

# Project Overview - Force Feedback Controls

This DIY force feedback flight yoke project is an ADVANCED level project. It needs good mechanical and electrical build skills to complete.

**The DIY FFB system is NOT a Plug 'n Play system.** It is very important that you read ALL the documents and study the ALL the plans before starting the project.

If you simply buy the cards, apply electrical power and fiddle with the software there is a good chance that all you will succeed in doing is blowing up your expensive hardware.

You will need to undertake and complete the following overall steps:

1. If you are NOT using plans available on the web site the you must first design the mechanics of your yoke, column or rudder controls. This is NOT a trivial step, and it needs to be done correctly. The controls must incorporate the correct transmission (gearing) ratios to connect the FFB motors to the control wheel/stick/peddles, and the transmissions and movement mechanisms must be designed to be smooth and friction free.
2. Build the control mechanics carefully and accurately, including fitting the electric motors and transmissions and the position feedback potentiometers.
3. Set up and calibrate the controls (and joystick card) as a normal game controller "joystick".
4. Prepare the power supply for the driver cards. READ THE DATASHEET COMMENTS ON THE POWER SUPPLY.
5. Connect the FFB driver/controller cards and, if required re-program the 20X2 control chip if non-standard motors, encoders etc are being used.
6. Test the individual FFB channels using the BFF Driver Test application. This is IMPORTANT, damage to the equipment can be done if a step by step approach to the system set up is not taken. This is NOT a "Plug and Play" system.
7. Run with the full BFF CL Software and flight sim active to test the FFB in flight and to tune the force settings to your requirements.
8. From here on only the BFF CL Software is used to run the system in its normal operational mode. On each system power up a simple movement calibration procedure is undertaken, following which the system is ready for use.

A more detailed list of setup and commissioning steps is given below – PLEASE FOLLOW THESE STEPS CAREFULLY.

## Detailed Flight Control Commissioning Steps

1. Make and assemble the mechanics of the flight controls (with brushless motors fitted). Ensure that the movement of the control axes is smooth and friction free – sticky and/or rough mechanical performance CAN NOT be improved by the CL control system!

2. Fit the position reporting and trim potentiometers (or buttons) to the controls and connect them to the joystick card. Connect the card to the PC and get the controls fully operational as a normal game controller – calibrate the movement using the PC game controller calibration applications. The BLDRV-12/24 cards will require full scale game controller movement of the joystick axes in order to fully complete their power-up calibration procedures.
3. READ the BFF Driver Test Application user guide from start to finish!
4. Use the BFF Driver Test application to check that the joystick axis letters are correct for the CL software. Check that Elevator, Aileron and Rudder are on X, Y and Z respectively, and Elevator trim, Aileron trim and Rudder trim are on R, U and V respectively (unless trim axis assignments are changed in the Pry\_S.cfg file). If the trim button option is used then check that the correct buttons have been specified – use the Windows game controller setup facilities.
5. READ the BLDRV-12/24 data sheet from start to finish!
6. Mount the BLDRV-12/24 cards in a location close to the controls. Ideally the card LED's should be visible from the pilot's seated position; they will indicate the initialisation and running status of the CL system. The driver cards should NOT be enclosed – they require a free flow of air over the heat sinks for effective cooling.
7. If you intend to operate the FFB system under sustained loaded conditions – eg for flying with simulated systems failures which require large control forces to be sustained, then force air cooling MUST be used. Fit PC case or similar fans over the BLDRV-12/24 card heat sinks.
8. Set up the power supply and wiring (2 x 17 AmpH or larger lead acid batteries are recommended for powering DIY systems). DO NOT use unregulated power supplies. Fully check the supply voltage and polarity and ensure it is within the acceptable limits for the cards. However DO NOT connect power to the driver cards at this stage.
9. Wire the BLDRV-12/24 cards to the BLDC motors (phases, hall sensor and encoder).
10. Connect each card to the serial data "daisy chain" (CN3-1). Set the correct address for each card (JMP-1).
11. Install the PICAXE AXE027 USB download cable drivers and connect the cable to the PC and one BLDRV-12/24 card.
12. If the driver cards require non-default programming the free PICAXE Programming Editor Software will need to be downloaded and installed on your PC.
13. Ensure the power supply voltage selector jumpers on the BLDRV-12/24 cards are correctly set for your supply voltage (12 or 24V), ensure the power supply voltage is within range and the polarity is correct. Connect power to each of the cards ONE AT A TIME AND SEPARATELY - monitor the cards for correct LED operation. NOTE that the voltage regulator heat sinks (the small ones) will become hot to the touch (approx "Hot radiator" temperature), this is normal. However if there are any signs

of overheating immediately power-down the cards and double check the power supply and other wiring.

14. If any BLDRV-12/24 card requires to be reprogrammed do so now. See the card data sheet Appendix 1 for instructions (but you will already know this having read the data sheet from start to finish in step 5 above).
15. Use the BFF Driver Test application to check the operation of each card / FFB axis individually. Note the power-up calibration procedures. Take particular care with the loading proportional to axis displacement – if on first use the control axis is driven suddenly away from, rather than towards, center then IMMEDIATELY disengage the software drive (or power-down the card). In this case invert the axis reporting in the test application and re-power and re-calibrate the card. Take note of any axes you need to do this for – it is likely that the axis will need to be inverted in the main CL software also.  
Check each axis for smoothness of force feel and monitor continuously the temperatures of the driver cards for signs of overheating. If they are operating in a high ambient temperature or are loaded at high levels for periods of several minutes there is a danger of overheating and damage – in these circumstances it is strongly recommended that additional forced air (fan) cooling is provided for the cards. Test initially with light loads and then increase the loading by steps to check the integrity of the electrical and mechanical systems.
16. Power down the cards.
17. You can now run the main BFF Control Loader software with a default configuration file and commence to tune the settings for your system. Start with the settings for axis inversion etc to ensure all axes are driven towards center rather than away from center. Note that the flight sim can be placed in a particular flight situation and then paused; for example pausing during straight and level flight at a slow speed will allow the main control centering force behaviour to be checked at low force levels. Pausing the flight during takeoff whilst on the runway will allow runway vibrations to be checked etc

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