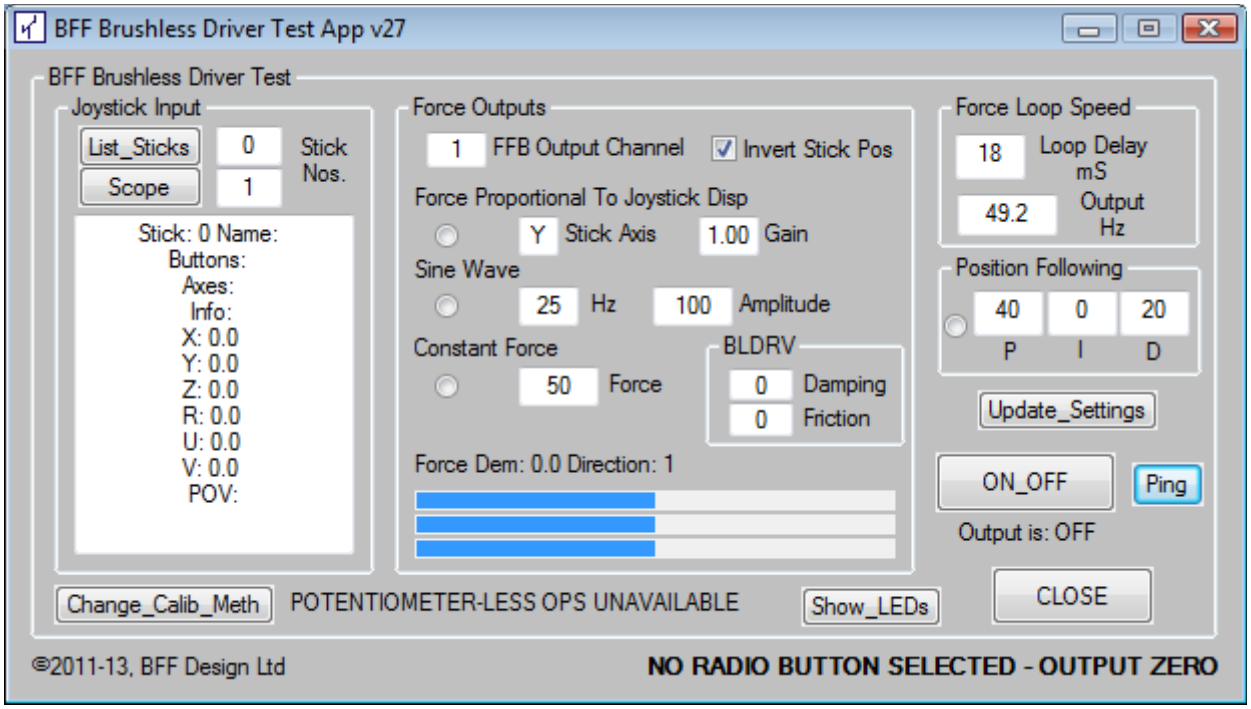
BFF Driver Test App – Quick Start Guide v1.2



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1. Introduction

The BFF Brushless Driver Test Application allows a single BLDRV-12/24 card to be controlled manually. The application can also be used to check the output from system joysticks in order to identify joystick numbers and active axis numbers.

WARNING – WHEN THE ON-OFF BUTTON IS USED TO ACTIVATE OUTPUT FROM THE SOFTWARE THE BLDRV-12/24 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.

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.

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.

2. Initial Settings

To set the serial data output the COM port number and baud rate should be set manually in the COMMS section in the DRVR_Test.ini file. This is located in the test application folder.....

[COMMS]

COMPort=COM8

Baud=516129

Out_Res=10b

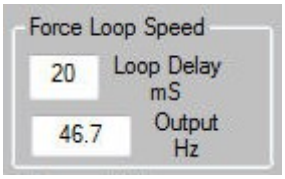
The 516129 baud rate is mandatory for use with BLDRV-12/24 cards. Use a PICAXE AXE027 USB download cable (or other FTDI chip based cable) to connect the driver card to the PC.

Parameter Out_Res must be set to “10b” for use with BLDRV-12/24 driver cards.

Parameter **Force_Scaler** in the **CONFIG** section sets the maximum allowable spring force output as a proportion of full scale output. This is set to **Force_Scaler=0.25** by default to limit the spring force to 25% of maximum. This is a safety measure to prevent overload of the BLDRV-12/24 card if the motor drives away from rather than toward mid position.

