Northern Virginia NTRAK "How-To" Article

MODERN ELECTRICAL "STUFF"

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BY

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Over the last 20 years there have been a lot of changes in the electrical support equipment available for use in model railroading. Sometimes we are a little slow embracing the changes that are occurring. The NVNTRAK Company Store has received some interesting donations that included very old electrical equipment that no longer has much practical use.

Recent module railroading publications have had articles on building power supplies and voltage regulators. There are still references being made to the use of automobile light bulbs as current limiting devices. There are a lot better options available now than some of the equipment we were using just a few years ago.

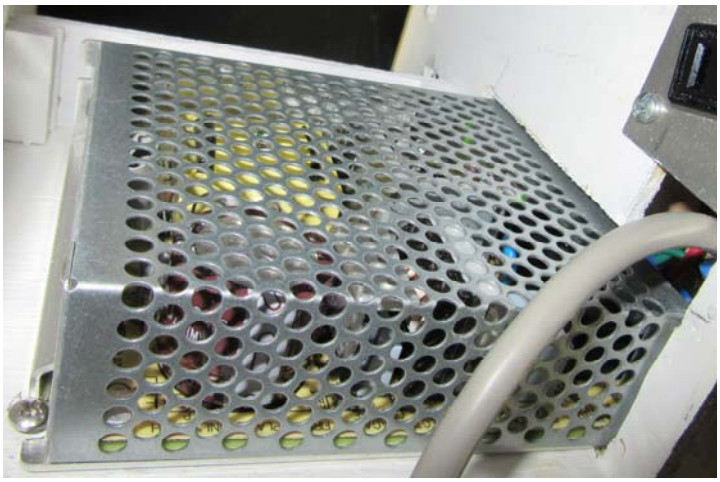
Low Voltage DC power supplies

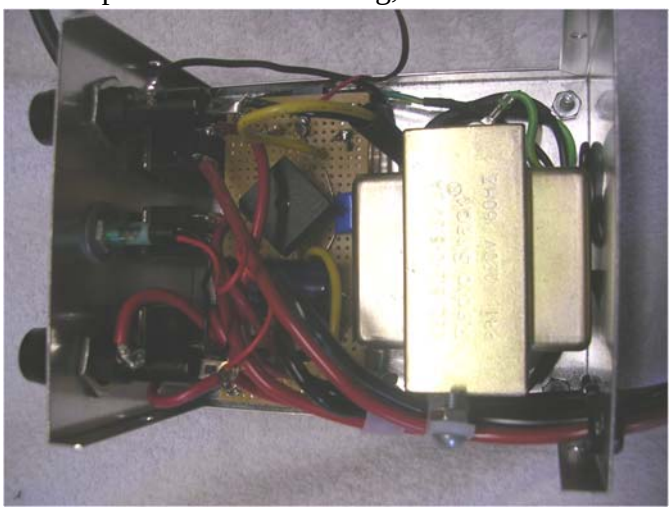
Commercial AC-to-DC switching power supplies are now better and cheaper than anything we can build.

We have many applications that need 12 to 15 Volt DC power. In 2008, the club built 12-volt DC 5-amp (60 Watt) power supplies for the Aristo Throttles. They were easy to design and build with a transformer, rectifier, fuses and a R-C filtering circuit.

The transformers available had a significant voltage drop as the current increased. In our case, using a Radio Shack transformer, the output drooped from 17 volts at 1 amp to 12 volts at 5-amps. To get a constant voltage you needed to add a voltage regulator circuit for the output, with associated heat sinks to handle the heat that was being dumped. The club spent $60.00 on each power supply.

Unfortunately, although it was fun, building these power supplies is no longer economical. Checking one electronics supplier catalog, a 12 Volt, 6 amp regulated switching power supply, shown below, costs about $20.00. It comes with over-current, over-voltage and under-voltage protection, and produces little heat. It is small and light, an advantage in when you are using it in a NTRAK Setup. In the same catalog, a transformer alone would cost $15.00.





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Over Current Protection

Need for Over-Current Protection: We all recognize the need for over-current protection against shorts and equipment failure. It is sometimes a mistake to assume the power supply will protect your equipment. A typical N-scale locomotive draws less than 0.25-amps at 12 volts DC. Many N-scale decoders are designed to handle one-amp.

For any power supply or throttle being used, you need to insure there is adequate protection for the equipment it is feeding, which could be a locomotive on the track or ancillary equipment. Most commercial power supplies and throttles have some sort of overload protection, but it is designed against the rated output, not the load. The Company Store has seen a wide variety of power supplies and throttles, some of them home made. In some cases, they did not seem to provide much protection.

