RASPBERRY PI LEARNING KIT

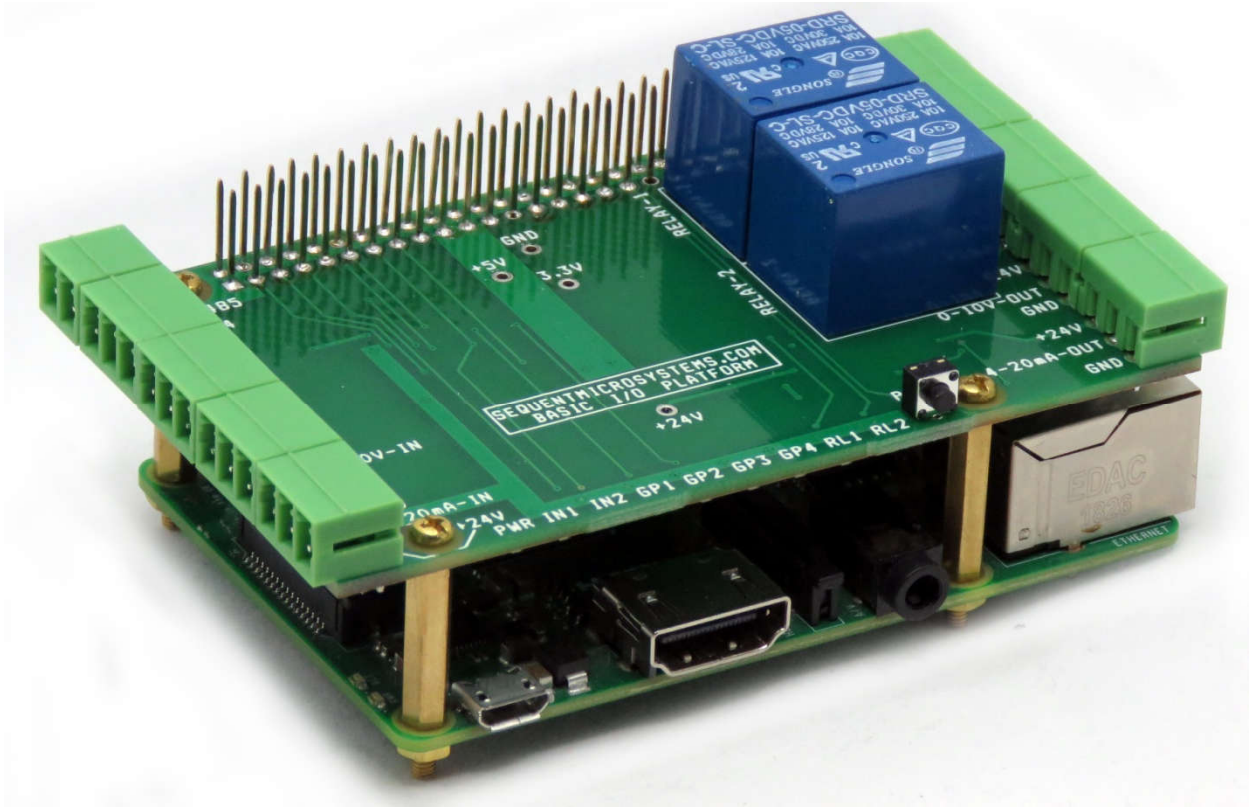
with a Complete

NODE-RED Tutorial

USER'S GUIDE VERSION 2.0

SequentMicrosystems.com

GENERAL DESCRIPTION



The Learning Kit brings to Raspberry Pi all the common interfaces needed to connect to the automation world. Digital inputs and relay outputs, 0-10V and 4-20mA analog inputs and outputs, one pushbutton and four programmable LEDs, and one proportionally controlled motor driver. It is compatible with all Raspberry Pi versions from Zero to 4.

Pluggable connectors make the card easy to use. Loads of up to 8A and 24V can be switched by all relays. Status LEDs show when relays are on or off and also when the inputs are activated.

