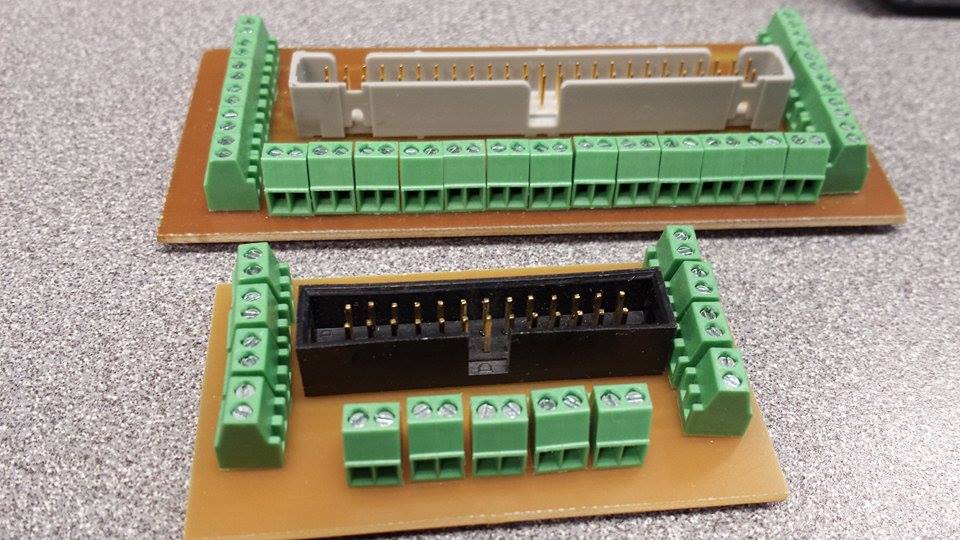
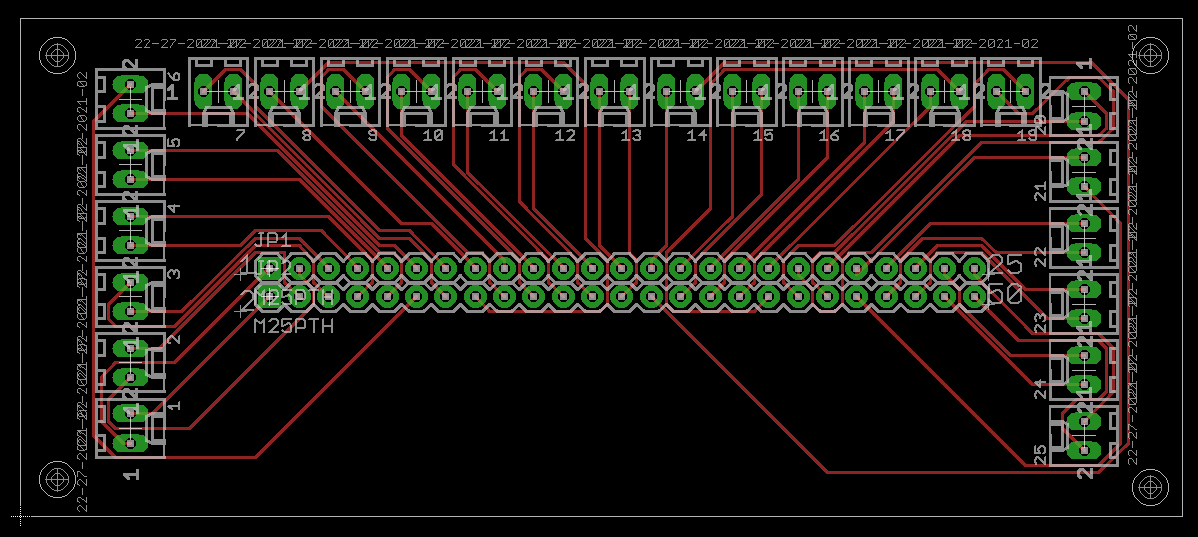
**Breakout Boards:**

To easily connect to the Sensoray 826 board, several breakout boards with screw terminals were made. There are two types of break out boards, a 50-pin board and a 26-pin board. 50 pin boards are used to connect to the digital and analog pins of the control board, while 26 pin boards are used to connect to the various counter channels. Shown below are mages of the boards them selves. With the empty side of the board facing you, the screw terminals are in order from 1 to 50/26 starting on the right hand side.

