THE ASTRO POWER CUBE

OR “HOW I GOT SICK AND TIRED OF ALL THOSE CABLES”

By Mike Earl

Many amateur astronomers have had this problem at one time. They wish to observe, but when they do, they have to connect up all those power supplies. For those without observatories, all those accessories, such as a dew heater, filter wheel, etc, the number of power supplies can be a hassle. Another problem is that when power supplies are moved, plugged and unplugged, their cables and connectors can get brittle and break, especially when cold weather, salt, humidity and dry searing heat are concerned. Amateur astronomers who travel to star parties also have to deal with this problem, especially when yet another item, the 12VDC power inverter, is added to the mix.

After a few years of doing this, I got tired of lugging those power supplies and cables around. I decided to build something that would allow me to carry all of my power supplies in one convenient place. This “Astro Power Cube” would also serve to protect my power supplies from nasty things like blowing snow, sudden rain storms, heavy dew, frost, and being kicked and stepped on in the dark!

The first thing I had to find was a box. The requirements were that it had to be durable, yet made of plastic so that I could easily install panel switches and indicator lamps and LEDs. I checked the regular hardware stores for a hobby box of at least 1 cubic foot in volume, but could not find any. I then checked stationary stores out of desperation, until I found what I was looking for. It was a simple $15 file box, about 15 by 12 by 10 inches in volume (not exactly a cube, but close enough!), which met all my criteria and included a handy snap-top lid! It was plastic, large enough, and the walls were thin enough to allow simple drilling and sculpting.

I then had to determine what I would want as switches, power indicators, power outlets, etc. I decided to keep with formats that were already being used with my equipment (telescope, CCD camera, dew heater, inverter). I also decided to have a dual power feature, which allowed both 120VAC main and 12VDC to 120VAC inverter power, so that the box could be used both at home and at star parties in isolated areas using a standard 12VDC deep cycle battery. Figure 1 shows the myriad of component parts that I would use to build my “Astro Power Cube”.

Figure 1: The component parts to the "Astro Power Cube". The power supplies to the telescope and CCD camera, as well as the inverter and dew heater assemblies would be installed. The letter file box is shown at the left, along with the 12V deep cycle battery that would power the dew heater and the inverter.

Decisions decisions! How many power outlets should it have? How many indicator lights should it have? How would I switch from main power to 12V inverter power should the need arise? Questions such as these were swimming in my head. As far as power outlets, I decided to keep it simple: two outlets per power source, i.e. two for main and two for 12VDC inverted. Figure 2 illustrates the design of the "high voltage" side of the cube.

One problem I wanted to solve was the maddening "freezing cable" phenomenon. You know: its 20 below and your power cables get stiff and brittle because the rubber in the insulation was manufactured by someone below the 40th parallel? Add salt to that mix, and you have a very messy and potentially dangerous problem. Salt deposits getting inside a power supply are not recommended. The cables will eventually split and could cause a bare wire short or break if the cable is twisted enough. So, I decided to use cable that was rated for -40C temperatures for all cables coming out of the box. I could use the original power supply cables within the box, since I would not be yanking them or twisting them anymore. The power supplies can stay snug in their new home, while the main cables outside the box are the ones being pulled and twisted. If the outside cables should break, the cable can be repaired or replaced without having to touch the original power supplies. This would extend the lifetime of all the power supplies involved.

Figure 2: The “high voltage” side of the “Astro Power Cube”. It features two power outlets per power source. The left-hand outlets would be for the 120VAC main power (for home use), and the right-hand outlet would be used for the 12V inverted power (for star party use). The switches on the top are the main power switches for the 120VAC main (left), and the 12VDC (right). The indicator lamps are there to indicate when the main power and/or the 12VDC power are active. Note the protective covers on the two power outlet assemblies.

With the “high voltage” side completed, I then had to decide how to design the “power output” side for the devices. I decided to stick with the formats that the respective devices used. For example, I would use a standard DC power jack for the telescope, a 5-pin DIN connector for the CCD camera, and a standard RCA jack for the dew heater. As an added bonus, these connector types are all different, and thus would prevent me from plugging any of the devices into the wrong outlet! I added a power indicator for the telescope power, something it did not have before, and removed the existing LEDs from the CCD power supply and the dew heater control circuit board, and replaced them with the power indicator LEDs installed on the box. That way, I can use the existing power supply circuitry to indicate when power is correctly being applied to the device. Another bonus is that I have finally removed those annoying green LEDs from the equation. All indicator LEDs are finally red! Figure 3 shows the “power supply output” side of the box.

The messy wiring details were omitted from this article. All that needs to be said is that it was wired up so that the proper power went to the devices. Ventilation is provided by holes drilled at the base of the cube. That way, it will be very difficult for rain or snow to drift inside. Four casters were also installed on the bottom to allow easy transport to other areas of the observing site, and to avoid tipping in the event the box is accidentally kicked.

Figure 3: The "power supply" side of the "Astro Power Cube". Power outputs for the telescope, CCD camera and the dew heater are shown here. I left extra space for any additional accessories. The dew heater's temperature control variable resistor was removed from the original box and placed on the cube's side wall.

After initial completion, testing was then required for the unit. I first tested out the dew heater, just to make sure that the heating coil heated properly. It worked as expected. I then checked out the CCD power, which was the scariest portion of this project. I checked and double-checked the power connections, at every junction, just to make sure that I had connected the right power supply cables to the right camera pins. This is where the camera's instruction manual was very handy! It worked well, but I had to test it out more rigorously in order to make sure that the power supplied to the camera was stable. For two hours, I took a continuous set of 5-second images of my local zenith and monitored what the camera outputted. I used the resulting images for an experiment (that will be revealed later). Figure 4 shows the CCD camera with the cube outside during testing.

Figure 4: My ST-9XE CCD camera on a simple tripod connected to the "Astro Power Cube" during testing. The camera obtained about 1000 images of my local zenith without incident. The images were sent to my laptop located indoors.

Another test was conducted with my telescope and CCD camera connected to the cube. There was a small chance that the power supplies in the box would interfere with each other (most used AC transformers), although I had no previous problems when the power supplies were in close proximity to one another. I tracked 20 satellites over the entire night (including the Chandra X-Ray Observatory at a distance 101,000km) and both telescope and camera operated flawlessly. Figure 5 shows the apparatus in operation.

Figure 5: The "Astro Power Cube" in action. Both the telescope and the CCD camera are connected to the device with low-temperature cables. If the cables should crack or break they can be replaced without having to touch any of the power supplies themselves. The dew heater is not connected in this image. If you look closely, you can see the telescope and CCD camera power indicator LEDs lit up on the cube!

The main advantages of having this new power supply box are that I will no longer be afraid of hurting any of the components inside by taking them to areas where blowing snow, sudden rain, dew, or high traffic is present. Instead of hooking up all the components one by one and placing the power supplies in convenient areas separately, I now have a convenient area where all the devices are stored for easy transport and hookup.

I have yet to determine just how much time I will save using this new power supply box, but at least I will extend the lives of my power supplies. This by itself is a good reason to take the time build such a thing!