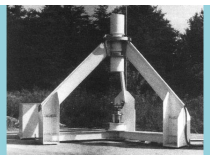
Instruments and Imaging Section
Technical Tips No. 2
5 November 2011



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At one time, the establishment of a permanent observatory consisted 'only' of providing a building – small or large – and setting up the instrument within. Clock drives were self-sufficient, electrically powered instruments could be run with a rechargeable 12V battery (car batteries were often used), a torch could be used for illumination, and an area power-cut during an observing session was welcomed by both visual observers and astrophotographers. Now, however, additional forward planning is required for the installation and provision of facilities for electronic imaging. The article in this issue provides a very useful guide.

The mystery object in the previous issue of *Technical Tips* is Will Hay's chronograph, dating from the early 1930s. Only one Member – Terry Ashton, of Leicester – identified it correctly, though several of you made admirable assumptions which would have placed it in a Museum of Curiosities. Hay's article was published in the Association's *Journal*, and there is a photograph of the instrument in the archives of the Royal Astronomical Society. Concerning this issue's mystery object (at top right), here are some clues. It is not an amateur instrument, it was set up in the 1960s, and although it was not designed for astronomical purposes it inadvertantly made some remarkable discoveries which have become of great importance in astrophysics and cosmology.

Joined-up astronomy: connecting all the hardware

John Mallett

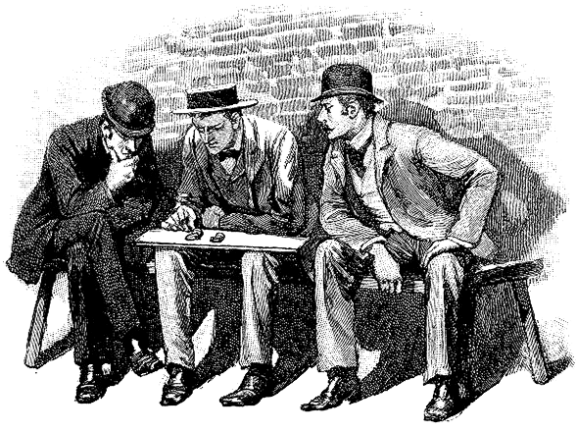
Equipment that allows state-of-the-art astronomical observation is now available to the amateur astronomer at prices well within the reach of the average enthusiast. Generally this equipment has been designed with some readily available standards such as RS232 and USB as a means of connecting the systems to computers. However, the number of devices, cables, and power requirements, if not considered carefully, can easily lead to unreliable operation. It can be really annoying to begin an imaging evening with the computer unable to find one of your USB devices – or worse, to complete a series of long exposures only to find that the guide camera has stopped talking to the computer.

Typical imaging set-up

What sort of things are required to connect together? Consider a typical imaging set-up:

Goto mount (EQ6)
Dew heaters (Kendrick)
Filter wheel (SX)
Focusing system (Lakeside)
Guide cameras (Lodestar)
Main camera (SXVR H18)

All of these need power, and most need a computer connection. So what is difficult about that? You might be tempted to simply acquire some long USB cables and connect each system directly to the computer. This will almost certainly produce unreliable operation, and in some cases will not work at all. In the observatory it is unlikely that you will be able to position the computer close to the pier, as it will impede routine observing. You also need to be able to walk round the pier without the risk of moving – or worse, tripping over – a cable in the dark. This can do serious damage to your expensive camera connectors, and will probably injure your dignity.



No... I think this one is the USB connector

Observations about the interconnection standards

From the many experiences that have cost me lost nights of observing over the years, these are the conclusions:

- Connectors that are not bolted together can come apart, so in the case of USB this will need some attention.
- They also tend to becomes more loose and unreliable the more times they are connected.
- If you have an expensive device that comes with a manufacturers power supply, use it, if you do not want to expend a lot of design effort and have to spend time on the telephone with the manufacturer.
- Very sophisticated equipment will in most cases be demanding of its interfaces: for example, SXVR H18 download, 8.3m-pixel 16-bit image in 4.5 seconds.
- Much of the IT standard equipment such as cables and USB hubs are designed to be used close to the computer in an office, not on a long-extension USB cable.
- Behind most office computers there are wires of which no-one can remember the purpose until they are disconnected! It is therefore worthwhile keeping a record of the set-up.