A LED also shows when power is applied to the board. A pushbutton permits the user to issue any general command to Raspberry Pi or to shut it down.

The card has also an RS485 driver which can communicate with other industrial equipment using the MODBUS protocol.

Mechanically, the Learning Kit card adheres to the Sequent Microsystems Modular Industrial format. It can be installed in the free 3D printable stackable enclosure. All the cards in this format have the same mechanical specifications.

FEATURES

- One RS485 serial port
- One PWM output capable of driving a 5VDC/100mA motor
- Four optically isolated contact closure inputs
- Two relays capable of driving 8A and 24V loads with LED status
- One 0-10V input and output
- One 4-20mA input and output
- On-board 10V step-up power supply for the 0-10V inputs
- On-board 24V step-up power supply for 4-20mA current loops
- On-board push-button
- Four general purpose LEDs

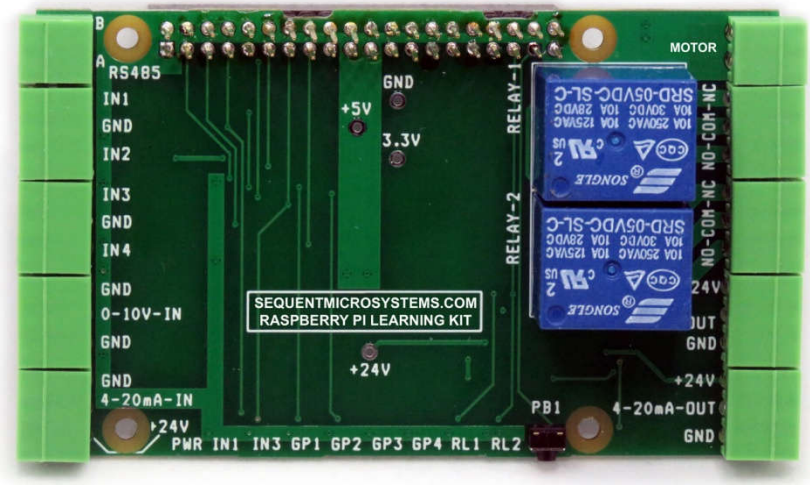
PROJECT REQUIREMENTS

In addition to the I/O Learning Kit, you will need the following:

1. Raspberry Pi. The Learning Kit will work with any Raspberry Pi version 3 or 4, but we recommend using the latest (4). Make sure you get a power supply and an SD Card. If you have never programmed the SD Card, you should get it pre-programmed for the Raspberry Pi of your choice.
2. USB keyboard and mouse.
3. Monitor or TV with an HDMI port.
4. DVM multimeter.
5. Optional IO Accessory Add-on.

WHAT IS IN YOUR KIT

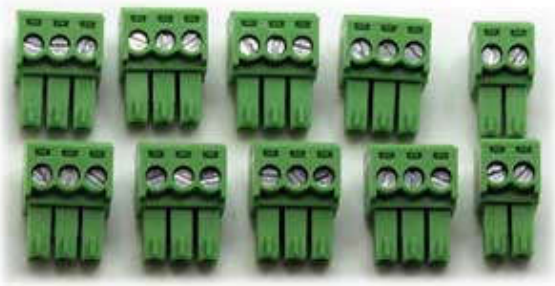
1. Learning Kit Card for Raspberry Pi



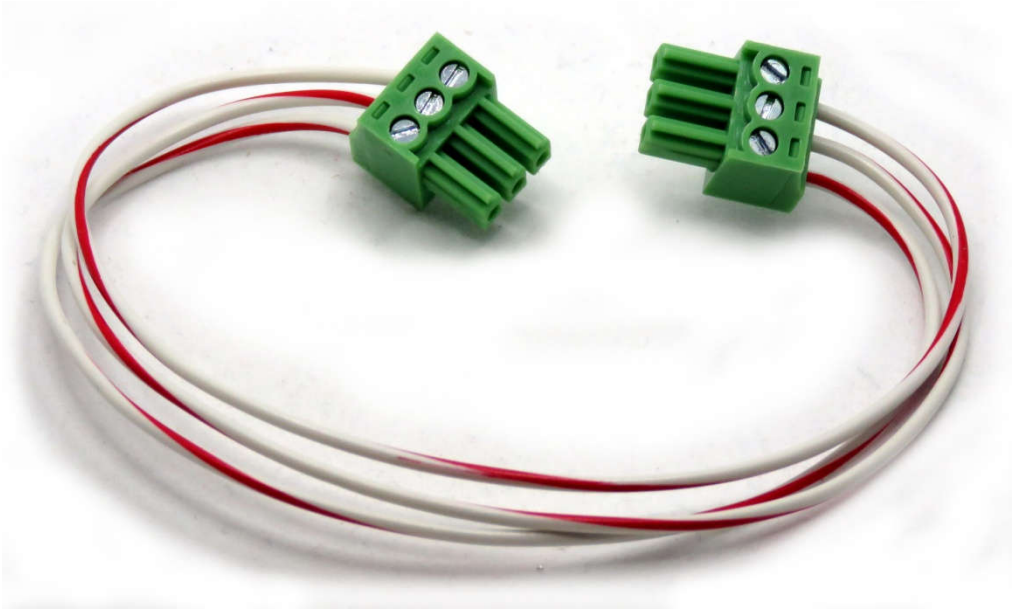
2. Mounting hardware

   a. Four M2.5x18mm male-female brass standoffs
   b. Four M2.5x5mm brass screws
   c. Four M2.5 brass nuts

3. All the required female mating connectors.



4. Self-test loopback cable

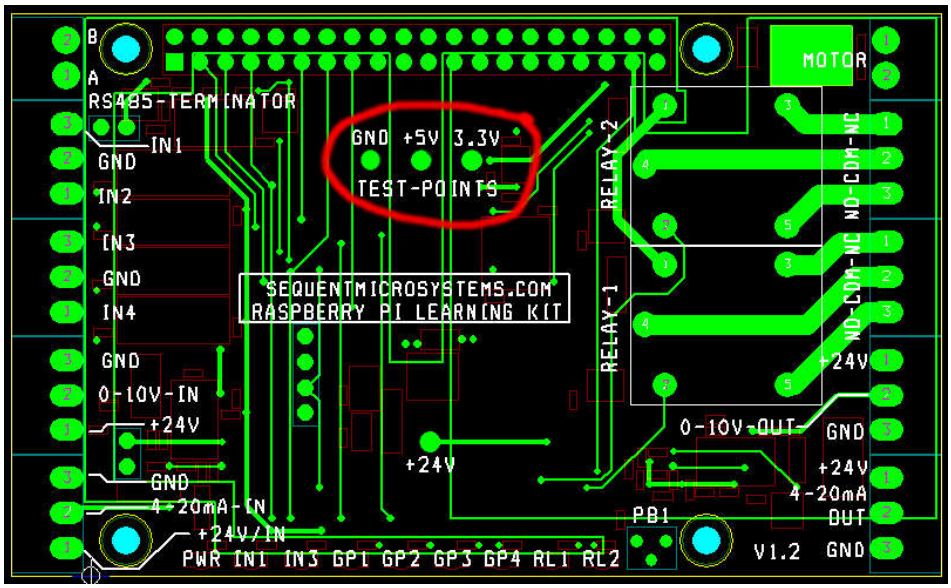


GETTING STARTED

Connect your Raspberry Pi to the HDMI monitor, keyboard, mouse and power supply and fire it up. It will greet you with the startup screen.

Good engineering practice is to check for shorts before plugging in new hardware. Set your multimeter on continuity check:

Place the two probes on the test points labeled GND/+5V and GND/3.3V. Make sure there is no short between the voltage points and ground.



