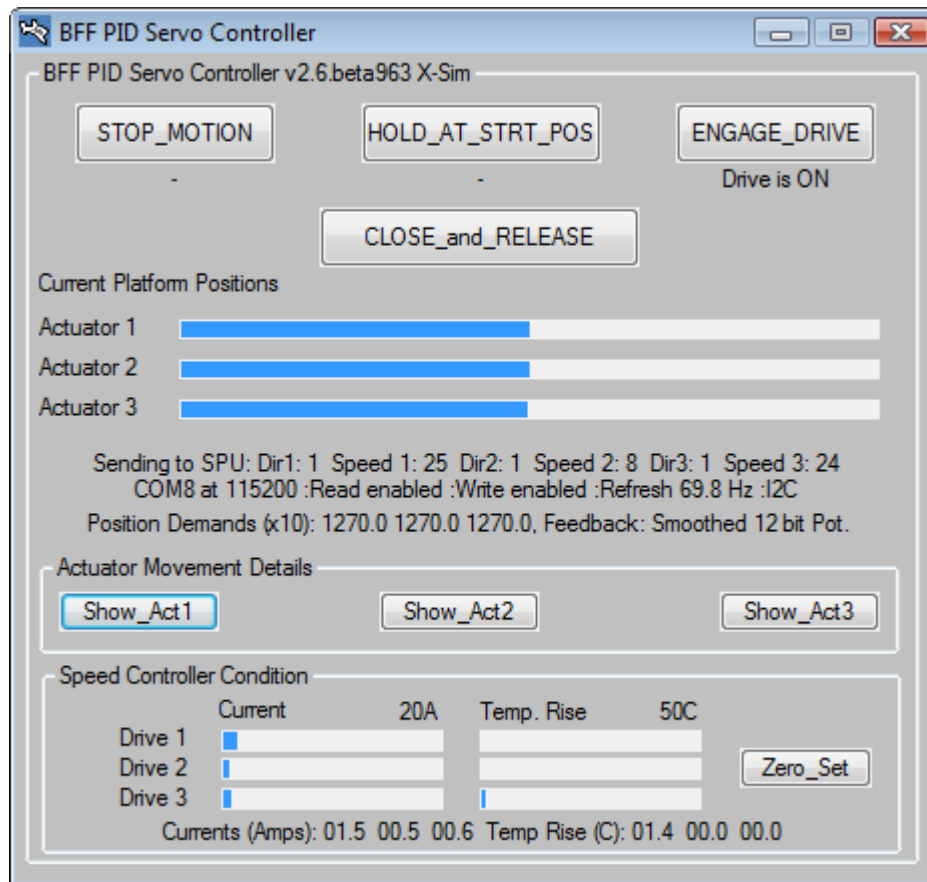


# ***BFF PID Servo Controller for X-Sim – Quick Start (Draft)***



## **1. Introduction**

The BFF PID Servo Controller and associated hardware was developed for use with the BFF Motion Driver for driving 3 degree of freedom DIY flight simulator motion platforms.

A version of the PID Servo Controller is now available to run with X-Sim Force Profiler 2.

This document provides some quick start information.

The BFF PID Servo Controller software runs in conjunction with the 64SPU-1 signal processor to provide a closed loop PID servo drive control system. For details of a typical system layout and details of the hardware see -

<http://buggies.builtforfun.co.uk/Sim/hardware.php>

In summary, the Servo Controller software reads actuator/motor position demand information from the shared memory area of X-Sim Force Profiler 2. Force Profiler Axes 1, 2 and 3 are read and used as position inputs to channels 1, 2 and 3 of the controller. Motor speed and direction commands are calculated by the Servo Controller using a PID algorithm and are exported to the system motor controllers via the 64SPU-1 card.

The default system motor controllers are Devantech 24V 20 Amp MD03's which the 64SPU-1 drives over an I2C bus. Dimension Engineering Sabertooth and SyRen controllers can also be used, and the 64SPU-1 programming can be customised to provide other outputs.

The 64SPU-1 can accept 10bit potentiometer or 12bit MA3 encoder position feedback,

12bit potentiometer position feedback is available using the 12ADC-1 extension card.

