



Pencom Design, Inc.  
PO Box 645  
Trumbauersville, PA 18970-0645

[Http://www.pencomdesign.com](http://www.pencomdesign.com)

[Sales@pencomdesign.com](mailto:Sales@pencomdesign.com)

# INSTRUCTION MANUAL

## Single/Dual Channel USB Relay Board

### Introduction

Thank you for buying our USB controlled relay board.

The goal of Pencom Design is to provide top quality equipment at low cost. All of our products are designed, built and tested in-house to meet our high quality standards.

### Models

This instruction manual covers all 1 & 2 channel USB relay boards including models with optional 8 channel I/O ports & 2 channel opto-isolated inputs ports.

Model U1-RLY-IO-EXT displayed in photo, single channel relay w/IO.

### Features

Two low cost relay versions available, both types include LED indicators that illuminate when the relays are active:

- Standard 1 or 2 channel USB relay board with heavy duty 10 Amp 250VAC/28VDC SPDT power/general purpose relays.
- Optional 1 or 2 channel USB relay board with SPST reed relays

I/O versions have one 8 channel input or output port with each pin selectable as an input or an output, and one 2 channel opto-isolated input port.

These boards utilize a USB to serial chip which allows a seamless transition from RS232 Boards to USB boards. Both board versions are interchangeable between our USB and RS232 boards -- since the same software may be used to control either board version. All the same commands are utilized, including the same communication protocols and baud rates.

Easy hook up using a standard USB cable, supplied with the unit.

Almost any software language that is able to write to the PC serial port can communicate with this relay board as the driver creates a virtual serial port on the supported operating systems -- Windows all versions, Mac and Linux.

Simple ASCII commands to control the relays. 4800 to 38400 baud (9600 default), 8 bits, no parity, 1 stop bit. Each relay will turn ON or OFF depending on what command is sent and will maintain this position until power is removed or changed again in software.

Two different Board design versions available, both are for mounting in the customers enclosure or an optional plastic enclosure is available for the "-EXT" version only.

- Circuit board with an external wall transformer.
- Circuit board with internal on-board mounted transformer.



A windows based, Relay Testing Program (RTP) is available to verify operation of the 1 & 2 channel relay boards before writing your own software program. The RTP software also has the capability to modify the features available, such as the changing the baud rate, other options. This software is available from our website.

## Applications

- Industrial control applications
- Automatic test equipment (ATE)
- Process control systems
- Power switching applications

## Specifications

### Dimensions:

Circuit Board:

- 3.04" Wide X 4.20" Length X 1.012" High (external Transformer version)
- 3.04" Wide X 4.20" Length X 1.500" High (internal transformer Version)

### Connections:

- 1 USB-B connector for connection to the PC.
  - 1 or 2 3 contact Terminal blocks for output connections for 14-22 AWG wire
  - 1 Power Jack for DC wall transformer (external transformer version) or optional 2 position terminal block for an external regulated power supply input (9-12VDC).
  - 1 120VAC 3-pin Terminal Block (internal transformer version)
- I/O versions:
- 1 10 contact terminal block for 8 channel I/O for 16-26 AWG wire (I/O Version)
  - 1 4 contact terminal block for 2 Channel opto-isolated input for 16-26 AWG wire.

### Power Requirements:

Standard:

- 9 Volts DC @ 300 ma amp wall transformer ("-EXT" suffix)
- 120 VAC 50/60 HZ internal transformer ("-INT" suffix)

Option:

- 240 VAC 50/60 HZ internal transformer ("-INT-2" suffix)

### Transmission distance, PC to relay Board:

Standard 2.0 USB specifications 16 feet maximum.

### Relay outputs: (See relay data sheets for full specifications)

- 10 Amp 250VAC/28VDC SPDT 1 form C general purpose/power relays
- Optional: "-R" 0.5 Amp 200 VDC/Peak AC Resistive SPST reed

### Operating Temperature & Humidity:

0° to 70° centigrade, 90% Relative humidity.

