## About use of diodes and their polarity

All diodes shown in below sections are required to eliminate so-called "Phantom-Buttons" effect which occurs in matrix key layouts when three or more buttons are pressed simultaneously. They are already included on the Key Matrix board. If you are using the Key Matrix board then don't bother reading this section.
The diodes shown are widely popular 1N4148 but may be any other type of low power fast switching diodes.
Since diodes are asymmetric devices it does matter which way you connect them. The black band shown on the diode in below illustration corresponds to polarity marking of 1N4148:
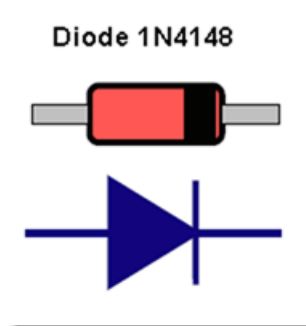

This band colour may be other colour depending on typical body colour of the diode. Other types may have different marking convention.
If you are not sure about the polarity of diodes you have you can easily test find this out by simple test described below:
1. Connect MJoy16 to PC via USB cable. Don't connect any digital controls yet. Make sure that Windows has installed the MJoy16 and open Game Controllers panel for "MJ16". This is done via Control Panel in Windows.
2. Take two wires Row A and Column 1 from MJoy16 digital inputs connector. When you connect these two wires together you should see Button 1 lighting up on "MJ16" panel.
3. Place the diode you have between these two wires in one or other way. When Button 1 lights up again make a note of the diode marking and remember this position as a reference.
4. When wiring all other controls use this reference to place all other diodes the same way.

Wiring digital controls
If you don't use Key Matrix board you will have to solder diodes directly to pushbuttons and switches. These diodes are necessary to avoid so-called "Phantom Buttons" presses. They should be soldered directly next to each button control. Below are some examples how pushbuttons and toggle switches are wired directly to MJoy16 board:
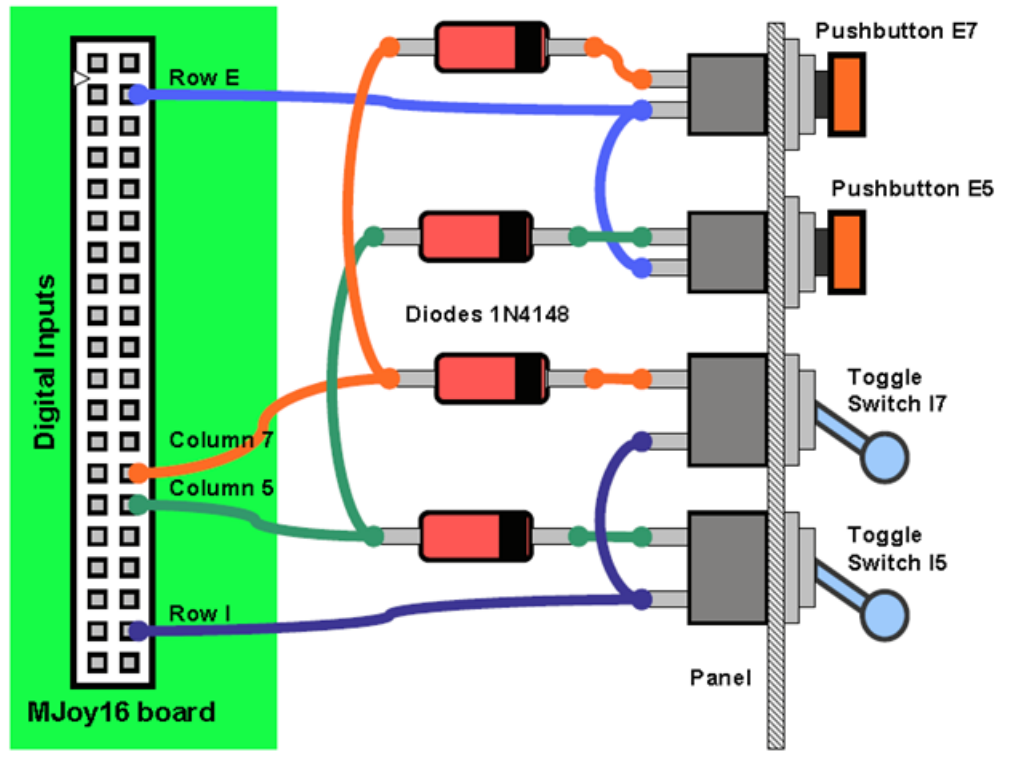
Wiring pushbuttons

