

**16-RELAYS for RASPBERRY PI**

**USER'S GUIDE VERSION 1.0**

**[SequentMicrosystems.com](http://SequentMicrosystems.com)**

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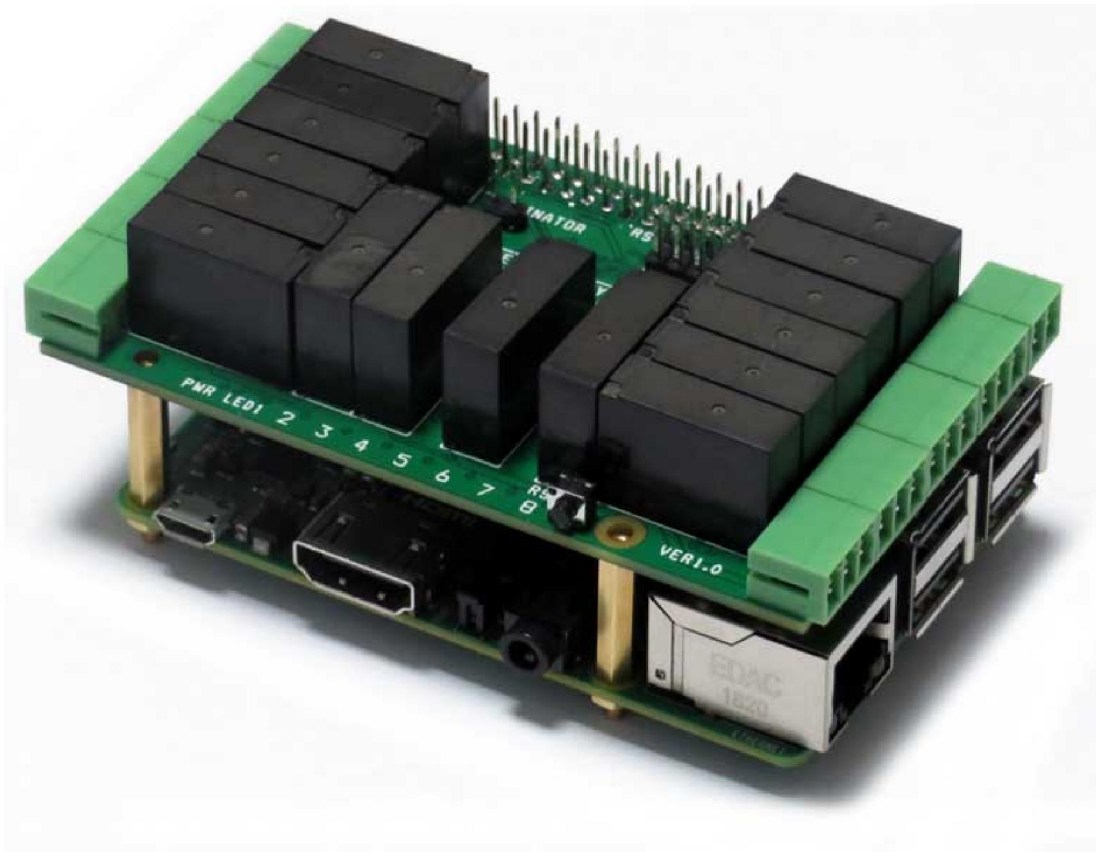
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## GENERAL DESCRIPTION



The 16-RELAYS card is a stackable expansion card for Raspberry Pi. The card is compatible with all Raspberry Pi versions from Zero to 4. It offers a compact and inexpensive solution for adding up to 128 relays to your Raspberry Pi project.

Pluggable connectors make the 16-RELAYS card easy to use when multiple cards are stacked up. Loads of up to 2.5A and 24V can be switched by all relays. Status LEDs show when relays are on or off.

Each relay has a corresponding LED installed on the long side of the card which turns on when the relay is energized. A LED also shows when power is applied to the board. A pushbutton permits the user to issue a command to Raspberry Pi or to shut it down (a script is required for the desired application). Since the long side of the board has room for only 8 status LEDs, a jumper selects to display the status of the left or right relay banks.

The 16-RELAYS card has also an RS485 driver which can enable the Raspberry Pi to communicate with other industrial equipment using the MODBUS protocol.