## Parts Listing

### All Models Include:

1 - 6' USB 2.0, A to B cable

### Models with "-EXT" suffix

1 - AC to 9 or 12VDC Wall Transformer adapter



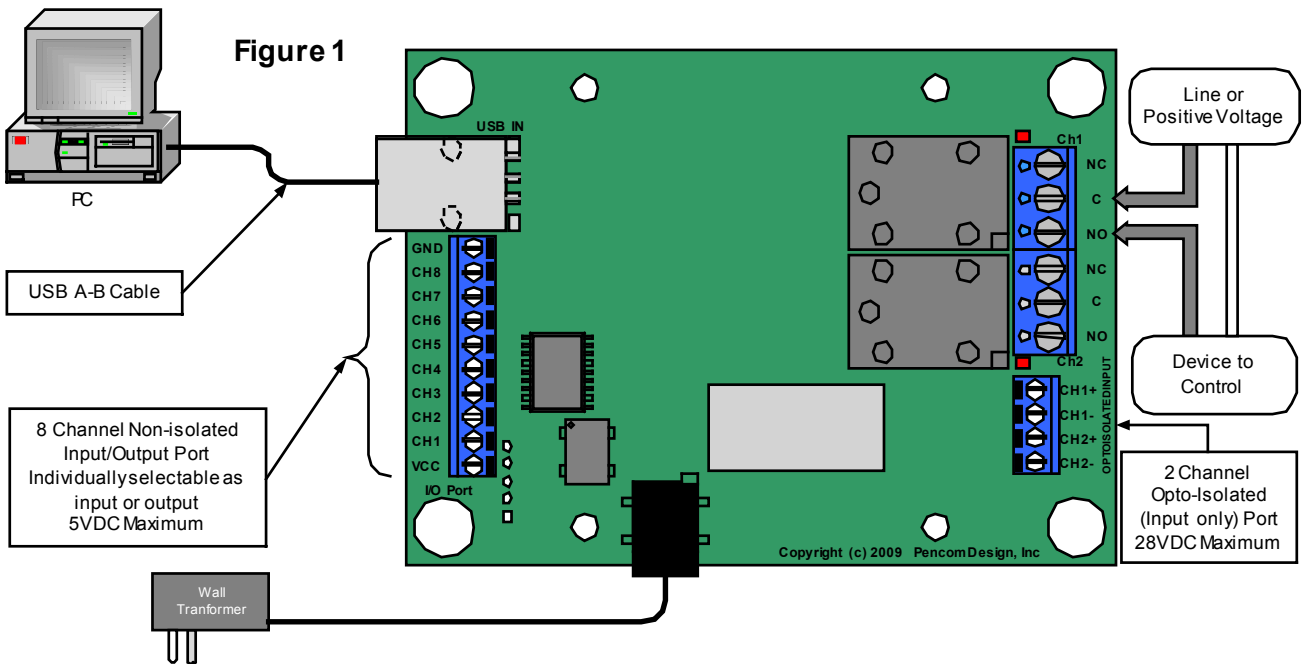
### Models with "-INT" suffix

1 - With internal power transformer 120VAC 50/60 Hz or optional 240VAC, with 3 position terminal block connection.

## Setup Instructions

Connect the computer, relay board, and wall transformer and last the USB Cable, as shown in Figure 1. If the unit P/N has a "-INT" suffix, the transformer is located on the board and a 3-position terminal block is used for the AC power connection. These connections are labeled as shown below:

- L1 (line 1) the Hot wire, typically black, but could be another color
- L2/N (Line 2 or Neutral), This pin is a dual purpose connection which depends on the voltage.
  1. Neutral wire is always white for standard 115-120VAC applications
  2. Line 2 is used if your unit has the optional 230-240VAC power input, this wire is typically red, but could be black or another color. **Do not connect this pin to a hot wire if your unit is marked 115V on the board, as damage will occur.**
- GND (ground connection) which is typically green or a bare copper wire.



Install the USB drivers from the CD - make sure the drivers match the operating system.