If you don't use Key Matrix board you will need to solder a diode in series to one of the pushbutton pins.
A wiring example is shown below:
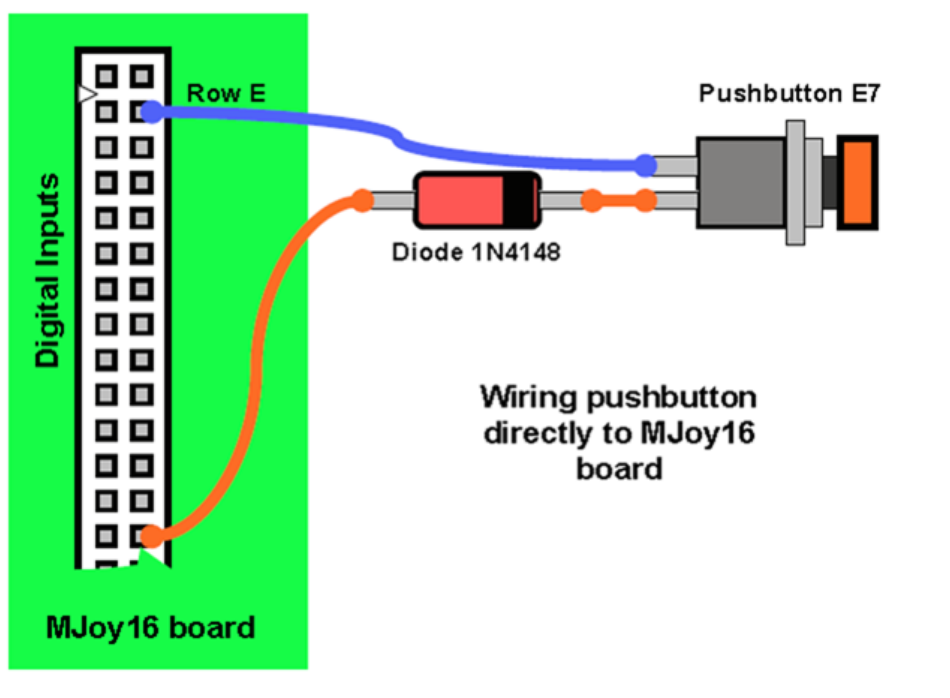
Wiring toggle switches

Toggle switches can be single throw or double throw. MJoy16-C1 is mainly designed for single throw toggle switches but double throw toggles may also be used if required by your cockpit application.

Single throw toggle switches have two positions: "On" and "Off". Single throw toggle switches are wired exactly as pushbuttons so please refer to pushbutton wiring description for wiring the single throw toggle switch.

