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INSTRUCTION MANUAL

8 Channel USB Relay Board

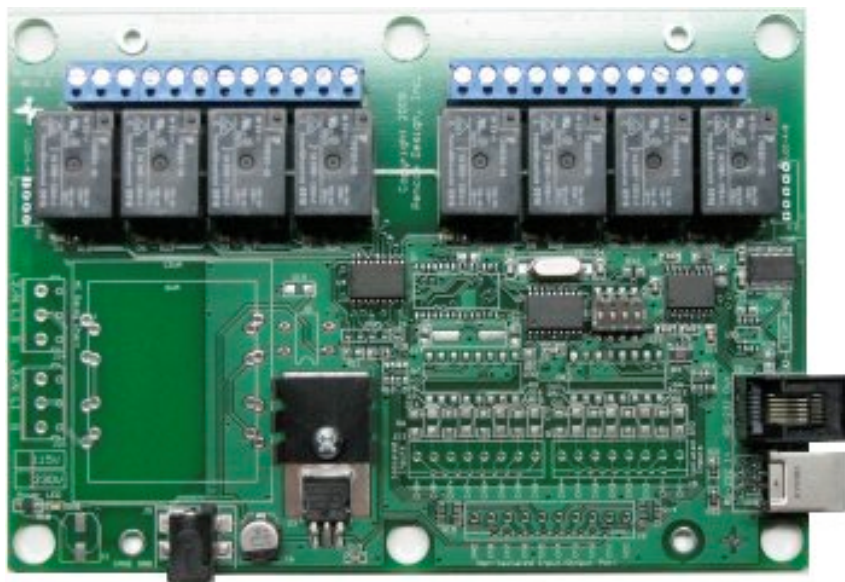
Introduction

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 8 channel USB relay boards including models with optional 8 channel I/O ports or 8 channel opto-isolated inputs ports.



Model U8-RLY-EXT-EL, 8 Channel relay with LED's without enclosure is shown.

Features

Two relay versions are available, both types may be ordered with optional LED indicators that illuminate when the relays are active, each board includes a power LED:

Relays available:

- Standard: 8 channel USB relay board with heavy duty 10 Amp 250VAC/28VDC SPDT power/general purpose relays.
- Optional: 8 channel USB relay board with SPST reed relays 0.5 amp 200 VDC/Peak AC Resistive

Two Input / output options:

- I/O versions have one 8 channel input or output port individual pin selectable, 5 VDC logic.
- Opto-isolated versions have one 8 channel input port, 28VDC maximum input.

Our relay 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.

Each unit has a RS232 output to daisy chain our standard RS232 relays boards, 15 additional standard relay boards may be connected to this USB relay board, using standard reverse wired modular cables.

Almost any software language that is able to write to the PC serial port can communicate with this relay board as the USB driver creates a virtual serial port on the supported operating systems -- Windows CE, 98 to Vista 64, Mac and Linux. USB drivers included on CD, or updated online.

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 versions are available:

- Circuit board with an external wall transformer "-EXT" version, mounted in a plastic ABS enclosure.
- Circuit board with internal on-board mounted transformer "-INT" version, 120VAC 50/60 Hz standard, 240VAC version optional "-2" suffix.

The internal transformer version is typically mounting in the customers enclosure, the external transformer version may also be purchased without the enclosure.

A windows based, Relay Testing Program (RTP) is available to verify operation of the relay boards before writing your own software program. The RTP software also includes a setup program that has the capability to modify the features available, such as the changing the baud rate, and other options. This software is included on disk, updated versions may be downloaded from the website.

Applications

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

Specifications

Dimensions:

With light gray Enclosure: 6.89" Wide X 4.88" High X 1.52" Deep

Circuit Board (with reed relays & no enclosure): 6.73" Wide X 4.66" High X 1.412" Deep

Circuit Board (with standard relays & no enclosure): 6.73" Wide X 4.66" High X 1.830" Deep

Standard Connections:

- 1 USB-B connector for connection to the PC.
- 1 RJ-12 Modular phone jack for RS232 output to next relay board (daisy chain)
- 2 12 position 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 3-pin Terminal Block 120VAC or optional 240VAC (internal transformer version), second terminal block for daisy chain optional.