If using the windows operating system, install the relay test program from the CD or download from our website. Run the relay test program software on your PC to test and setup the options on the board. Select the correct COM port in the software that was assigned by the USB driver. Operation of the relay test program is explained in the help file.

Plug in the wall transformer or apply power to board (on-board transformer). Make sure the board address in the software is set to "A". This is the software default and is used in a single or dual channel board configuration. Click ON #1 relay in the software program and there should be an audible click from the relay selected and the LED will illuminate.

## Connecting Relay Outputs

Connect the device that will be under computer control to the terminal blocks marked, NO (normally open), NC (normally closed), and C (common). **Note: Reed Relay versions only use the Common and NO connections.** Relay channel numbers are marked next to each terminal block.

The positive if DC or (Hot side of the AC power) should always be connected to the "C" which is the common terminal. The device under control should be connected to either the NC or the NO terminal depending on the following conditions. **For safety reasons, the neutral (AC) or ground (DC) side of the circuit should never be used to control the circuit through a relay or switch.**

1. If the device under control is always ON, and will be turned OFF under computer control, then connect the wire to the NC (normally closed position). When the relay is OFF (deactivated), or the board is powered down, the device will be turned ON.
2. If the device under control is normally OFF, and will be turned ON under computer control, then connect the wire to the NO (normally open position). When the relay is OFF (deactivated), or the board is powered down, the device will be turned OFF.

Strip the insulation back on your wire approx. ¼ inch. Insert the stripped wire into the side of the terminal block and tighten the screw to clamp the wire in place. The terminal blocks are designed for 14-22 AWG wire size. Do not exceed the current rating of the relays.

The NO (normally Open) position is commonly used for most applications. Note: only one output connection is shown on the drawing, although this is a dual channel unit.

### 8 Channel Input / Output Port (Port #1)

The I/O port is on the 10 position terminal block near the USB connector. Warning these connections are for 5VDC logic only, do not exceed this voltage or damage to the board will result. They are current limited to sink or source approx. 15ma. The I/O ports are typically used for dry contacts (switch inputs) or controlling an external device with a 5V input. A connection to VCC (+5VDC) and ground are supplied on this connector, and is utilized depending on how the input/output is connected. Please note, the VCC connection is for use with the I/O port not for powering external devices. Use the RTP software on the PC for setup.

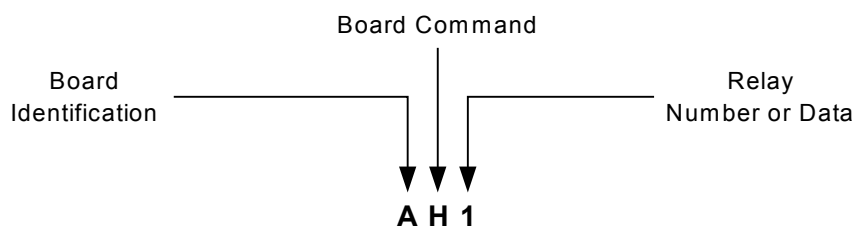
### 2 Channel Opto-Isolated Input Port (Port #2)

The opto-isolated input is the 4-pin terminal block on the lower right of the board next to the relay outputs. This is a input only port and is optically isolated from the circuit on the board, the inputs are capable of handling up to 28VDC directly to the pins and must be driven from an external power source to maintain isolation. The positive side of the voltage is connected to + and - to negative or ground.

## Software

The relay board recognizes standard ASCII characters that are transmitted from the host computer. Commands are case sensitive.

The commands are transmitted in the following format in one string from left to right: All the board commands and values explained below may be tested using the relay testing software on the CD or available for download from our website.



"<Board Identification><Board Command><Relay Number or Data><Carriage return>"

Board Identification  
The Board ID is "A" For the single or dual channel relay boards, these boards will only respond to this address.

Board Command  
H = Relay HIGH (ON)  
L = Relay LOW (OFF)  
R = Read relay status  
W = Write data latch  
M = Momentary Delay  
T = Toggle relay  
I or a = Read port 1 input  
O or A = Write port 1 output  
b = Read port 2 input

Relay Number or Data  
(H or L) = Relay number 1 or 2 or 0 to turn ON all relays on the selected board  
(R) = receive a number 0 - 3  
(W) = write a number 0 - 3

### **Board identification:**

The board address is the first part of the command sent to the relay board, it is set to "A" in firmware and may not be changed for the single and dual channel relay boards.

