NOTES – BFF DIY Control Loader System – Brushless Wiring & Config.

A) **IMPORTANT – POWER SUPPLY PROVISION**

The BLDRV-12/24 cards will operate on either 12V or 24V power supplies. It is strongly recommended that Lead-Acid batteries or the suggested power supply is used for DIY systems; these will provide a very smooth current source. If a PSU is to be used it MUST be a smooth, voltage regulated supply capable of sustaining the supply voltage at the demanded current draws – variation of the supply voltage above the data sheet specifications will damage the cards, and any electrical noise on the supply will be felt as roughness in the force feedback at the controls.

As an alternative to Lead-Acid batteries a suggested PSU is **Mean Well S-350-24**. This is a 24V 14.6 Amp power supply suitable for 2 motor systems – the current supply is a bit low for 3 cards at rated output.

See - http://www.meanwell.com/search/s-350/s-350-spec.pdf

DO NOT IGNORE THE ABOVE REQUIREMENTS.

1. BFF Control Loader software and FS9/X with FSUIPC installed. The system should be set to run the CL Software at or around 50Hz (see the delay parameter in the Pry_S.cfg file). The CL software should be run on the same PC as the flight sim; this is to allow it access to the joysticks used for the sim and to issue instructions to the sim during its AP following operation. The brushless BLDRV-12/24 drivers are programmed to do much of the force calculation on the card – this allows the CL software to run with less CPU resource than for earlier beat versions.

   The CL software will also operate with X-Plane V9.6+. XPUIPC needs to be installed – see CL Software user guide.

2. Three BLDRV-12/24 brushless motor drivers are used – one for each control axis. Each is addressed using jumper settings on the cards. The BLDRV-12/24 brushless motor drivers receive serial input via the AXE029 download cable at approx 500kbaud, the baud rate is set in the .cfg configuration file.

   The single serial data connection is shared by the brushless drivers – see note 3. The drivers process force demands from the PC software at a rate of approx 50Hz and the CL software should be set to export at this rate, the BLDRVR-12/24 internal force calculations are done at 500Hz. The data export frequency of the CL software is adjusted by altering the loop pause time in the Pry_S.cfg file. Force demands will be held if the BLDRV-12/24's detect loss of serial data comms from the PC.

3. The BLDR-12/24 drivers are daisy chained on the same serial lines. This allows operation from a single COM port on the PC. On-board terminal CN3-1 provides access to the serial lines for wiring. Each is addressed using jumper JMP-1 settings on the cards – 1 is for Elevator, 2 is Aileron and 3 is Rudder.

4. Wiring details are shown for the Aileron drive only – the Elevator and Rudder wiring is the same to their respective drivers. All the drivers can be supplied from the same 12/24V DC power source so long as it has adequate current capacity. A pair of

38Ah lead-acid rechargeable batteries makes a good DC source capable of high current output and capable of sinking current when required.

The driver to motor wiring connects the 3 power phases, the quadrature encoder and one hall-effect position sensor to the driver. The hall sensor input is used to calibrate the absolute position for the quadrature encoder. The quadrature encoder provides the continuous motor shaft position feedback required for the motor commutation.

5. Bodnar BU083(A) 10 or 12bit joystick card. 10 or 12bit resolution recommended for future compatibility with pilot/co-pilot motion following features. Other joystick cards can be used, however do not use poor (8bit) resolution cards.

   Note the joystick axis mappings to the control axes – Aileron – X, Elevator – Y, Rudder – Z, Elev Trim – R, Aileron Trim – U, Rudder Trim – V. Do not enable these trim axis assignments in FS9/X and do not use the FS9/X internal trim adjustments otherwise the sim and CL flight controls zero positions will not match.

   Trim pots on a separate joystick card can be used – settings are made in the Pry_S.cfg file. The joystick number and the axes letters to be used need to be specified.

   It is also possible to use trim up/down buttons as an alternative to pots. Again settings are made for this is the Pry_S.cfg file. The joystick number and the numbers of 6 up/down trim buttons on the joystick require to be specified. The rate at which the trim moves when a trim button is depressed can also be set.

   NOTE the BFF Driver Test application can be used to examine and identify the active output axes from your joystick card.

6. Precision potentiometers should be used for the control axis position reporting. They should be mechanically geared to ensure that as much of their electrical working range is employed as possible – this helps to maximise the resolution of the position reporting. The pots should be **electrically isolated** from the drive motors to prevent noise propagating to the position signals. The pots must be connected to the BU083(A) card using shielded (screened) cable and the cable shields should be grounded to 0V on the BU083(A) card. This will help to minimise the effects of RF radiation from the motors on the signal resolution.

7. The CL software implements trim forces separately from the FS9/X internal trim system. Three trim posts are required – connected as shown to the joystick board, or alternatively six (6) up/down trim buttons (2 for each control axis) can be used. See item 5 above for more details.

   NOTE: if more analogue outputs are connected on the BU083(A) card the physical location of the trim channels on the card may move. If you think this has happened the BFF Driver Test application can be used to examine and identify the active output axes from your joystick card.

8. Force feedback motors. Brushless DC motors with near sinusoidal back EMF characteristics of the type specified. Not all low cost BLDC motors will operate satisfactorily in a CL system – even with the BLDRV-12/24 drivers. Many have trapezoidal back-emf characteristics and can not generate smooth enough torque output.

If required ground the motor cases and power cable shielding to minimise noise transmission effects.

The motors should have 360cpr quadrature encoders fitted.

The mechanical design of the motor to control drive is another critical area for the overall system performance, as is the mechanical connection of the position pots to the controls. Transmissions must be stiff and precise with low levels of friction and as little backlash as is possible.

9. The Elevator and Rudder axis wiring is the same as is shown for the Aileron. All three drivers can share the same power supply if it has adequate current capacity.
10. To maintain smooth performance the BFF CL software needs to export the force demands to the BLDRV-12/24's at high baud rates. The default baud is 516129 to match the baud of the BLDRV-12/24 default programming. This is a non-standard baud but it is supported by FTDI chip based USB/Serial cables and so also the PICAXE AXE027 cable. To obtain best results at this baud the “Latency Timer” setting in the advanced options for the virtual com port associated with your cable should be reduced from 16 to 1 ms. Do this through the control panel – device manager on the PC.