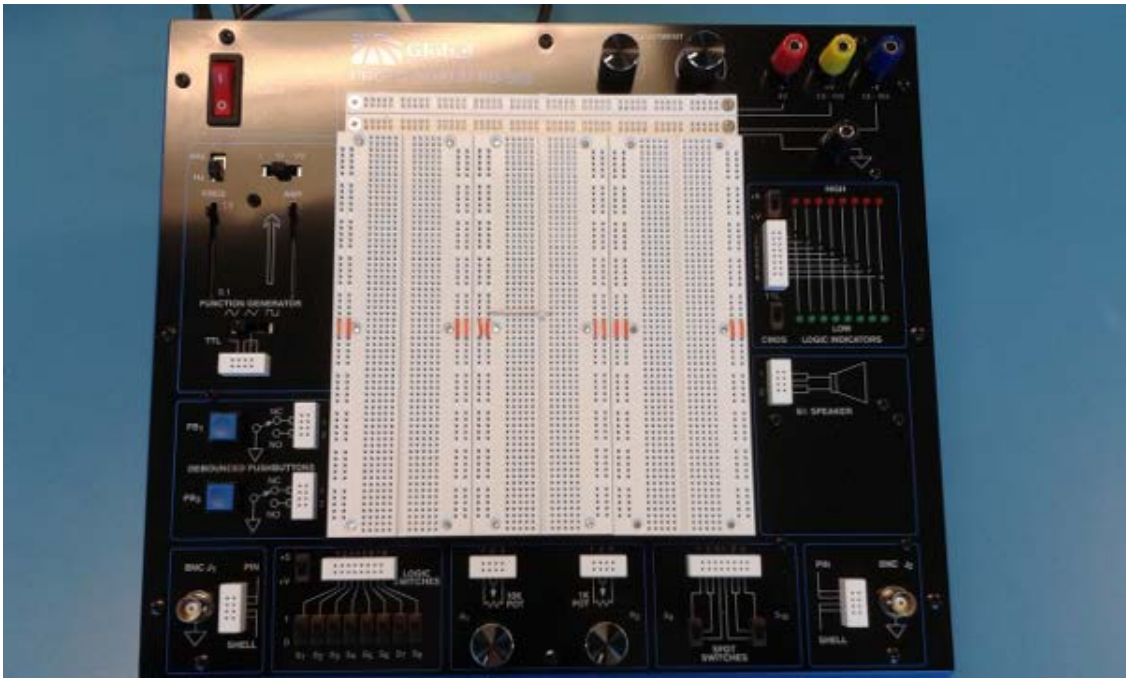
Proto-Board Tutorial

PB-503



The Global Specialties Proto-Board PB-503 is used to connect and test electrical circuits. It contains three breadboard units and several peripheral devices including power supplies, LEDs, a speaker, various switches, potentiometers, and a function generator. This document only covers the devices that we use in EE271.

Power Supplies

As shown in Figure 1, the row of holes along the top of the breadboard is connected to the internal fixed +5V power supply. The white line on the PB-503 to the right of the top row indicates that this row is also connected to the red +5V connector.

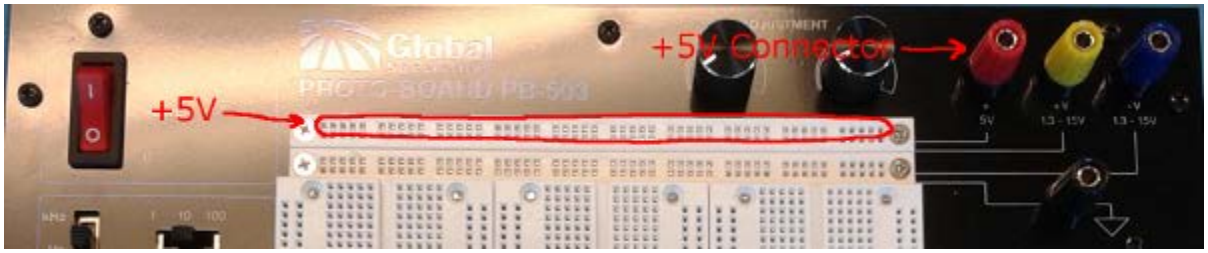


Figure 1: Fixed +5V supply

In a similar way, the second row of holes is connected to the internal positive variable supply, which has a knob that can adjust the voltage between 1.3 and 15 Volts (see Figure 2).

Figure 2: Variable positive supply

The third row of holes is connected internally to the negative variable supply, and the other knob is used to adjust the voltage between -1.3V to -15V. The fourth row of holes is connected internally to ground.

Since these top four rows are connected to the internal power supplies inside of the PB-503, **do NOT connect any external power supply to these rows!**

Logic Indicators

The Logic Indicators (see Figure 3) are a set of LEDs that indicate the logic level (voltage) of a digital circuit. The +5/+V switch should be set to +5 if the power supply for the circuit is 5V, or to +V if the variable positive supply is used as the power supply. The TTL/CMOS switch should be set to TTL for TTL logic circuits and CMOS for CMOS logic circuits.

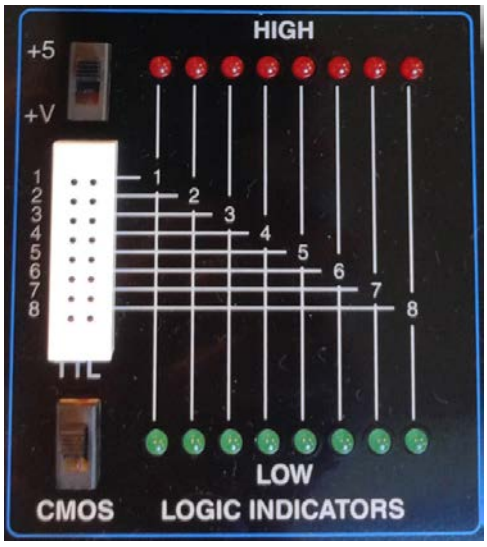


Figure 3: Logic Indicators

Speaker

As the white lines on the PB-503 indicate, the top two rows of holes are connected internally to one side of the speaker, and the bottom two rows are connected to the other side of the speaker (Figure 4).