INSTALL THE LEARNING KIT SOFTWARE

Commands you must type are shown in *italics*. Open a command line terminal and type the command:

~$ *sudo shutdown now*

Unplug the power supply and plug in the Learning Kit board. Power up the Raspberry Pi again, open the command line terminal and type the command:

~$ *sudo raspi-config*

Select 5. Interfacing Options, to enable I2C communication:

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

Back to the command prompt, install the command line functions for the I/O Learning Card:

~$ *sudo apt-get install git*

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

~$ *cd lkit-rpi/*

~/*lkit-rpi$ sudo make install*

~/*lkit-rpi$ lkit*

The program will respond with a list of available commands.

TESTING THE LEARNING KIT CARD

SELF TESTING THE RELAYS

Type the command:

~$ *lkit reltest*

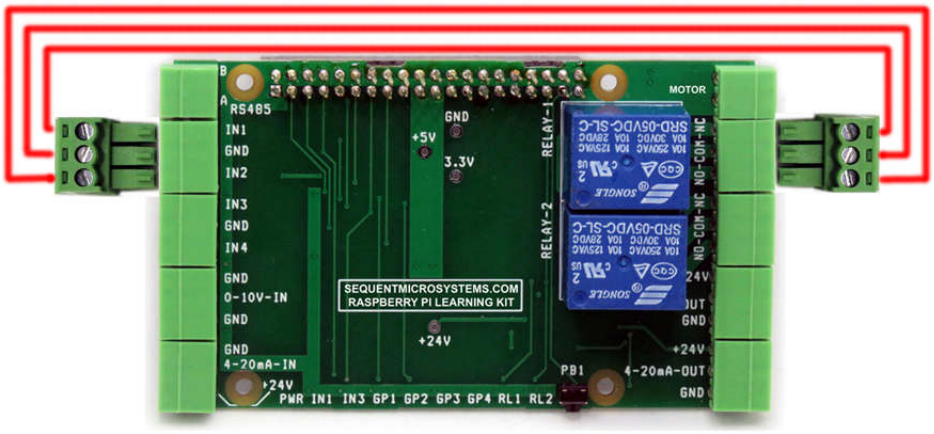
The card will turn all the relays on, in numerical order, at 150mS interval, and then will turn them off with the same frequency. The command runs until you stop it from the keyboard. You can hear the relays closures and can watch the corresponding LED's lighting.

All inputs, outputs and relay contacts can be tested using the loopback cable included with the kit.

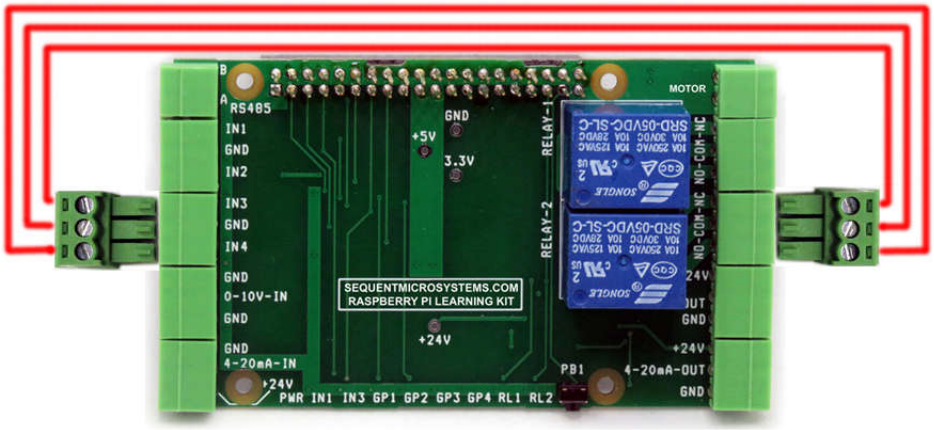
SELF TESTING THE INPUTS AND OUTPUTS

Use the self-test loopback cable to test corresponding pairs of inputs and outputs. Insert the cable as shown bellow and run the self-test command.

