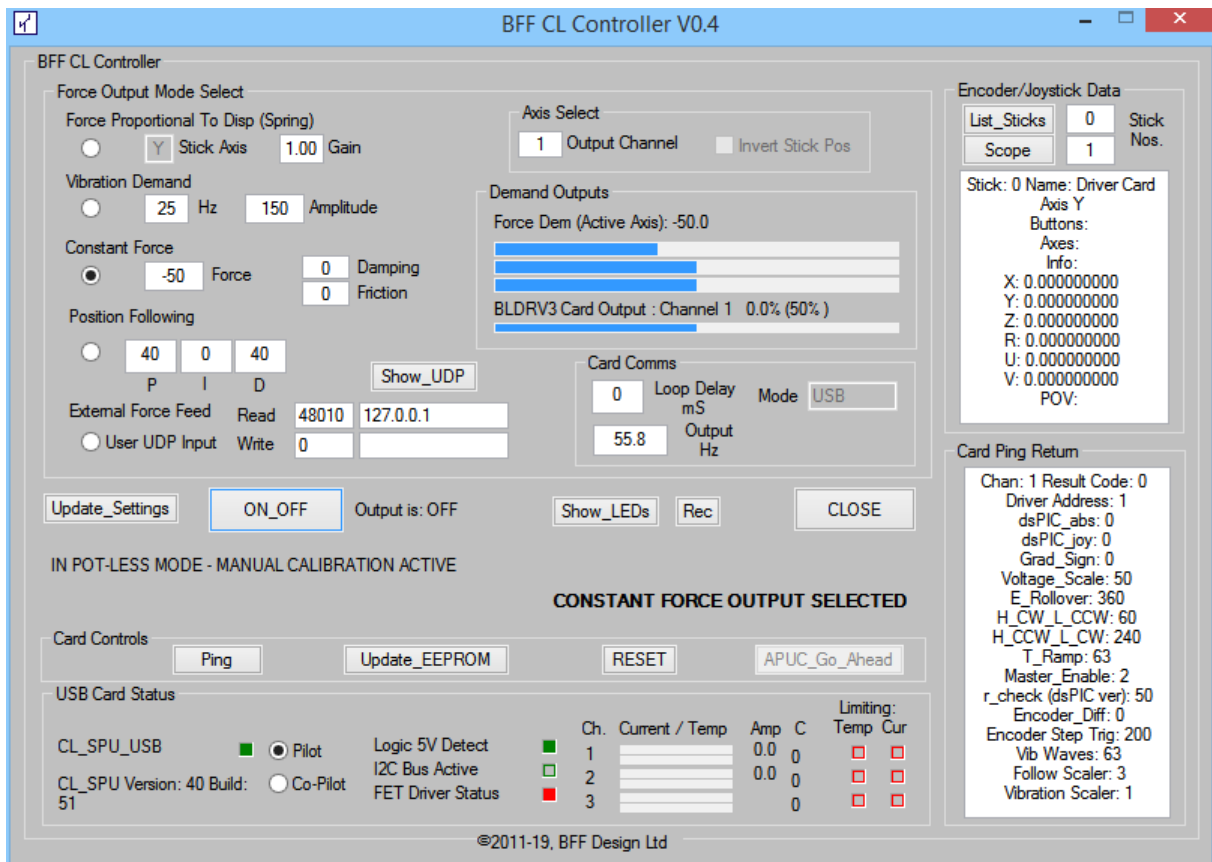


# BFF CL Controller – User Guide R0.1



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## 1. Introduction

The BFF CL Controller allows a CL\_SPU\_USB and BLDRV3 driver cards to be controlled manually.

When in UDP input mode the CL Controller will accept live loading data from 3<sup>rd</sup> party apps and so allow 3<sup>rd</sup> part control of the CL drives.

The application can also be used to check the output from system joysticks in order to identify joystick numbers and active axis numbers.

In its standard test modes the application can generate spring force output, vibration output and constant force output. The output can be directed to driver channel 1, 2 or 3. In addition the damping and friction terms for the brushless driver can be tested. If available on the driver card, position following mode can also be activated and tested.

The app also allows the CL\_SPU\_USB EEPROM settings to be inspected and altered, and also display status information for the cards including current and temperature data.

