- OPERATING INSTRUCTIONS -

- for -

- QUAD EFB CONTROLLER -

- printed February 27, 1999 -

An EFB (Electronic FeedBack) controller is used to control up to four independent servo loops. Each of these loops consists of a servo valve, an actuator (hydraulic or pneumatic cylinder), and a transducer (10 Kohm variable resistor) linked to the actuator.

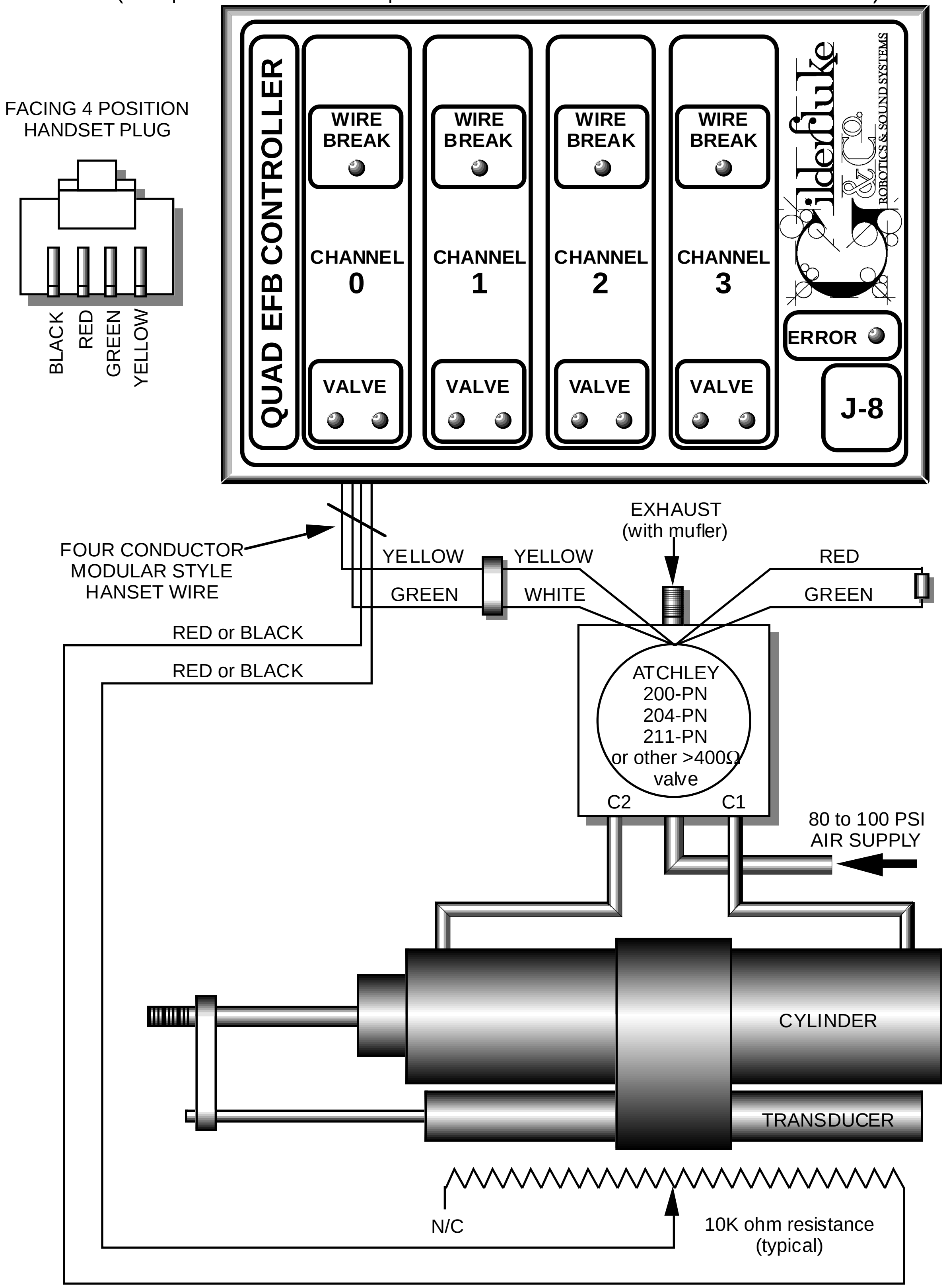
In operation, a control voltage (nominally 0 to 10 VDC) is sent to the EFB controller. The EFB circuitry compares this incoming voltage with the current position of the actuator as sensed by the transducer. If the current position of the actuator and input voltage disagree, then the EFB controller opens the valve so that the actuator moves towards the target position until they do agree. If the difference between the command and the actual position was small, then the servo valve is only opened a little. If the difference in position is great, then the valve is opened all the way. Servo valves differ from typical solenoid valves in that they can open just a little or a lot.

