

Appendix B: Networking the Controllers

Communications Cabling

All of Animated Lighting's controllers connect together using RS485 standard data cables (Cat5 cables). This applies a balanced transmission line in a multi-drop configuration to achieve long distances (up to 4,000 feet) and high transmission speeds.

The signal travels over twisted-pair wire which provides reliable communications in electrically noisy environments. You can easily find and purchase these cables at a reasonable cost from us or other sources. Or, make your own using standard Ethernet pin-outs.

Communications Speed

Animated Lighting's controllers are configured to operate at 57,600 bits per second (bps). This is adequate for most animated shows. In situations where you want to increase the communications speed, run the controllers directly from your computer (through an RS485-RS232 converter) or use *Monster Brain Plus*. The standard Monster Brain runs at 57,600 bps.

To configure the communication speed, set it using the **Hardware Speed** settings in the **Hardware** tab of the **System** window in **Animation Director**.

However, faster speeds will increase the likelihood of communications errors induced from noise or line reflections. You should experiment by reducing the hardware speed if you're experiencing intermittent errors.

To set the speed at which the serial connection between your computer and Monster Brain communicates, choose the appropriate **Speed** option in the **Settings** tab of the **System** window. This is valid only for serial communications (not USB or Ethernet) and works with all versions of Monster Brain.

Network Termination

As signals travel down the line and get to the end, they can be reflected back and distort new signals. This is especially true at higher data speed rates and long cable lengths.

To help alleviate this problem, the RS485 cable specification recommends that a 120 ohm termination resistor be placed at each end of the network. All of Animated Lighting's controllers have a termination jumper next to the RS485 connection jacks. You should retain this jumper on the two boards at each end of the network, and remove the jumper from all controllers in between.

Repeaters and Hubs

The RS485 cable specification limits the number of controllers in the chain to 32, unless a repeater is used to re-amplify the signal. You can often get away with more than this especially if the length is relative short.

Once your controller count passes 32 nodes, you should add an RS485 repeater or hub. These will regenerate the signal and allow you to add more controllers.

A basic Repeater has a one-to-one line in/line out. Hubs or Multi-port Repeaters have one input and many outputs and they form a star configuration. Typically, each output port can drive another 32 controllers.

Repeaters come in two forms, isolated and non-isolated. Isolated repeaters are better, but more expensive. They optically isolate the two sides of the network.

Isolation

Once the RS485 network exceeds about 32 nodes on a network, serious consideration should be given to using galvanic isolation. Galvanic isolation means electrically isolating signals from one another. This is usually accomplished using optoisolators.

Even though you can build a network consisting of 256 controllers using repeaters, you may not want to build such a network. One reason is that large networks can accumulate distributed electrical noise which can make communications unreliable.

In general, it is very important not to run communications wires in the same trough or conduit or in parallel with AC power cables. Maintain as much distance as possible and cross any power cable at a right angle.

By "isolating" sections of a large network, the accumulated noise on one isolated leg is not so likely to cause a data error that will propagate to another leg of the network. Galvanic isolation will break a large problem into several small, but manageable ones. Galvanic isolation can also help eliminate "ground loops."

Another potential problem with large networks without isolation is that severe damage can occur to your entire system if a high voltage source is connected to your communications lines. With galvanic isolation, the damage is generally limited to only one leg of the network, except in extreme cases of very high voltage (induced by lightning for example).

If you need to go beyond 32 controllers and your budget can afford it, always opt for the isolated repeater or hub.

R.E. Smith Company makes a whole line of RS485 repeaters and hubs for really large installations.

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