**NOTE: Pop-up help tips are available for each button / input on the GUI – move and hold the mouse cursor over an item and the help tip will appear.**

**WARNING – WHEN THE ON-OFF BUTTON IS USED TO ACTIVATE OUTPUT FROM THE SOFTWARE THE BLDRV3 CARD CONNECTED AND POWERED WILL BECOME ACTIVE AND MAY MOVE WITH FORCE AND SPEED. PLEASE ENSURE THAT THE OUTPUT SETTINGS ARE CORRECT AND YOU ARE PREPARED FOR MOVEMENT OF THE CONTROLS BEFORE ACTIVATING THE OUTPUT FROM THE TEST SOFTWARE.**

## 2. Initial Settings

The App settings are held in the CL\_Controller.ini file. This is located in the CL Controller application folder.....

The basic comms settings are fixed, most other settings are changed through the software window.

One manually set parameter is:

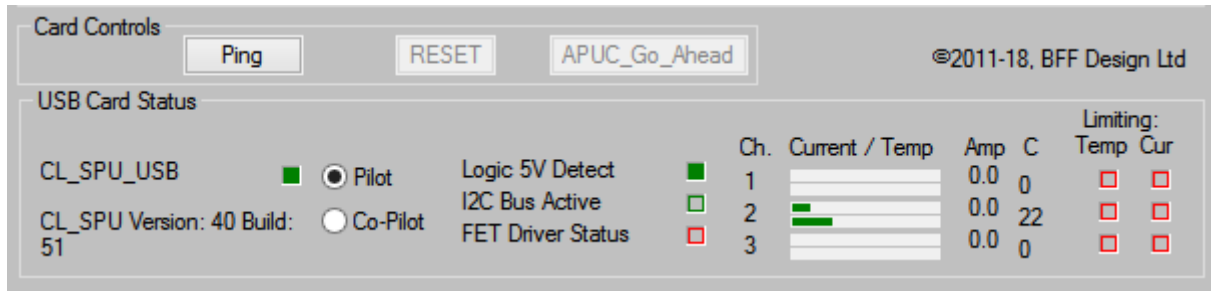
Parameter **EOSC\_Restrict** in the **CONFIG** section sets the number of joystick axes that are checked for end-of-travel conditions for safety auto-release of the loading. **EOSC\_Restrict = Yes** sets the software to check only the active input axis, **=No** sets the check on all three movement axes of the input joystick.

## 3. Connecting to the CL\_SPU\_USB

Comms with the CL\_SPU\_USB will not commence until the CL\_SPU\_USB card is powered up.

Once the connection is made the USB Card Status area will display the connection and

card status.



The Ping button is used to force a read of the card data and write it to the Scratchpad\_Dump.log file in the Logs folder and to ensure the App is displaying the current card status.

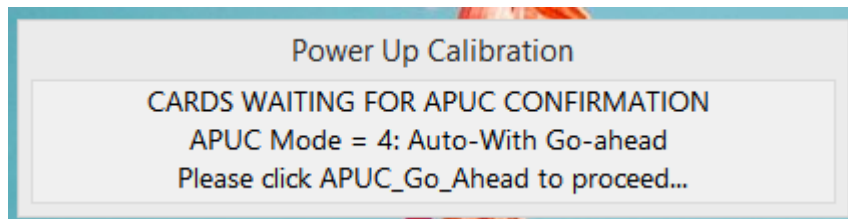
If a CL\_SPU card is not connected and powered at the time the CL Controller starts the app will check approximately every 10 secs for the connection. When the CL\_SPU becomes active the app will connect.

#### 4. To Calibrate the Driver Cards at Power-up

The card power-up procedure depends on the power-up calibration mode set in the CL\_SPU\_USB EEPROM.

APUC Mode 4 is the default – Automatic with go-ahead.

The App will detect the APUC mode of the CL\_SPU\_USB when comms is established and if an automatic power-up calibration mode is detected which requires user go-ahead a splash window will display.



Click the APUC\_Go\_Ahead button to start the automatic calibration movements. Once complete the splash window will close.

Click Ping to update the card status – the App will update accordingly.

If APUC Mode=1 – Manual, is detected then the BLDRV3 cards must be calibrated using manual movements.

All active channels can be calibrated (1, 2 or 3) regardless of output channel setting.

Click Update\_Settings.

The BLDRV3 and CL\_SPU\_USB cards should be showing flashing yellow LED's. Proceed with the manual calibration movements by moving the control axis back and forward end

stop to end stop at a steady pace until the yellow LED flashing stops.

Click Ping to update the output channel card status – the App will update accordingly. If calibration is complete the X, Y and Z position data will display in the Joystick Input area and should vary as the control axes are moved.

More details of the manual calibration can be found in the card datasheet and in the APUC Mode documentation.

