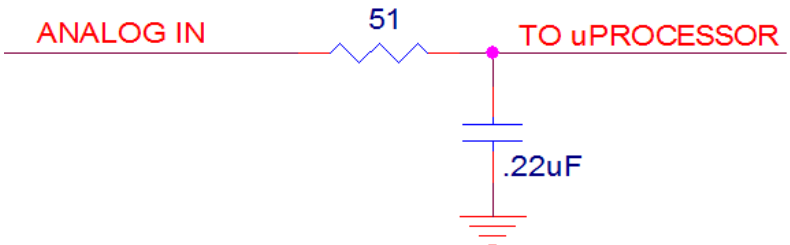
GPIO INPUTS/OUTPUTS, 1 of 6



OPEN-DRAIN OUTPUTS, 1 of 4

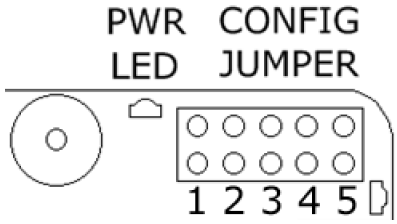


ANALOG INPUTS, 1 of 8



STACK LEVEL JUMPERS

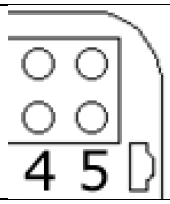
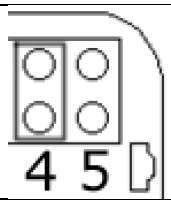
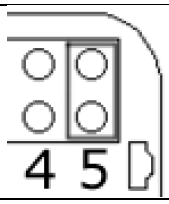
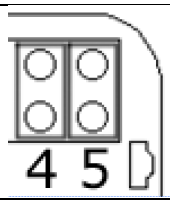
The 2x5 pin jumper installed in the upper right corner of the MEGA-IO card has the following functions:



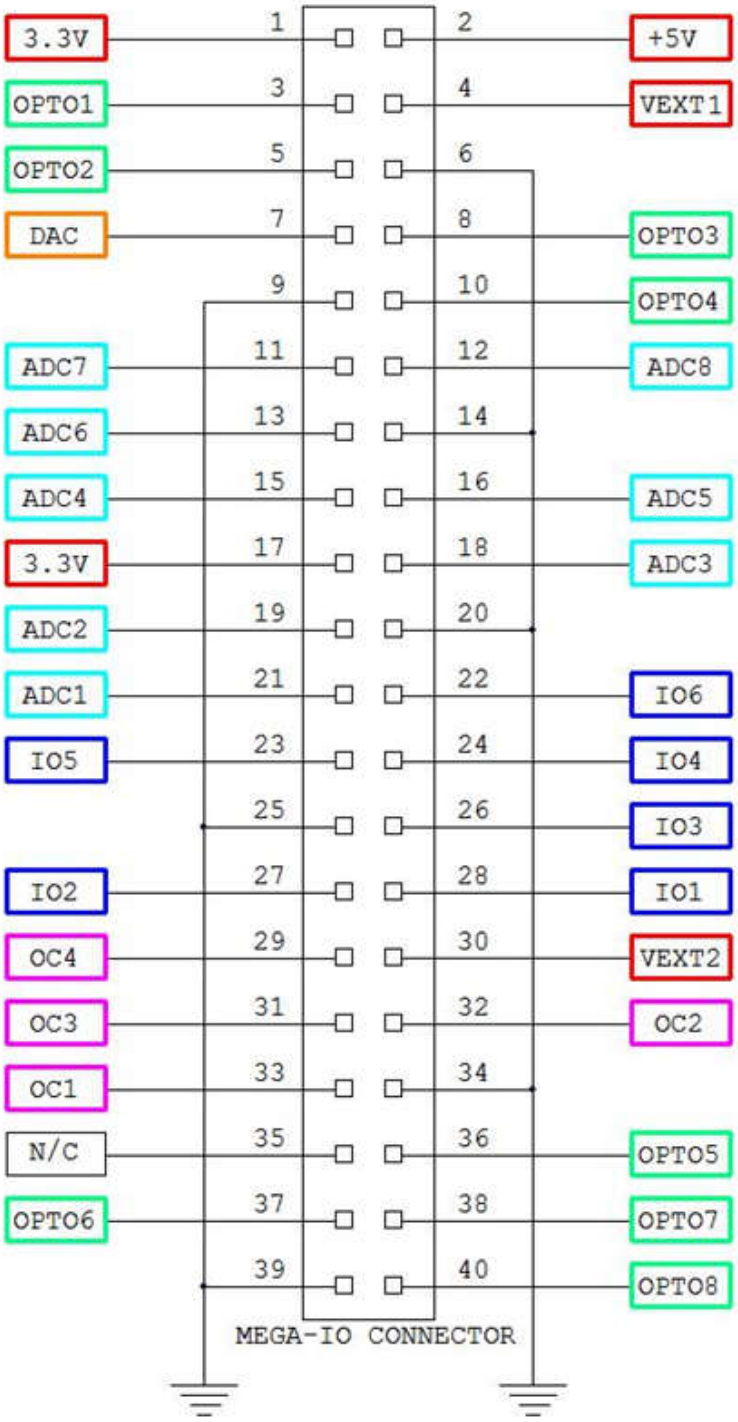
Position 1-2: Factory use only.