### **Board Commands:**

The board command is the second part of the serial data sent to the relay board. These commands work in conjunction with the third part of the serial data that will be explained in the following section.

**H** = Relay High (ON) – Sending an "H" will direct the board to turn ON the relay (making a connection between the NO & COM contacts on the board).

**L** = Relay High (OFF) – Sending an "L" will direct the board to turn OFF the relay (breaking the connection between the NO & COM contacts on the board).

**W** = Write data latch – Sending an "W" will write directly to the port. This command allows you to turn multiple relays ON or OFF on the same board at the same time.

**R** = Read relay status – When this command is sent to the board, the board will respond back to the PC with a decimal number, which corresponds to the status of the relays on the board. This will be explained in more detail below:

**M** = Momentary Command – This command will briefly activate or deactivate a single relay or all relays. The initial state of the relay will determine whether the relay toggles ON – OFF – ON or OFF – ON – OFF. The momentary delay default is 30 milliseconds, but may be changed from 10-50 milliseconds in the setup.

**T** = Toggle command - The toggle command will reverse the relay from it's current position. The initial state of the relay will determine whether the relay toggles ON or OFF.

**I or a** = Input command – Read the inputs on 8 channel I/O port #1

**O or A** = Output command – Set the outputs on 8 channel I/O port #1

**b** = Input Command – Read the inputs on 2 channel opto-isolated port #2

### **Relay Number or Data:**

The relay number or data command is the third part of the serial data that is sent to the relay board(s) - this data is numerical. The data that is sent or received will relate directly to the board commands that were explained in the previous section.

If the board command is "**H**" or "**L**":

Send a number 1 or 2 which represents the relay number on the board and will turn ON or OFF the individual relay specified. Sending a zero that will turn ON or OFF **ALL** relays on this board.

If the board command is "**W**":

Send a number from 0 to 3. When this number is converted into binary, it represents the relay numbers on the board. This command allows you to turn multiple relays ON or OFF at the same time with one command. Binary data is one's and zero's which represents ON and OFF on the relay board (ON = 1 & OFF = 0). See table #1

### **"W" command Example:**

To turn ON relay 2 and leave relay 1 OFF you would send decimal number 2.

To turn ON relay 1 and leave relay 2 OFF you would send decimal number 1.

If board command is "**R**":

Send any number from 0 to 255 (it doesn't matter it will be ignored). The relay board will immediately respond with decimal number from 0 to 3 representing which relays are active in the same method as explained above.

If the board command is "**M**"

Send a number from 1 to 2 which represents the relay number available on the board, and it will momentarily active (or deactivate) the individual relay specified. You may also send a zero which will momentarily active (or deactivate) **ALL** relays on this board. The initial state of the relay will determine whether it is turned ON or OFF.

If the board command is "T":

Send a number from 1 to 2 which represents the relay number available on the board, it will reverse the relay from it's current position on the individual relay. Sending a zero which will toggle **ALL** relays on this board. The initial state of the relay will determine whether it is toggled ON or OFF.

If the board command is "I" or "a":

Used to read I/O port #1, transmit a zero as the data, and the unit will read the status and reply with a return value of 0-255. Valid data values to send are 0 to 255 decimal, values greater than zero is a mask function and is explained below.

If the board command is "b":

Used to read port #2, transmit a zero as the data, and the unit will read the status and reply with a return value of 0-3. Note this is an input only port.

If the board command is "O" or "A":

Used to write to I/O port #1 when channels are setup as outputs. Valid data values are 0-255. I/O ports are set to inputs at the factory and must be changed in the setup program to use as output ports.