The most common failure in animated figures which use EFB analog movements are broken wires leading to the transducer. For that reason Gilderfluke's EFB controller was designed so that it only needs two wires to the transducer (three are usually required) and it constantly checks the status of these wires. If there is a wire break, it will immediately switch the gain setting to a secondary 'low gain' control, which you can adjust to keep the movement from slamming one side. When a break is sensed, or when power is first applied to the EFB controller, it will stay in the error condition for approximately 10 seconds. This will keep circuits with loose wire connections from jumping in and out of error condition.

There is a 'broken wire' indicator LED for each of the four channels in the EFB controller. If any of the circuits is in an error condition, then the 'error' LED will light. This error signal can be remoted through a standard J-8 cable. The EFB controller provides an optically isolated transistor output between the black wire (collector) and the white wire (emitter). The White wire isn't normally used by the connections to the Standard Micro MACs bricks, so that the same cable can be used to sum the error indicators and control signals from any number of bricks and EFB controllers and route them to a central indicator panel. Smart Brick Systems will need to use a separate cable, as these two conductors are used for other purposes in the Smart Brick Network cables.

If any channels are left unused on the Quad EFB controller, you will need to short together the transducer inputs on the unused channels to turn the ERROR LED off.

Installation: (Setup for channel 0 output shown. All other channels are identical.)



The cylinder can be virtually any type of double acting cylinder available (rotary, linear, etc.). The stroke and diameter of the cylinder can be used to determine the size of valve you need to use by calculating the approximate displacement of the cylinder and comparing it to the cubic feet per minute (CFM) capacity of the valve.

A number of different styles of position transducers are available. These include standard linear and rotary potentiometers as well as 'string pots' in which a small steel cable extends to measure distances. Whatever type of transducer is used, it must be linked to the actuator so that it closely follows the movement and uses as much of it's 10 Kohm stroke as possible. For any permanent installation you must use a potentiometer which is made for this type of heavy duty use. Typical life span ratings are in the 2 to 20 million cycle range.

The output which goes to the valve is +/- 10 volts at a current up to 20 ma. This is compatible with the 250 ohm coils on most servo valves. If air use is a factor in your design, you should use a two stage valve (like the Atchley 204-PN) in that there quiescent air consumption is lower than a single stage valve (like the Atchley (200-PN).

Controls:

There are three adjustments available on each of the four EFB circuits. These are:

1) Gain. This controls how much the valve will be opened for a given movement. This control is bypassed when there is an error condition in the feedback transducer wiring or on power-up. Turning it counter-clockwise lowers the gain.
2) Velocity. This control limits the maximum amount the valve may open by adding a resistance in series with the valve. Turning this control counter-clockwise lowers it's effect.
3) Low Gain. This control serves the same function as the normal gain control, but only at the times when there is an error condition in the transducer wiring or when the EFB controller has just been powered up. At all other times this control is bypassed. You can use this control to set the speed at which the movement will go when power is first applied to a circuit or there is a problem in the transducer wiring. Turning this control counter-clockwise lowers the gain.

