Talon SRX Adapter Boards

Breakout and 5v to 3.3v Analog Converter

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Introduction

For a team whose history exceeds almost 13 years, The Zebracorns have little experience with creating custom circuit boards. Considering this, along with what we perceived as a lack of a perfect Talon SRX breakout, we began the design of a few boards to develop the skills of our students and, hopefully, provide a low-cost and effective breakout board to the community.

Our design process began with the identification of desirable features not currently offered by other boards. Namely, we wanted a board that mounts directly to the Talon (there are bolt holes just asking to be mounted) and has breakout pins to facilitate easy connection/disconnection rather than solder pads. Also, we wanted to provide an opportunity to develop the aspiring electrical engineers on our team. A few adapter boards designed in production grade software, Altium, seemed like the perfect opportunity.

Design

Altium Designer was used for this project mainly because of its heavy use in industry. Eagle and Fritzing were both considered, but after review, Altium's features and widespread adoption made it the most appealing software. Additionally, Altium is the only program which can easily render and export boards to 3D models for use in Solidworks. This makes enclosure design ridiculously easy.

To begin the design of the actual board, several parts were created as Altium's built-in libraries are limited to the most common parts and connectors. The general workflow consists of creating a Parts Library in Altium, then creating a Schematic Library and PCB Library within that Parts Library. A library is simply a repository for all parts. Our team uses one central library to store all team-created parts.

Within a Schematic Library, a symbol for the part is drawn using the software's built-in tools, and pins are added to facilitate connections to other symbols (**FIG. A**). A PCB footprint can then be created in the PCB Library. As with schematic symbols, PCB footprints are easily created in Altium using built-in tools (**FIG. B**). Data sheets for the Talon SRX[1] and each of our electrical components provided dimensions, so footprint creation simply consisted of placing pads and setting coordinates. After adding designators to each pad, a footprint and its pads could be linked to a schematic symbol and its pins. Additionally, a 3D model could be added to the part from a STEP file by importing and dragging it to align with its footprint.

[1] http://content.vexrobotics.com/vexpro/pdf/Victor-SP-Talon-SRX-Info-Sheet-20140819.pdf

