



Servo Controller

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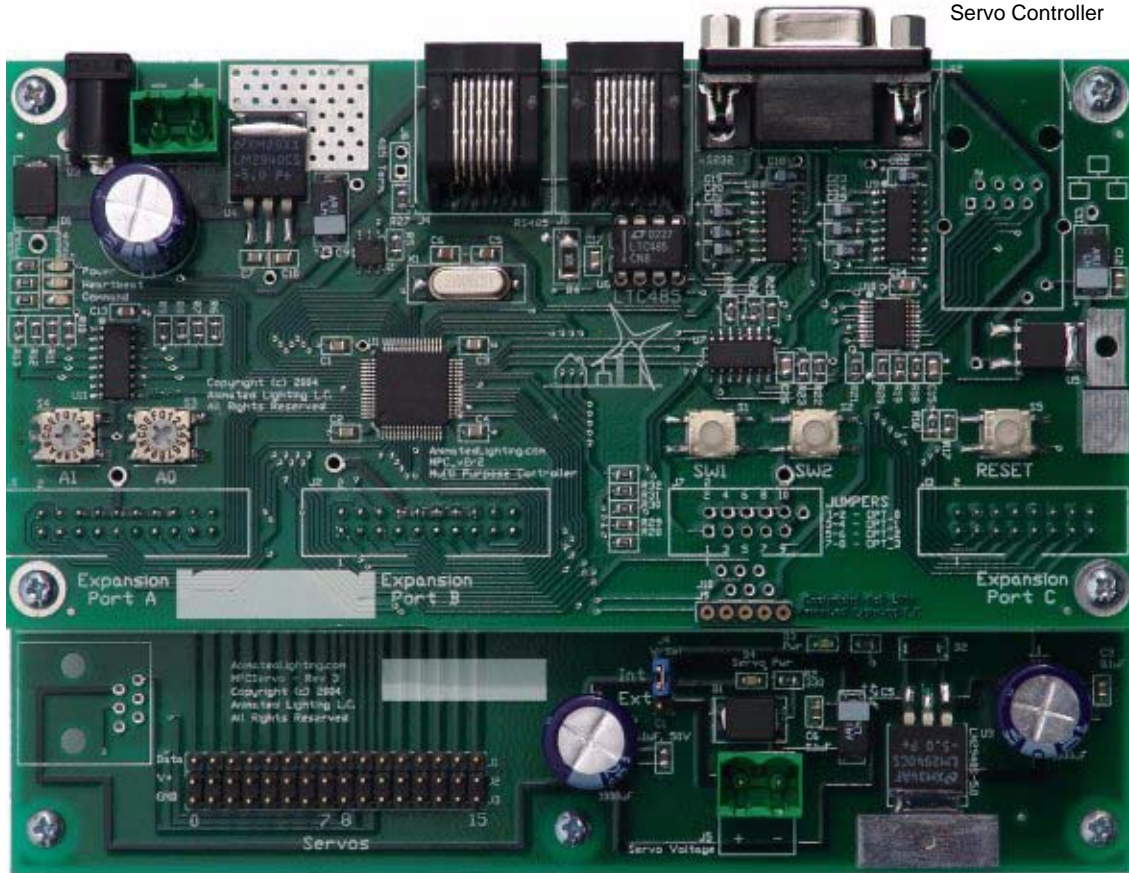
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# Servo Controller