I/O versions:

- 1 10 contact terminal block for 8 channel I/O for 16-26 AWG wire (I/O Version)
- 2 8 contact terminal block for 8 Channel opto-isolated input for 16-26 AWG wire.

Optional Connections:

DC power plug on "-EXT" versions may be replaced with a terminal block, to allow connection to an external regulated power supply in daisy applications, includes reverse voltage protection.

Pluggable terminal blocks are available for the relay contacts, and the power input on the 120VAC versions, (and on DC input versions above when ordered without the enclosure).

I/O Versions:

The terminal blocks may be replaced with pluggable .100 headers for use with IDC connections. Pre assembled IDC connectors with custom length wires may be ordered to fit your application.

Power Requirements:

9 Volts DC @ 1.2 amp wall transformer ("-EXT" suffix) included (9-12VDC with external supply option)

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

Transmission distance:

PC to relay board, Standard 2.0 USB specifications 16 feet maximum.

Relay board to relay board, Standard RS232 specifications 50 feet, minimum.

8 Relay outputs: (See datasheets for full specifications)

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

Operating Temperature & Humidity:

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

Parts Listing

All Models Include:

1 – Mini-CD driver disk with instruction manual, application notes and software.

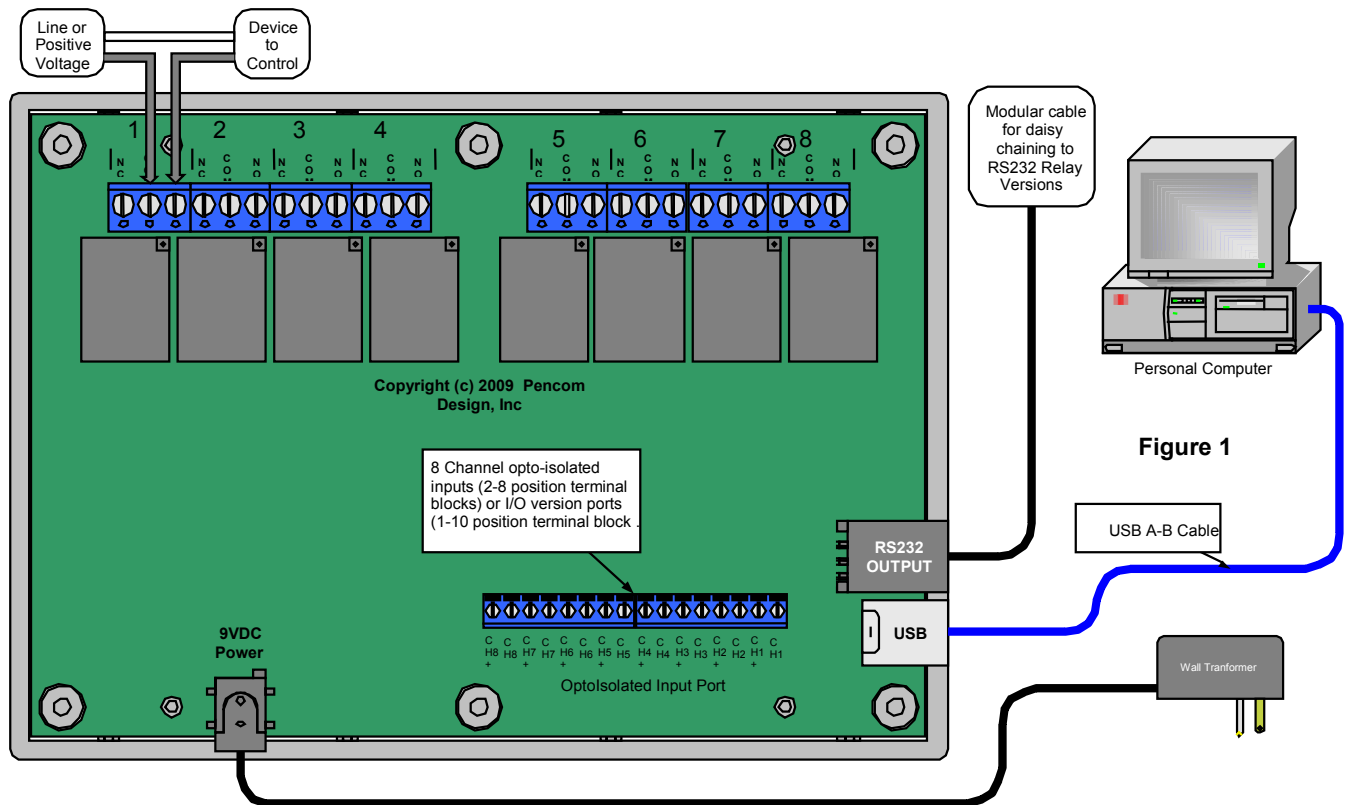
1 – 6' USB 2.0, A to B cable

Models with "-EXT" suffix

1 - AC to 9VDC 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