Position 3: Processor reset.

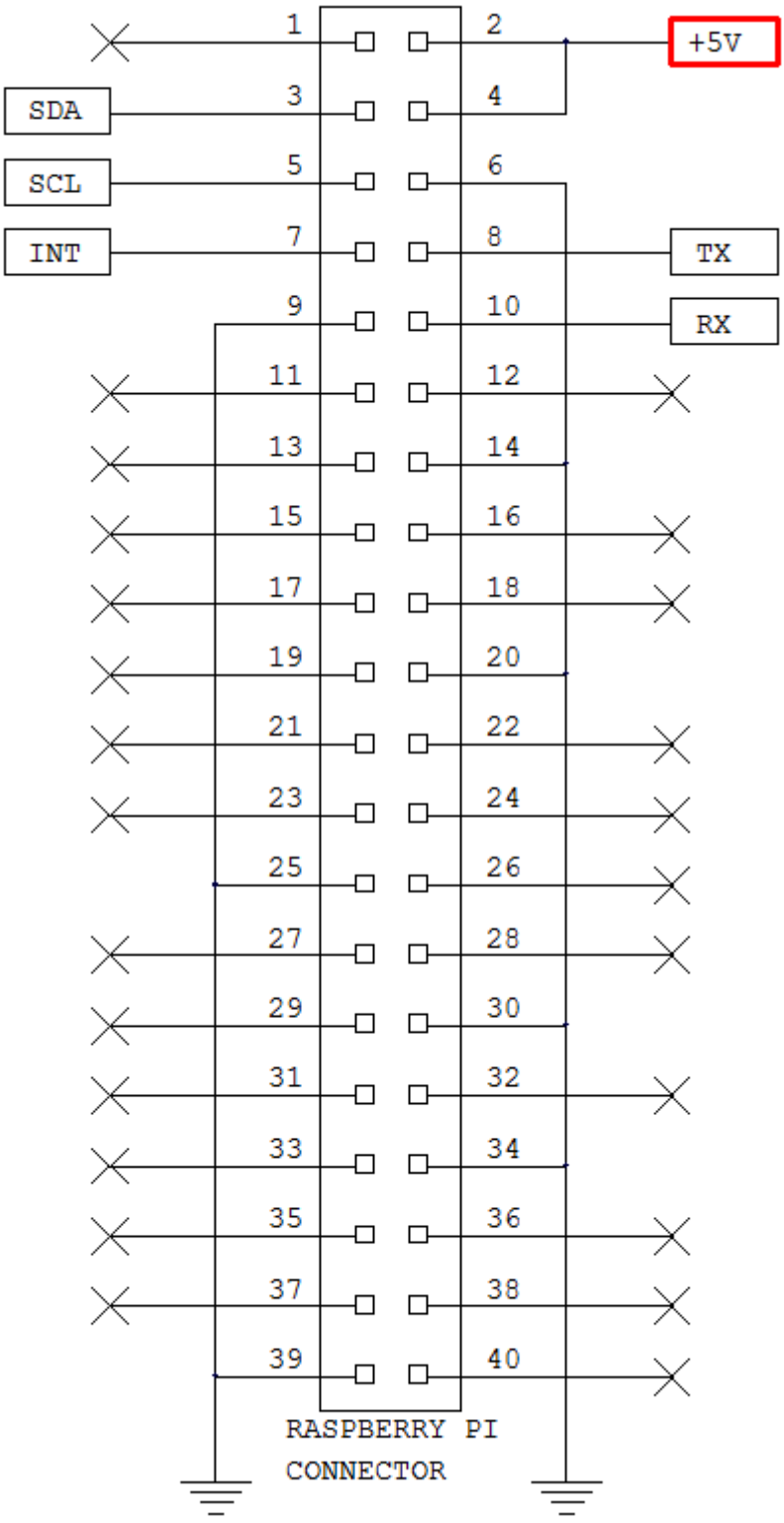
Position 4-5: Stack Level. These two jumpers permit addressing multiple MEGA-IO cards on the I2C bus. No jumpers need to be installed if only one card is present. If two or more cards are stacked up, the card I2C address 0 - 3 is as follows:

Jumpers 4-5				
Stack level	1	2	3	4
I2C Address	0x31	0x32	0x33	0x34

MEGA-IO HEADER



RASPBERRY PI HEADER



RELAY HEADERS

RELAYS 1-2 HEADER

Pin#		
1	R1-COM	□
2	R2-COM	○
3	R2-NC	○
4	R2-NO	○
5	R1-NC	○
6	R1-NO	○

RELAYS 3-4 HEADER

Pin#		
1	R4-COM	□
2	R3-COM	○
3	R3-NO	○
4	R3-NC	○
5	R4-NO	○
6	R4-NC	○

RELAYS 5-6 HEADER

Pin#		
1	R5-COM	□
2	R6-COM	○
3	R6-NC	○
4	R6-NO	○
5	R5-NO	○
6	R5-NC	○

RELAYS 7-8 HEADER

Pin#		
1	R8-COM	□
2	R7-COM	○
3	R7-NO	○
4	R7-NC	○
5	R8-NO	○
6	R8-NC	○

POWER REQUIREMENTS

The Mega-IO card requires +5V power, supplied either from the Raspberry Pi expansion bus, or from its own 2.1mm power jack. The on-board relays are connected to the +5V. A local 3.3V regulator powers the rest of the circuits.

We recommend using only one +5V source to power both the Raspberry Pi and the Mega-IO card.

Raspberry Pi 3 current consumption:	250 mA @ +5V
Mega-IO current consumption:	60 mA @ +5V (all relays OFF)
	800 mA @ +5V (all relays ON)

The USB connector which powers the Raspberry Pi can supply maximum 1.5A.

The jack which powers the Mega-IO card can supply 3A. We recommend using this jack and a 5V regulated power supply rated at 2A or higher.

The Mega-IO card can be stacked up to four levels. A multi-stack configuration can be powered from any of the cards. A four stack needs 500 mA for electronic circuits, leaving 2.5A for relays. With some margin of error, not more than 24 relays can be ON at the same time.

In the rare event that your application uses four Mega-IO cards and requires that all relays be ON at the same time, you need a power source that can supply minimum 4A. You also need to split the power cable and feed the +5V through two Mega-IO cards.

HARDWARE SPECIFICATIONS

MICROCONTROLLER: STM8L151C3T6

SIX GPIO pins:

- Operating voltage: 3.3V
- CPU frequency: 16 MHz
- Touch sensing capability: Yes
- Maximum input voltage: 4V
- Series protection resistor: 51 Ohms
- Output Low Level: Maximum 0.45V
- Output High Level: Minimum 2.6V

FOUR OPEN COLLECTOR OUTPUTS:

- Driver: ULN2003F12FN-7
- Output Low Voltage: 0.6V
- Max Pull Up Voltage: 20V
- Maximum sink per channel: 100mA @ 3.3V Logic Input, 140mA @ 5.0V Logic Input
- ESD: 4kV HBM, 1kV CDM

EIGHT 12 bit ADC:

- Sample rate: Up to 1 Msps
- Input low pass filter: 0.22µF/51 Ω

ONE 12 bit DAC:

- Resistive load: Minimum 5 KΩ
- Output impedance: Maximum 10 KΩ
- Capacitive load: Maximum 50 pF
- Settling time: Maximum 12 µs
- Update rate: Maximum 1 Msps

OPTOISOLATORS:

- Transceiver: TLP293-4
- LED current limit resistor: 1 KΩ
- Input Forward Current: Typical 5 mA, maximum 50 mA
- Input Reverse Voltage: 5V
- Input Forward Voltage: 1.25V @ 10 mA
- Isolation Resistance: Minimum 10^{12} Ω
- Isolation Voltage: Typical 10,000 V

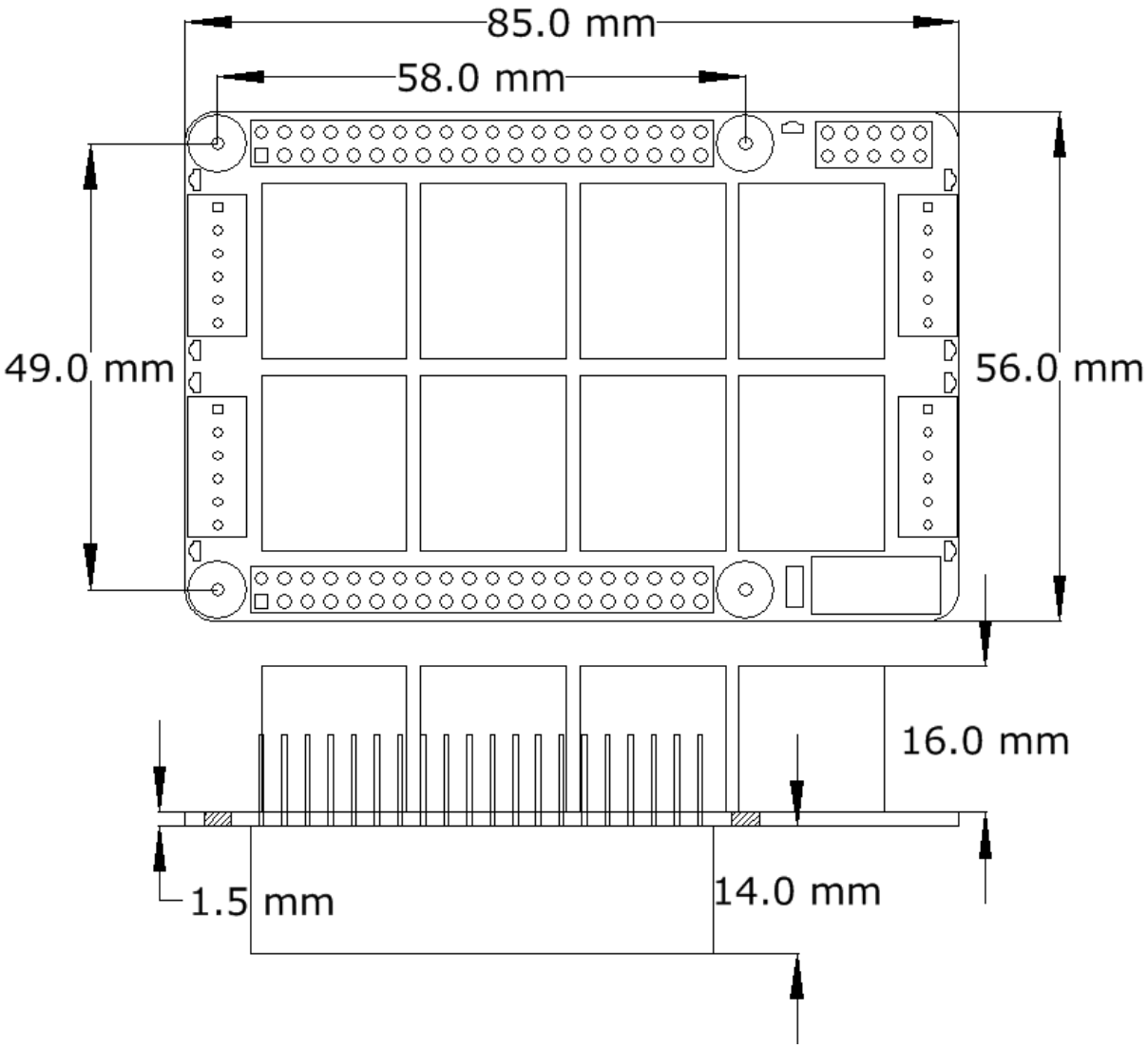
RELAYS: SRD-05VDC-SL-C

- Relay maximum current/voltage: 10A/250V
- PCB maximum current/voltage: 5A/48V

POWER CONSUMPTION:

- 60 mA @ +5V (all relays OFF)
- 800 mA @ +5V (all relays ON)

MECHANICAL SPECIFICATIONS



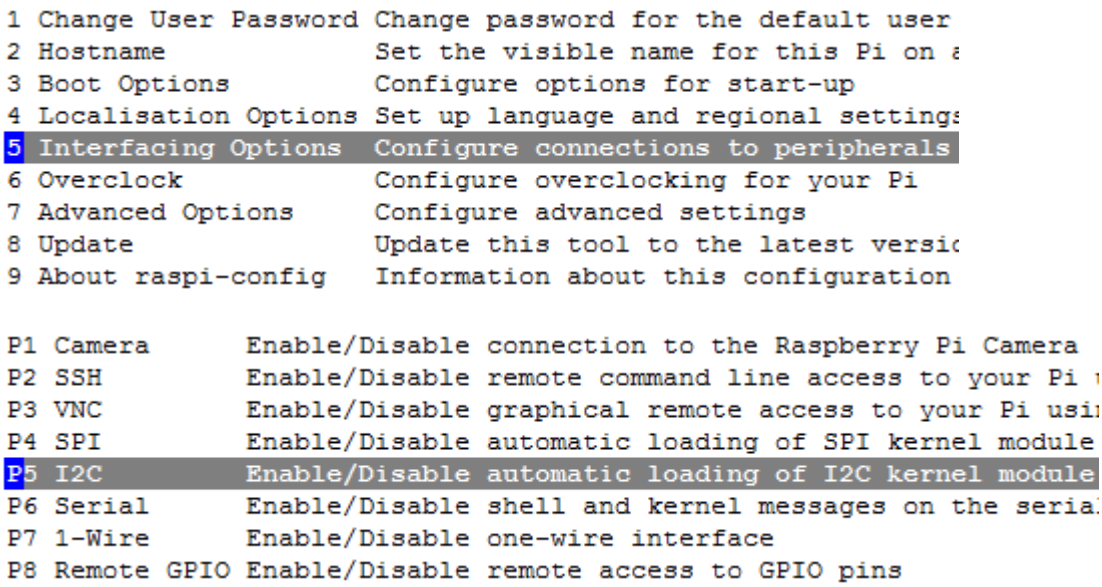
SOFTWARE SETUP

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

2. Install the Wiring Pi library (many thanks to Gordon Henderson)

3. Enable I2C communication:

~$ sudo raspi-config



4. Install the megaio software from github.com:

~$ git clone https://github.com/SequentMicrosystems/megaio-rpi.git

5. ~$ cd /home/pi/megaio-rpi

6. ~/megaio-rpi$ sudo make install

7. ~/megaio-rpi$ megaio

The program will respond with a list of available commands.

Type "megaio -h" for online help.