Mechanically, the 16-RELAYS 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

- Sixteen Relays with Status LEDs
- Pluggable Connectors, 26-16 AWG wires
- All Relays with NO and COM Contacts, rated 2.5A/24VAC or DC
- RS485 Port with TVS protection
- Reverse polarity power supply protection
- General purpose pushbutton
- All mounting hardware included: stand-offs, screws and nuts
- Software self-test
- Command Line, Node-RED, Python and OpenPLC Drivers

Up to eight 16-RELAYS cards can be stacked on top of one Raspberry Pi. The 16-RELAYS 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. 16-RELAYS Card for Raspberry Pi



### 2. Mounting hardware:

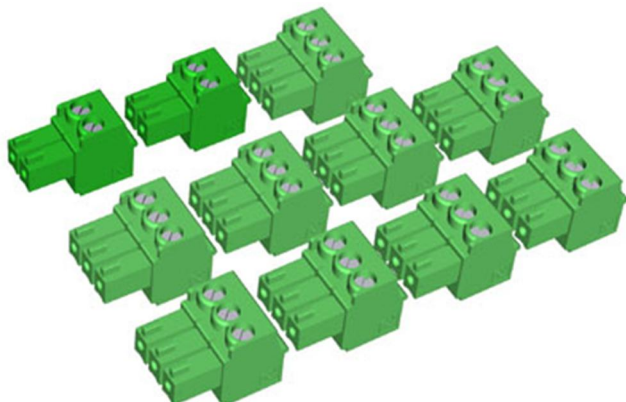
- a. Four M2.5x19mm male-female brass standoffs
- b. Four M2.5x5mm brass screws
- c. Four M2.5 brass nuts



### 3. Two jumpers.



### 4. All the required female mating connectors.

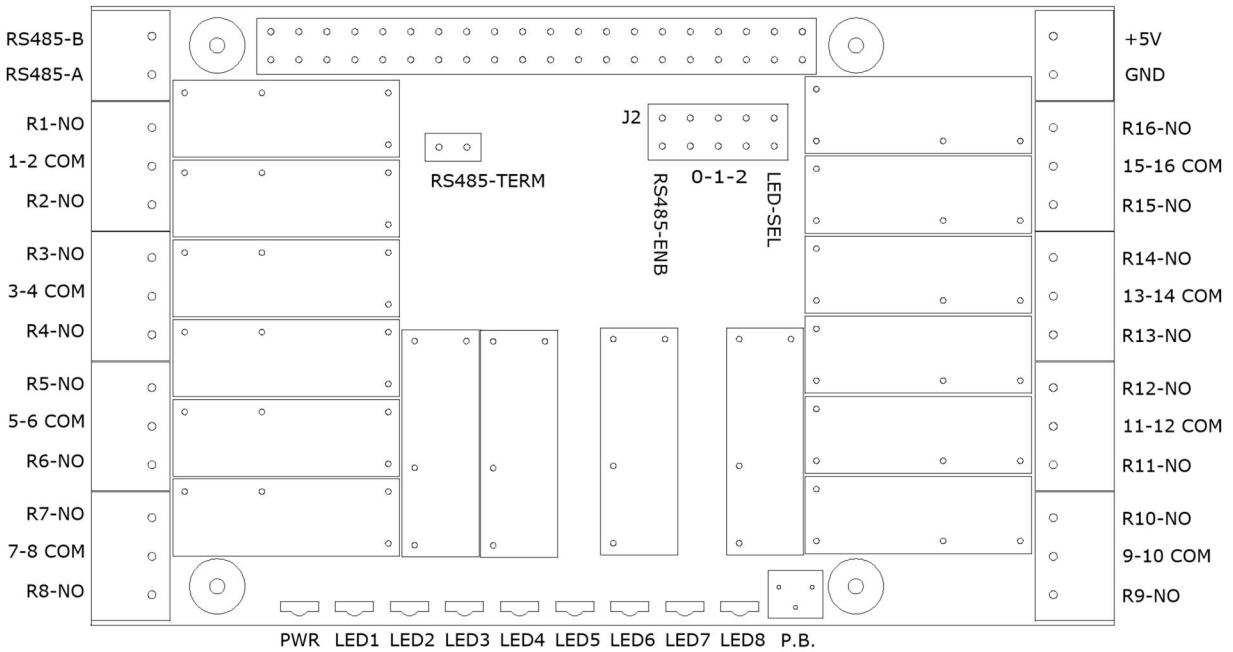


## QUICK START-UP GUIDE

1. Plug your 16-RELAYS 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 16-RELAYS software from github.com:
  - a. ~\$ `git clone https://github.com/SequentMicrosystems/16relind-rpi.git`
  - b. ~\$ `cd /home/pi/16relind-rpi`
  - c. ~/16relind-rpi\$ `sudo make install`
4. ~\$ `16relind`

The program will respond with a list of available commands.