## 5. To Send Force Demands

Three output force types are available:

1. Force proportional to stick displacement (spring force)

The cards will drive the motor back towards mid position (of the calibrated range). The force will be proportional to the displacement of the axis away from mid and the Gain setting (stiffness).

A Gain of 1.0 will induce a return force equal to maximum output when the displacement is full range.

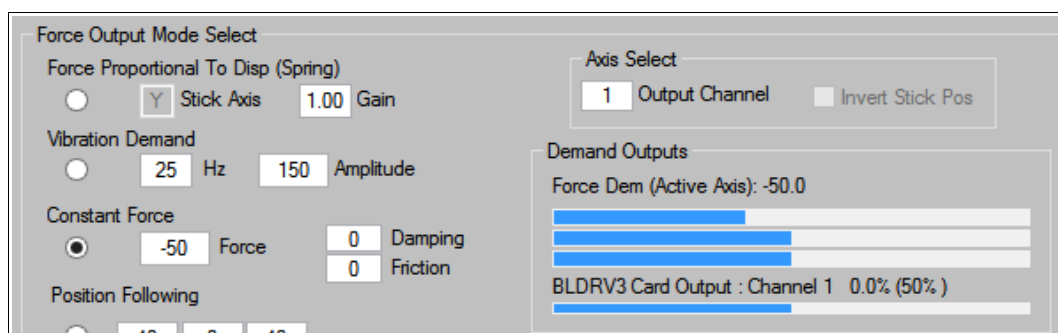
2. Vibration output

To generate vibration output at the specified base frequency and amplitude. The vibration is from the “engine” vibration channel of the BLDRV3 and uses a 3 wave mix – it is not a pure sine wave output.

3. Constant force

To generate a constant torque output regardless of axis position. The range is +/- 255.

This will cause the motor to drive the axis with a constant force level. If the axis is not held it will drive to the end-stops.



- The cards should be powered and calibrated.
- Set the correct **FFB Output** Channel
- Select the Radio Button for the required for the output type

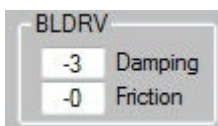
- Set the relevant values (Gain, Force level, Freq etc) .
- **CAUTION** – Click the **ON\_OFF** button to activate the output. The force demand will ramp up to the set value. If the cards are operational it will drive the connected brushless motor to the demanded output.
- Click the **ON\_OFF** button to return the force demand to zero – the demand will ramp down to zero.

Further changes to settings will not take effect until the **Update\_Settings** button is clicked. To help reduce the risk of accidental unintended output the output will automatically be switched to **OFF** whenever the **Update\_Settings** button is clicked. To switch the output back on following a settings update click the **ON\_OFF** button again.

**AUTO-RELEASE:** Note if an axis is held at or close to an end stop for longer than 5 seconds the App will automatically release the loading. This is to protect the cards in the event of an unintentional hard drive against the end stops.

Parameter **EOSC\_Restrict** in the **CONFIG** section sets the number of joystick axes that are checked for end-of-travel conditions for safety auto-release of the loading. **EOSC\_Restrict = Yes** sets the software to check only the active input axis, **=No** sets the check on all three movement axes of the input joystick.

## 6. Setting Damping and Friction



The damping and friction simulations of the BLDRV3 driver can be activated by specifying non-zero values in the **Damping** and **Friction** inputs. These values should generally be small in the range 0 to 10. -ve values can be set, in which case the effect is not to resist motion but to

enhance it.

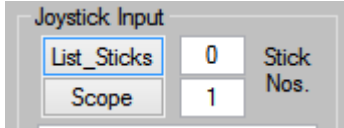
Damping is a resistive force proportional to the speed of movement of the control. Friction is a constant force acting against the motion (unless specified as -ve) and is independent of speed of motion. Both terms, but friction in particular, depend for their effective simulation on a good resolution on the motor quadrature encoder.

The **Damping** and **Friction** values will be present on top of all other force outputs. If you wish to test these alone then select **Constant Force** output with a zero **Force** setting to ensure no other force components are present.

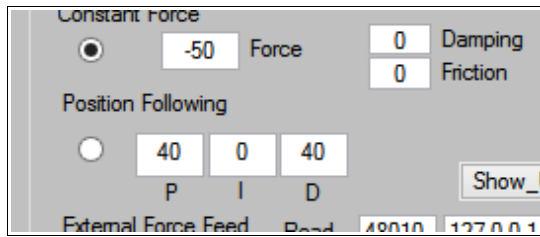
-ve values can be used to “lighten” the feel of the controls and is particularly useful when heavier gearing is used.

NOTE: setting too large -ve values will cause instability in the drive – so take care when testing -ve values.