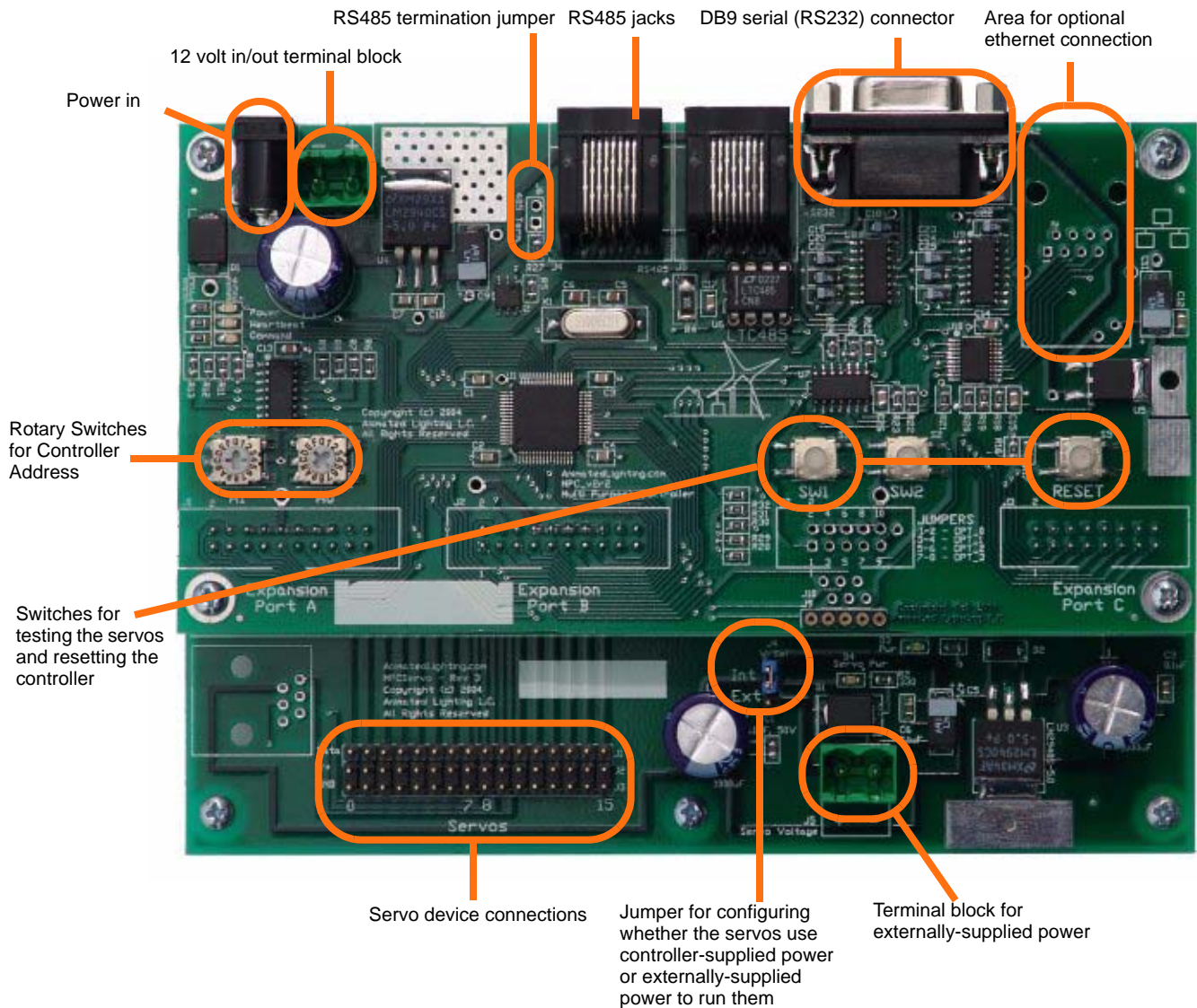
Servos are excellent devices for many types of animatronic movements to add atmosphere or personify creatures that might otherwise be motionless. Use servos to move or rotate the body parts in your creatures, such as the eyes, head, torso, or limbs. Servos are positionable motors containing a rotating shaft for moving attached objects to an exact position. You tell the servo to go to a specific position and stay there, or move back and forth repeatedly. Servos move the attached object within a certain range, usually 120 degrees from one extreme to the other, but some can move the object to about 180 degrees.



The Servo controller lets you work with 250 possible positions for each servo, providing better than 1 degree of accuracy. You set the home (or start) position, the end stop position, and how fast you want attached object moved. You can even control when to turn a servo off, when using the kind that turn continuously.


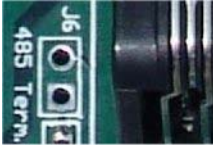

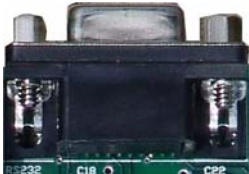
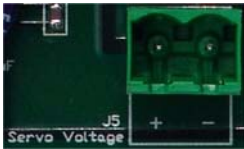

The controller lets you perform fine control for as many as 16 servo devices. Multiple Servo controllers (up to 256) can be controlled by Monster Brain and in combination with Animated Lighting's other controllers to synchronize lights, music, digital devices, and servos.