## BOARD LAYOUT



Your 16-RELAYS card comes with appropriate mounting hardware. Up to eight 16-RELAYS cards can be stacked on top of one Raspberry Pi. Eight LEDs indicate the status of their respective relay. An LED is lit when the corresponding relay is energized. The General Purpose Pushbutton GPB is connected to pin 37 of the Raspberry Pi GPIO connector (GPIO26). In order to use the pushbutton you need to write a shell script to accomplish the desired function.

All relays have NO and COMMON contacts brought out to pluggable connectors. Pair of 2 relays share the COMMON pin.

The right-most position of the J2 jumper selects which bank of relays displays the status on the LEDs. The next three positions are used for selecting the stack level (see next section). The left position is used for the RS485 port. The port is driven by the serial pin of Raspberry Pi. Install the jumper if you want to use the RS485 port. Remove the jumper if the serial port of Raspberry Pi is used for another purpose.

## STACK LEVEL SETTINGS

Up to eight 16-RELAYS Cards can be installed on top of one Raspberry Pi. The 16-RELAYS Card shares the same I2C address with the 8-INPUTS, 8-MOSFETS, 8-RELAYS AND 16-INPUTS cards. If a combination of these cards is used in the same stack, a total of eight cards can be installed.

The 16-RELAYS card is controlled by Raspberry Pi using only the I2C interface. The card occupies the address space 0x20 - 0x27. The local address can be configured using the Stack Level Jumpers or DIP switches. A maximum stack of eight cards requires a total of 12 jumpers.

Cards can be installed on Raspberry Pi in any order. The 3 position jumper or DIP switch is selecting the stack level of the card, as follows:

|             |      |     |     |      |     |     |      |    |     |      |    |     |
|-------------|------|-----|-----|------|-----|-----|------|----|-----|------|----|-----|
| JMP/SW      | OFF  | OFF | OFF | ON   | OFF | OFF | OFF  | ON | OFF | ON   | ON | OFF |
| STACK LEVEL | 0    |     |     | 1    |     |     | 2    |    |     | 3    |    |     |
| I2C ADDR.   | 0x27 |     |     | 0x26 |     |     | 0x25 |    |     | 0x24 |    |     |

|             |      |     |    |      |     |    |      |    |    |      |    |    |
|-------------|------|-----|----|------|-----|----|------|----|----|------|----|----|
| JMP/SW      | OFF  | OFF | ON | ON   | OFF | ON | OFF  | ON | ON | ON   | ON | ON |
| STACK LEVEL | 4    |     |    | 5    |     |    | 6    |    |    | 7    |    |    |
| I2C ADDR.   | 0x23 |     |    | 0x22 |     |    | 0x21 |    |    | 0x20 |    |    |

To find out the stack level of all the cards installed in your system run the command line with the “-list” option.

## OpenPLC SETUP

When using OpenPLC only two 16-RELAYS Cards can be accessed in one system, on stack levels 4-5.

The stack level 0-3 is reserved for the 8-RELAYS and stack level 6-7 reserved for 16-INPUTS Cards.

## RS-485 COMMUNICATION

The 16-RELAYS cards card contains a standard RS485 transceiver which can be accessed by the serial port of the Raspberry Pi. In order to enable communication, the jumper labeled RS485EN on J2 connector needs to be installed.

## POWER REQUIREMENTS

The 16-RELAYS card requires +5V power, supplied either from the Raspberry Pi expansion bus, or from its own pluggable connector. The on-board relays are powered at +5V (See Schematic).

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

16-RELAYS Card current consumption:                      10 mA @ +5V (all relays OFF)

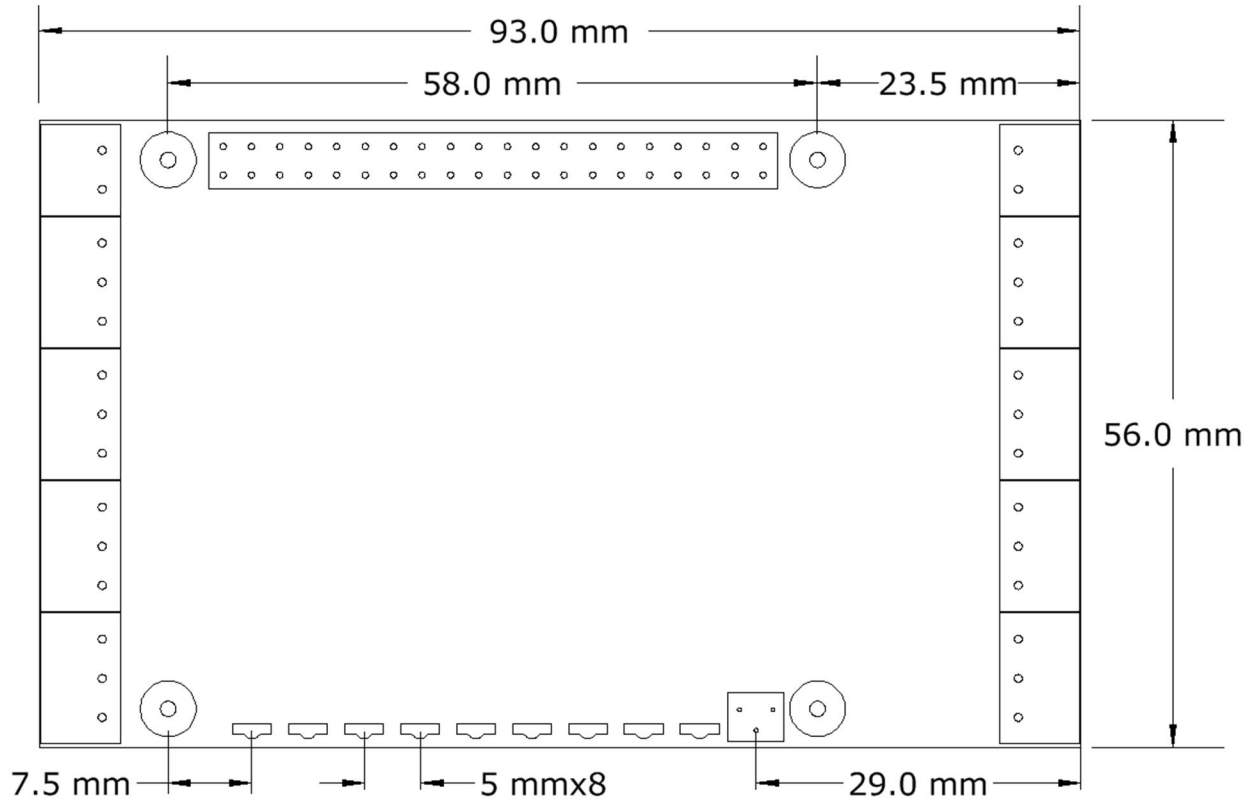
700 mA @ +5V (all relays ON)

The power connector which powers the 16-RELAYS card can supply up to 4A and is protected by a 3A resettable fuse. We recommend using a 5V regulated power supply rated at 3A or higher. The 16-RELAYS card can be stacked up to eight levels. A multi-stack configuration can be powered from any of the cards.

If your application requires multiple relays to be ON at the same time, we recommend using a power supply rated 4A or higher, with a split cable to power multiple cards.



## MECHANICAL SPECIFICATIONS



The card is compatible with any card manufactured by Sequent Microsystems and can be mounted in any order. You may also mix cards from other vendors, assuming they do not use the same I2C address. It can be installed in the 3d-printable modular enclosure available for download from our website.

## SOFTWARE SETUP

The 16-RELAYS board occupies the I2C addresses from 0x20 to 0x27.

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                   |

3. Install the 16relind software from github.com:

```
~$ git clone https://github.com/SequentMicrosystems/16relind-rpi.git
```

4. 

```
~$ cd /home/pi/16relind-rpi
```

5. 

```
~/16relind-rpi$ sudo make install
```

6. 

```
~$ 16relind
```

The program will respond with a list of available commands.

Type "**16relind -h**" for online help.

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

1. 

```
~$ cd /home/pi/16relind-rpi
```

2. 

```
~/16relind-rpi$ git pull
```

3. 

```
~/16relind-rpi$ sudo make install
```