Figure 4: Speaker

Potentiometers

The potentiometers are variable resistors (see Figure 5). As the white lines on the PB-503 indicate, the two holes on the left are connected to one side of the potentiometer, the middle four holes are connected to the adjustable part called the wiper, and the two holes on the right are connected to the other side of the potentiometer.

The potentiometer can be modeled as two resistors in series as shown in Figure 6. When the knob is turned all the way counter-clockwise, the resistance R_1 will be 0Ω and R_2 will be the maximum value (which is about 10 kΩ for the 10K POT or about 1 kΩ for the 1K POT). When the knob is turned all the way clockwise, the resistance R_1 will be the maximum value and R_2 will be 0Ω. Regardless of where the knob is set, the sum of the two resistors (which is the resistance between pin 1 and pin 3) always equals the maximum value: $R_1 + R_2$ = maximum value.

Figure 5: Potentiometers

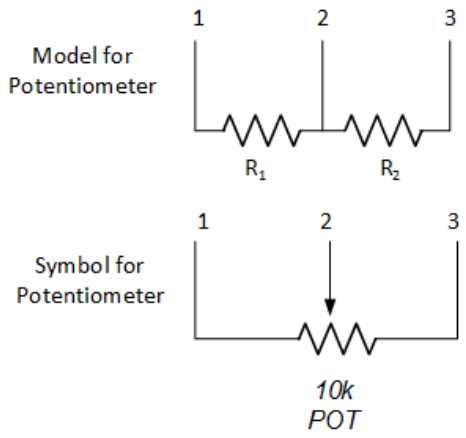


Figure 6: Electrical Model for Potentiometer

Logic Switches

The eight logic switches shown in Figure 7 provide an easy way to generate binary signals. For switch S_1, for example, both of the holes that are circled and labeled S_1 in Figure 7 are the output of the switch. When the switch is down, the outputs are connected to ground (0 Volts). When the switch is up, the outputs are connected to either the internal fixed +5V supply or the internal positive variable supply (+V) depending on the Source switch. So, for example, to use switch S_1 to generate either 0V or 4V, we would adjust the internal positive variable supply (+V) to 4V (see the Power Supplies section above for details), set the Source switch to +V, and take the output from one of the two holes that are circled in Figure 7.

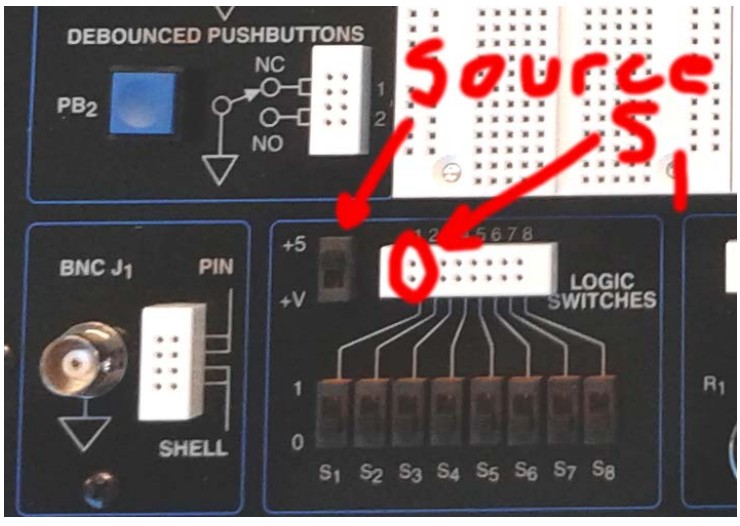


Figure 7: Logic Switches

Debounced Pushbuttons

When a mechanical switch closes, the contacts often bounce, which causes it to open and close a few times. The Debounced Pushbuttons (see Figure 8) have a circuit that ensures that output will not bounce. The NC (Normally Closed) contact is connected to ground internally when the switch is not pressed, and is open when the switch is pressed. The NO (Normally Open) contact is open when the switch is not pressed, and is connected to ground internally when the switch is pressed. Often a pull-up resistor is connected to the switch to pull the output to the power supply voltage when the switch is open.

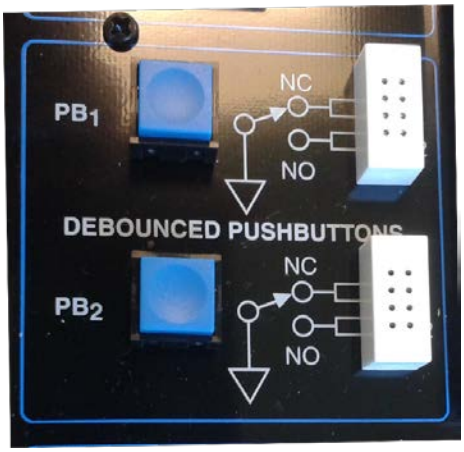


Figure 8: Debounced Pushbuttons

BNC Connectors

There are two BNC connectors (see Figure 9) that make it convenient to connect BNC cables to the breadboard. As the white lines on the PB-503 indicate, the top two rows of holes are connected to PIN, which is the inside conductor of the BNC cable that carries the signal, and the bottom two rows are connected to SHELL, which is connected to ground internally by the Protoboard.

Figure 9: BNC Connector