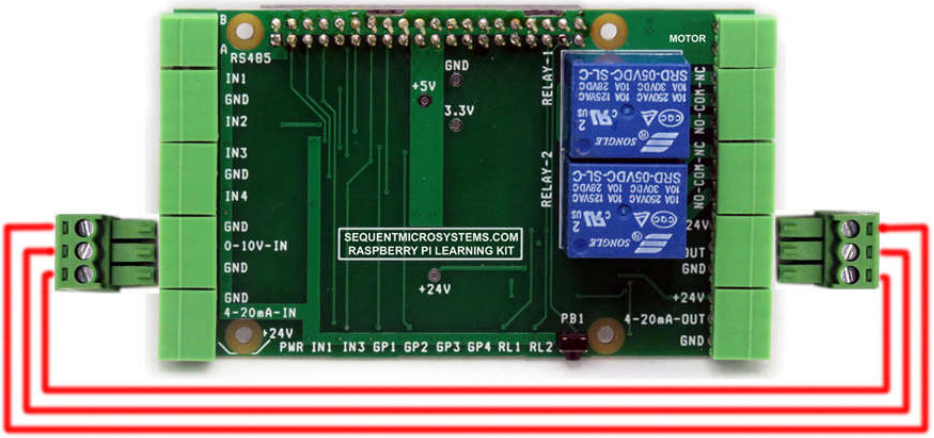
1. Test digital inputs IN1 and IN2 using RELAY-1.



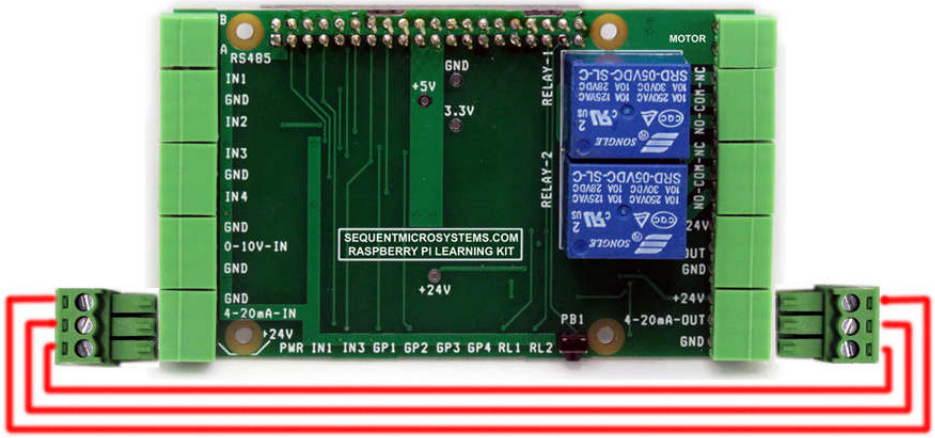
2. Test digital inputs iN2 and IN4 using RELAY-2