**Image of board:**



**Layout:**



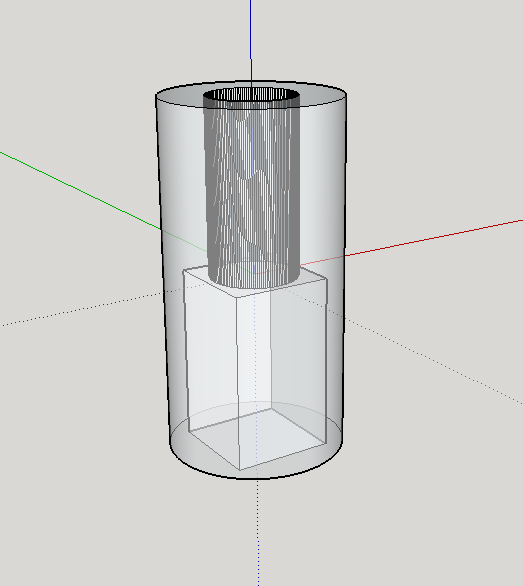
**Temperature Sensor:**

An infrared temperature sensor will be used to measure the temperature surrounding the weld area. These temperature sensors typically have a higher operating range than other types of temperature sensors. The chosen sensor is the CTLM-1M-1H1-CTL-CF4 from Micro-Epsilon. This sensor was chosen of it’s operating range was 800C to 2200C. It has multiple configurable output types, including current output, voltage output, and alarm outputs. This sensor also has a focus point at 450mm (~18 in) which gives considerable distance from the weld, and it is not impractically far away. Further documentation can be found [here](../Documentation/Datasheets%20and%20Manuals/man--thermoMETER-CTL--en.pdf). The Sponsor has agreed to take care of mounting the sensor on the machine.

The chosen output type of the temperature sensor is chosen to be a voltage output with a full-scale range of 0V to 10V. This range was chosen because the ADC on the Sensoray 826 are configurable to accept up to +10V and another Analog input needed the input configured to +10V. Setting the output range to 0V-10V on the current sensor removed the need to write additional software to solve an issue that was solved in other means.

**Incremental Encoder:**

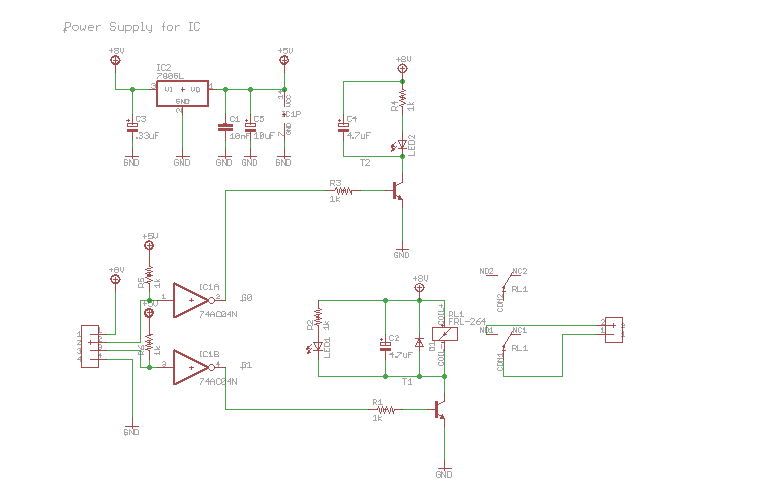
The Incremental Encoder is used to measure the actual wire speed of the welder wire. The encoder needed to be incremental because of the need to know speed, and that current position did not matter. The chosen encoder is the U.S. Digital S5-5000-250-IE-D-B. Initially a pulley on a shaft type encoder was going to be used. The pulley be mounted to the frame of the welder and the encoder would be placed under tension underneath the wire that is being fed to the weld. However this was not successful as there could not be any external tension placed on the wire inside the welder.

Fortunately the main drive pulley has a square drive shaft and stuck out past the edge of the pulley. A small plastic “coupler” piece was 3D printed that adapted the round end of the encoder, to the square drive shaft of the drive pulley. The CAD drawing of this part can be seen to the left. This piece allowed an accurate measurement of the actual wire speed of the welder to be interpreted by the Sensoray 826. [Here](../Hand%20Calculations/Wire%20Speed%20with%20Encoder.pdf), the calculations for the wire speed can be found.

**Relay and Indication Module:**

A relay was used to interface the Sensoray 826 with the welder. A relay provides isolation from any harmful voltage spike that occurs on the welder’s circuit. It also acts as a mechanical switch, which is the same as the trigger on the welder gun itself. It is unknown what type of signal is passed through the welder switch weather its DC, or AC the relay will on act differently, as a transistor might. The interface circuit includes a transistor drive circuit that switches an 8V supply (which comes from a wall wart power supply) across the coil of the relay on and off. This module also includes LEDs to indicate what state the CNC machine is currently in. A schematic and an image of the final module can be seen below.

There were some issues with the relay module, where were that the Sensoray 826 has internal 10k pull up resistors, and when the machine powers up, the active low DIO pins are initialized to a 0-state, which means that the voltage is high on the pin. When connected to the welder, this meant that when there was not any code being executed the welder would be activated. To remedy this issue, an inverter was placed on the input.

Schematic:

Layout:

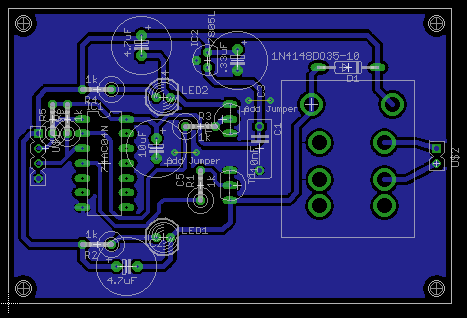


Image:

**Stepper Motor Controller:**

**PWM Controller:**

**Current Sensor:**

**Wire Speed Home Switch:**