## 7. Position Following Mode



The BLDRV3 can be operated in position-following mode in which the output motion is driven to follow the input motion from the specified joystick axis.



It is recommended that you do not attempt to operate the BLDRV3 driver in position following mode until you are satisfied it is fully functional in the normal force output modes.

The lower **Stick Nos.** box sets the joystick who's motion is to be followed. The **Stick Axis** setting in the proportional force area sets the specific axis

to be followed on the joystick.

The **PID** terms of the proportional, integral, derivative control algorithm used by the card are set in the **Position Following** area.

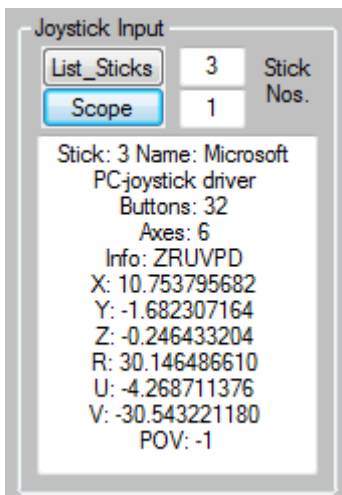
To enable position following mode using the set PID terms check the **Position Following Radio Button**.

**CAUTION** – Click the **ON\_OFF** button to activate the output. The PID terms will ramp up to the set values and so bring the control into position following mode with increasing strength up to the set levels. If the BLDRV3 is operational it will drive the connected brushless motor to the demanded position. Moving the joystick axis from which the position demand signal is taken should cause the motor to follow position.

**CAUTION** - If position following is being operated for the first time it is recommended that the I and D terms are set to zero and the P term is tested with small values initially. It is easy to cause unstable oscillation in the control by setting too strong PID terms. In some conditions this can cause rapid motion of the motor and of the control mechanism driven by the motor.

NOTE: The resolution of the joystick used for the position demand will have a direct effect on the smoothness of the position following movements. It is best to use a joystick with 12bit resolution to ensure the demand is smooth.

## 8. To Check a Joystick



Button **List\_Sticks** lists the sticks and their “slot” numbers on the PC.

Button **Scope** plots the output from the three main axes of the joystick numbered in the upper Stick Nos. input field.

**Stick Nos. - (top input)** sets the active joystick. Data from the joystick is displayed in the lower text window.

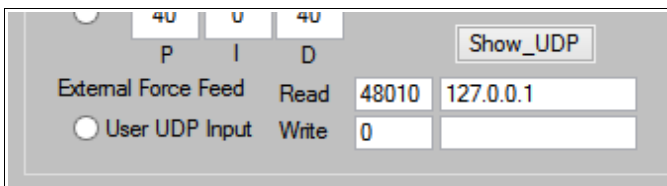
If Stick No. is set = 0 position data derived from the motor encoder of the selected channel will be displayed. The BLDRV3 card for that axis must first be power-up calibrated and an initial Ping performed.

**Stick Nos. - (bottom input)** is relevant for testing position

following mode only. It sets the joystick to be followed.

To check the output from a joystick set the correct stick number in the top **Stick Nos.** box, and then read the output in the text window. The joystick active axes will be displayed. If you move your controls you should see movement in the respective output data.

## 9. External Force Feed (UDP Data Input Mode)



In External Force Feed mode the CL Controller will accept force data via UDP. This allows 3<sup>rd</sup> party software to control the CL drives via the CL Controller.

In this mode the UDP data controls all loading on all channels. However the CL Controller will continue to handle power-up calibration, ping, on/off ramping and other card management functions.

The CL Controller, when in UDP Input mode, looks for loading control data in 180 byte packets received by UDP on the Port and IP Address specified in the CL\_Controller.ini config file (parameters **Port** and **IPAddress** in the **[Comms]** section).

The Port and IP Address can also be set via GUI.

The CL Controller will return a 50 byte response packet on each input packet receive. This UDP return will be via port **Port+1** to the IP Address and Port specified by the sender app within the 180 byte input packet.

The 180 byte input and 50 byte return packet format is detailed on-line here -

[http://bffsimulation.com/Manual-CL-USB/Appendix\\_J\\_CL\\_Controller.php](http://bffsimulation.com/Manual-CL-USB/Appendix_J_CL_Controller.php)

Follow the link for further details of the UDP input mode.

The Show\_UDP window will display the incoming packet data and also the out-going return packet data.

June 2019 – 1<sup>st</sup> draft for CL Controller v0.4

Ian Hopper (BFF Design Ltd), June 2019