Single Board Configuration:

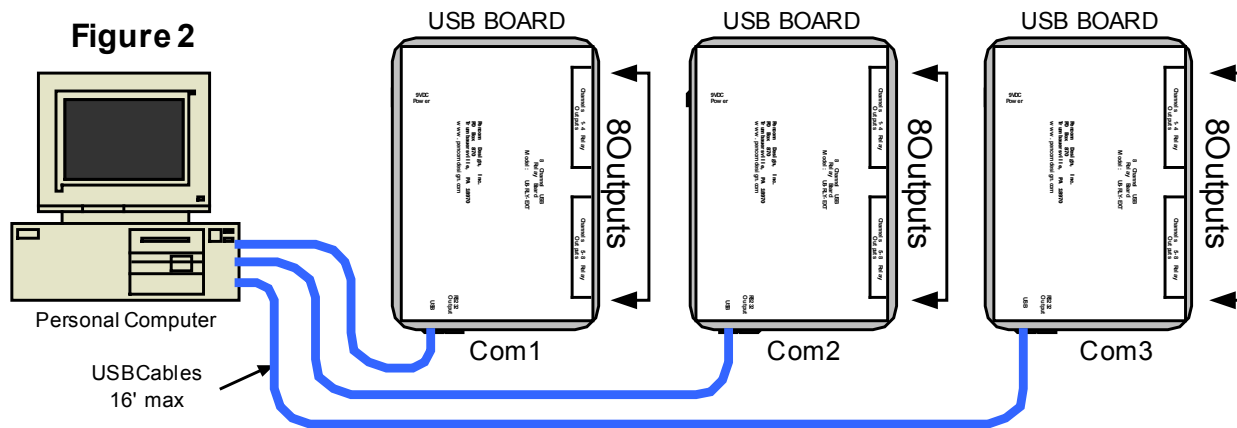
Connect the computer, relay board, and wall transformer and last the USB Cable, as shown in Figure 1. If the unit P/N has a "-INT" suffix, the transformer is located on the board and a 3-position terminal block is used for the AC power connection. These connections are labeled as shown below:

- 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
 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. **Warning 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 typically used in a single board configuration. This must match the board address which is set to "A" (all switches OFF) as the factory default. Click ON #1 relay in the software program and there should be an audible click from the relay selected and the LED will illuminate.



Multiple board configuration (2 or more USB Boards on the same PC):

Connect the computer, relay board, power, and last the USB Cable, as explained in the single board configuration above. Connect the second USB relay board to another USB port as shown in Figure 2, and the PC will recognize and install the driver as needed. The driver will assign a second serial port using the virtual driver. This second port will be used to control the second relay board. The DIP switch which controls the address on the board, should be left in the factory default position "A" (all switches OFF).

To control the second board, change the serial com port in the RTP program or in your software, to match the com port number assigned to the second board.

Each additional USB board is configured using the same method.