Double throw toggle switches have three positions: "On1", "Off" and "On2". "Off" is the middle position. These toggle switches use 2 pairs of contacts on keys matrix. The principle of connecting them is that common pin is connected to Column signal wire and the other two pins are connected to different Row signal wires. Below is example of wiring double throw toggle switch without Key Matrix board:
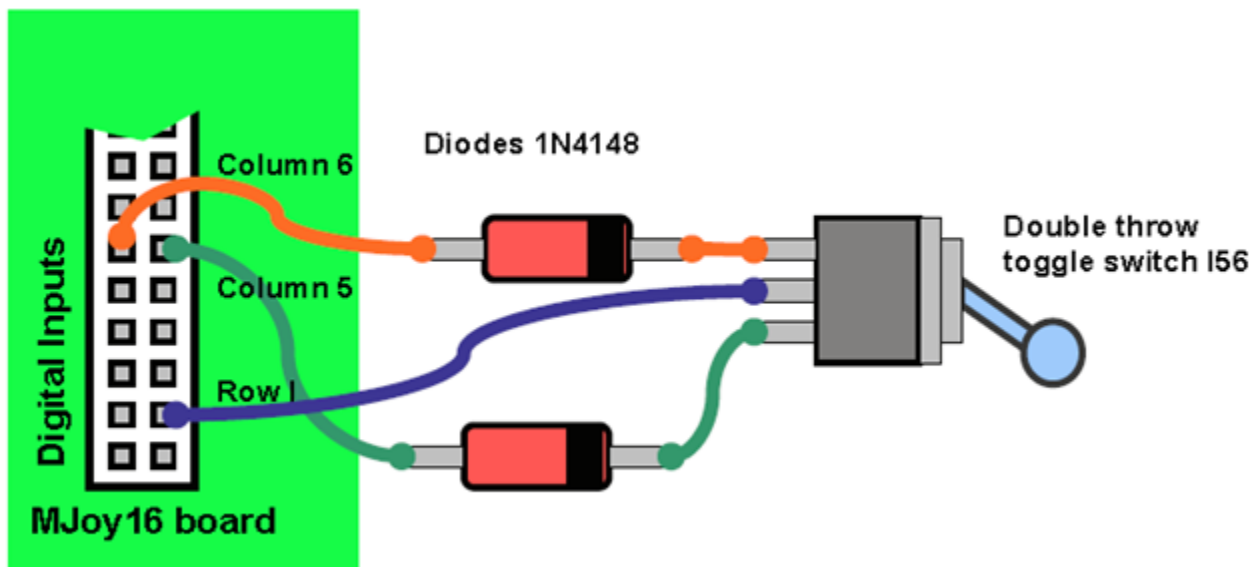
Wiring rotary switches

Wiring of phase shifted rotary switches is similar to wiring of double throw toggle switches. The first thing is to find out which pin on the rotary switch is common. Its position depends on the type of rotary. On some rotary switches it may be in the middle but some may have it on one side.
Below is an example how to directly wire a rotary switch to the MJoy16 board:

Wiring rotary switch to MJoy16 board
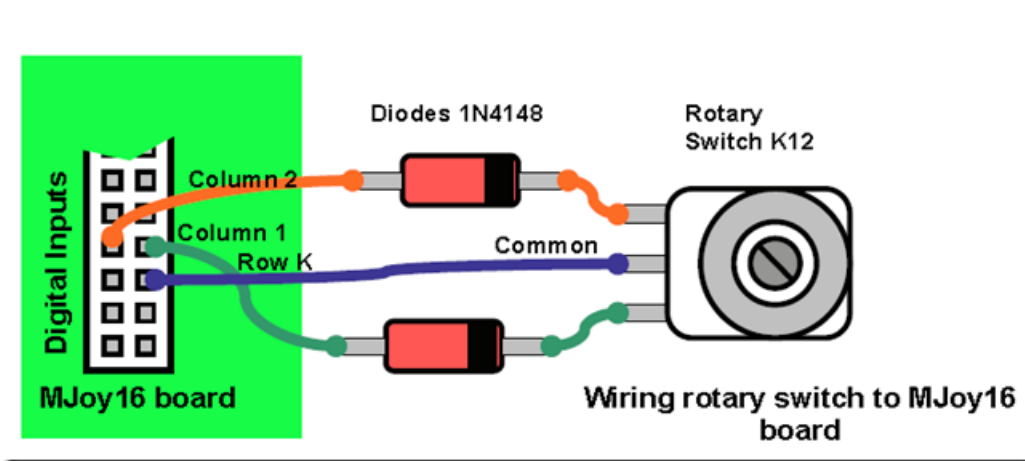
Wiring Hat switch

Hat switch is 8-way hat switch and it is made of 4 microswitches arranged on 4 sides of hat switch enclosure. A small joystick handle presses one or two switches at a time depending on angle of deflection. When only one switch is pressed it gives four main directions at 90 degrees angles:
"UP", "RIGHT", "DOWN" and "LEFT".

When two switches are pressed it gives intermediate directions: "UP-RIGHT", "UP-LEFT", "DOWN-RIGHT" and "DOWN-LEFT".

Below is a diagram showing how to wire the hat switch directly to the MJoy16 board: