Victor BB Comprehensive Guide

Preliminary

Revision 1.4

Table of Contents

1. Purpose of this Guide 4
2. Installing the Victor Dashboard 5
2.1. Installing Serial Drivers 7
2.1.1. Installing Serial Drivers – Prolific PL2303 7
3. Connecting to the Victor BB over UART-USB 8
3.1. Wiring requirements. 8
3.2. Opening Application, Selecting the port 9
3.2.1. Troubleshooting 10
3.3. Field-upgrade to latest firmware 12
4. Status Signals 14
4.1. Status Signals (Detailed) Tab 14
5. Configuration Settings 15
6. Controlling motor output 15
7. Logger 15
8. Custom Calibration 16
9. Current-Limiting 16
9.1. Terms 16
9.2. Theory of operation. 17
9.3. Additional tuning 18
10. Status LED Blink Codes 19
11. Calibration Procedure 19
12. CRF Firmware History 20
13. Revision History 20

Warning: Do not apply >5.5v to the center wire of the Victor BB's input connector. Doing so can damage the Victor BB circuit and render the unit non-functional.

1. **This applies to systems using the VEX ARM® Cortex®-based Microcontroller.**
2. **This applies to systems that use a receiver battery that is charged to a voltage higher than 5.5v.**

We recommend that for all application where the Victor BB is not being used in Battery Eliminator Circuit (BEC) mode that you simply cut the center wire of your PWM input cable. This will ensure the Victor BB circuit cannot be damaged.

1. Purpose of this Guide

The purpose of this guide is to document the functionality of the Victor BB Motor Controller.

2. Installing the Victor Dashboard

The installer installs…

- Dashboard EXE and supporting DLL
- Microsoft Visual C++ 2015 redistributable (x86) if not installed already v14.0.23506
- Microsoft .NET Framework 4.5.2 if not installed already

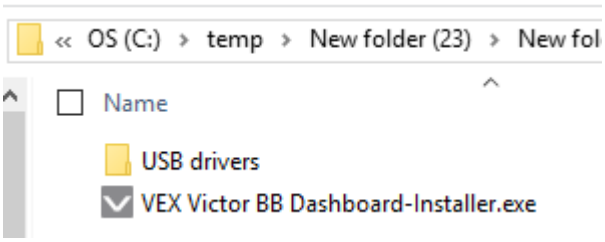
The following also requires installing depending on which cable solution is used.

- FTDI USB Serial Drivers Drivers (v2.12.14)
- PL2303 Prolific USB Serial Drivers (1.12.0)

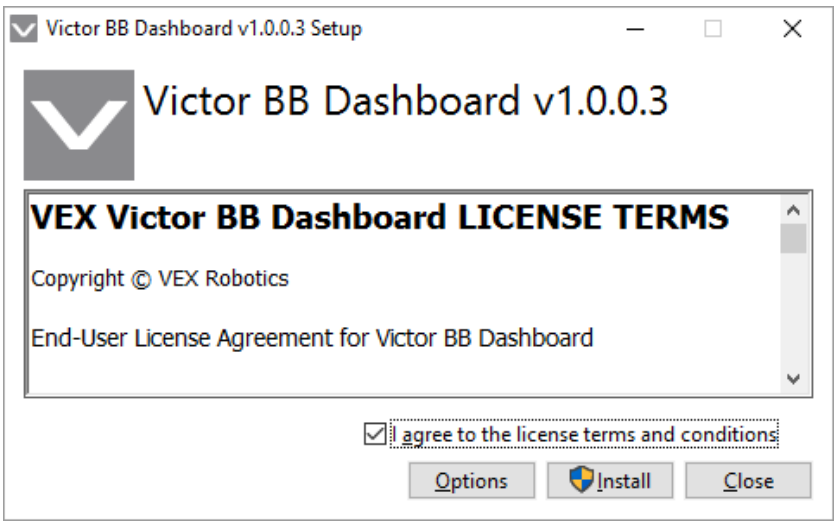
Download Link:

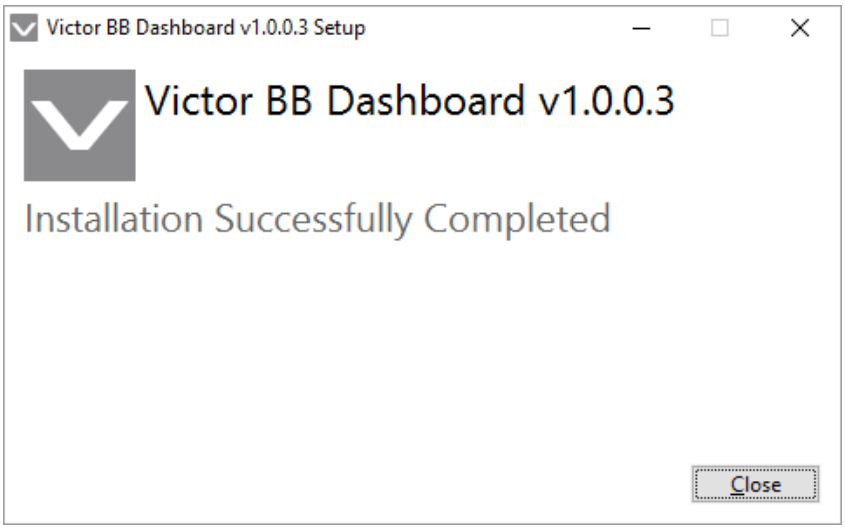
http://www.ctr-electronics.com/downloads/installers/VEX Victor BB Dashboard-Installer-1.0.0.5.zip

Download and extract the zip. Inside there is an installer and folder for USB drivers…

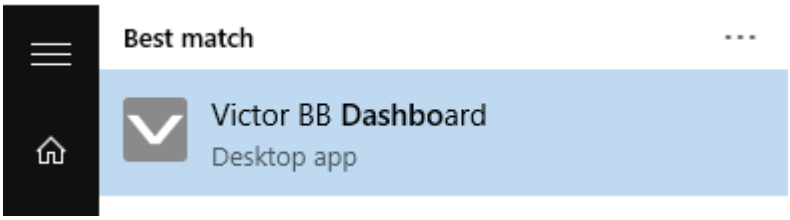


Run the installer to install the Dashboard.





After install the Dashboard will be on the desktop and start menu.

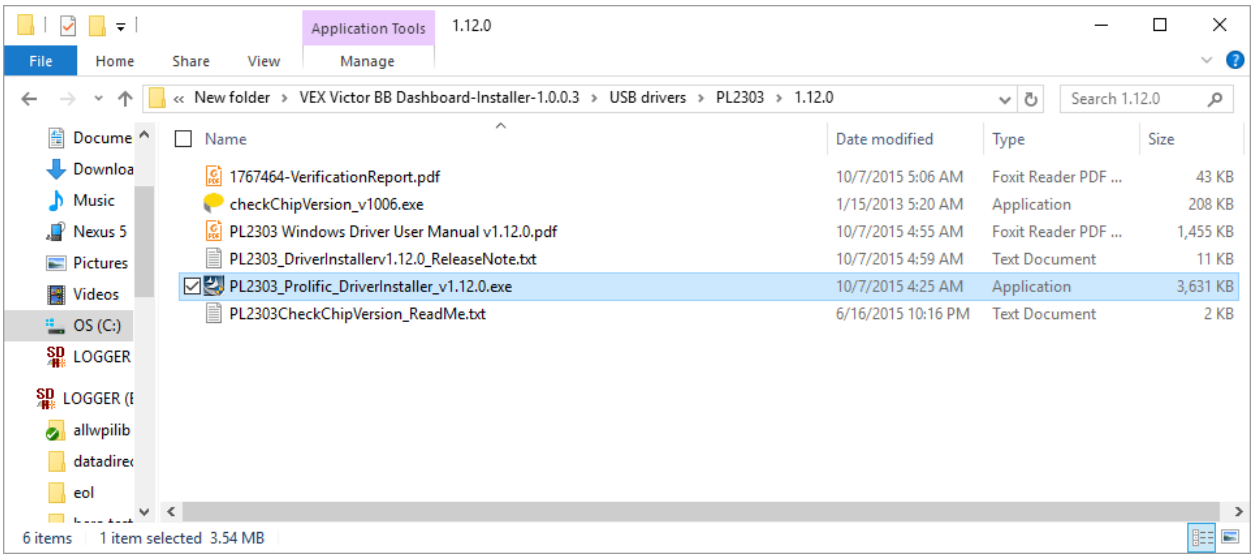


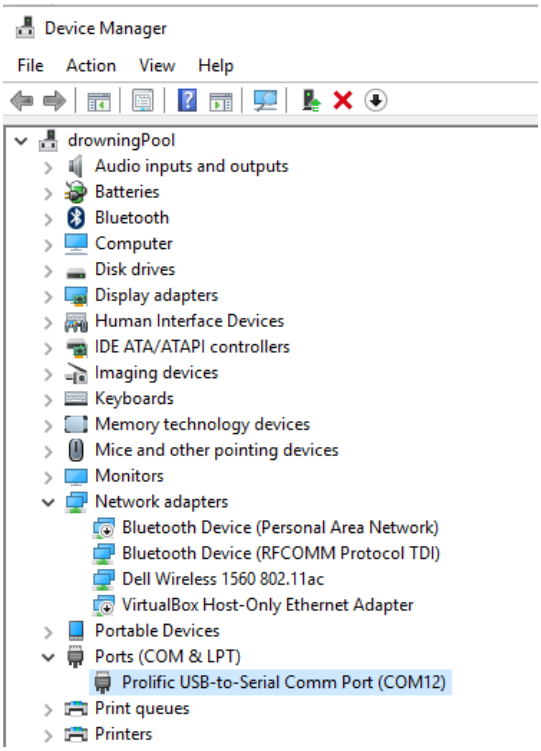
2.1. Installing Serial Drivers

There are two sets of drivers in the zip for each cable solution.

2.1.1. Installing Serial Drivers – Prolific PL2303

Inside the subfolder USB Drivers/PL2303/1.12.0, there is an installer exe that will install the drivers.



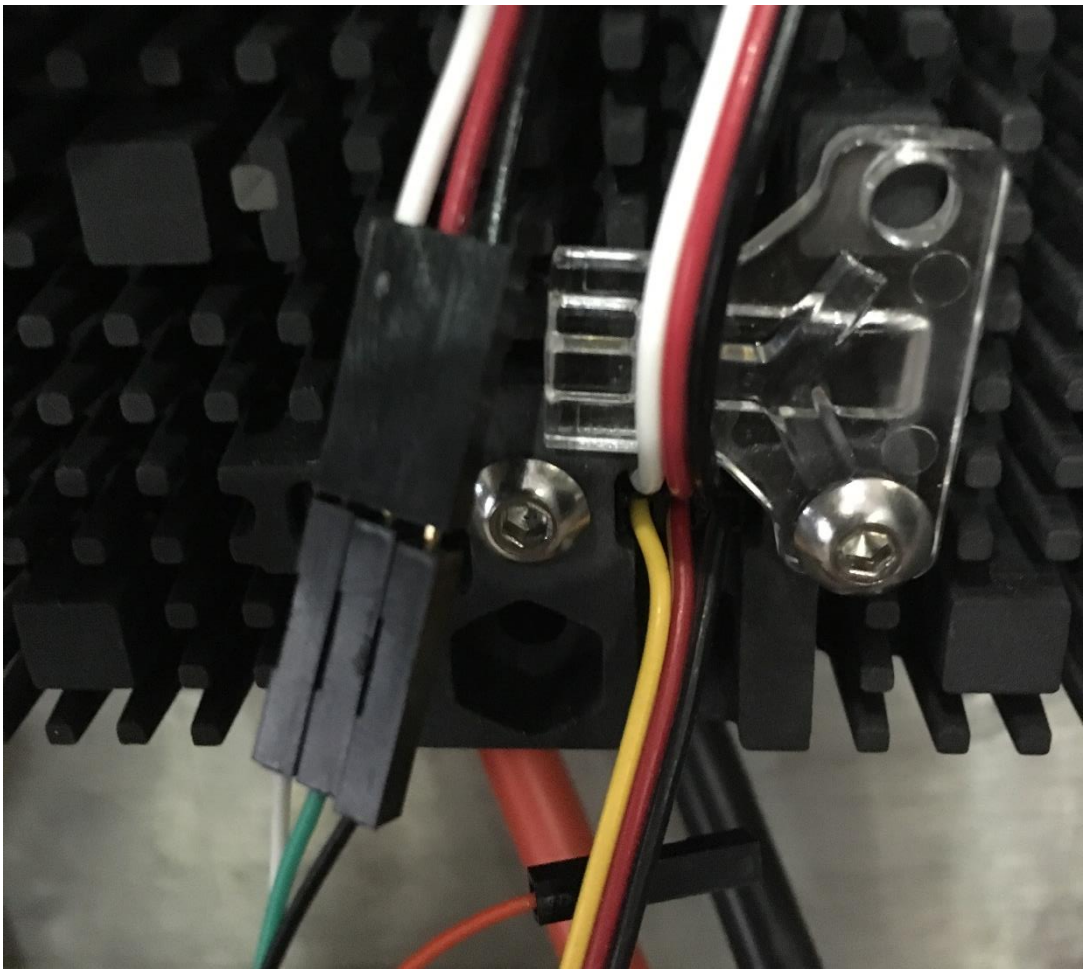


At this point you can insert a Serial USB Cable and it will appear in device manager.

3. Connecting to the Victor BB over UART-USB

3.1. Wiring requirements.

The pinout on the Victor's male 3pin UART cable is …
Ground (outside of case)
Victor Receive
Victor Transmit (inside of case)

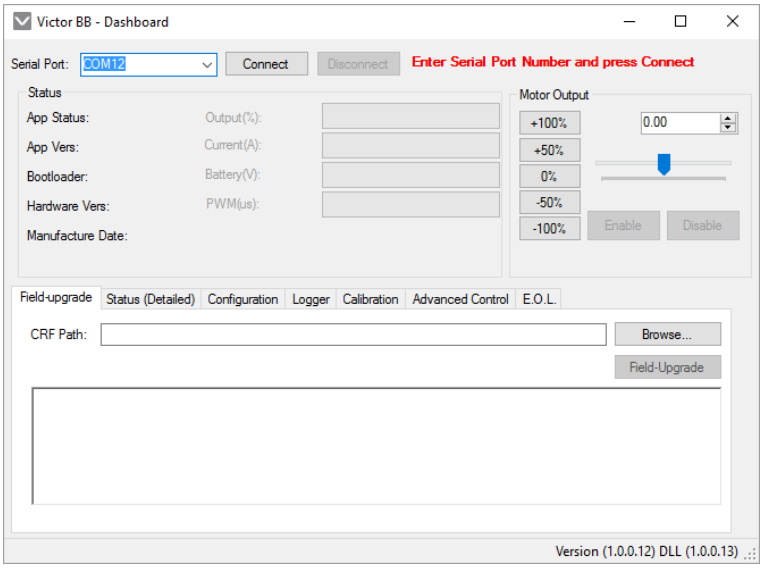


You can directly connect the Adafruit UART-USB cable (Adafruit product ID: 954) to a standard PWM cable as shown above.

The wire connections are:
White to white
Green to red
Black to black

3.2. Opening Application, Selecting the port

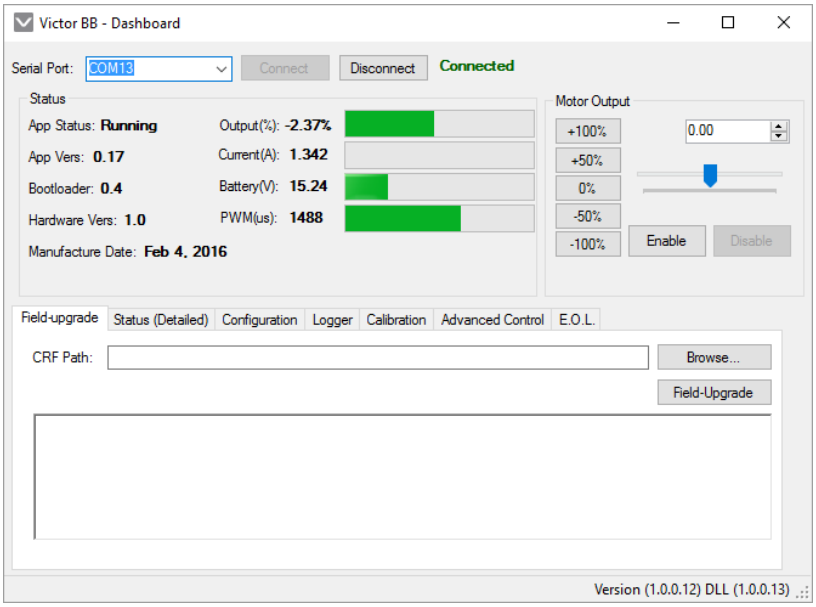
Open the Victor Dashboard program.



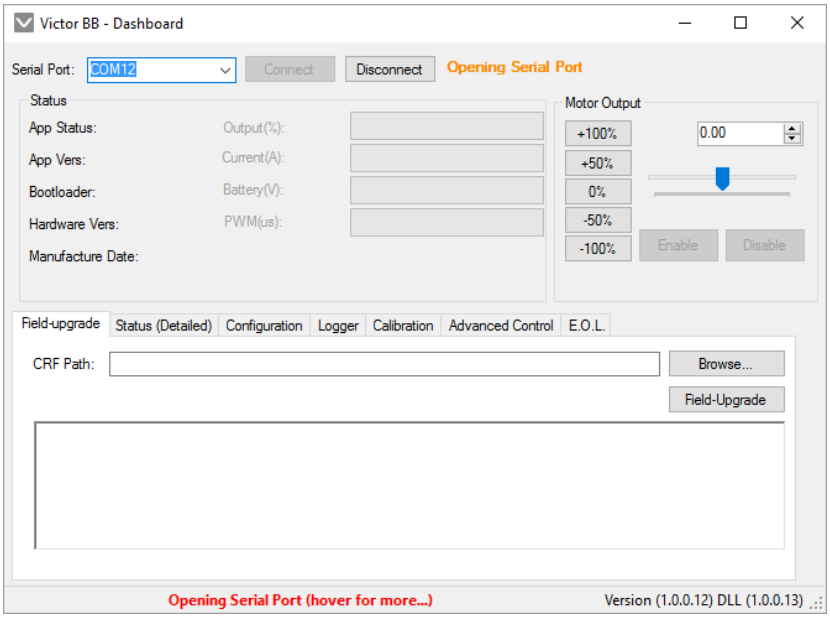
Bring down the dropdown and select the appropriate COM port. If the list is empty, then no serial cable is attached to the PC or drivers are missing. See Section 2.1 for instructions.

Once selected press **Connect**.

If the wiring is correct, Dashboard will report that it's connected. The progress bars may be disabled if Victor has no firmware. This is ok, just go to section 3.3 to field-upgrade the Victor.

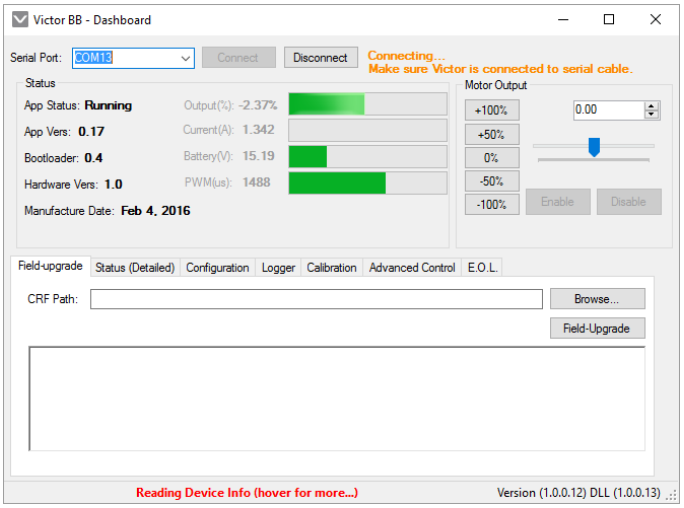


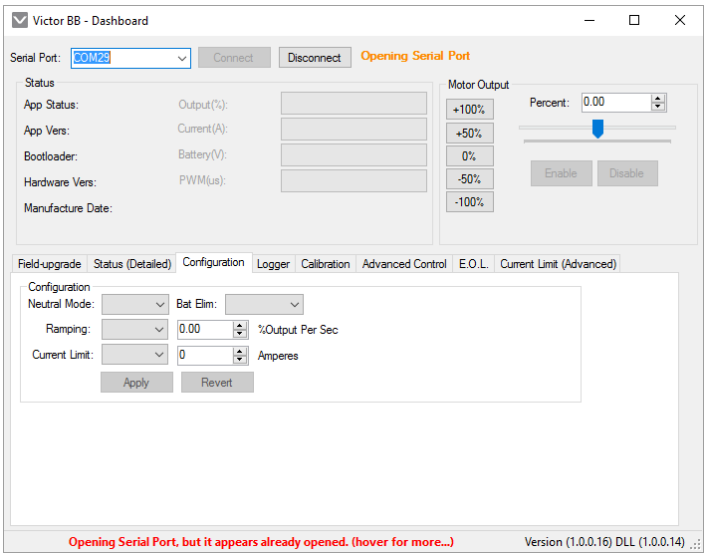
3.2.1. Troubleshooting



If application can't open the Serial Port, check device manager to confirm the correct serial port number is selected.

If Dashboard is reporting the following error, check the cable at the Victor end. Make sure Victor is powered and that the wiring is correct.

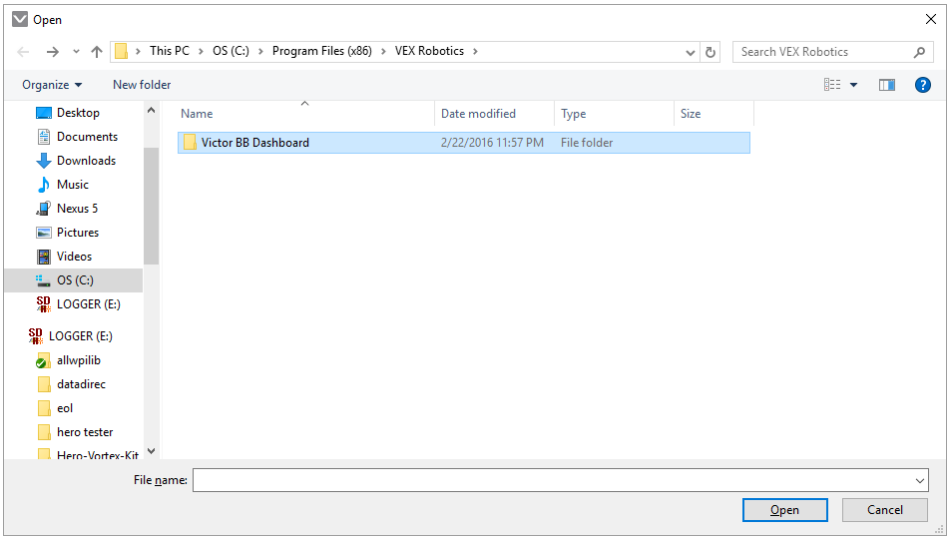




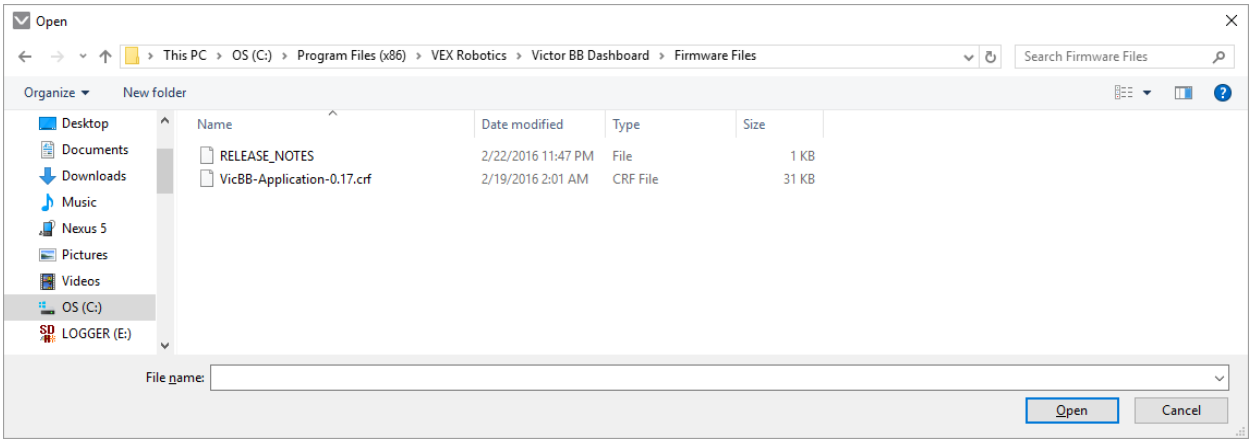
If the serial port is already opened by another program (such as another Dashboard instance) the bottom status message will reflect this.

3.3. Field-upgrade to latest firmware

Press the browse button under the Field-upgrade tab.

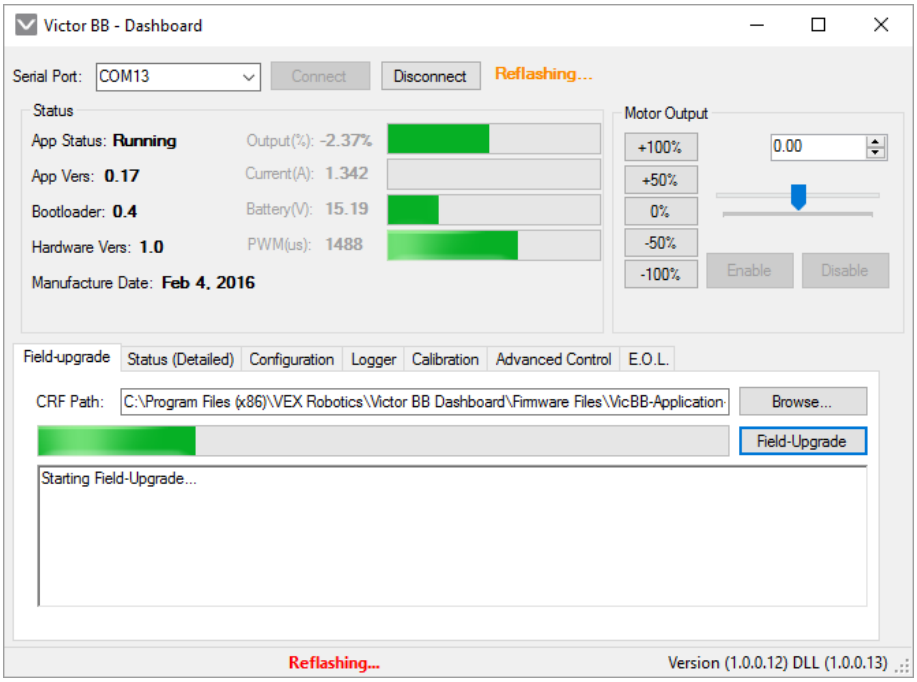


Navigate into Program Files (x86)\VEX Robotics\Victor BB Dashboard\Firmware files

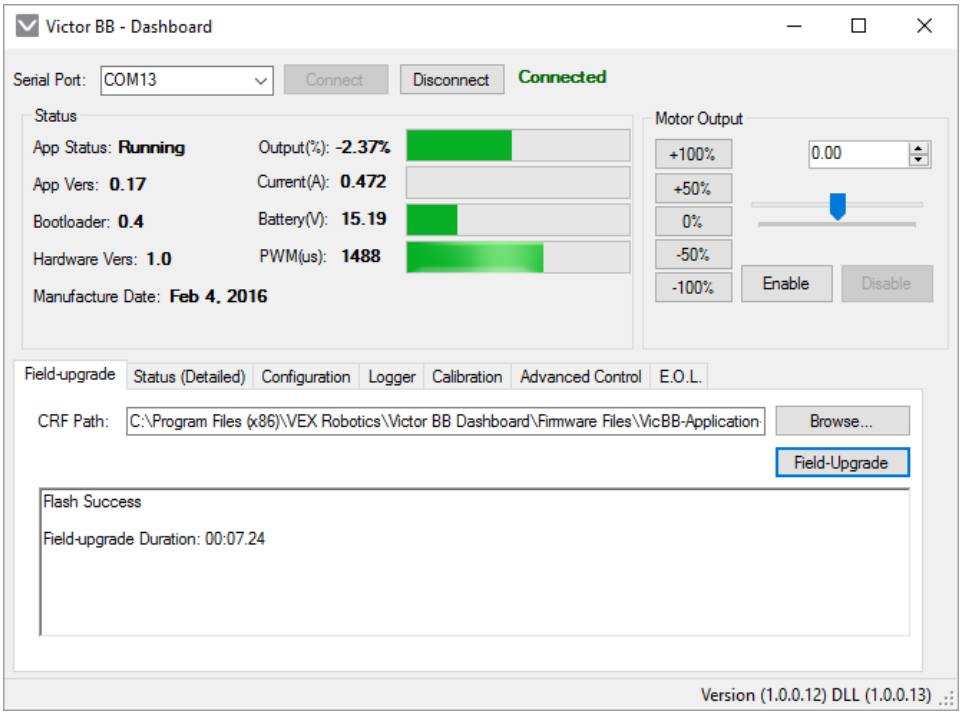


Select the latest CRF and press Open.

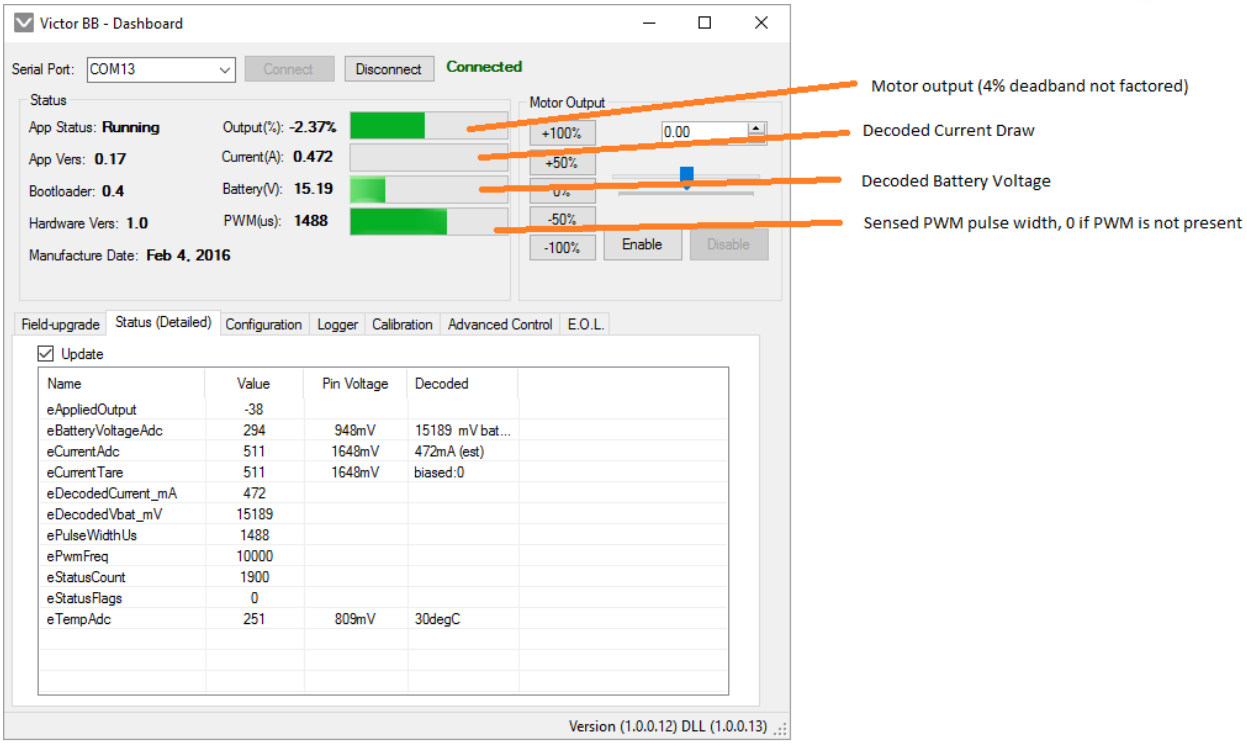
Then press field-upgrade…



The field-upgrade should take about eight seconds.

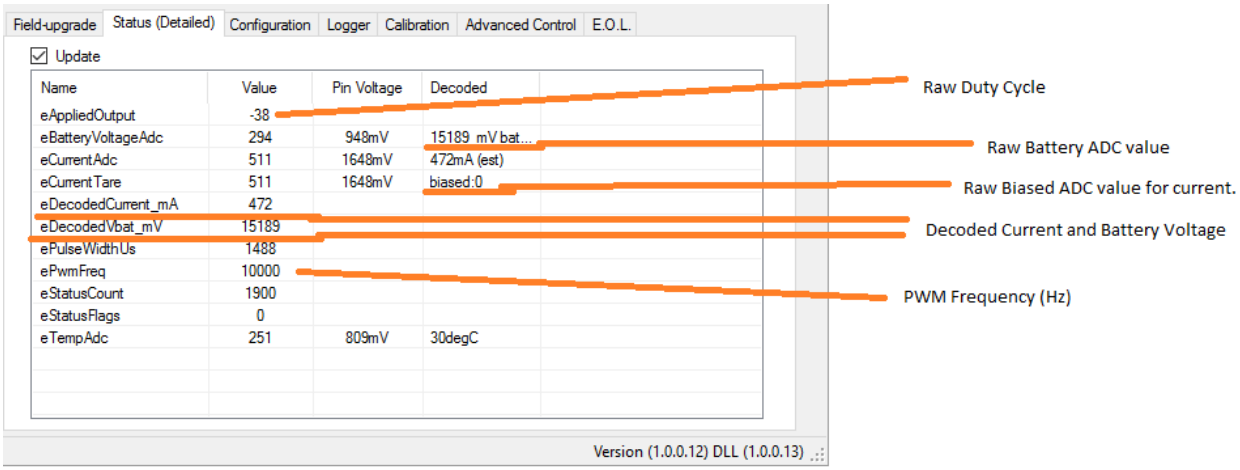


4. Status Signals

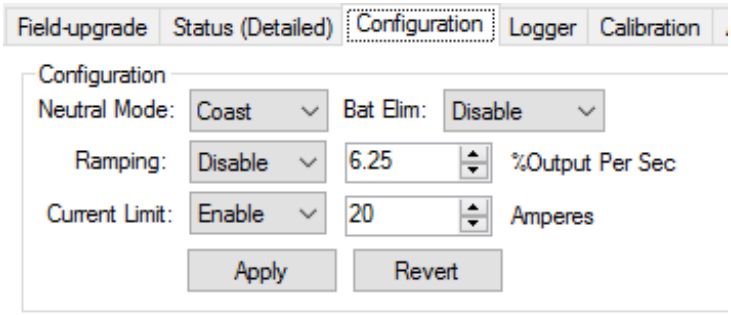


4.1. Status Signals (Detailed) Tab

The Dashboard has an advanced tab for signal values sourced from Victor Firmware. As this is an advanced feature, this tab may not be accessible in public release.



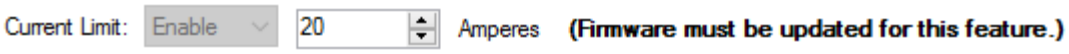
5. Configuration Settings



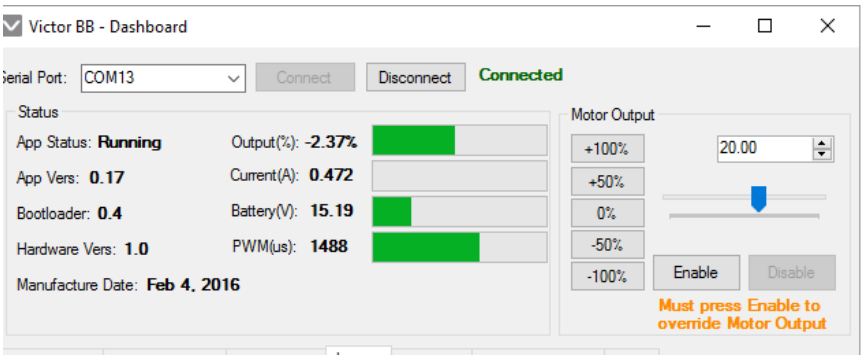
Brake vs Coast in neutral can be selected in the configuration tab. Additionally, the battery eliminator can be enabled here.

Ramping can be enabled to prevent rapid changes in motor output during PWM (and UART) control.

If firmware does not support current-limit, the following message is seen.



6. Controlling motor output

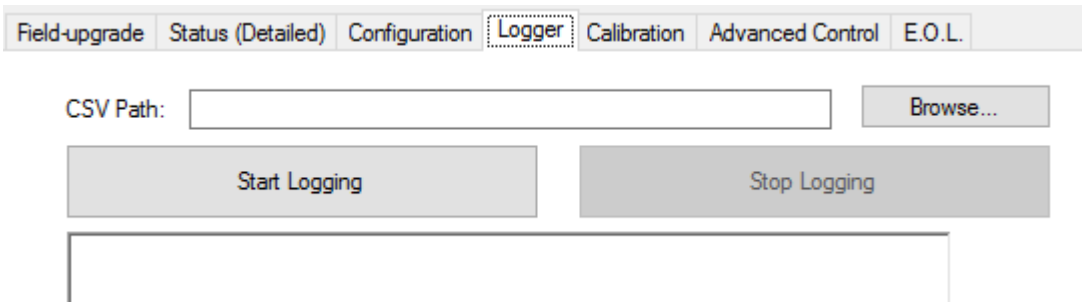


Press the shortcut buttons or change the number entry or scrollbar to override the motor output percent.

Note user must press "Enable" to override the output.

7. Logger

Logger tab can be used to data log a CSV file format with battery voltage, current, temperature, throttle, etc...

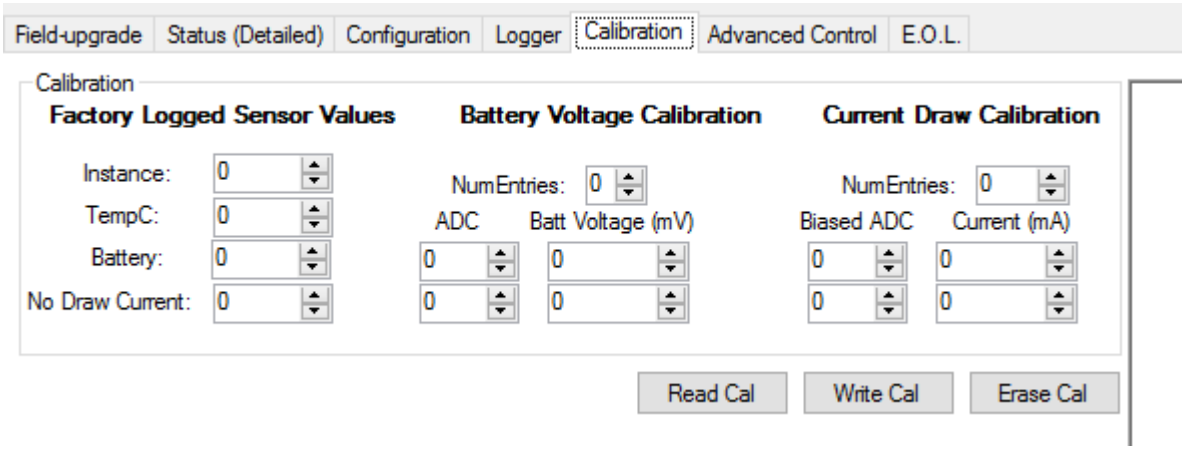


8. Custom Calibration

The decoded battery voltage and current-draw values are based on an equation written in firmware. However, the Victor supports custom calibration where the ADC value and interpreted value can be hand written into flash, providing even greater accuracy for vbat measurement and/or current measurement.

Select Number of Entries of '1' to enter a single ADC/Value pair. This will perform a single point calibration from 0,0 to the entered pair.

Select Number of Entries of '2' to enter two ADC/Value pairs. This will perform a two point calibration allowing for a line that does not cross the origin.



9. Current-Limiting

Starting with firmware 0.20, current-limiting is supported. The current limit is specified in amps in the Configuration tab (See section 5).

9.1. Terms

Req-throttle: The requested throttle from PWM/UART-Dashboard after the user selected Ramp.

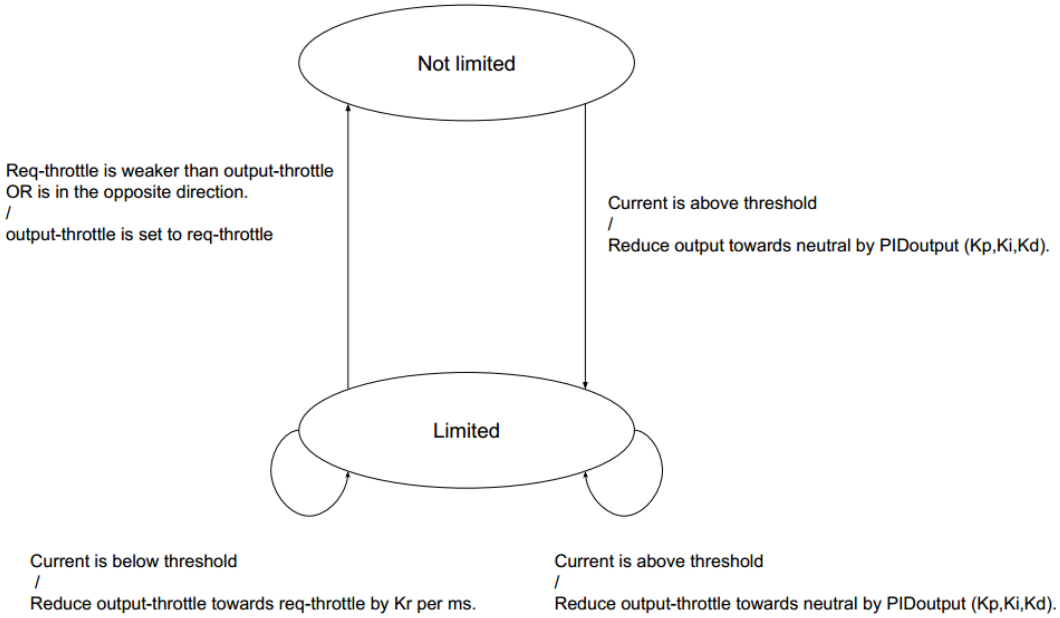
Output-throttle: The applied output throttle leaving the h-bridge.

"Weaker" throttle: If two throttles A and B are the same sign (both positive or both negative) and A has a less than throttle than B, then A is 'weaker' than B. For example, a throttle of 75% is weaker than 80%. Similarly -75% throttle is weaker than -80%.

Resume Rate (Kr): Rate at which current-limited ramps output-throttle back up to request-throttle if current-draw is below threshold and output-throttle is weaker than request-throtttle.

9.2. Theory of operation.

The Victor BB runs a PID closed-loop that servos to the target current-draw. The error is the difference between the target current-draw and present current-draw. Once the PID loop yields a negative term (current is too high) the output-throttle is reduced (approaches neutral) by the magnitude of the PID-output. Note that the output is registered, meaning that a constant P-error and P-gain will result in a constant reduction rate of the output throttle. As a result, I-gain is not needed as the output will latched to its previous value plus the reduction term provided by PID.



D-gain can be used to hasten the response as a function of the rate of change of the current-error.

Once the current is too high, the current-limiting state is set to 'Limited', meaning the output throttle is ramp towards neutral according to the rate provided by PID.

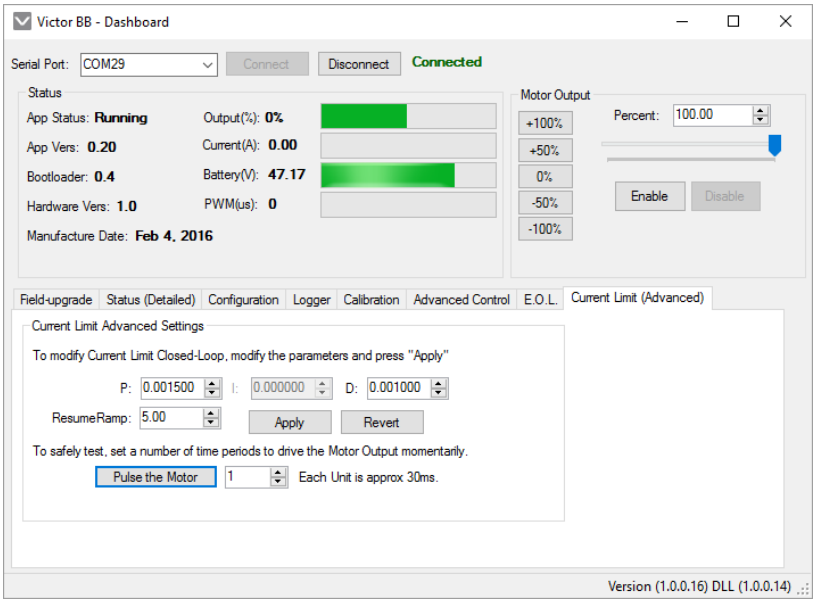
If the requested throttle is changed to be "weaker" than the currently applied output-throttle, the current-limiter will reduce the output-throttle to the req-throttle and leave the limited state.

If current-draw is reduced to at or below the current-threshold, the output-throttle is then ramped up to the req-throttle at the recovery rate of Kr. Kr is in throttle units per 1ms, where 1560 units presents full throttle.

Additionally, if the user decides to change direction in req-throttle, the current-limiter will also leave the limited state and follow req-user. If this also causes a current-limit condition, the Victor will simply re-enter the limited state.

9.3. Additional tuning

The default gain/ramp values used were tested by stalling an Amp Flow (700A rated) motor with a 48V source.

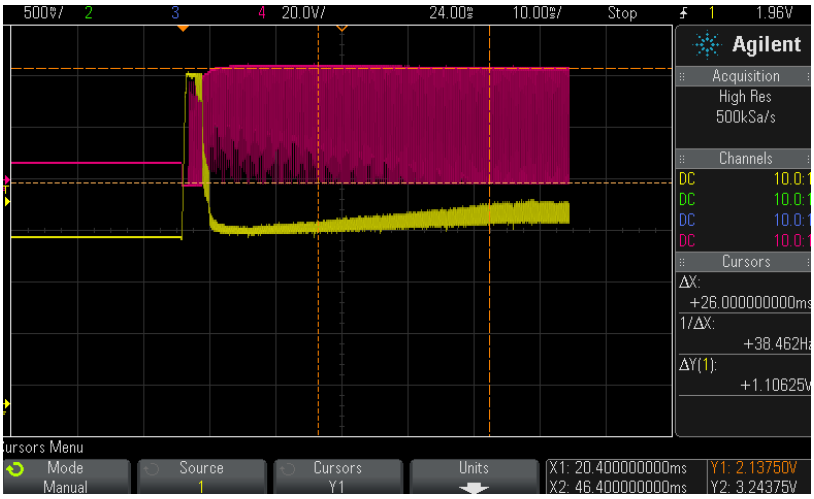


The additional advanced tab allows customization of the P-gain, D-gain, and Resume rate (Kr).

This feature is not necessarily meant to be public (TBD) however may become useful as this feature sees more testing.

The “Pulse the Motor” button can be used to drive the motor to the selected throttle (top right) for a small fixed period of time. This allows safer testing of high current events at various current limits while oscilloscope-ing the output of the current-sense chip for tuning-feedback.

Below is a reduction in throttle (purple is M-) in response to a 2ms wide current-spike from the current-sense chip (yellow).



10. Status LED Blink Codes

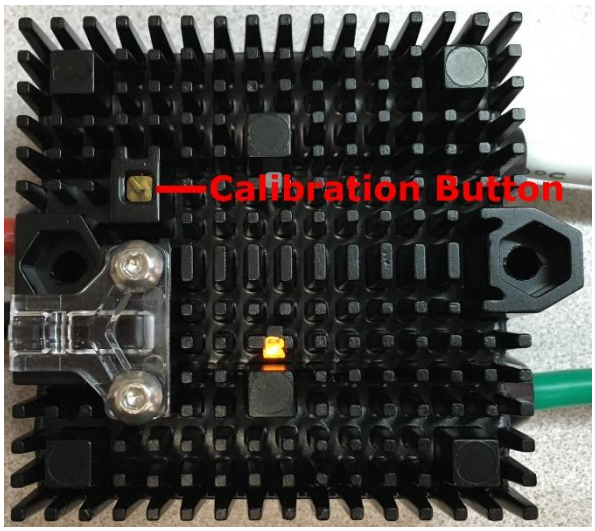
Blink Codes During Calibration	
Status LED Blink Code	**Victor BB State**
Flashing Red/Green	Calibration Mode
Blinking Green	Successful Calibration
Blinking Red	Failed Calibration

Blink Codes During Normal Operation	
Status LED Blink Code	**Victor BB State**
Solid Orange	PWM signal is within 4% of deadband
Blinking Red	Reverse PWM is applied – Blink speed is proportional to input
Solid Red	Full Reverse PWM is applied
Blinking Green	Forward PWM is applied – Blink speed is proportional to input
Solid Green	Full Forward PWM is applied
Blinking Orange	No PWM Signal

11. Calibration Procedure

Press and hold the calibration button for approximately two seconds. The LEDs will flash Red/Green when calibration mode is entered. While holding the button, press the control stick full forward, then full reverse, then let the stick center. Release the calibration button. If calibration was successful, the LEDs will flash Green, otherwise the LED will flash Red.

If the calibration procedure fails repeatedly, if possible, increase the travel of the control axis to the maximum on the transmitter and recalibrate.



12. CRF Firmware History

Revision	Date	Description
0.20	3/16/2016	Current limiting Added
0.18	2/25/2016	Added new signal “current ADC Sum” for current calibration. Updated the default current math based on cased Victor BB measurements.
0.17	2/20/2016	Initial testing release

13. Revision History

Revision	Date	Description
1.4	10/20/2016	Added LED status light tables and calibration procedure
1.3	3/23/2016	Warning about PWM supply voltage added
1.2	3/16/2016	Current limiting Added
1.1	2/25/2016	Added more EOL content for calibration. Added EOL Victor LEDs during B/C Test.
1.0	2/23/2016	Initial draft.