Multiple board configuration (with 1 USB and 1 or more RS232 boards on the same USB port):

Connect the computer, relay board, power and last the USB Cable, as explained in the single board configuration above. Connect the input of the RS232 relay board to the output RS232 jack on the USB relay board using a reverse wired modular cable (P/N MC4-7). Additional RS232 boards may be connected as shown in Figure 3,

Dip Switch Setting				Board Address
1	2	3	4	
OFF	OFF	OFF	OFF	A
OFF	OFF	OFF	ON	B
OFF	OFF	ON	OFF	C
OFF	OFF	ON	ON	D
OFF	ON	OFF	OFF	E
OFF	ON	OFF	ON	F
OFF	ON	ON	OFF	G
OFF	ON	ON	ON	H
ON	OFF	OFF	OFF	I
ON	OFF	OFF	ON	J
ON	OFF	ON	OFF	K
ON	OFF	ON	ON	L
ON	ON	OFF	OFF	M
ON	ON	OFF	ON	N
ON	ON	ON	OFF	O
ON	ON	ON	ON	P

Table 1

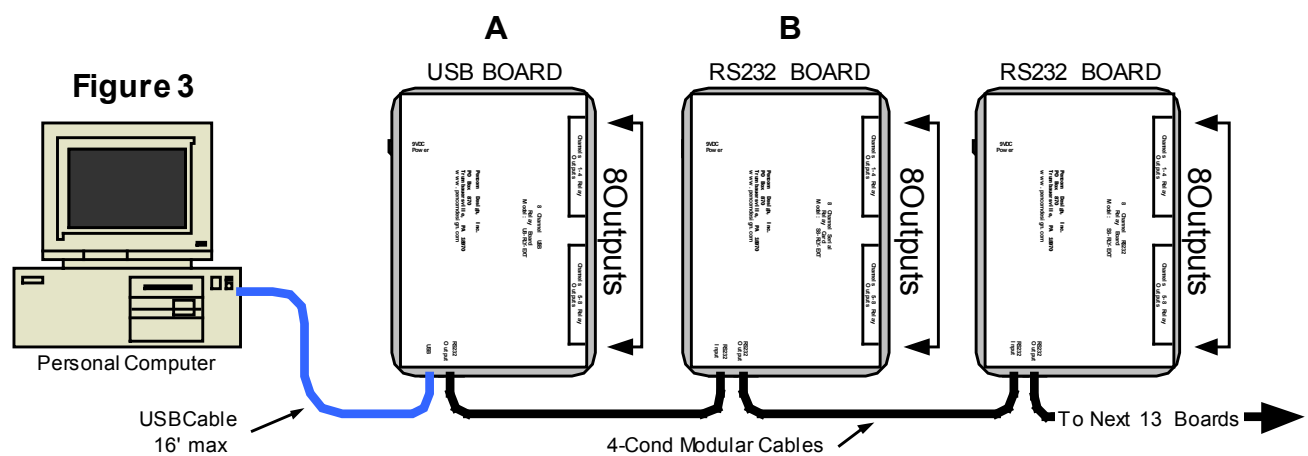
from the output of the each board to the input of the next board. A total of 15, RS232 boards may be connected to one USB Relay Board.

Note each 8-channel relay board has a four position DIP switch. For normal operation using only one board, all the switches are left in the OFF position address "A". When used in multiple board applications these switches are used to uniquely identify each board.

Since all the boards are connected to the same virtual serial RS-232 port through the USB board, the host computer needs to communicate with each board without talking to the other boards on the same channel. The board address codes are listed in table 1.

Every board must be set to a different address to operate correctly. The board address code range is between A and P, these letter address codes will be used as part of the command codes when sending serial data from the host to the relay board. The DIP switch is located below the right bank of relays. On units with the enclosure, remove the six screws on the back and lift off cover.

Plug in the wall transformer or apply power to board (on-board transformer). Make sure the board address in the software is set to the board you wish to test. Click ON one of the relays in the software program and there should be an audible click from the relay on the selected board.

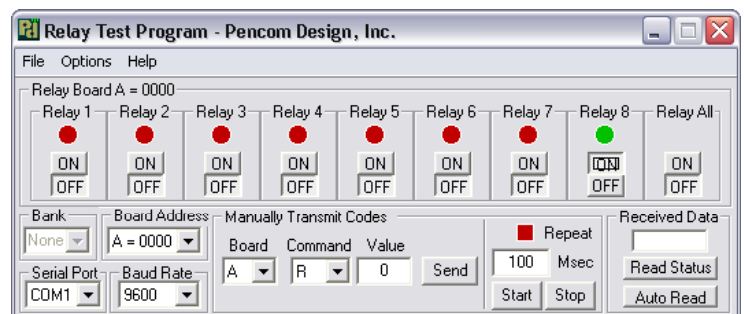


Multiple board configuration (with 2 USB and 1 or more RS232 boards on the same PC:

This configuration is almost identical to the multiple board configurations using one USB. The diagram in Figure 4, shows that multiple USB boards may be connected to a PC with additional RS232 boards daisy chained together. Each USB relay board is connected to another USB port, and the USB driver will create an additional virtual serial port.