The servos connected to the controller can be run in standalone mode using macro for each servo or run from Animated Lighting's Monster Brain. A macro is a series of actions or commands performed, allowing it to be used as a complete animation controller in many applications. Use our Animation Director software to define the details of engagement and movement for each servo you're using.

## Servo Controller Connections



Board Component	Description
	<b>Power-In</b> - Power is typically supplied by a 12 volt wall power brick such as Animated Lighting's AC-ADP. This input is protected from reverse polarity connections.
	<b>12 Volts Out/In</b> - This terminal block can be used to power other low current 12 volt devices, eliminating multiple power bricks. This output is limited to 500 milliamps or less. This output is not regulated and comes directly from the Power-In connector through a diode.  This terminal block may also be used to power the board from another 12 volt source.

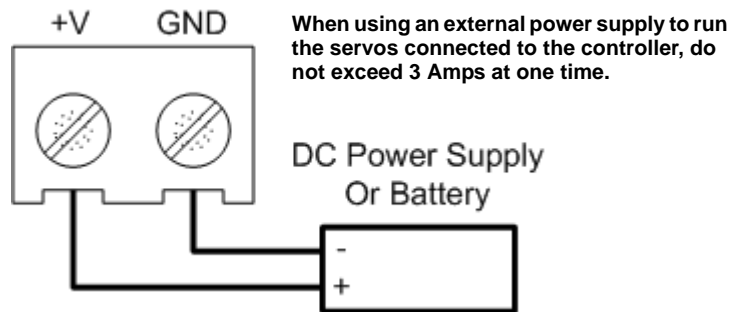
Board Component	Description
	<p><b>RS485</b> – There are two RJ45 jacks for connecting the Servo Controller to a Monster Brain and other controllers. All controllers are connected in a daisy-chain. Both connectors are identical so you can use either one. Standard data network cabling can be used to connect the controllers. These cables are available from your local electronics store, most large hardware stores, or Animated Lighting.</p>
	<p><b>RS485 Termination Jumper</b> - There is a termination jumper for the RS485 connection. In small setups or short cable runs, this jumper usually doesn't need to be installed. On longer runs, this jumper should be installed on the first and last boards in the daisy chain of Animated Lighting controllers.</p>
	<p><b>Ethernet</b> – If the optional Ethernet connector is installed, you can connect this board to a data network. This will allow you to control the board remotely over the network. See the separate documentation concerning Ethernet connections.</p>
	<p><b>DB9 Serial Connector</b> – There is one DB9 serial connector located on the top of the board between the RS485 connectors and the Ethernet connector.</p>
	<p><b>Servo DC Voltage</b>– Connect a maximum 7V power supply to this terminal for the servos to run higher currents. Keep the maximum current used at one time among the 16 servos below 3 amps.</p>
	<p><b>V Sel Jumper</b> - The Voltage Select jumper is for telling the controller whether you're using controller-supplied power or externally-supplied power to run the servos. It must be one or the other, not both.</p> <p>Position jumper over top two pins (Int for Internal) when using controller-supplied power (5V-300 milliamps maximum); or over bottom two pins (Ext for External) when using externally-supplied power.</p>

## Choosing the Power Source

The typical voltage supply for a servo is 4.8 volts, although most servos will operate between 4.4V and 6.0V. The higher the voltage, the faster the response and greater the torque. Servos can safely operate up to about 7.0V, but it's best to keep power around 6.0V or less.

Supply current requirements depend greatly on the servo and the load it's moving. The current drain depends mainly on the torque being put out by the servo motor, and can be in excess of one amp if the servo is stalled. In many applications the servos should have their own power supply and not use the controller's power. Momentary current surges caused by pulling heavy loads can cause many control systems to reset or lock-up.

It is best to measure the specific servo current under its intended load separate from the controller to determine how much power it needs. Then, if you are using only a few servos, moving light loads, you can run the servos using power from the controller, which provides you with a maximum of 5V and 300 milliamps of current. If you are using many servos or moving heavy loads, use an external DC power source (5V to 7V) that can tolerate a maximum of 3 Amps. Don't forget to set the V Sel jumper accordingly.



## Servo Controller Indicator LEDs

There are three indicator LEDs on the controller. They are near the power connector.