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.

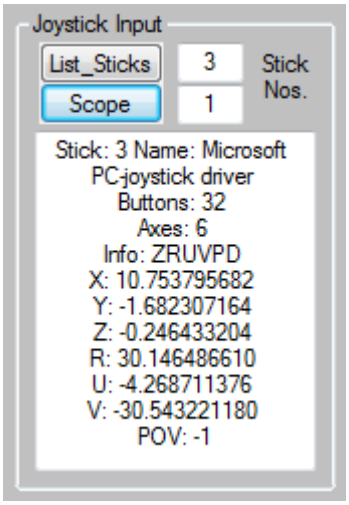
Most of the remaining parameters are set through the application GUI. See section 10 for exceptions.



Force Loop Speed – These settings control the refresh rate of the

data sent to the BLDRV-12/24 driver. The **Loop Delay** should be adjusted to produce an **Output** frequency of approx 50Hz.

2. 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.

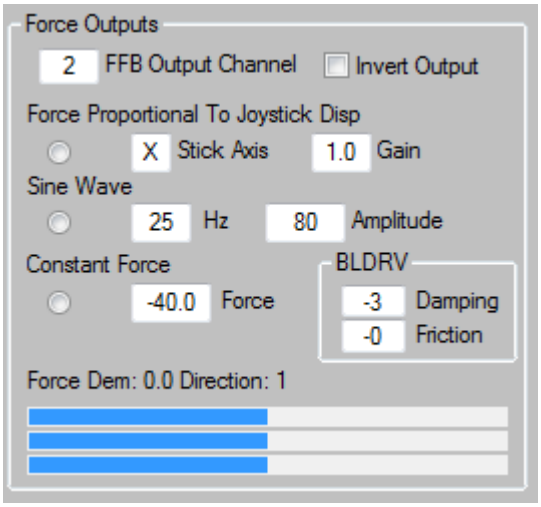
Stick Nos. - (top input) sets the active joystick. Data from the joystick is displayed in the lower text window. The active joystick provides the position input used by the spring force output option (force proportional to joystick displacement). It also provides the joystick movement range output used by the BLDRV-12/24 to calibrate its position.

If Stick No. is set = 0 and the driver card is pre-set for "**potentiometer-less**" operation then the data displayed will be derived from the motor encoder position. Data will be available only if the addressed card is active and calibrated.

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.

3. To Calibrate the Driver Card at Power-up



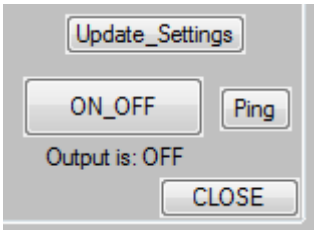
- Set the **FFB Output Channel** to the channel of the BLDRV-12/24 card you wish to calibrate (note for reference, channel 1 is Elevator, channel 2 is Aileron, channel 3 is Rudder).
- Set the **Invert Output** check box if required to reverse the sense of the joystick position output.
- Set the **Stick Axis** you wish to use as the position input – this is the X, Y, X R, U or V axis of the Active joystick.
- The axis position will be sent immediately to the output and will be available to the BLDRV-12/24 card on the selected output channel to use for the normal position calibration procedure when the card is powered up. NOTE the ON_OFF button does NOT need to be set to ON for the calibration to proceed – the button should be left at OFF and all force demands will

remain at zero whilst the card calibration is carried out.

Please read the BLDRV-12/24 data sheet for details of the card calibration procedure.

NOTE: For cards pre-set for “potentiometer-less” operation calibration will complete WITHOUT the need for valid game-controller axis data. In this mode the stick axis setting is not relevant.

4. To Check the Status of the Driver Card



The **Ping** button sends a request to the BLDRV-12/24 on the active output channel to return its status. The results are displayed in a pop-up text window.

NOTE data output from the software is suspended whilst the results window remains open.

