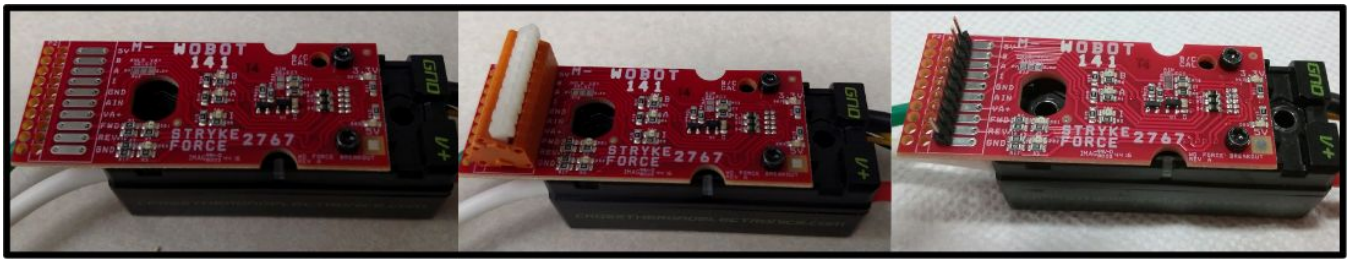
The Sentinel - Talon-SRX Breakout Board, rev A
User's Guide

December 13, 2016 - document rev A

Thank you for purchasing the the Sentinel Talon-SRX Breakout Board. Within this guide, you will find information on how to install, operate, and troubleshoot the breakout board. Sections are included detailing the functions of the Board, how to mount your breakout board onto a Talon and wire it, the status LEDs and what they indicate, and other information necessary to fully utilize the product.



To the left, the basic the Sentinel Talon-SRX Breakout Board. The center view is of the Sentinel Talon-SRX Breakout Board shown with a WAGO 233-510 quick-release terminal block. To the right is the Sentinel shown with a header pin strip.

History and Collaboration:

The idea for the the Sentinel Talon-SRX Breakout Board was conceived after FIRST Robotics Teams 141 and 2767 had experiences with breakout boards that had compatibility or ease of use issues when used with the Talon SRX.

In order to create an effective and easy to use interface between the Talon SRX and external electrical components, the mentors and high school students of both teams collaborated in order to develop the the Sentinel Talon-SRX Breakout Board.

The process of developing this product has not only produced an electrical part that will allow FIRST robotics teams to more easily interface external components to the Talon-SRX motor controller, but has also provided a learning experience for the students of both teams, allowing them to gain insight into the worlds of marketing, product design, engineering, manufacturing, and sales.

You will notice that WOBOT 141 and Stryke Force 2767 appear on the PCB silkscreen.

What's Included:

One the Sentinel Breakout Board, rev A.
One quick-setup card with a link for current user information.

Functions of the the Sentinel Breakout Board:

The the Sentinel Breakout Board acts as an interface between real-world devices and the Talon-SRX, as a way to secure and easily connect external wiring, and as a signal and power monitoring device.

The breakout board powers and accepts input signals from quadrature encoders; it supports A, B, and Index signals.

It also provides inputs for forward and reverse travel limit switches.

In addition, it provides power for and accepts a signal from an analog device with a 0-3.3V or 0-5V output signal. This signal input is high impedance. The breakout board buffers this signal, and provides a low impedance, properly scaled analog output signal to the Talon-SRX.

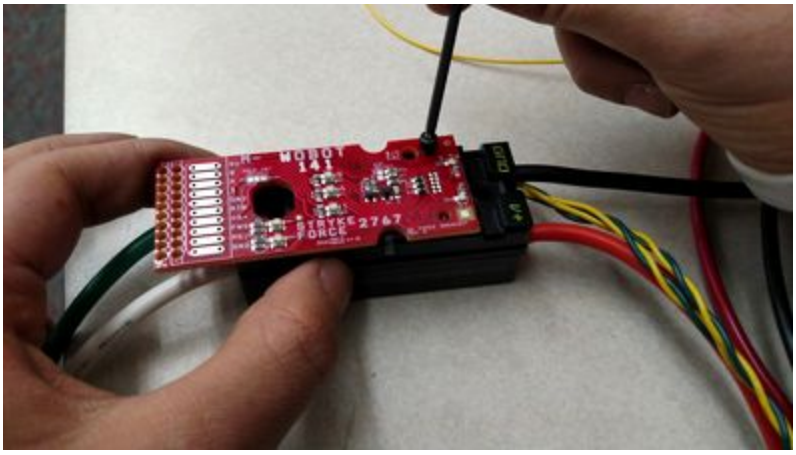
LED indicators on the breakout board indicate the status of the 3.3VDC and 5VDC power, the encoder A and B quadrature and Index signals, and the states of the forward and reverse travel limit switches.

The the Sentinel Breakout Board is compatible with all Talon-SRX versions, and adds special protection to early-version Talons prior to version 1.7. For additional information, refer to the Talon user's guide.

Wiring Options:

The breakout board may be wired before or after mounting to a Talon-SRX. We will choose to cover mounting first. You may choose either option. Please follow the recommendations in the following sections when mounting and wiring your the Sentinel Talon-SRX Breakout Board.

Mounting the Breakout Board:



Previewed is the mounting of the breakout board to the Talon-SRX.

Remove the two #4-40 screws from the Talon-SRX and remove the clear header cover. Remove the breakout board from its packaging and mount it to the Talon-SRX, very carefully centering and mating the 10-pin breakout board female connector to the 10-pin Talon-SRX male header.

After mating the connectors, you must check to make sure you can see the threaded holes in the Talon-SRX centered in the mounting holes of the breakout board. If you see half-a-hole, the connectors are mismated. If this occurs, you must try again until the threaded holes appear centered in the breakout board mounting holes!

The breakout board must be oriented so that the solder pads for connecting to external devices (or the WAGO terminal block, if installed) are near the end of the Talon-SRX that the green and white motor wires exit from.

Once the breakout board is mated to the Talon-SRX, replace and tighten the two #4-40 screws through the holes provided in the breakout board. Use care not to overtighten the screws.

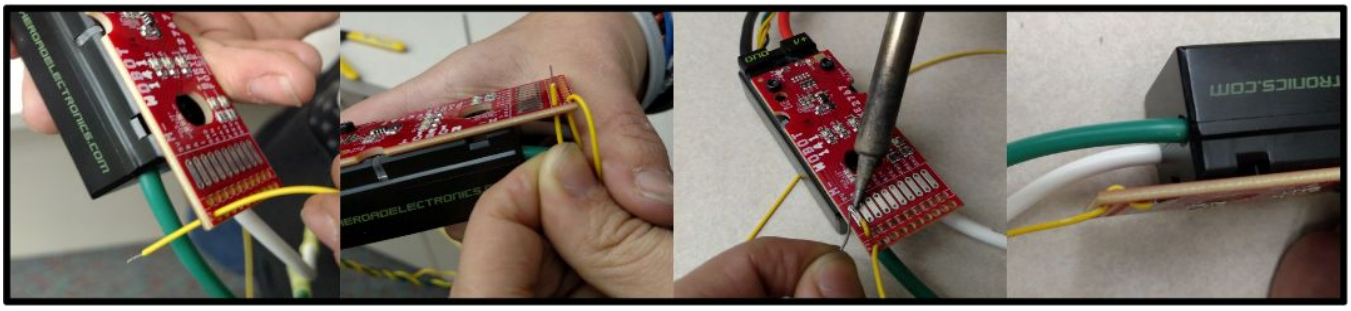
Note: There is no need to insulate the Sentinel from the Talon, as the bottom traces on the PCB have been carefully located in areas where the aluminum heat sink has recesses. You should mount the Sentinel directly to the Talon-SRX.

Note that the breakout board has a large hole near the external connections end. This hole allows a nut that is thicker than normal (such as a nylock nut) to be used to hold the Talon down without interfering with the breakout board.

Wiring the Breakout Board:

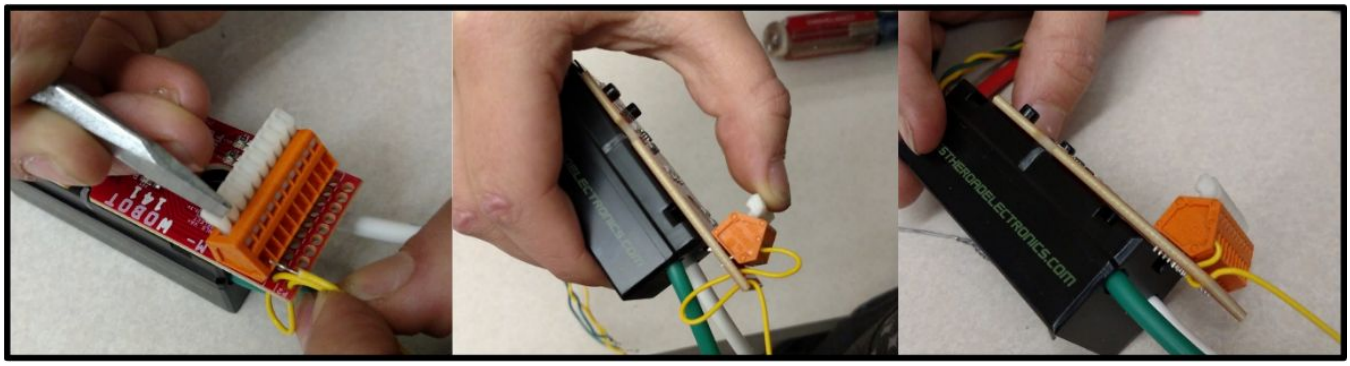
The the Sentinel Breakout Board can be wired two ways. You may choose to solder the wires to the pads at the connection end of the breakout board, or you may obtain and install a WAGO part number 233-510 terminal block (or any other terminal block or header with a 0.1 inch pin spacing) over the same pads and wire to the quick-release terminals. When soldering a quick -release terminal block to the pads, orient the block so that the wire entry openings of the terminals face the ten wire strain-relief holes in the edge of the breakout board. The WAGO 233-510 terminal block is available from Newark Electronics and other electronic distribution outlets.

There are holes near the edge of the breakout board are for wires from external components to be be threaded through for strain relief. These holes are sized to accept typical PVC insulated hookup wires from 22 AWG to 26 AWG. If your wire is larger than the holes provided, it probably does not need strain relief.



Shown above is the process of soldering the wires onto the breakout board.

If soldering wires to the breakout board, strip the insulation from the wire end for about ¼ inch and tin the wire end. Insert the wire through the bottom side of the hole in the breakout board, pull it upward through the hole, and fold the previously stripped and tinned wire end over to be soldered to the corresponding pad on the breakout board. Tug the wire back down through the hole in order to snug the wire between the solder pad and the hole.



Shown above is the process of wiring to the WAGO terminal strip.

If wiring to a WAGO or similar quick-release terminal block, use the procedure listed above to prepare the wire for insertion into the terminal strip. It is not absolutely necessary to tin the wire end, but it does help to control loose strands from becoming a short-circuit hazard. If tinned wires are used with the terminal block, do not use excessive amounts of solder when tinning larger gauge wire, or it may not fit into the terminal.

The WAGO 233-510 terminal block is designed to accept wire sizes within the range of 20 to 26 gauge. Most encoders and analog devices will have cables with wires within this size range.

Note: Only one wire may be inserted into each quick-release terminal; if multiple wires must be inserted into a single terminal or soldered onto a single pad, join multiple wires into a single wire externally to the breakout board, then thread the single wire through the board and insert it into the quick-release terminal or solder it to the appropriate pad.

Very Important Note: Do not connect the encoder power (5V) and analog power (VA+) pads together or serious damage may occur to the breakout board or Talon-SRX.

Connecting External Devices; Pad/Terminal Descriptions:

5V - Provides 5VDC power to the encoder. The chosen encoder should operate with 40mA or less supply current from this source.

Very Important Note: If you want to use an encoder that requires an external supply voltage above 5 VDC, the encoder must have open collector type outputs. The encoder inputs to the Sentinel must not be pulled above 5 VDC or the Talon will be damaged. We recommend choosing and powering a suitable 3.3 or 5VDC encoder from the Sentinel. If the encoder is powered from the Sentinel, it may have either open collector or driven outputs (push-pull).

B - accepts the B channel quadrature input signal from the encoder. The encoder's B channel signal driver should be able to sink 3mA to operate correctly with this breakout board.

A - accepts the A channel quadrature input signal from the encoder. The encoder's A channel signal driver should be able to sink 3mA to operate correctly with this breakout board.

I - accepts the Index channel input signal from the encoder. The encoder's I channel signal driver should be able to sink 3mA to operate correctly with this breakout board. Note: This channel will also accept a PWM-style absolute encoder output on this channel as long as it will sink 3mA.

GND - Common power return for the encoder and the analog device. (Pin is located between **A** and **AIN**).

VA+ - Provides 3.3VDC or 5VDC power to the analog device. The chosen analog device should operate with 20mA or less supply current if it is powered by 3.3VDC, and no more than 40mA if it is

powered by 5VDC. Refer to the Solder Jumper section of this guide for instructions on how to select the supply voltage for the analog device.

Very Important Note: If you want to run an encoder and an analog device both on 5VDC, the sum of both devices current requirements must not exceed 40mA. The Talon-SRX has 50mA available at 5VDC, and 30mA available at 3.3VDC. The breakout board consumes 6mA from the 5VDC supply and 8mA from the 3.3VDC supply.

AIN - Accepts either a 0-3.3VDC or a 0-5VDC range analog signal. Refer to the Solder Jumper section of this guide for instructions on how to select the signal range the breakout board will accept.

FWD - Connects to a forward travel limit switch. The FWD switch is connected between this input and ground. The switch may be a normally open or a normally closed switch (the Talon software can be set to operate with either type of limit switch, but the default setting is for normally open switches). The FWD LED will illuminate when the switch contacts are closed.

REV - Connects to a reverse travel limit switch. The REV switch is connected between this input and ground. The switch may be a normally open or a normally closed switch (the Talon software can be set to operate with either type of limit switch, but the default setting is for normally open switches). The REV LED will illuminate when the switch contacts are closed.

GND - Common power return for the FWD and REV limit switches. (Pin is located next to **REV**.)

Note on travel limit switches: If you are using a powered switch such as a photoeye or proximity switch for a travel limit switch, be aware that most of these switches operate from a 10-30VDC power source. You should always use a switch that has an open collector output, never a driven (push-pull) output, and you should power the switch from a regulated 12 VDC or greater power source, never from the battery supply or through the circuit breakers on the power distribution panel, as the unregulated voltage may drop well below 10 VDC, potentially causing unpredictable switch operation.

Solder Jumper Functions and Setup:

Two solder jumpers are provided.

SJ1 - Selects the scaling of the analog input signal; if a 0-3.3 volt signal range is used, make sure the solder jumper is left open; if a 0-5 volt input signal range is used, solder these two jumper pads together. If the jumper pads are soldered together, the breakout board will scale a 0-5 volt signal range down to a 0-3.3 volt signal range that is compatible with the Talon-SRX analog input. Normally this option is selected when a 5V analog device is used and is powered at 5V. **SJ2 must be soldered if using a 5V analog device or the analog readings will be inaccurate/nonlinear.**

SJ2 - Selects either no power, 3.3V, or 5V DC to power the analog device (at **VA+**). Note: The power for the encoder is fixed at 5VDC (at **V+**). Solder between either the 5V pad or the 3.3V pad and the center pad to select the desired voltage to power the analog device. **Do not solder across all three pads or the talon will be damaged.**

Default Jumper Settings:

SJ1 - Closed (0-5 volt scale is selected). **SJ2 must be soldered if using a 5V analog device or the analog readings will be inaccurate/nonlinear.**

SJ2 - 5V selected (5 volts is provided to terminal **VA+**). **Do not solder across all three pads or the talon will be damaged.**

Status LEDs:

5VDC - The green 5VDC LED illuminates when 5VDC power is being supplied from the Talon-SRX.

3.3VDC - The green 3.3VDC LED illuminates when 3.3VDC power is being supplied from the Talon-SRX.

A - The amber A channel LED illuminates when the encoder's A channel is pulled low.

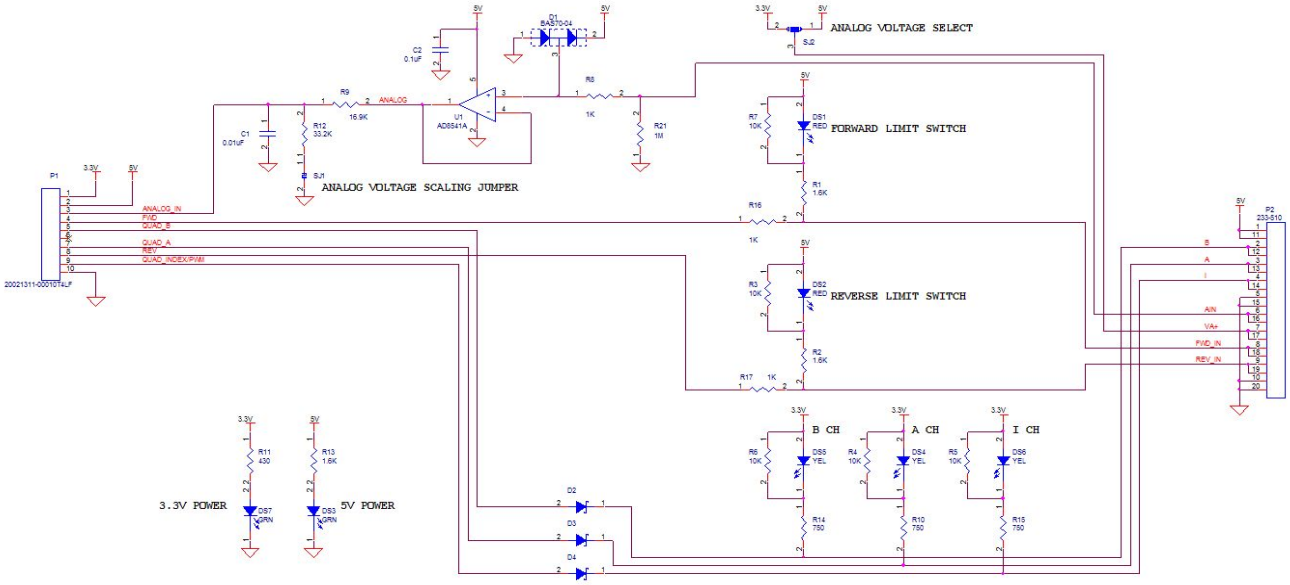
B - The amber B channel LED illuminates when the encoder's B channel is pulled low.

I - The amber Index channel LED illuminates when the encoder's Index channel is pulled low.

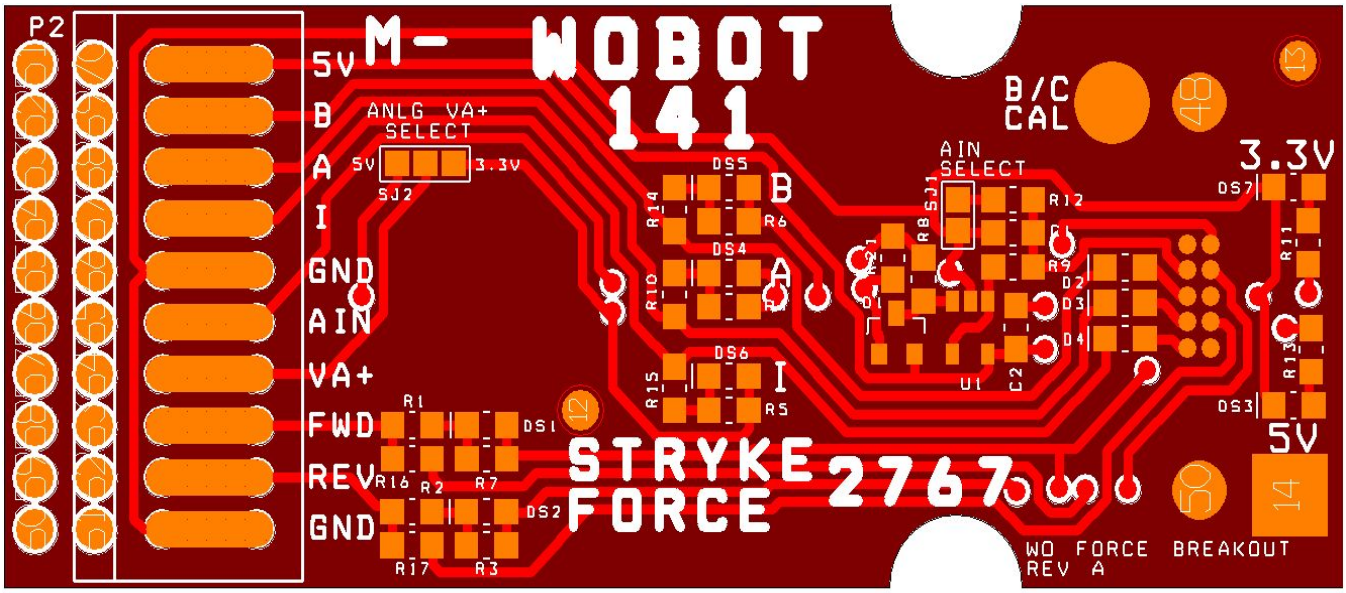
FWD - The red FWD limit LED illuminates when the FWD input is connected to GND.

REV - The red REV limit LED illuminates when the REV input is connected to GND.

Reference Information:



Sentinel Breakout Board, rev A - Schematic diagram



Top View of the Sentinel Breakout Board, rev A

The West Michigan Robotics Alliance (www.wmralliance.com) is an entity created to foster innovation and the sharing of ideas and products for the FIRST community. The Alliance is open to any FIRST robotics team or sponsor who would like to contribute ideas or financial support. All technology developed is open-source to the FIRST community. At present, the WMRA is comprised of Team 141, WOBOT and Team 2767, Stryke Force. The WMRA designed and manufactured the Sentinel Breakout Board.