Here are a couple of examples of why you may need to add extra protection:

- The Aristo throttle we used for a long time is a classic. It was built for use with garden railroads and is rated at 10 amps and is protected by a 10-amp automotive fuse. Power for the Aristo is a 5-Amp power supply which has two fuses, a one-amp fuse on the AC inlet side and a 5-amp slow blow fuse on the output. The two fuses are there to protect the power supply. The club has always used a one-amp to two -amp fuse on the outlet of each Aristo to protect the locomotive running on the track.
- The Digitrax Boosters are rated at 5-amps or 8-amps. The DCC Committee decided that for N-Scale use, the PM42 was needed to provide adequate protection for locomotives. The trip is normally set at 1.5 amps.
- It is hard to figure what protection AC to DC Wall Adapters provide. What does the rated amperage really mean? Checking the on line data sheet for several, a common answer is “thermal protection at 115 degrees F.” Since we have seen two overheat and fail during shows it appears that some do not have any protection.
- On my home layout, I am using a 12 volt, 6 amp switching power supply is used to feed a bunch of auxiliary equipment. It has over current protection. However, most of the items being powered require an input less than 0.5-amps. I have added 0.5 amp resettable fuses on the input to each piece of equipment being powered. That way, both the power supply and the loads are protected.

Over-Current Protection Devices:

Transistors and LEDs have transformed electronic equipment design. There have been an equally important changes in overcurrent protection devices.

In the *Throttles for NTRAK and Home Layouts* printed in December 2003, you will find several throttle designs that used an automotive light bulb to act as a current limiter. As the current increases in the bulb the filament heats up and resistance increases. For the recommended bulb the current would be limited to 0.7 amps when there was a short. Of course prompt action was required to remove the short since this level of current can still do a lot of damage over time.

Everyone recognizes the fuse in the middle of the

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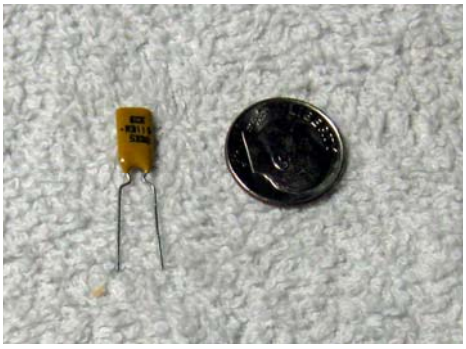
picture, since it is used extensively. Again it is a thermal device, with the filament burning up if the current gets too high. It provides better protection because it interrupts the circuit, but the down time while replacing a fuse is annoying. The also cost about fifty cents a pop.

Finally, on the right, is a resettable fuse which is also a thermal device that will trip on overcurrent, but resets when the short circuit is removed.

Resettable Fuses



Resettable fuses offer a significant advantage in most applications, yet there does not seem to be much discussion of them in model railroading publications. As seen in the picture, a resettable fuse is relatively small, looking a lot like a capacitor.

Instead of a wire it uses an organic polymer with carbon in it. At low temperatures (i.e. low current) the polymer is crystalline and aligns the carbon so it is conductive and has low resistance. As the device heats up it becomes amorphous (i.e. disorganized) breaking the carbon chain so resistance becomes very high, essentially opening the circuit. As long as the short circuit is still there a very small current will keep the resettable fuse hot, and tripped. When the short is removed the fuse cools and resets.

Fuses come in various trip ratings. One frequently used by the club will not trip up to one-amp. At two-amps it will trip immediately. For a current between one and two amps there will be a slight time delay before it trips. The effect is very similar to the one-amp slow-blow fuses that have been used in he past. They only cost about fifty cents each and should not fail for several thousand cycles.

Once we decide to add over-current protection, we have some choices. There is, of course, the standard fuse. It is what you want on the AC side of a power supply. If the input fuse blows, there is a problem that needs to be fixed inside the power supply.

Protection locomotives running on the track present a different issue. When there is the inevitable short circuit caused by a derailment or wheel across a turnout contact, power needs to be interrupted until the problem is fixed. A slow-blow fuse will provide adequate protection. But, replacing the fuse takes time and is disruptive. It was also expensive; the club was spending over $50.00 a year on slow-blow fuses.

It turns out that resettable fuses do the same job, reset as soon as the short circuit clears, and are cheap. Resettable fuses are available from any of the electronic suppliers and cost about fifty cents each. Their small size allows them to fit in a lot smaller space than a regular fuse would take. NVNTRAK has been using resettable fuses for several years and has never had to replace one.

For our decoder-in-a-box we are using 4-amp decoders with resettable fuses on both outputs to the track to protect both the decoder and DC locomotive. When a DC input is being used from another source, such as an Aristo, resettable fuses are also used and will trip before the Aristo output fuse blows.

A resettable fuse is definitely worth considering in a spot where you need over-current protection.