The following data is returned:

- Ping Return Value : = 0 for driver active, = -1 for ping timeout (driver not active/connected/powered on the active channel)
- Channel No: as confirmed by card - 1, 2 or 3
- dsPIC_abs : = 0 for driver electrical position uncalibrated, = 2 calibrated
- dsPIC_joy : = 0 for driver joystick mapping uncalibrated, = 1 calibrated
- Speed_Scale : in-driver force demand scaling factor (2 = 1/2, 4 = 1/4 etc)
- E_Rollover : Encoder edges per motor electrical rotation (not per shaft rotation!)
- H_CW_L_CCW : Hall sensor transition angle stated in encoder edge count scale - going high clockwise & going low counter-clockwise
- H_CCW_L_CW : Hall sensor transition angle stated in encoder edge count scale - going high counter-clockwise & going low clockwise
- T_Ramp : Ramping setting - time to ramp zero to max = 1/t_ramp, so for example, 63 => 1/0.0159 & ramp time = 0.0159 secs or 15.9 ms.
- Master_Enable : = 0 for output disabled by 20X2 chip, = 2 for output enabled by 20X2 chip
- r_check : internal check sum, = 6 for dsPIC chip reports all settings established, < 6 = internal problem with settings . >6 = the dsPIC firmware version (for later dsPIC firmware only)

The following values are valid only for 20X2 beta7 firmware programming or later -

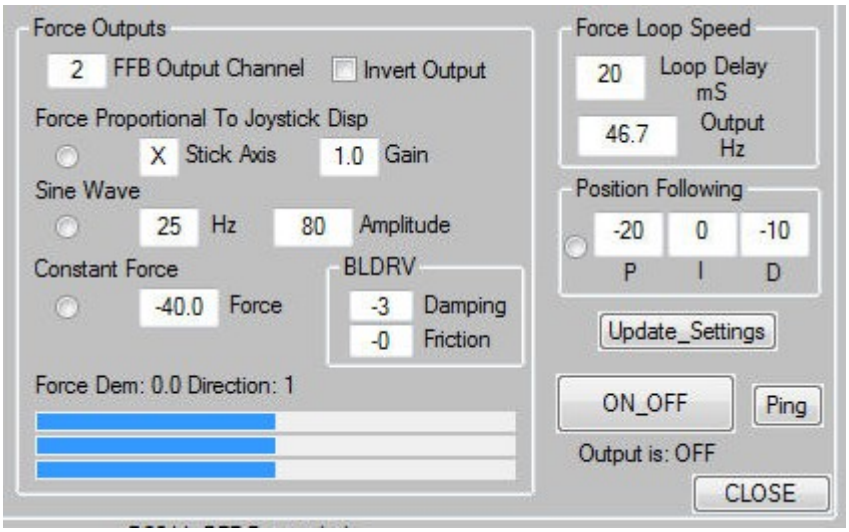
- Encoder_Diff : Encoder position range used for mapping against joystick range - in edge counts
- Supply Voltage (beta9+ firmware on v1.3+ card only) : Card supply voltage
- Encoder Step Trig : Encoder step position change / 10 which triggers unexpected

step handling processing

- TRC_Scale : Torque Ripple Compensation Scaler (127 is zero)
- Vib Waves : 8bit binary value for vibration wave make-up
- Follow Scaler : Strength of position following torque output = max/n where n = value, ie 5 = max/5 = 0.2 of max
- Vibration Scaler : Strength of maximum vibration torque = percent of max / 10, ie 2 = 20 percent of max
- 20X2 Ver : 20X2 control chip firmware version (versions below 7 will not be reported)

The ping results will also be written to the BFF_Test.log log file in the Logs folder. The log file also contains the results of internal pings which are made each time the ON_OFF button is clicked.