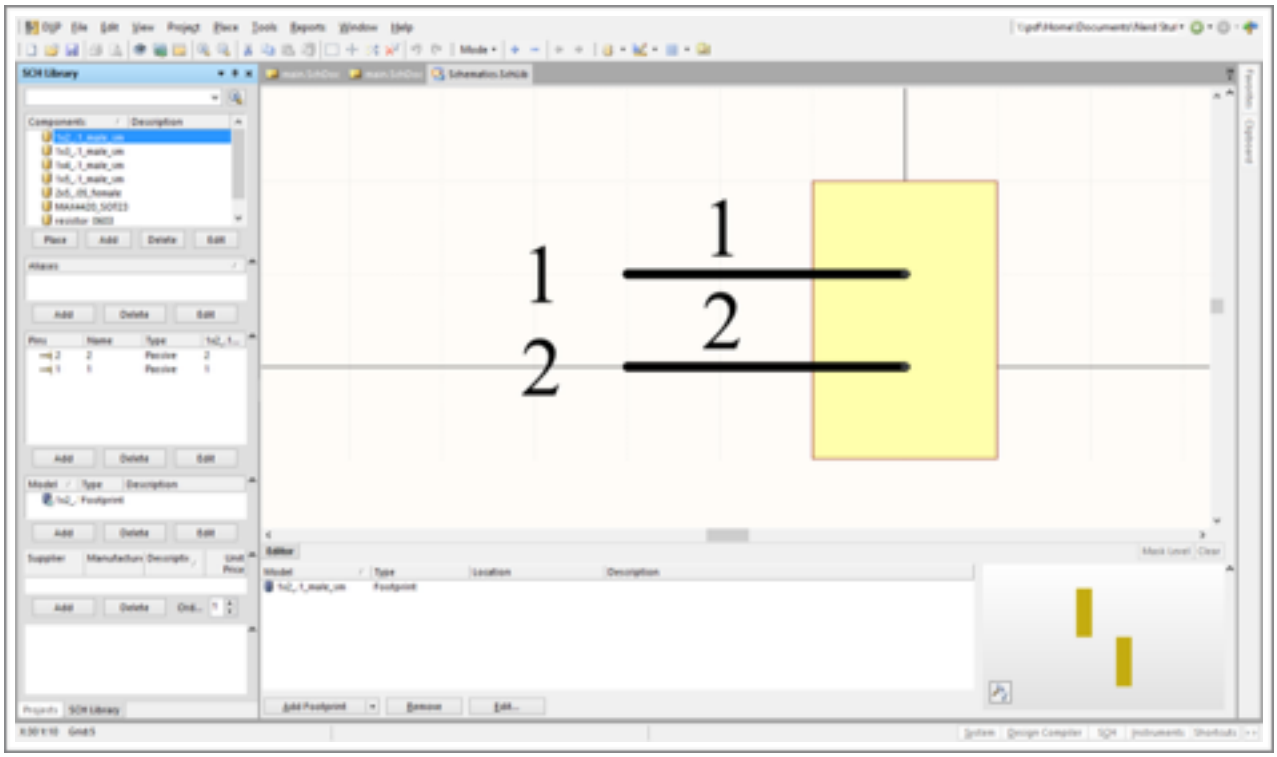


FIG. A

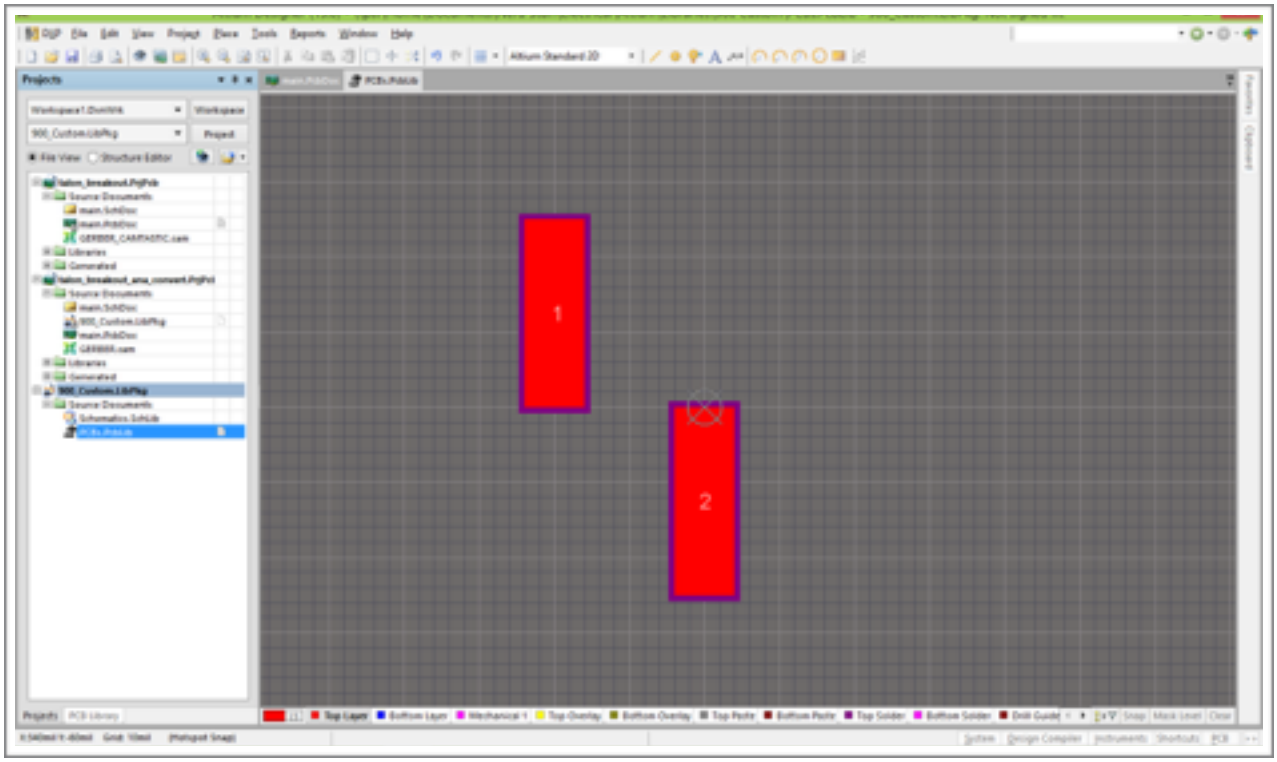


FIG. B

Talon SRX Breakout

This board design was tricky due to wire routing. After placing components, we had to route traces while keeping in mind design and manufacturing constraints such as the allowable distance between traces and other components. We also specifically desired a one-sided board to prevent accidental shorting from contact with the face of the Talon. This board proved especially tricky because many of its connections crossed. After routing all signal wires successfully, we were left with one ground trace surrounded by other wires. To route this to its ground pin, we used a copper fill, which should work just fine (**FIG. C**).

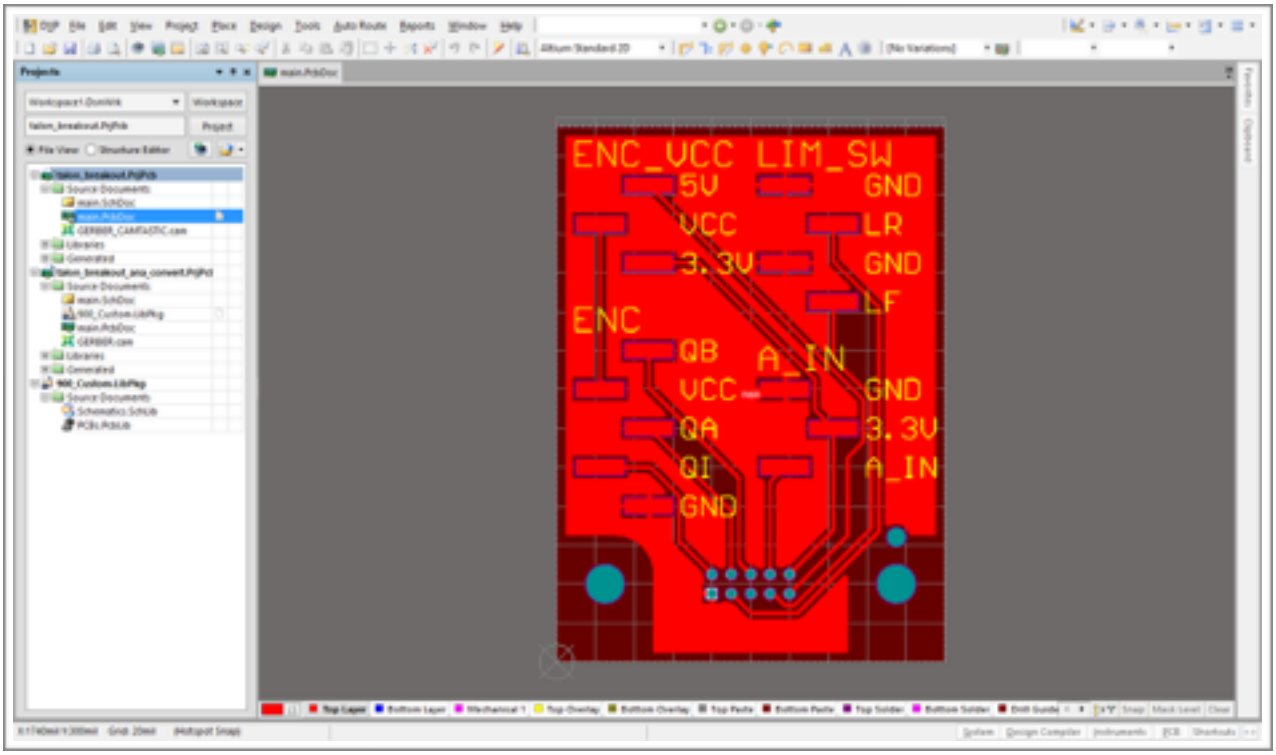


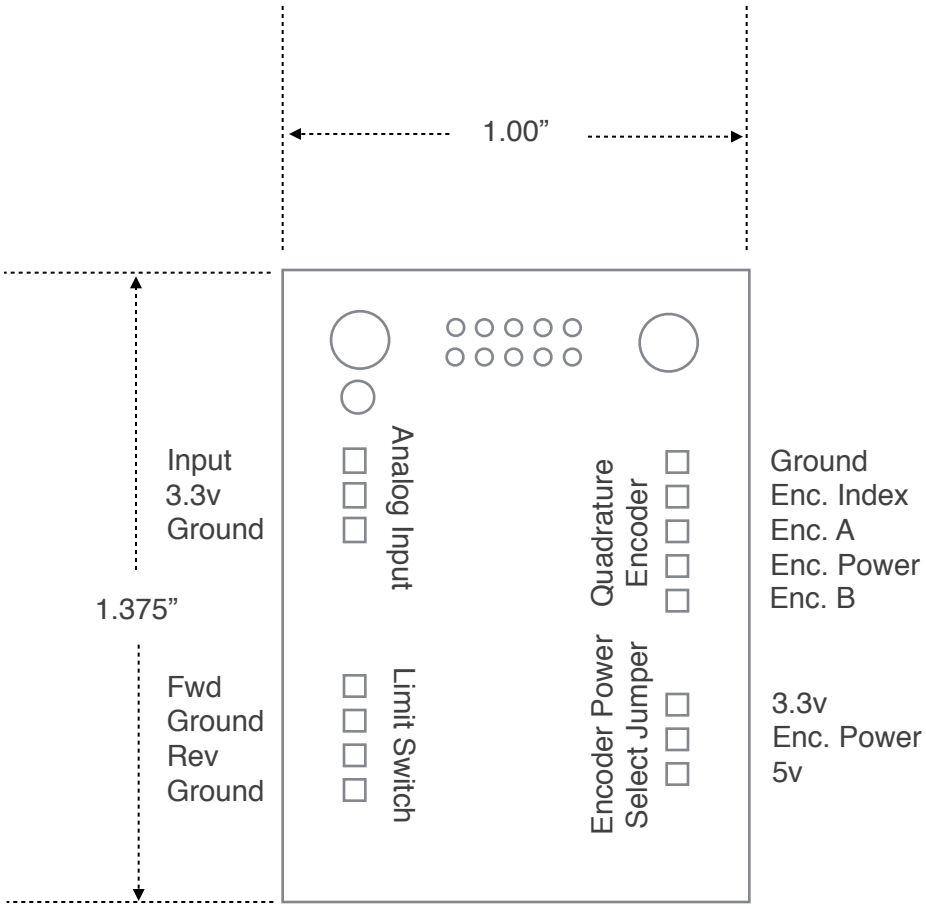
FIG. C

Additionally, just to play it safe, we left enough space between the mounting holes on the PCB and any copper to fit a bolt head. This way, if someone wishes to be rough while mounting their board, scratches in the board's silkscreen will not give way to a short between the bolt head, copper fill, and a trace.

Parts List

- 2x 0.1" Pitch 3-Pin Surface Mount Male Header (http://www.digikey.com/product-detail/en/M20-8770342/952-1951-ND/3727918)
- 1x 0.1" Pitch 4-Pin Surface Mount Male Header (http://www.digikey.com/product-detail/en/M20-8770442/952-2353-ND/3906342)
- 1x 0.1" Pitch 5-Pin Sufrace Mount Male Header (http://www.digikey.com/product-detail/en/961105-6300-AR-PR/3M9487CT-ND/2071622)
- 1x 0.05" Pitch 10-Pin Through-Hole Talon Connector (http://www.digikey.com/product-search/en?KeyWords=609-3754-ND&WT.z_header=search_go)

Technical Specifications and Pinout

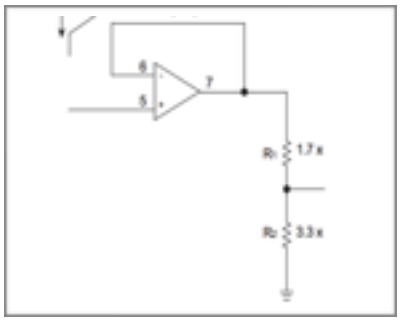


Full Feature Spec

3.3v Analog Input
Forward and Reverse Limit Switch Breakout
Quadrature Encoder Breakout with Selectable 3.3v/5v Encoder Power
Low-Cost One-Sided Board
Compact
Talon SRX Mounting Holes

Talon SRX Analog Breakout

The analog breakout board was built to facilitate a 5v analog input to the Talon SRX, which normally only accepts a 3.3v input. The board features a built-in 5v to 3.3v analog signal converter using an op-amp and resistor attenuator. This design was partially inspired by Cross the Road's analog breakout[2] and uses a circuit published by Microchip[3].



Active Analog Attenuator Circuit from Microchip

The heart of this chip lies in the unity gain buffer amplifier op-amp circuit. This outputs the same signal as the input but draws power from a separate source, which allows a device to pull as much power from the circuit as necessary without affecting the input signal. Following the op-amp circuit is a resistor attenuator, also known as a voltage divider. The complete circuit is shown to the right where R1 is 66.5k and R2 is 33.2k to produce a voltage of 3.3v.

Parts List

- 1x Op Amp MAX4470 (http://www.digikey.com/product-detail/en/MAX4470EXK%2BT/MAX4470EXK%2BTCT-ND/2234361)
- 1x SMD 66.5k resistor (http://www.digikey.com/product-detail/en/RMCF0603FT66K5/RMCF0603FT66K5CT-ND/1943108)
- 1x SMD 33.2k resistor (http://www.digikey.com/product-detail/en/RMCF0603FT33K2/RMCF0603FT33K2CT-ND/1943091)
- 1x 0.05" Pitch 10-Pin Through-Hole Talon Connector (http://www.digikey.com/product-search/en?KeyWords=609-3754-ND&WT.z_header=search_go)
- 1x 0.1" Pitch 3-Pin SMD male header (http://www.digikey.com/product-detail/en/M20-8770342/952-1951-ND/3727918)
- 1x 0.1" Pitch 4-Pin SMD male header (http://www.digikey.com/product-detail/en/M20-8770442/952-2353-ND/3906342)

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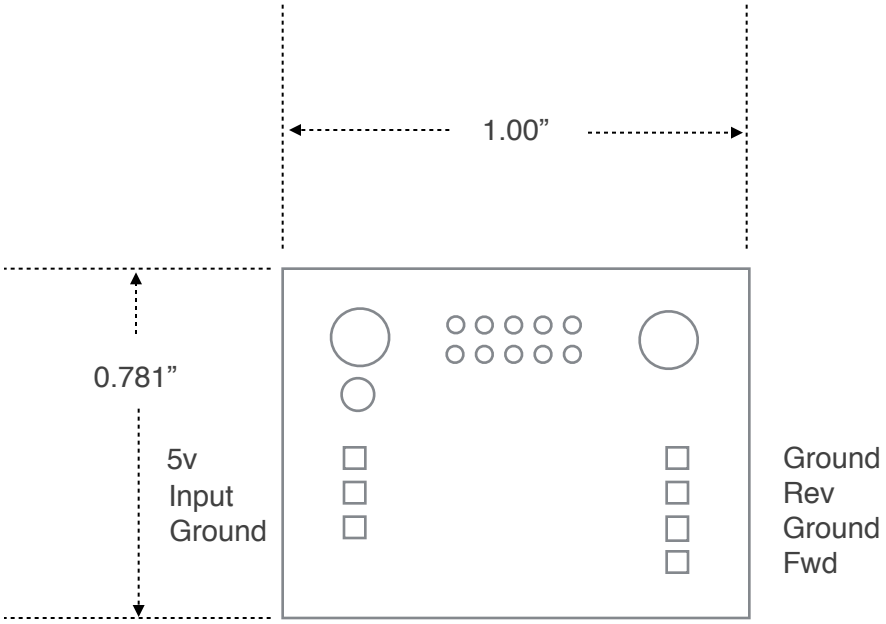
[2] http://www.vexrobotics.com/217-4401.html

[3] http://ww1.microchip.com/downloads/en/DeviceDoc/chapter%208.pdf

Technical Specifications and Pinout



Full Feature Spec

5v Analog Signal Input to 3.3v
Compact
Mounts directly to Talon; no cables required
Low-Cost One-Sided Board
Forward and Reverse Limit Switch Breakout