What are the needs of the equipment?

The process of thinking through a design for the operation of your observatory should have at its core reliability, simplicity of operation, and, of course, safety. So, starting with the basic design, consider installing a plastic pipe of, say, 2–3 inches diameter under the floor or set in the concrete, to take computer cables and power either close to the base or up the centre of the pier. They can be laid under the wooden floor, but I have found that mice like some types of cable. Ensure that those bulky USB and maybe even RS232 connectors can be fed through the pipe. It is better to feed the mains cables through a separate pipe. A reliable earthing cable for the pier is also a good idea. To me, all this is the easy part!

I am sure you are now thinking that you will have to take an Open University course in electrical engineering to have the observatory working properly; but I think the following guidelines will help without the need to understand the detailed operation of the interfaces.

There are three basic electrical needs of a sophisticated device such as, for example, a cooled camera:

- Clean and well-regulated power with the capacity to meet all the operational demands.
- Good data-signal levels.
- Sufficient uninterrupted bandwidth (data rate) to operate with the computer software drivers.

USB powered
Power for device operation is supplied by the port

For all items that are *only* connected by a USB cable, where it also supplies the power, use a powered hub at the pier, with the power for the hub provided at the pier. Because this hub will be some distance from the computer it would also be wise to use an active or buffered USB extension cable. This will apply to items such as the Lodestar guide camera, which takes a lot of current from the USB. The internal signal buffering in the active cable will also ensure that clean and reliable USB signal levels are available at both ends. On this hub you might also be able to place equipment that has very low data demands, such as a filter wheel. It is not advisable to connect the main camera and the guide camera on the same hub, as they both have high data transmission rates. The main camera would therefore probably be best placed on its own active USB extension cable without the need for a hub, as in the case of the SXVR H18, which has a manufacturer-supplied power supply. It is therefore unlikely that the USB cable will have to supply much current.

RS232 systems

Most goto mounts and focusing systems are driven by RS232. Since the conversion process requires some power, I would adopt the 'USB powered' process and install a separate powered hub for all the RS232 converted systems such as the focusing device and mount, even though the mount has its own power feed. The alternative is to buy a quad USB to RS232 box, and provide power to that.

Supply voltages: 12V and 240V

That leaves just the two other power requirements: 12V and 240V AC for the manufacturers' power supplies at the mount. If a 12V cable is run up the mount it should be sized to take at least three times the maximum current that will be used at the pier. Dew heaters take quite a significant current, as does the mount when slewing fast, so you do not want noise on the 12V at the mount to have an impact on the RS232 signals. I have found that for simplicity a 12V distribution box at the mount that comes from a fused and switched source in the computer bay is the best solution. This switch also controls a relay to connect the mains power to the extension sockets on the pier. I therefore need to press only one switch to turn on all the pier equipment.

USB connector issues

It is important that USB connectors in particular do not move relative to the equipment to which they are connected, as the design allows some sideways movement and potential for electrically noisy connections. So, allow a loop where coming out of the camera or filter wheel, and then attach the cable to the nearest non-moving metalwork.

Cable tidy

The cables running around the mount need to be able to move without snagging as the mount moves. This will be very individual to the telescope configuration, but I have found that there are many 'cable tidy' solutions on the market that are able to smooth the movement as the mount moves over its full excursions. I have used a simple plastic spiral to enclose the cables, fixed at the pier and at a central location between the main and guide scopes.

Go for gold – where possible!

Finally, take a look at the buffered USB extension cables and all connectors used in the observatory. If available, use versions that have gold-plated pins. This decreases electrical contact resistance, and reduces the chance of humidity causing bad connections.

Some useful links

12V charging controller
http://www.sunshinesolar.co.uk/khxc/gbu0-catshow/Regulators.html

Nikkai 5M active USB2 cables (gold-plated)
http://www.maplin.co.uk/Module.aspx?ModuleNo=097272&TabID=1&QV=Y

Four-port RS232 powered converters
http://www.easysync-ltd.com/product/537/es-h-1004-m.html

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In the previous issue of *Technical Tips*, concerning the resolution of difficulties with webcam drivers, Gerard Gilligan was among the contributors. However, he wishes it to be recorded that the advice he transmitted was supplied by David Galvin of Liverpool. – *Director*