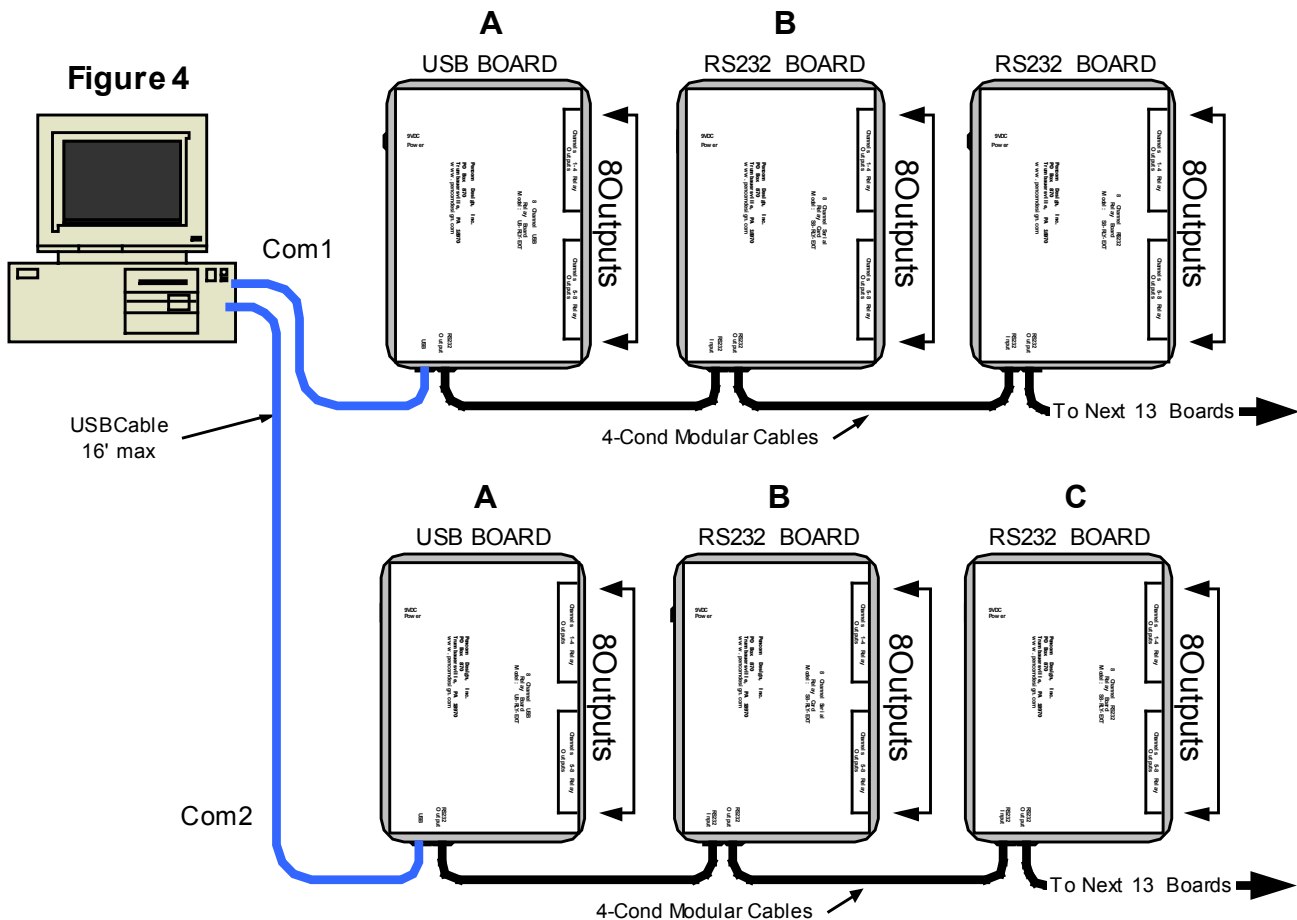
Additional USB relay boards may be connected, expanding the number of relays under computer control immensely. Each USB relay board, may have 15 additional RS232 relay boards connected to each unit.