Adjustment:

Adjusting an EFB movement is part skill and part art. Unfortunately it must be done to taste, so there are no set rules about making these adjustments. The following procedure will usually yield satisfactory results [1] :

1) When you first turn on a EFB circuit to start testing it, you should first turn the gain controls all the way down (counter-clockwise) and the velocity control all the way out (counter-clockwise).
2) Turn the gain control clockwise as you apply a varying command voltage to the movement to sweep it back and forth. As the gain comes up, you will start to see the valve indicator LEDs start

[1] If this is the first time the circuit has been turned on, you may find that the movement turns the valve on hard in one direction and just wants to stay there. This means that there is something crossed in the EFB's hookup. To correct this problem you will need to reverse the connections at one and only one of the following points:

1) Switch the wiring on the transducer. One of the two wires to the transducer is attached to the wiper. Leave this one alone. The other wire is attached to one end of the resistor. Move this wire to the opposite end of the resistor (this would be the connection marked 'N/C' on the illustration).
2) Switch the two wires on the valve. If the valve is opening in the wrong direction, reversing the two wires to the valve will reverse the direction the valve opens.
3) Switch the plumbing between the valve and the cylinder. Just cross the two hoses at either the valve or cylinder end of the hookup.

to glow as the valve opens and the actuator starts to follow the position commands . Continue turning the gain up until the movement starts to show signs of oscillation.

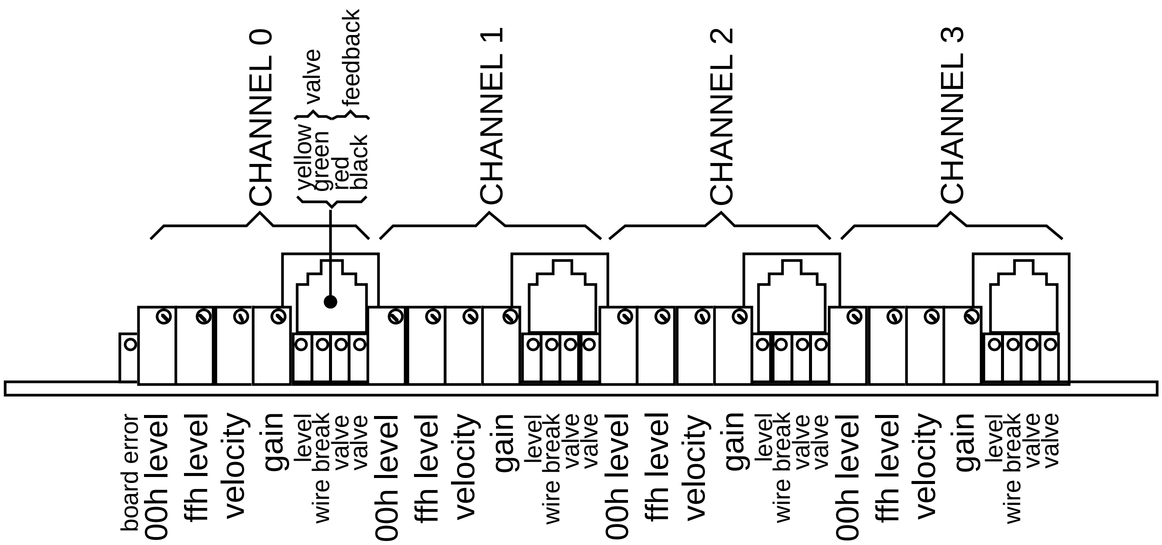
3) Turn velocity control clockwise to stop the oscillation. Now turn it back down (counter-clockwise) until you find the point just above where the movement can be made oscillate by applying fast moving command voltages.

At this point the movement should be adjusted reasonably well. Depending on the nature of the movement, you may want to continue to tweak it to taste.

The low gain control is usually set at it's minimum value (fully counter-clockwise). If you want to adjust it, you will need to force an error condition by temporarily unplugging the wire for that circuit. It will stay in error condition for about 10 seconds, during which time you can adjust it.

Quad D/A and EFB ("George Board"):

This board combines the functions of a Quad D/A converter and a Quad EFB. The adjustments are a combination of those you would find on both of these other products. The only function which was eliminated is the 'low gain' control on the EFB. When a transducer wire break occurs, the gain will immediately go to its lowest possible value, effectively shutting off the valve. The valve and transducer connections, indicator LEDs, and adjustments are arranged as follows.



As with the regular Quad EFB controller, the wire break error signal from all four channels is summed to a single indicator LED and output. This is a optoisolated transistor output on pins 4 (collector) and 6 (emitter) of the backplane connector. This output can drive a LED, solid state relay, or small electromechanical relay. There is also a four pin jumper header, which when two jumpers are installed horizontally will bring these same signals out to pins 1(collector) and 6 (emitter) on the backplane. These connect to the white and blue wires on the backplane's RJ-11, which are unused if the rest of the cage is populated with other Quad D/A&EFB boards or dumb bricks, but which is incompatible with any smart bricks in the cage. These jumpers are normally left off.

Note: The Wire Break Collector & Emitter are the 2 wires used by the George Board to transmit remote wire break indication. If you do not need this feature you can isolate the George board from the back plane by removing the 2 jumpers located near edge pin #1.

Caution : Never connect edge pins 1& 2 of a George Board to edge pins 1 & 2 of a brick card unless the 2 jumpers near edge pin 1 are removed.

wire #	Edge pin #	color	wire function
J8 Black	1	N/A	Wire Break Collector
J8 White	2	N/A	Wire Break Emitter
	3	N/A	
	4	N/A	
	5	N/A	
	6	N/A	
	7	N/A	
	8	N/A	
	9	N/A	
	10	N/A	
#1	11	brown	J6 out channel 0 Ground
#2	12	red	J6 out channel 0 bit 7
#3	13	orange	J6 out channel 0 bit 6
#4	14	yellow	J6 out channel 0 bit 5
#5	15	green	J6 out channel 0 bit 4
#6	16	blue	J6 out channel 0 bit 3
#7	17	violet	J6 out channel 0 bit 2
#8	18	gray	J6 out channel 0 bit 1
#9	19	white	J6 out channel 0 bit 0
#10	20	black	J6 out channel 0 + Supply
#11	21	brown	J6 out channel 1 Ground
#12	22	red	J6 out channel 1 bit 7
#13	23	orange	J6 out channel 1 bit 6
#14	24	yellow	J6 out channel 1 bit 5
#15	25	green	J6 out channel 1 bit 4
#16	26	blue	J6 out channel 1 bit 3
#17	27	violet	J6 out channel 1 bit 2
#18	28	gray	J6 out channel 1 bit 1
#19	29	white	J6 out channel 1 bit 0
#20	30	black	J6 out channel 1 + Supply
#21	31	brown	J6 out channel 2 Ground
#22	32	red	J6 out channel 2 bit 7
#23	33	orange	J6 out channel 2 bit 6
#24	34	yellow	J6 out channel 2 bit 5
#25	35	green	J6 out channel 2 bit 4
#26	36	blue	J6 out channel 2 bit 3
#27	37	violet	J6 out channel 2 bit 2
#28	38	gray	J6 out channel 2 bit 1
#29	39	white	J6 out channel 2 bit 0
#30	40	black	J6 out channel 2 + Supply
#31	41	brown	J6 out channel 3 Ground
#32	42	red	J6 out channel 3 bit 7
#33	43	orange	J6 out channel 3 bit 6
#34	44	yellow	J6 out channel 3 bit 5
#35	45	green	J6 out channel 3 bit 4
#36	46	blue	J6 out channel 3 bit 3
#37	47	violet	J6 out channel 3 bit 2
#38	48	gray	J6 out channel 3 bit 1
#39	49	white	J6 out channel 3 bit 0
#40	50	black	J6 out channel 3 + Supply
black	51	brown	power supply ground
black	52	red	power supply ground
black	53	orange	power supply ground
black	54	yellow	power supply ground
black	55	green	power supply ground
red	56	blue	+ power supply input
red	57	violet	+ power supply input
red	58	gray	+ power supply input
red	59	white	+ power supply input
red	60	black	+ power supply input