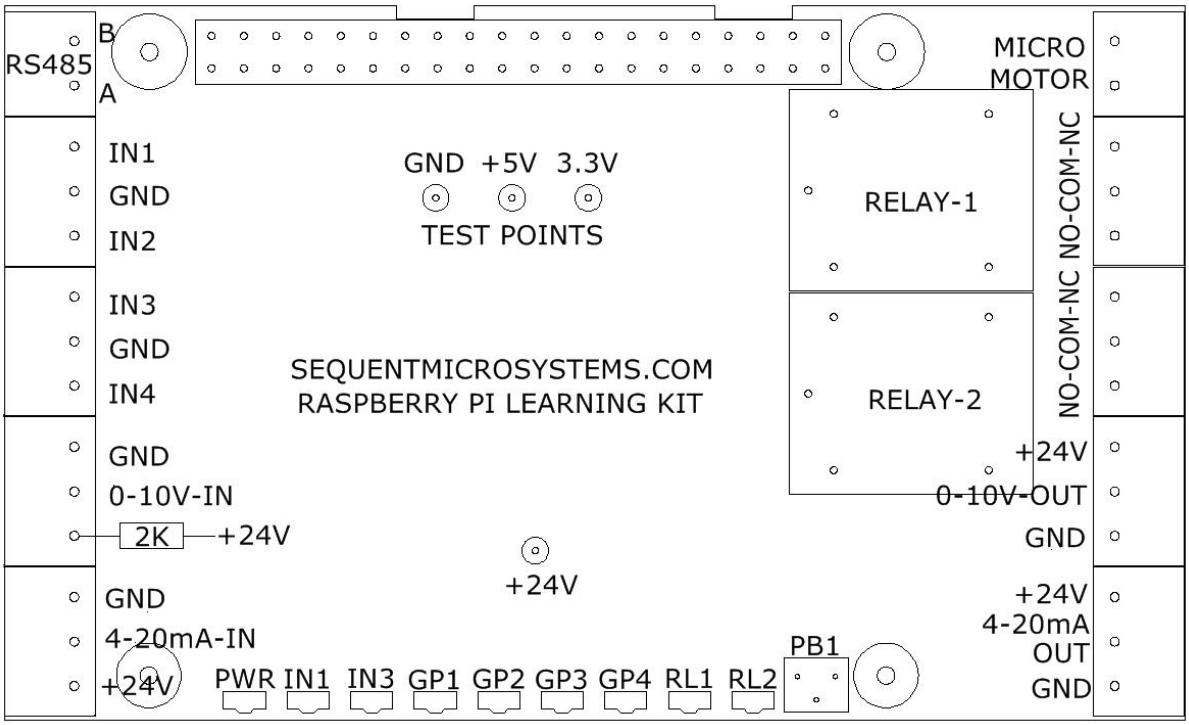
3. Test 0-10V-IN port using 0-10V-OUT



4. Test 4-20mA-IN port using 4-20mA-OUT



BOARD LAYOUT



The Learning Kit Card comes with all the appropriate mounting hardware.

Nine LEDs on the bottom edge of the board show you the status of the inputs and outputs. The leftmost LED shows when the power is connected to the board. The next two LEDs, labeled IN1 and IN3, show the status of the corresponding opto-isolated digital inputs.

The middle four LEDs are general purpose. They can be connected in software to show the status of any input or output. They can also be programmed to light at a certain input or output level. For example, you can learn how to turn on a LED when a temperature reaches a threshold. You can also blink a led slower when a temperature is relatively low, and faster as it approaches a preset limit.

The two rightmost LEDs are routed to the corresponding relays and show when the relay coil is activated. A LED is lit when the corresponding relay is energized. The General Purpose Pushbutton PB1 is connected to pin 37 of the Raspberry Pi GPIO connector (GPIO26).

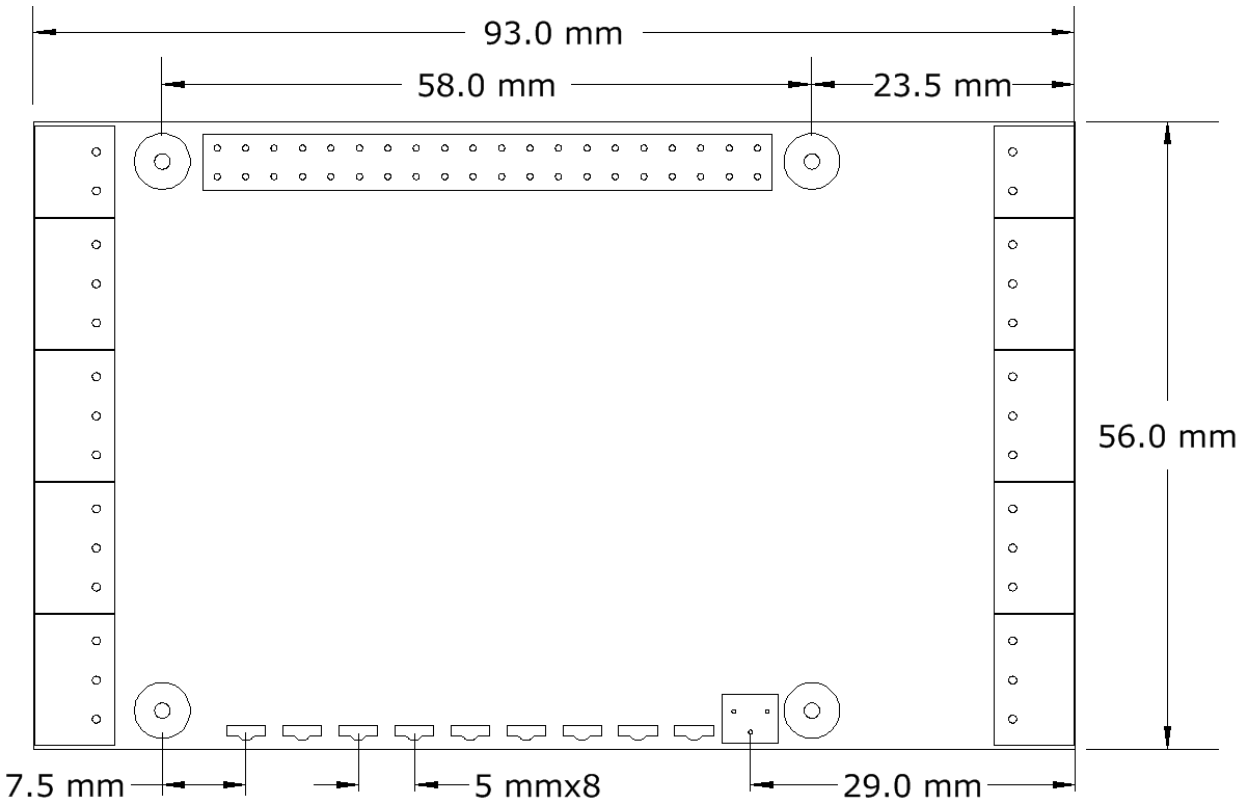
RS-485 COMMUNICATION

The Learning Kit Card contains a standard RS485 transceiver which can be accessed by the serial port of the Raspberry Pi.

POWER REQUIREMENTS

The board needs 5V/50mA to operate with the relays off, or 200mA with both relays on. It is powered from the Raspberry Pi through the GPIO connector. A Raspberry Pi power supply able to provide minimum 3A is recommended.

MECHANICAL SPECIFICATIONS



ANALOG INPUTS/OUTPUTS CALIBRATION

All the analog inputs and outputs are calibrated at the factory, but firmware commands permit the user to re-calibrate the board, or to calibrate it to better precision. All inputs and outputs are calibrated in two points; select the two points as close to possible to the two ends of scale. To calibrate the inputs, the user must provide analog signals. (Example: to calibrate 4-20mA inputs, the user must provide a 4mA and 20mA current source). To calibrate the outputs, the user must issue a command to set the output to a desired value, measure the result and issue the calibration command to store the value.

The values are stored in flash and the input curve is assumed to be linear. If a mistake is made during calibration by typing the wrong command, a RESET command can be used to reset all the channels in the corresponding group to factory values. After RESET calibration can be restarted.

The board can be calibrated without a source of analog signals, by calibrating first the outputs and then routing the calibrated outputs to corresponding inputs. The following commands are available for calibration:

CALIBRATE 0-10V INPUTS:	megaind <id> uincal <value>
RESET CALIBRATION OF 0-10V INPUTS:	megaind <id> uncalrst
CALIBRATE 4-20mA INPUTS:	megaind <id> iincal <value>
RESET CALIBRATION OF 4-20mA INPUTS:	megaind <id> iincalrst
CALIBRATE 0-10V OUTPUTS:	megaind <id> uoutcal <value>
RESET CALIBRATION OF 0-10V OUTPUTS:	megaind <id> uoutcalrst
CALIBRATE 4-20mA OUTPUTS:	megaind <id> ioutcal <value>
RESET CALIBRATION OF 4-20mA INPUTS:	megaind <id> ioutcalrst