

S6PWM Servo Technical Manual

For controlling our L16s and W-Series Linear Actuators. Rev. 04-23-14

S6PWM Summary of Features:



- Proven Performance when reliability counts in RPV applications.
 - High frequency (31.25 kHz) PWM for smooth, quiet motor operation.
 - All Pre-Programmed PID Servo Loops for best performance possible.
 - 12 bit resolution (4096 steps) for accurate positioning.
 - Animatronics Bio-Motion™ Algorithms to produce life-like motion.
 - Bio-Motion has 4 built-in settings. A must for Animatronics.
 - 6 Jumper Options for custom applications.
 - R/C or DC Control Input.
 - Soft Start for 8 seconds to prevent abrupt movements at power-up.
 - No user programming necessary.
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- Built-in user selectable "self-test" mode which cycles the actuator slowly without any R/C input.
 - Built-in, optional 0-5VDC voltage control input rather than pulse width, requiring only an external potentiometer for 12 bit position control.
 - Deadband typically less than 0.001 msec.
 - Fault indicator LEDs to simplify maintenance:
 - Red LED "On" indicates loss of input or presence of invalid pulse width.*
 - Yellow LED "On" indicates over-temp or if it is "blinking" it is in the Nap mode.*
 - Green LED "Blinking" indicates normal operation of the control system processor.*
 - *Opto isolator R/C input. Requires .7ma of input current.*
 - Stores last valid R/C input pulse.
 - RC input range: 1.00 to 2.00msec pulse widths @ 55Hz Bandwidth
 - Frequency range, 44to160Hz. Period from 6-23 msec.
 - Power supply voltage range is 12 volts to 32 volts. H-Bridge will "Cut-off" under 10V.
 - Drives motors rated at up to 75 watts at 24 volts continuously, limited only by availability of heatsinking and/or cooling airflow for the servo controller's H-Bridge I.C.
 - Designed to provide up to 3 amps continuous and 6 amps intermittent output with adequate heatsinking and/or cooling airflow for the servo controller.

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1.) Jumper Options: To dynamically alter the Actuators performance to meet your special applications. See Fig 2 below.

RC Reversal Enable: For RC input function only

Installing this jumper will reverse the direction of the R/C servo travel.

0-5V Enable for DC Input Command:

Installing this jumper the servo will follow an external 0-5V control, and not the R/C signal if present. An external potentiometer wiper, or an analog input voltage, is connected to the card-edge connector pin A8. The bottom of the potentiometer or the ground reference of the analog input is connected to the card-edge at pins 9 or 10. The top of the potentiometer should be connected to the servo controller reference voltage on the card-edge connector pin B7. If a shielded cable is utilized, the shield should be connected to the card-edge connector ground on pin A10 or B10. The potentiometer resistance should typically be between 2K and 20K ohms for best performance. You can order the S-Cable with the 0-5V input plug For use with an external analog input, the maximum input voltage should be equal to the reference voltage on the servo controller card-edge connector pin B7. The maximum permissible current drain out of pin B7 is approximately 5 milliamps. The reference voltage is 5.0 ± 0.25 VDC. The minimum input voltage should be equal to the ground reference on the card-edge connector pin A9. The analog input is protected by a 10K ohm series resistor. The nominal input impedance is over 1 Meg ohm. Do not use the RC Reversal Enable with this function.

Bio-Motion™ : The Bio-Motion A & B Jumpers feature is designed to simulate inertia and serves to greatly reduce jerky motion, which is a valuable feature in animatronic applications. For example, a powerful motor moving the arm or leg of an animatronics creature will often move the limb much too abruptly, resulting in a very unnatural, jittery motion. By choosing the appropriate amount of Bio-Motion acceleration processing, it is possible to produce much more realistic motion, with smoother, more life-like movement and a visual impression of a system having a realistic amount of inertia. The Bio-Motion algorithm also smoothes the R/C signal and provides gentle transitions between the abrupt jumps in the R/C pulse widths. The Bio-Motion algorithm is calculated in 32 bit floating point math for ultra high resolution. Bio-Motion digital acceleration processing currently is available in four different values. The speed numbers indicate the maximum acceleration. The currently available values are 30, 10, 5, and 0. The jumpers for the Bio-Motion processing for Fast (default), Medium and Slow acceleration are installed by the end user. Also jumper A is on the connector (A7) so you can switch it on or off via switch on the fly. Switch to signal gnd. pin A8 or B9 on the connector. Play with these options; it is a must if you are doing animatronics.