**Power** - lights constantly if the controller is powered.

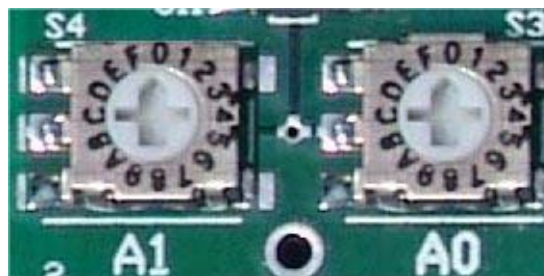
**Heartbeat** - blinks continuously when the controller is operating properly.

**Command** - lights whenever the controller is receiving valid data.

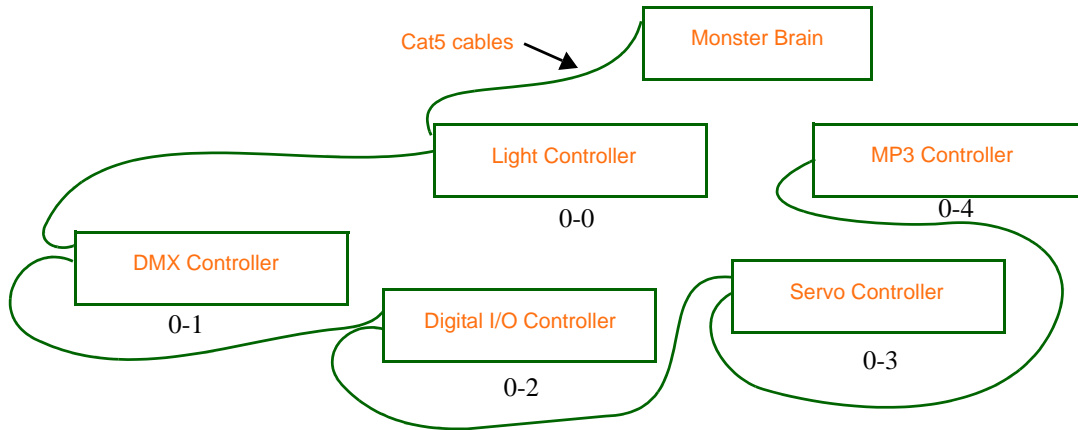
If the controller senses that its program has been corrupted, it reverts to the bootloader state and the red heartbeat LED will light continuously (not blink). This means the program on the controller has been corrupted and new firmware needs to be installed. This is easily done using the Animation Director software. For more information about updating firmware, see *Appendix F: Firmware Updates*.

## Setting the Servo Controller Address

Each controller in the system must have a unique address to differentiate one controller from another and for Animation Director to know what commands to send to which controller. The address is set using the two rotary address switches on the controller. There are 16 positions on each switch, where the combinations allow a possible 256 addresses (16 \* 16).

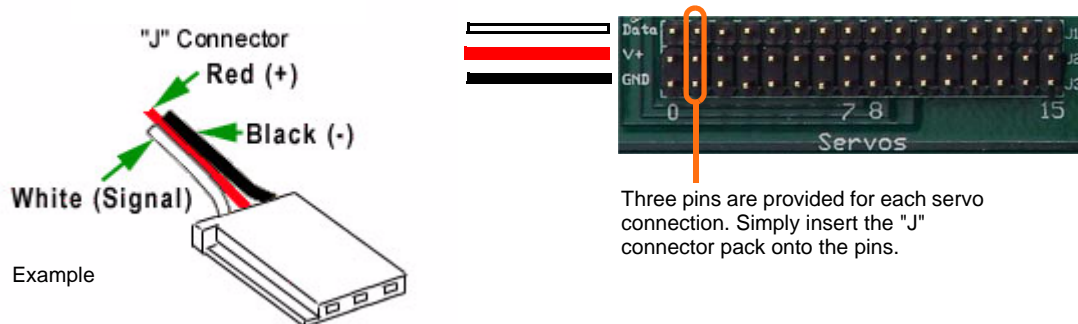


Connect the controllers in order and don't skip address numbers. For example, the controller nearest Monster Brain should be set at 00, the second out at 01, the third out at 02, etc. See *Appendix A: Setting Board Addresses* for a list of address settings.



