

Contemporary astronomy kit is usually equipped with a serial interface for control or transferring camera data. We then inevitably have to use USB connections in some part of our system (not least for the connection to a PC or laptop).

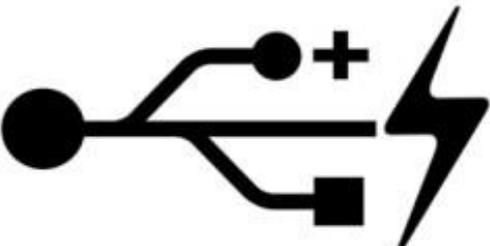
I've written this brief note to collate some of the more arcane details of USB and to highlight some of the less-obvious pitfalls I've stumbled over recently in implementing an astrophotography system separate from my "warm-room". I don't claim it's an exhaustive list or that any conclusion is absolute or correct. If you have other contributions or corrections please let me know at [ntanton@guildfordas.org] and I'll revise this note with due acknowledgement.

The USB interface and its history is described in some detail at <https://en.wikipedia.org/wiki/USB>.

- Within Settings/Hardware and Sound/Device Manager on a PC the term "Universal host" implies USB 1.1, "Universal host & enhanced host" implies USB 2.0 and "USB 3.0" implies USB 3.0.
- The recognised symbols for USB outlets are as shown overleaf.
- A blue insert in the USB connector implies a USB 3.0 connection BUT this isn't always applied.
- I've seen several laptops in which not all USB outlets provide power.
- It's not always clear from any legend on a laptop/PC what level of USB support a particular outlet has. Even if labelled it may be embossed/in bas-relief and therefore hard to read (eg. dark grey on a dark grey background).
- USB cables are limited to 3m for low-speed USB 1.1 devices. A hub can be used to extend a cable length for up to 5m at a time.
- The USB standard allows seven cascaded tiers of ports. The root hub (typically the PC/laptop) is the first of these and the most downstream devices would be the seventh so this allows only five tiers of hubs between them.
- A bus-powered (passive) hub should not be followed directly by another passive hub.
- A compliant bus-powered/passive hub can have no more than 4 downstream ports ($500\text{mA} = 4 \times 100\text{mA} + \text{itself}$).
- To allow high speed (USB 2.0) devices to operate in their fastest mode, all hubs between the computer and the device must themselves be high speed.

- Some self-powered hubs cannot supply enough power to drive a 500mA load on every port (e.g. a 7-port device may only be able to drive 4 full-load devices).
- I use a powered hub immediately before the longest USB lead (i.e. between laptop in the warm-room and my pier) and a powered hub immediately downstream at the pier to buffer the signals down that long lead.
- Powered hubs aren't necessarily designed for cold conditions so you may need to ensure that any "brick" power supplies (inc. for a powered hub at your pier) are designed for or guaranteed to work at sub-zero temperatures.
- Sadly there is a vogue for some hubs (as also some USB/RS232 ASCOM interfaces) to be fitted with bright blue LEDs. You may need to use black tape to avoid consequential loss of night vision.
- Just note that USB connectors don't always mate securely – if they're associated with equipment which moves in normal operation (e.g. guide-scope, focuser, filter wheel, imaging camera etc.) make sure there's enough cable length for that last drop and use insulating tape to reduce the chance of escape and disappointment. Unwanted disconnection will only happen when you're already 95% through a long LRGB capture.
- USB connectors are also not designed to be engaged or disengaged many times so may start to mate less securely if you keep plugging and unplugging them.

USB 2.0 Symbol	USB 3.0 Symbol
	

USB 2.0 with charging port


<p>Version 1.01 Acknowledgements : Martin Baker</p>
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