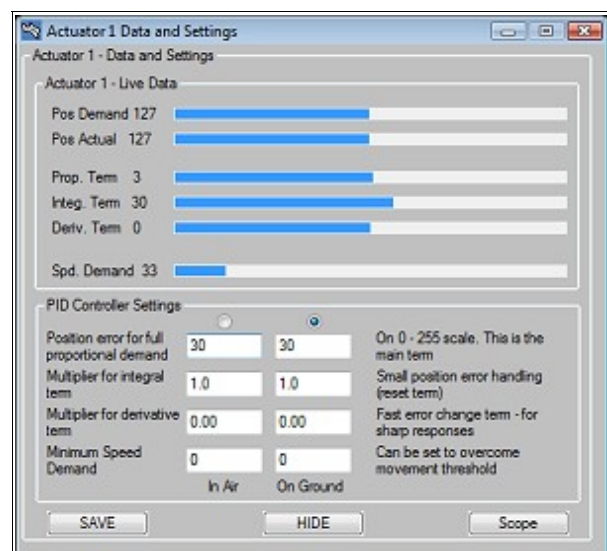
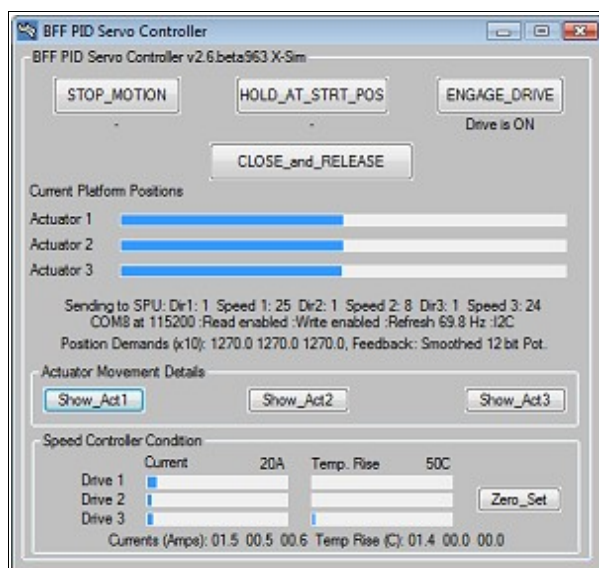
The BFF PID Servo Controller allows the PID terms of the control algorithm to be adjusted to tune the control system. Separate PID terms can be specified for on-ground and in-air conditions allowing the system response to switch automatically between harder and softer responses on take-off and landing. Loop fresh rates are typically 50Hz, with up to 70Hz when the 12AD-1 12bit pot feedback card is used.

The Servo Controller also provides facilities for scaling and centering the output motion, and for mixing cues for 3-point support type motion platforms. X-Sim outputs can be used unadjusted also.

## 2. Setup

1. Make any required 64SPU-1 card settings in the BFF PID Servo Controller's PID26.cfg file – see [64SPU-1 data sheet](#) section 3.
2. Make any required settings in the PID\_Extern.cfg config file – see Section 3 below.
3. Make sure X-Sim is active and the Force Profiler 2 “Math setup” has been completed for Axis 1, 2 and 3 (typically pitch, roll and heave motions) so that active position demand data is available in the Force Profiler shared memory area.
4. If possible ensure that the frame rate of your game, the Force Sender send rate and the “Math engine rounds/s” for the Force Profiler are the same or better than the PID Servo Controller loop rate. This will typically be between 50 and 70Hz. You may have to experiment with your settings.
5. Assuming the 64SPU-1 is configured and connected to the PC power-up the 64SPU-1. The PID Servo Controller will not run if it can not connect and communicate with the 64SPU-1 card. If you wish to test the PID Servo Controller software without hardware then the hardware comms will need to be disabled using the “No\_Hardware” parameter in the PID\_Extern.cfg file. See section 3 below.
6. Start the PID Servo Controller .exe.
7. The main window buttons allow the drive to be stopped, sent to park/start position or fully engaged.