Self-Test (Demo Mode) Enable:

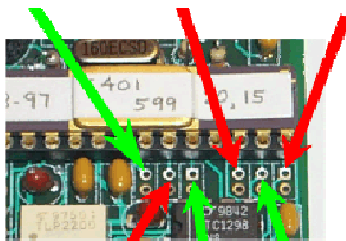
To enable: Install the jumper or use a remote switch wired to the card-edge connector pin A6 and A10. When enabled: The servo will slowly move 50% of its full travel from its center point with the A coded CPUs. The B coded CPU s will move 90% of its travel. The range of motion, velocity and the duration of the pause at each end point may be customized at the time of manufacture of the servo controller CPU.

No Nap:

When the commanded position and servo position are equal the "Yellow Led" will start flashing indicating its in a napping state. The motor will be in a dynamic brake mode using no motor power consumption to help hold its load and position, thereby allowing both the motor and the servo controller to run much cooler. As soon as either the command position or the servo position changes by 125 steps, normal operation is immediately restored. This can cause a slight pulse effect if a servo can creep or be back-driven. For a 2" Linear Actuator the change is .060". Installing this jumper will disable the Nap feature.

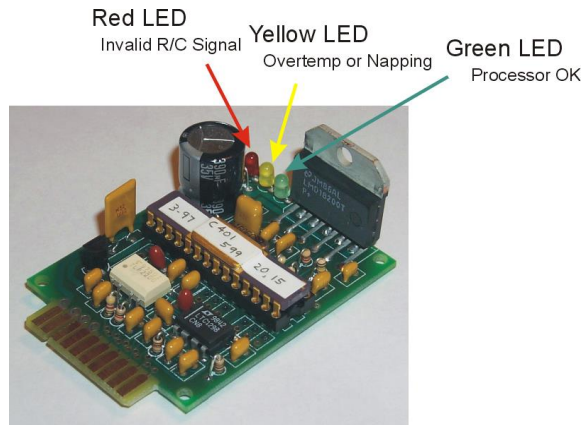
Fig 2

RC Reversal 0-5V Enable Self Test Mode



No Nap
Bio-Motion B Bio-Motion A

Bio-Motion A	Bio-Motion B	Bio-Motion Result
none	none	Fast acceleration
Installed	none	Medium acceleration
none	Installed	Slow acceleration
Installed	Installed	Full speed, no Bio-Motion



2.) LED Indicators:

Green LED:

System OK. Flashes green about 7 times per second to indicate that the processor is operating properly.

Yellow LED:

Napping. Yellow LED flashes in sync with the green LED to indicate that the controller is napping. Napping mode is used to save power, but should only be used with servos that are not subject to being backdriven. In napping mode, whenever the controller detects that the servo motion has stopped and power could be saved, the motor current is turned off.

Lights yellow continuously at 140°C to indicate that the controller is overheating and will be shutdown at 170°C.

Red LED: Invalid R/C or No input pulse if on.

Solid Red indicates that the R/C pulse width is either outside of the permissible range of 0.920 msec to 2.120 msec or that the R/C pulses are entirely missing. The full range of travel of the servo corresponds to R/C pulse widths from 0.988 msec to 2.012 msec. Pulse widths from 0.920 msec to the lower limit of 0.988 msec will be treated as if they were 0.988 msec. Similarly, pulse widths from the upper limit of 2.012 msec to 2.120 msec will be treated as if they were 2.012 msec. Pulse widths below 0.920 or above 2.120 will be completely ignored and treated as if they had never occurred.

3.) Power-up, Soft-Start Feature: “Always have signal present before turning S6PWM’s power on or off”.

At power up, the S6PWM has an 8 sec. Soft or Slow Start. Check Actuators movements directly after Power-Up Make sure the actuators are not over there rated load at start-up.

4.) CPU Codes:

The S6PWM has a 28 pin IC socket for the CPU chip, which has a label code on it. This code should match the code labeled on the actuator being controlled. The code contains the PID program and settings for the best performance for CK Design Tech actuators with feed-back.

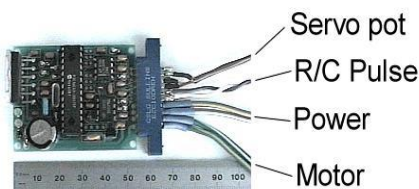
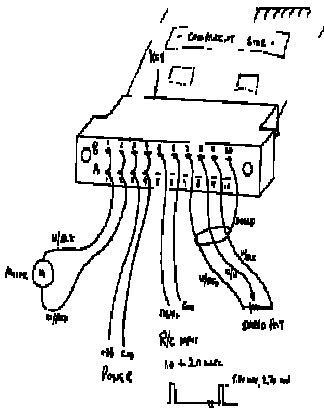
5.) Heat-Sinking and Cooling:

The S6PWM is designed to provide outputs up to 3 amps continuous and 6 amps intermittent with adequate heat-sinking and/or cooling airflow for the servo controller output IC. In general, for low motor currents, below 1 amp, there is no need for any heat sinking or forced airflow. As the motor current increases above 1 amp, the power output stage of the controller will need to get rid of some heat, which may be accomplished by heat sinking or by providing some cooling airflow. The output stage may safely be run at temperatures around 150 deg F, but higher temperatures should be avoided. The PWM output amplifier IC contains built-in thermal protection in which it will shut down at 170°C, intended to protect the IC from some types of overloads. Avoid power up if servos have higher than rated loads on them.

6.) PCB Connector:

The Precision Servo Driver is designed with a gold plated “card-edge connector”, which allows quick and easy replacement and troubleshooting of the system. The connector is also available with pc board pins, so that a system motherboard can be created. Note that a connector key is used between pins 2 & 3 contacts to prevent incorrect insertion of the circuit board.

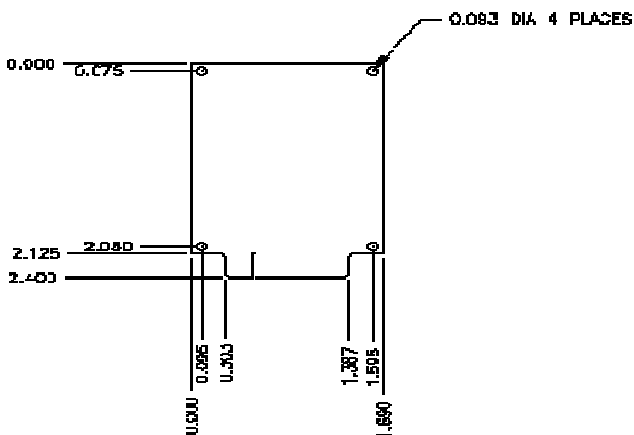
CONNECTOR WIRING: B = Top side of PCB. A= Bottom side of PCB.