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

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

2. ~/megaio-rpi$ git pull

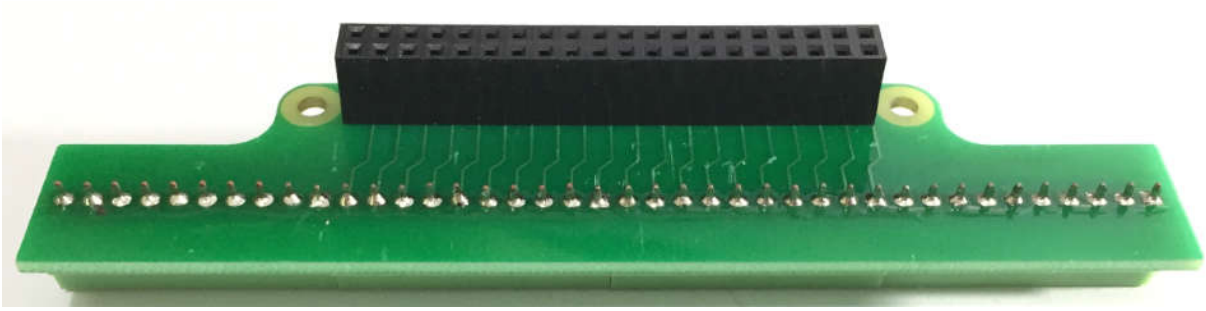
3. ~/megaio-rpi$ sudo make install

ADD-ON CARDS

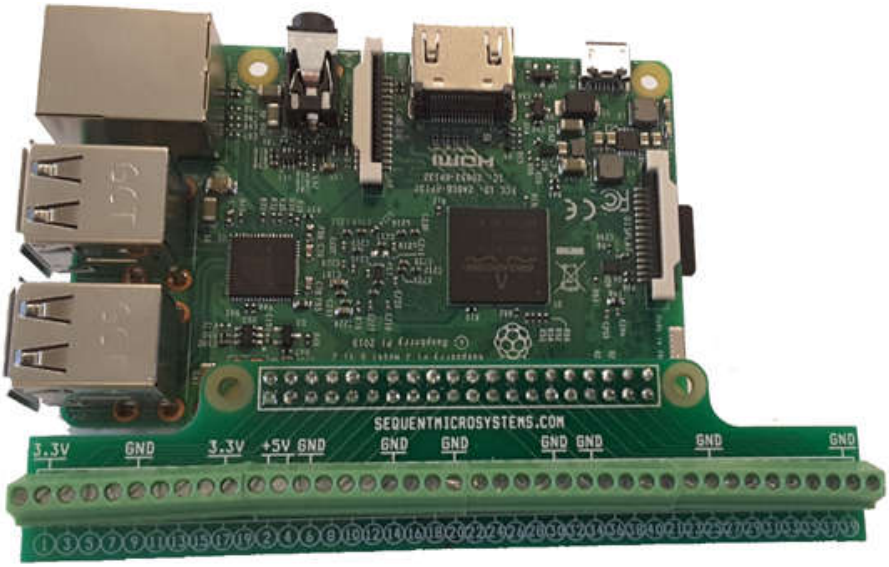
MEGA-IO BREAK-OUT CARD

The Break-out card plugs into the MEGA-IO expansion connector and brings all the IO pins to screw-type terminal blocks. It can be used also as a break-out card for the Raspberry Pi GPIO connector.

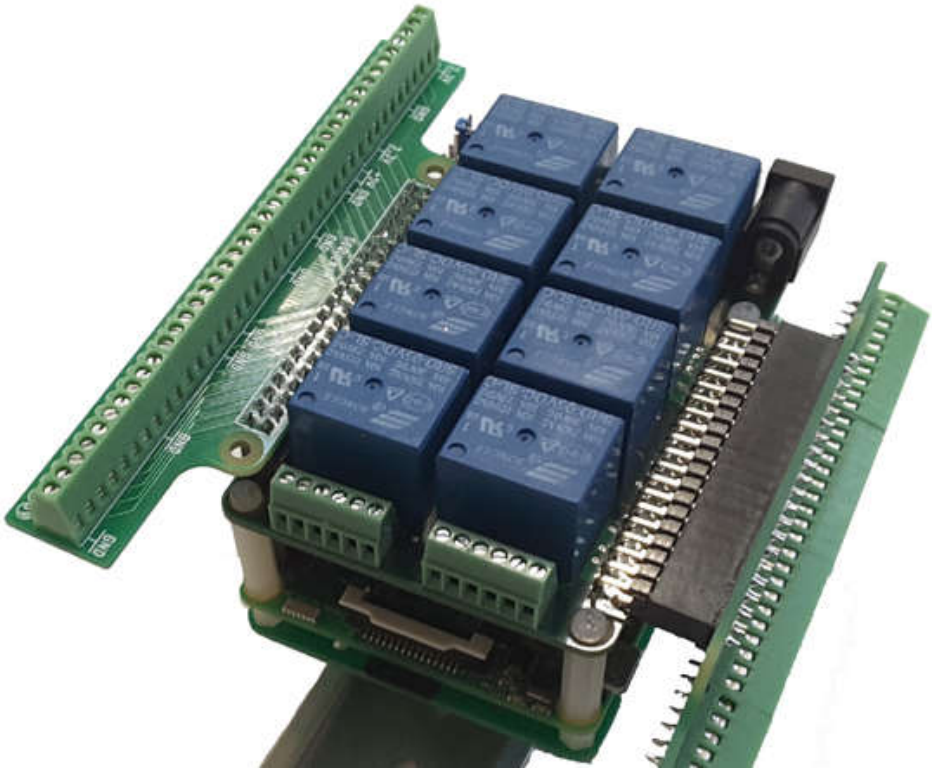
Break-out card top view



Break-out card back view



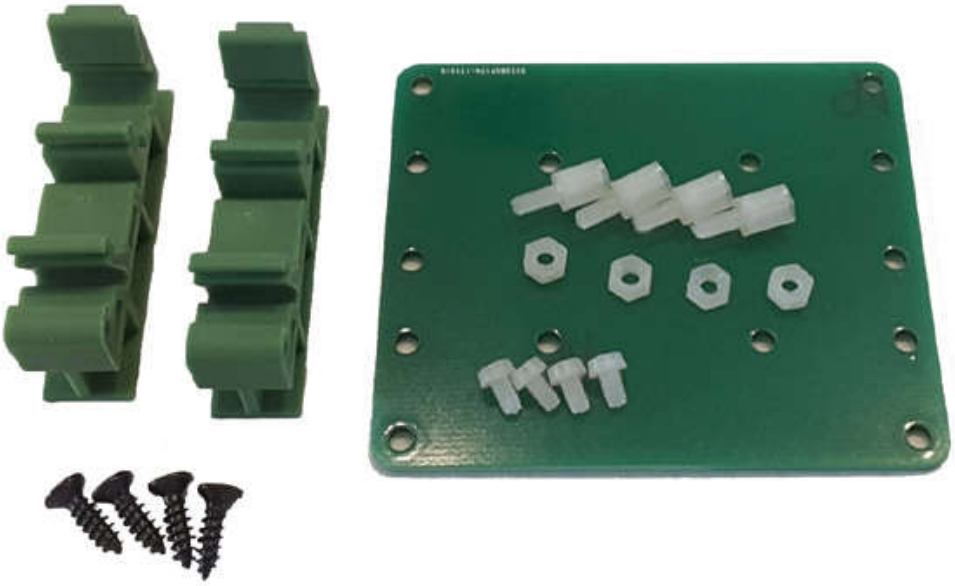
Raspberry Pi with Break-out card



Break-out cards for MEGA-IO and Raspberry Pi

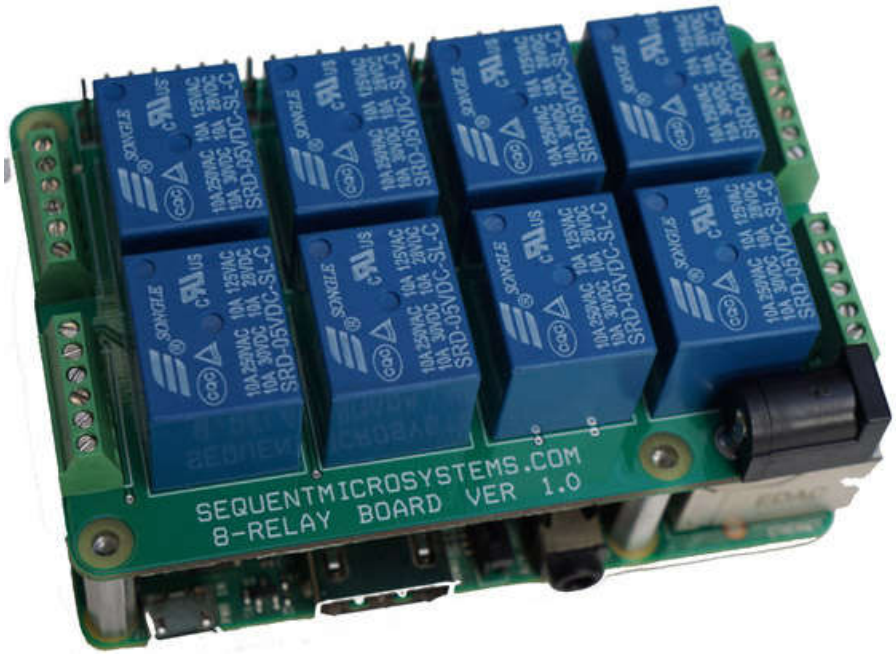
DIN-RAIL KIT for RASPBERRY PI

The DIN-Rail Kit permits mounting any Raspberry Pi on a DIN-Rail. It contains all the necessary screws and stand-offs.



8-RELAY CARD

The 8-RELAY card can be mixed with the MEGA-IO card when more relays are needed, without adding more IO functions. The board is similar with the MEGA-IO, but all the IO functions have been removed in order to save cost. Up to four MEGA-IO and 8-RELAY cards can be mixed in any configuration.



MEGA-IO SELF TESTING

The analog and digital I/O's of the MEGA-IO card can be self-tested by running a one wire jumper between one input and one output. The I/O's under test need to be disconnected from any external sources. The following commands are available for one wire self testing:

OPEN COLLECTOR OUTPUT TO OPTO-ISOLATED INPUT:

Command: megaio [0:3] test-opto-oc [1:8] [1:4]

Example: megaio 0 test-opto-oc 1 2

This command requires a jumper from +5V (pin 2) to VEXT1 (pin 4) to power the OPTO-INPUTS, and another jumper from OPTO1 (pin 3) to OC2 (pin 32). The software will set the output low and high and check the values on the input.

DIGITAL INPUT TO DIGITAL OUTPUT:

Command: megaio [0:3] test-io [1:6] [1:6]

Example: megaio 0 test-io 2 5

This command requires a jumper from IO2 (pin 27) to IO5 (pin 23).

ANALOG I/O self test command: megaio [0:3] test-dac-adc [1:8]

Example: megaio 0 test-dac-adc1

This command requires a jumper from DAC (pin 7) to ADC1 (pin 21). The software will set the DAC output to 0, 25%, 50% and 100% of the full scale, and measure the corresponding values on the ADC input.

The MEGA-IO card can also be tested using its own IO Commans. Here are examples for testing all IO functions:

1) IO Test

- Connect pin 27 to pin 28 (IO1 to IO2)

- Set IO1 as output : pi@raspberrypi:~$ megaio 0 iodwrite 1 0

- Read IO2 pin : pi@raspberrypi:~$ megaio 0 ioread 2 (Response should be 0)

- Write IO1 pin: pi@raspberrypi:~$ megaio 0 iowrite 1 1

- Read IO2 pin : pi@raspberrypi:~$ megaio 0 ioread 2 (Response should be 1)

2) DAC - ADC test

- Connect pin 7 to pin 11 (DAC to ADC channel 7)
- Write DAC value 0: pi@raspberrypi:~$ megaio 0 awrite 0 (0V)
- Read ADC channel 7: pi@raspberrypi:~$ megaio 0 aread 7 (Response should be less than 150)
- Write DAC value 2000: pi@raspberrypi:~$ megaio 0 awrite 2000 (1.6V)
- Read ADC channel 7: pi@raspberrypi:~$ megaio 0 aread 7 (Response should be 2000 +/-75)
- Write DAC value 4095: pi@raspberrypi:~$ megaio 0 awrite 4095 (3.3V)
- Read ADC channel 7: pi@raspberrypi:~$ megaio 0 aread 7 (Response should be more than 3950)

3) Open collector output - Opto-coupled input

- Connect pin 2 to pin 4 (5V to Opto 5V external)
- Connect pin 3 to pin 33 (Opto channel 1 to open collector channel 1)
- Set OFF OC channel 1 : pi@raspberrypi:~$ megaio 0 ocwrite 1 0
- Read opto channel 1: pi@raspberrypi:~$ megaio 0 optread 1 (Response should be 0)
- Set ON OC channel 1 : pi@raspberrypi:~$ megaio 0 ocwrite 1 1
- Read opto channel 1: pi@raspberrypi:~$ megaio 0 optread 1 (Response should be 1)