5. To Output a Fixed Force Demand

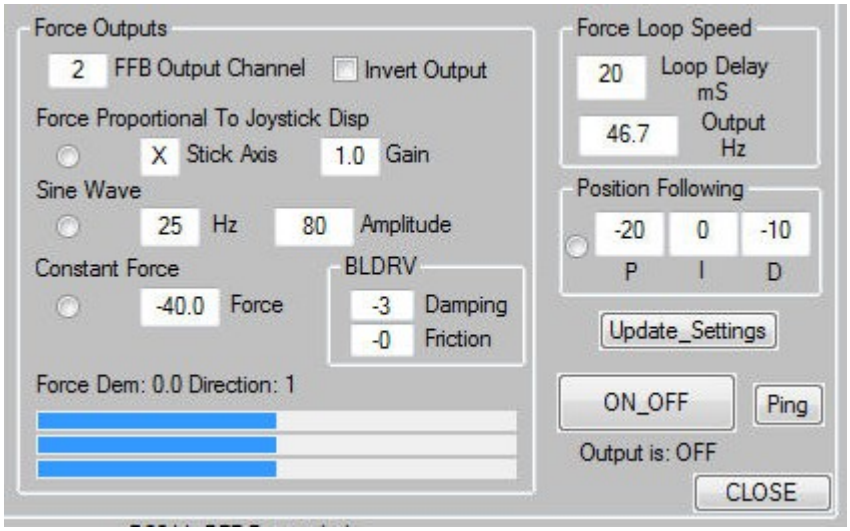


- The BLDRV-12/24 card should be powered and calibrated.
- Set the correct **FFB Output** Channel
- Set the **Force** value under the **Constant Force** section.
- Check the **Constant Force radio button** to enable the constant force output option.
- **CAUTION** – Click the **ON_OFF** button to activate the output. The force demand will ramp up to the set value. If the BLDRV-12/24 is operational it will drive the connected brushless motor to the demanded force/torque level.
- 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.

6. To Output a Force Proportional to Joystick Axis Displacement

This can be used to simulate a simple spring return on the control axis. A force demand proportional to the movement of the set joystick axis is sent to the driver. The spring rate is set by the “Gain” setting which should always be +ve. If a +ve gain causes drive away from rather than towards mid then there is an issue with the phase or hall sensor wiring.



In this case remove power from the system and investigate the wiring problem.

If “**potentiometer-less**” operation of the cards is in use then first set the **Stick No. = 0** (see section 2).

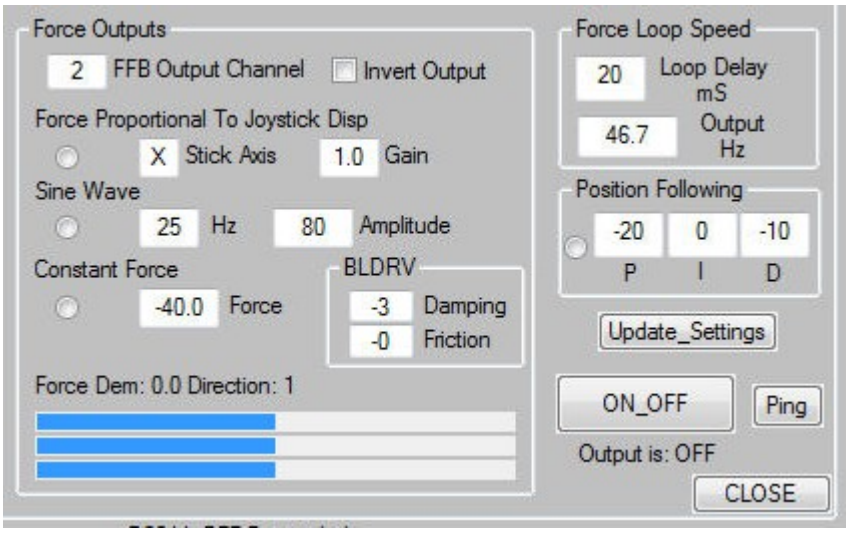
- The BLDRV-12/24 card should be powered and calibrated.
- Set the correct **FFB Output** Channel
- Set the **Stick Axis** to define the joystick axis. For “**potentiometer-less**” operation the stick axis is not relevant.
- Set the **Gain** value under the **Force Proportional to Joystick Disp** section.
- Check the **Force Proportional to Joystick Disp radio button** to enable the proportional force output option.
- **CAUTION** – Click the **ON_OFF** button to activate the output. The spring rate will ramp up to the full value. If the BLDRV-12/24 is operational it will drive the connected brushless motor to the demanded force/torque level proportional to the displacement of the set axis.
- 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.

NOTE The “spring” force output will be capped at the proportion of maximum output specified in the DRVR_Test.ini file by the **Force_Scaler** parameter. This is a safety measure to protect the card against incorrect setup causing reversed motor drive away from center.

7. To Output a “Sine Wave” Force Demand

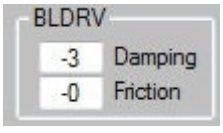
This option can be used to simulate vibration effects. Note that for the brushless drive the “Sine Wave” settings actually define the characteristic amplitude and frequency of the Engine Vibration simulation of the BLDRV-12/24 driver. This is a combination of saw-tooth wave forms rather than a single pure sine wave.