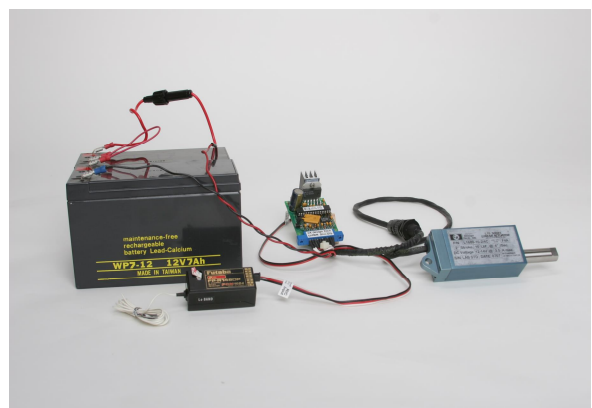
Function	Connector Pin
Motor -	A1 and B1
To Motor +	A2 and B2
12- 32 V Pwr In	A3 and B3
Power Gnd	A4 and B4
Mfg. test	A5 n/c or mod for Curr Monitor
Self-Test	A6 Switch to ground to enable
Bio "A" Enable	A7 Switch to ground to enable
0-5Vin Pot Wiper	A8 (Note: Enable with PCB jumper)
Signal Gnd	A9 (Shield gnd. for B8)
Signal Gnd	A10 Gnd for External Ref.
R/C pulse input	B5 (Wht wire Futaba RC Plug)
R/C ground	B6 (Blk wire Futaba RC Plug)
+5V ref.	B7 +5V ref.@3ma (pot high side,..)
Servo pot wiper	B8 Can be used for position information. 0-5v for L16's; 1.25-3.75V for W-Series
Signal Gnd.	B9 (Gnd for Servo pot)
Shield Gnd.	B10 (for servo feed-back cable shield)

7.) Mechanical Specifications:

Dimensions: The following illustrations show the outline dimensions of the circuit board as well as the location of four corner mounting holes that are available. Also note that there is a keying slot between the second and third connector fingers which prevents improper insertion of the circuit board into the mating connector.



Typical RC Set up



Application Notes:

Power Supplies: *Switching power supplies or regulators are not recommended due to RF noise.*

1. Calculation of power with peak currents must be implemented during the design stage.
2. Batteries: Always monitor the internal resistance to avoid power voltage reduction.

Note: Carefully monitor a voltage drop during peak currents. The rush current that occurs when starting servo motors can cause an internal voltage to drop. If a supply voltage drops below 10.5V even for a 1msec. your system will become problematic.

Voltages:

Our 24v actuators are tested at 26V; there range is 24V-28V.

Our 12v actuators are tested at 13.5V; there range is 12V-16.5V.

Aviation:

Always use a 24-28V system for best reliability performance. 12V systems generally are not recommended for any flight applications; as if the supply dips under 10V many devices become unstable.

Fusing:

It is a good practice to always use a fast blow rated at ½ of the servos max rated current for your first power up for the S6PWMs. These fuses should not blow under safe operating conditions.

The L16 internal poly-resettable-fuse prevents catastrophic motor failure. To re-set power system down a few seconds.

Actuator Travel:

In order to avoid hitting the internal end stops in the L16 actuators, the controller is set to move the actuator from 1% to 99% of its travel. This range of motion can be set to custom values during manufacturing. The W-Series actuators are set at 25% to 75% because only 50% of the pot travel is used. At half stroke the pot is factory set to center of its travel.

Noise vs Motor Over-Heating:

Many "Servo Control Systems" are plagued by noise that can ride in the electrical signals and will affect auto-pilots, gyros and servos. These noisy signals cause jitter in the servo system and can cause servo motors to overheat. Noise must be eliminated to obtain smooth servo operation. It is advised to check power supplies, auto-pilots and gyros for noise and filter if needed. Also keep servo update rates at a minimum. Severe vibrations if not dampened on a servo output shaft can also cause noise and motor over-heating.

Some Dos and Do Not's:

Never bundle power wires with signal wires.

Never daisy-chain the power and grounds to the servo motor controllers.

Avoid ground loops.

Avoid switching regulators and switching power supplies as they emit RF noise.

Never power up servos under higher than rated loads.

Immediately check each servos operation after power up.

Limit Switched Actuators: (ie. L13's, SL16's and SW-Series)

They do not use a servo motor controller. They use a DPDT switch configuration.