## Connecting Servo Devices

There are a wide variety of servos on the market today with varying size and torque. Other features that differ between various models include ball-bearings, metal gears, and higher precision. They all operate on a standard PWM (pulse width modulated) signal and usually connect with an industry standard Futaba "J" connector (3-pin female plug). One wire is the power supply, one is the ground, and the other is the position signal.



Three pins are provided for each servo connection. Simply insert the "J" connector pack onto the pins.

The servo constantly receives a signal from the controller telling it what its current position should be. The servo compares its current position to the new position and attempts to move the shaft to the new position and hold it there.

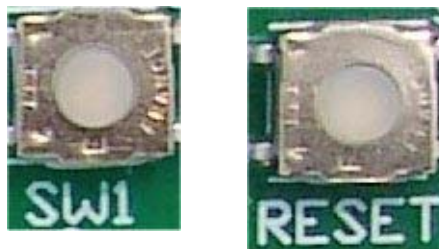
The expected signal is a pulse of a certain width, called Pulse Width Modulation (PWM). The width of the pulse determines the servo position. usually between 1 millisecond and 2 milliseconds long with 1.5 milliseconds usually specifying the center. The pulse has to be continually repeated for the servo to hold its position, usually around 50 to 60 times a second. If the pulses do not arrive in time, the servo de-energizes the motor. In this state, it can be pushed out of position and it will not return to the commanded position.

The maximum amount of force the servo can exert is the torque rating of the servo. The torque of these little servos is measured in ounce/inches. The standard S148 Servo by Futaba delivers 43 ounce/inches of torque. This means that if you have a 2 inch diameter pulley/wheel or arm (1 inch radius from the center point) on the shaft of the servo, this drive will be able to hold up to 43 ounces of weight before it stalls.



## Testing the Servos and Resetting the Controller

To test the servos, press the SW1 button on the Servo controller. Each servo is turned on and rotates to its end position and back to its home position, one at a time. Press the Reset button to reset the onboard microprocessor. Press this button if the controller address has changed, or the board appears to be "frozen." In general, you should rarely need to press this button.



## Technical Specifications

Power: 12VDC from 2.1mm I.D., 5.5mm O.D. connector

Control of 16 Servos

Optional External Servo Voltage Input

Programmable Home, End Stops, and Velocity

16 Macros

Standalone or networked to other Animated Lighting controllers

Ability to synchronize with Monster Brain

## Troubleshooting Tips

Servos were originally invented for use in Radio Control models to move the control surfaces and throttle of RC aircraft, and the throttle and steering of RC cars. Servos are designed to move a control arm (sometimes called a control horn) to a specific angle, and keep it there against other forces.

They can be considered a "closed-loop" system. That is, you tell the servo to go to a specific position and it will move to that location and stop. If a force such as wind on the ailerons of a RC airplane pushes against it, the servo will respond by increasing the force to keep the control arm at the desired angle.

Servos can also be modified to rotate continuously with the speed and direction determined by the pulse width. Usually this involves taking the servo apart and replacing a part or removing a piece of plastic. Several manufactures sell servos modified in this way. There are also Internet sites that describe how servos can be modified to rotate continuously.

The following dealers and manufactures have servo information on their web sites.

### **Servo Dealers**

[www.towerhobbies.com](http://www.towerhobbies.com)

[www.servocity.com](http://www.servocity.com)

### **Servo Manufactures**

Futaba - [www.futaba-rc.com/servos/index.html](http://www.futaba-rc.com/servos/index.html)

Airtronics - [www.airtronics.net/Servo\\_specs.htm](http://www.airtronics.net/Servo_specs.htm)

Hitec - [www.hitecrcd.com/Catalog/Servos/Servo.htm](http://www.hitecrcd.com/Catalog/Servos/Servo.htm)

JR - [www.horizonhobby.com/products/jr.asp](http://www.horizonhobby.com/products/jr.asp)

### **Checklist if you have problems with the controller:**

- Does the unit have power? Is the power LED lit?
- Is the heartbeat LED blinking to indicate proper operation? If it isn't try pressing and releasing the reset button.
- If the unit shows no response to Monster Brain commands, is the RS485 cable connected between the Servo controller and Monster Brain? Can you communicate with the Monster Brain or other Animated Lighting controllers?