- The BLDRV-12/24 card should be powered and calibrated.
- Set the correct **FFB Output** Channel
- Set the **Hz (frequency)** value under the **Sine Wave** section.
- Set the **Amplitude** value under the **Sine Wave** section.
- Check the **Sine Wave radio button** to enable the sine wave output option.
- **CAUTION** – Click the **ON_OFF** button to activate the output. The vibration demand will ramp up to the set value. If the BLDRV-12/24 is operational it will drive the connected brushless motor to the demanded force/torque level.
- 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.

8. Setting Damping and Friction

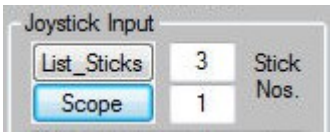


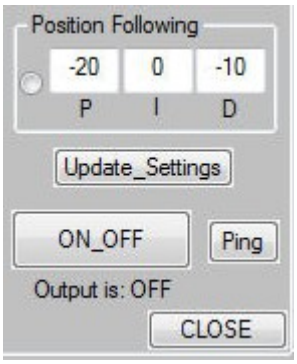
The damping and friction simulations of the BLDRV-12/24 driver can be activated by specifying non-zero values in the **Damping** and **Friction** inputs. These values should generally be small in the range 0 to 10. -ve values can be set, in which case the effect is not to resist motion but to enhance 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.

9. Position Following Mode





The BLDRV-12/24 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 BLDRV-12/24 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. NOTE depending on the mechanical and electrical setup it may be necessary to specify -ve values for the terms to define stable closed-loop behaviour.

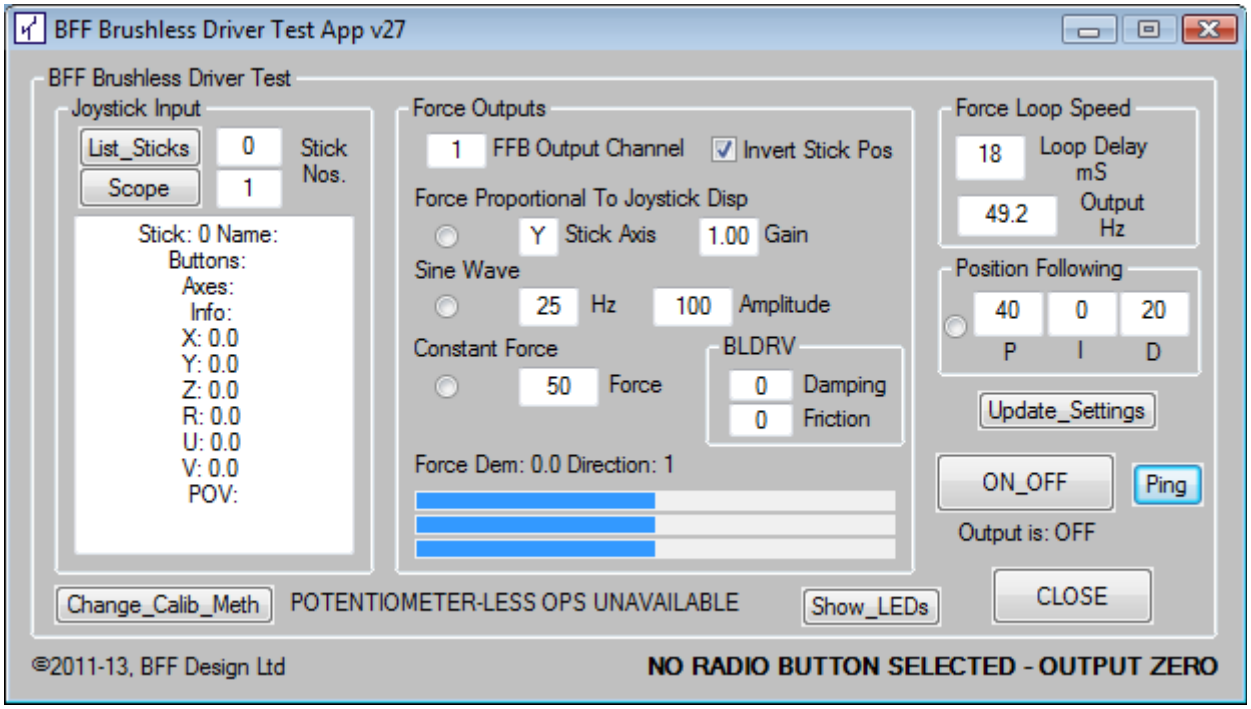
To enable position following mode using the set PID terms check the **Position Following Radio Button**.