Detail windows are available for each output channel where the PID settings can be adjusted and control parameters viewed. A built-in oscilloscope is provided to display position demand, actual position and speed demand for each channel.



### 3. Configuration File Settings

There are two configuration files used by the PID Servo Controller – the PID26.cfg and PID\_Extern.cfg files.

**PID26.cfg** contains the current PID parameter settings which are set through the software and don't need to be adjusted manually. There are however a small number of others to be set manually. These are the binary entry which controls the 64SPU-1 and some settings for use when DE Sabertooth controllers are used.

See the [64SPU-1 data sheet](#) section 3 for 64SPU-1 related settings, and see the [Sabertooth Quick Start Guide](#) for Dimension Engineering controller related settings.

**PID\_Extern.cfg** contains a number of parameters which control the PID Servo Controller's behaviour when it is used with X-Sim. The file entries are:

#### [Port\_Data]

COMPort=COM8 ;Com port number for PID Servo Controller to 64SPU-1 comms

#### [Process]

Delay=5 ;Delay in ms to insert each servo control loop, some delay will reduce the  
;CPU usage of the software, too much and the refresh rate will reduce. =0  
;for full speed.

No\_Hardware=No ;=Yes for software testing WITHOUT hardware present. If =Yes it is probably  
;advisable to add approx 10ms to Delay. When =Yes the position feedback will  
;be set to mid position (see below).

Display\_Loops=3 ;eg update GUI every 3 servo loops, set =1 for fastest GUI update

#### [Platform\_Type]

Rig\_Type=Mixed ;=Independent, for platforms with one actuator for each degree of freedom.  
;=Mixed, for 3 point support type platforms in which the X-Sim outputs are  
;mixed by the servo controller to drive the combined-movement actuators.

Pitch\_prop=0.9 ;\*\_prop terms are only valid for Rig\_Type=Mixed platforms. They are the

Roll\_prop=0.9 ;proportions by which the individual pitch, roll and heave demands are

Heave\_prop=0.5 ;combined to generate the demanded positions for the actuators in 3-point  
;support platforms. Range is 0 to 1.0

#### [Mid\_Positions]

mid1=127 ;Mid stroke position for each actuator within feedback range 0-255. Leave at

mid2=127 ;127 if cue offsets are already defined within X-Sim.

mid3=127

#### [Stroke\_Lengths]

stroke1=100 ;Working stroke length of each actuator within range 0-255. Leave =255 if

stroke2=100 ;the cues are already stroke limited to less than 255 by X-Sim  
stroke3=100

#### [Start\_Positions]

start1=87 ;Start/Park positions of each actuator within feedback range of 0-255  
start2=87  
start3=87

#### [In\_Air\_Flag]

IA\_Gauge\_no=0 ;X-Sim gauge slot number to use as the In-Air / On-Ground indicator. =0 for  
;don't use (default = on-ground). A non-zero value is used by the servo  
;controller to automatically switch to the in\_air PID control settings. Otherwise  
;the on-ground settings are used. To use this you will need to define a gauge  
;in X-Sim which can detect the take-off / landing transitions for your game.

To use the unadjusted axis outputs from Force Profiler as the actuator position demands set **Rig\_Type=Independent** and leave the mid stroke positions at 127 and the working stroke lengths at 255.

To apply your own actuator stroke length scaling and mid point positions to the X-Sim output use the **mid\*** and **stroke\*** parameters.

To apply X-Sim single DOF outputs to a 3-point support (coupled) platform set **Rig\_Type=Mixed** and set the **Pitch\_prop** etc parameters to adjust the proportions by which the combined-movement actuator demands are calculated.

To reverse the motion direction of any axis add an "Invert Axis" operator in the Maths Setup section in Force Profiler.

## 4. Applicability

The PID servo controller and 64SPU-1 card can be used to drive various platform types - 2 or 3 degree of freedom (DOF) uncoupled actuator types and 2 or 3 DOF coupled actuator types.

NOTE – PLEASE DO NOT install the X-Sim version of the PID Servo Controller in the same directory as the BFF Motion Driver – keep the X-Sim version separate in its own directory!

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