Every board must be set to a different address to operate correctly and this is the same configuration as in Figure 3. The board address code range is between A and P, these letter address codes will be used as part of the command codes when sending serial data from the host to the relay board. The difference is that each chain of relay boards is accessed from a different virtual serial port.



Example: Assume the first daisy chain in Figure 4 is set to COM1 and COM2 as shown.

To activate relay #8 on board "A" on the first chain in the relay test program, you would set the serial port to COM1, board address to "A" and click relay #8 as shown in the RTP photo. To switch relay #1 on board "A" on the second daisy chain, you would change the serial port to COM2 and click on relay #2.



Connecting Relay Outputs

Connect the device that will be under computer control to the terminal blocks marked, NO (normally open), NC (normally closed), and COM (common) as shown in Figure 1. **Note:** Reed Relay versions only use the Common and NO connections, there is no connection to the NC position. 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 "COM" 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.

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.

I/O and opto-isolated ports

The 8 channel relay boards may be ordered with an 8 channel input/output port or an 8 channel opto-isolated input port depending on your requirements. These ports are used to read the status of a switch or other device (input), or active a device or light an LED (output). See application note #158 for additional details.

8 Channel Input / Output Port (optional)

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 setting up the pins as inputs and/or outputs.

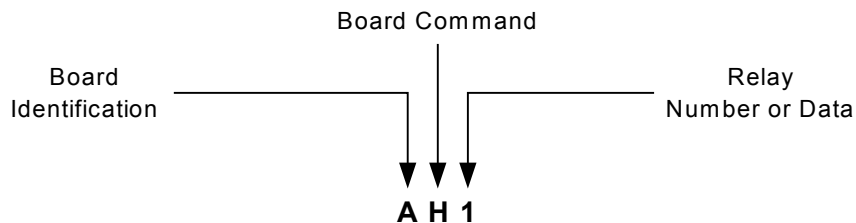
8 Channel Opto-Isolated Input Port (optional)

The opto-isolated input is the 2, 8 position terminal blocks at the bottom on the board in Figure 1 next to the USB connector. 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, and a carriage return must be sent to complete the string.

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>"

<u>Board Identification</u>	<u>Board Command</u>	<u>Relay Number or Data</u>
The Board ID is the letter code shown as the board address in Table 1.	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	(H,L,M,T) = Relay number 1-8 or 0 to turn ON all relays on the selected board (R) = receive a number 0 - 255 (W) = write a number 0 - 255

Board identification:

The board address is the first part of the command sent to the relay board(s) it ranges from A to P as shown in table 1. If your only using one board connected to the PC this command will always stay the same (factory default = A). If your using multiple boards, this part of the command will change depending on which board you want to address. The board address must be sent with any command. Note this command must be in uppercase.

Example: Dip switch setting = ON-OFF-ON-ON or (1011 in binary) = board address "L", you would replace the 'A' with a 'L' to address this board.

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. Note this command is case sensitive.

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 the 8 channel I/O or opto-isolated port.

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

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 from 1-8 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 255. 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 #2

Table #2									
Relay numbers								Decimal	Relays Active
8	7	6	5	4	3	2	1	Equivalent	
0	1	0	1	0	0	1	0	82	(relays 2,5,7 ON)
1	0	1	0	1	0	1	0	170	(relays 2,4,6,8 ON)
0	0	0	0	0	0	0	0	0	(All relays OFF)
1	1	1	1	1	1	1	1	255	(All relays ON)

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 255 representing which relays are active in the same method as explained above.

If the board command is “**M**”

Send a number from 1 to 8 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 8 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 **"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.

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
EOFEEnable = 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 CD. Select options>setup from the menu to load the setup window. Instructions for program operation are available in the help file. If using a non-windows environment a terminal program may be used to enter the setup program, an instruction document is located on the CD, or contact support for a copy.

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.

Additional information is available on our website at www.pencomdesign.com/support