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 BLDRV-12/24 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 recommened 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.

10. “Potentiometer-less” Driver Card Operation

Driver cards with recent valid firmware (dsPIC v35, 20X2 v29 or later) can be operated without matching game-controller joystick card potentiometers on the control mechanisms. This feature allows controls to be built without separate position reporting potentiometers which simplifies the mechanical construction – instead the control position is derived from the motor encoder position.



To operate in this “pot-less” mode the driver cards must first be pre-set for “pot-less” power-up calibration so that their power-up calibration can be completed in the absence of the normal joystick card position data. Use the **Change_Calib_Method** button to do this pre-set.

The pre-set must be carried out for each card individually. Once a card is set for “pot-less” calibration the procedure does not need to be repeated (unless the 20X2 chip on the card is subsequently re-programmed).

To set “potentiometer-less” calibration:

Make sure the card is powered and connected (it does not need to be calibrated). Set the **FFB Output Channel** to the required channel (1, 2 or 3) and click **Update_Settings,** and then click the **Change_Calib_Method** button.

– the application will automatically check the firmware validity on the card and report the current calibration setting. If “pot-less” calibration can be supported by the card you will be prompted to proceed with the setting change.

To load test a card which is set for “pot-less” operation first set the **Stick No = 0** (see section 2). The stick position data displayed in the Joystick Input area will then be that derived from the motor encoder on the selected channel (if the card is active and calibrated). No position data is available if the card is not active and calibrated. The force application settings can then be used as normally.

11. Additional manual .ini file settings

In addition to the above settings there are a small number of parameters that can be set manually in the DRVR_Test.ini file.

Manual changes to the DRVR_Test.ini file will only become active when the test application is re-started.

BREAKOUT FORCE SETTINGS

[BREAKOUT]

BO_Fact=30

BO_Rate=1

Later versions of the BLDRV-12/24 cards can support a “breakout” force component. This is a force which must be applied to the controls in order to displace them away from mid position. It acts similarly to a V notch detent in mechanical controls and is similar to a breakout friction force effect.

BO_Fact sets the magnitude of the breakout force (typically 20 – 50 on a force scale of 255).

BO_Rate sets the rate of onset of the force (analagous to the steepness of the sides of the V notch – typically 1 – 4 with 4 being sharpest force response).

The breakout force component will be active only when the “spring” force (ie force proportional to stick displacement) output is selected. It is NOT present for the fixed or vibration force outputs.

ENCODER POSITION REPORTING

[CONFIG]

Enc_Pos_Flag=0

For driver cards with dsPIC firmware 31 or later.

In the default =0 setting the PING data returned by the card includes parameter Encoder_Diff which is the encoder range returned for the card calibration. If Enc_Pos_Flag=1 is set this value is the live encoder position.

CARD CALIBRATION METHOD

[CONFIG]

Calib_method=0

Manual setting of this parameter should not be necessary with Test App v27+ – use the Change_Calib_Method button on the GUI instead.

For driver cards with dsPIC firmware 32 or later.

When Calib_Method is set =1 the BLDRV-12/24 cards switch to a potentiometer-less power-up calibration method. In this mode the cards do not need to receive valid game-controller movement data in order to calibrate. Instead they will detect repeated end-of-stroke positions as the axis is cycled over its full working range. This can be useful for testing the card before the full system is assembled with game-controller joystick axis position pots.

When Calib_Method=2 the card reverts to the normal calibration method.

When Calib_Method=0 the existing setting remains unchanged.

To use this feature set the parameter to the value required, then start the test application and ping the cards to save the setting to the card. Then stop the application, reset the parameter =0 in the ini file, restart the test application and ping the cards again to lock the new setting and prevent unnecessary overwrites of the 20X2 chip EEPROM.

June 2011 – 1st draft for Test App v13

Feb 2012 – V1.1 for Test App V20

June 2013 – V1.2 for Test App V27

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