### Input Mask:

To read only one or multiple pins you may send a value between 1 & 255, this is a mask that will restrict which of the port pins you wish to read. Example: to read channel 1 you would send a mask of 1 (00000001 in binary) to read this pin only. If this pin is active it will reply with a 1, if this pin is a zero it will respond with a zero. If you want to read channel 8 send a value of 128 (10000000 in binary). If this pin is active it will reply with a 128, if this pin is a zero it will respond with a zero.

If you want to read both channels 7 & 8 you will send a mask of 192 (11000000 in binary). If both pins are zero it will return a zero if pin 8 is active and pin 7 is zero it will return a 128 (10000000 in binary). If pin 7 is one and pin 8 is zero it will return a 64 (01000000 in binary) If both pins are active it will return a 192 (11000000 in binary) showing both pins are active.

### Reading the output port status:

To read the status of the output port, follow the procedure for reading the inputs above using the lower case command that matches your output port. The mask may be used to isolate only the status of the output pins you want to read.

The board command structure is explained in more detail in application note #156, available on the CD or download it from our website.

There are numerous software languages that can utilize the PC for serial communications. Information is readily available on the internet and in books explaining how to output to the serial ports, in other languages. We are only

showing you one example using the popular graphical language Visual Basic. It's an easy language to learn and has many powerful features, when using the Windows operating system.

Relay #	Decimal	Relays
2	1	Equivalent
0	0	Both Relays OFF
0	1	Relay #1 ON
1	0	Relay #2 ON
1	1	Both Relays ON

### Visual Basic Example

This example transmits data out to the relay board using the MSComm function to turn ON Relay #2.

```
MSComm1.Output = "A" & "H" & "2" & Chr$(13)
```

1. "A" = Board address
2. "H" = Board Command (relay = high)
3. "2" = Relay Number as a string (quotes required), if using it in an equation use str(2).
4. "Chr\$(13)" = carriage return, this must be sent after each command string.
5. The ampersand "&" operator is used to force string concatenation of the expressions.

Setup the Mscomm properties as follows:

DTREnable = False	InBufferSize = 1024	Rthreshold = 1
EOFFenable = False	InputLength = 0	RTSEnable = False
NullDisboard = True	InputMode = 1	Sthreshold = 1
HandShaking = 0	OutBufferSize = 512	Settings 9600,8,n,1

The following code receives the data from the relay board on the "R" (Read command).

```
Private Sub MSComm1_OnComm()  
    'Receive data on the serial port  
    Select Case MSComm1.CommEvent  
        Case comEvReceive  
            Dim buffer As Variant  
            Dim Data As String  
            buffer = MSComm1.Input  
            ShowData (StrConv(buffer, vbUnicode))  
    End Select  
End Sub  
Private Static Sub ShowData(Data As String)  
    'Eliminate line feeds.  
    Do  
        i = InStr(Data, Chr$(10))  
        If i Then  
            Data = Left$(Data, i - 1) & Mid$(Data, i + 1)  
        End If  
    Loop While i  
    'Eliminate carriage returns.  
    Do  
        i = InStr(Data, Chr$(13))  
        If i Then  
            Data = Left$(Data, i - 1) & Mid$(Data, i + 1)  
        End If  
    Loop While i  
    'Display data in a text box  
    TxtData.Text = Data  
End Sub
```

Note: The Visual Basic example is sending the command string out the serial port, which is a virtual serial port created by the driver. The board will respond exactly as if it was directly connected to a hardware serial port. This allows a seamless transition from our RS232 Boards to USB boards, without any software changes in the controlling software.

## Board setup options

To modify the setup options on the board, baud rate, momentary delay, or I/O selection, install the RTP (relay test program) from the website. Select options>setup from the menu to load the setup window. Instructions for program operation are available in the help file.

Pencom utilizes the FTDI USB Chips and drivers to handle the USB to Serial Conversion for use in our boards. These chips were the best choice as their drivers support most of the operating systems in use today, and they are constantly updating the drivers when new versions are released. Latest drivers are available at the following location:  
<http://www.ftdichip.com/Drivers/VCP.htm>

Additional information is available on our website at [www.pencomdesign.com](http://www.pencomdesign.com)