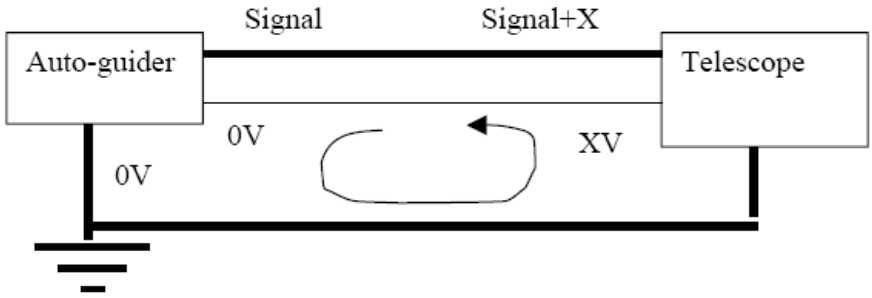
Ground loops

What is a ground loop?

A ground loop occurs when two pieces of equipment are connected to ground through more than one path. The ground paths form the equivalent of a loop antenna that efficiently has current induced into it from any nearby Electromagnetic Interference (EMI). The resistance in these paths transforms these currents into voltage fluctuations. As a consequence of ground loop induced voltages, the ground reference in the system is no longer a stable potential.
A common situation is where astronomy equipment is connected together by signal cables. Telescopes mounts are frequently connected to other equipment such as an auto-guider through more than one path. The result is that a ground loop is formed and whenever a ground loop exists, there is a potential for damage to equipment and erratic behavior.
Usually what a ground loop causes is a potential difference in the grounds of the two pieces of equipment. This in turn causes a current to flow in any cables that are used to interconnect the two pieces of equipment. This in turn can cause damage and erratic behavior.
Here is an example situation where a telescope is connected to an auto-guider through a signal wire that connects the ground of the two systems together, and creates a ground loop in what may be to some and unexpected way.
In this diagram, the ground loop that is caused by directly connecting the auto-guider to the telescope is causing a current to flow in the line that interconnects the auto-guider to the telescope. In turn, this cause the ground potential of the telescope to be at X volts and not 0 volts like the auto-guider.
Because there is voltage difference between the auto-guider and the telescope, the signal in the interconnection wire sees that difference added to signal. If this difference becomes large enough, it cannot only cause erratic behavior it can damage your equipment.



Ground loop problems are one of the most common problems in systems where equipment is interconnected through signal cables. A typical indication of a ground loop problem is flaky behavior such as a system locking up, resetting for no apparent reason and in extreme cases cables that are hot or even burned from excessive current.
Many times when a user thinks that his system is 'bad' or has 'gone bad' the fault is often electrical or magnetic in nature. Intermittent lockups of computers are often the cause of a ground loop. As already explained this is an electrical problem that sometimes manifests itself when a system and its peripherals are improperly interconnected.
Have you ruled out ground loops in your system?

What can you do about it?

The easiest way to insure that you will never have any trouble from ground loops is to electrically isolate your equipment. This is typically done using either relays or some kind of optical isolation device. Optical isolation devices are solid-state in nature, provide extremely high isolation levels, and are more reliable than relays.

To electrically isolate your auto-guider from your mount you can use one of the opto-couplers that I have available at my website. They are highly reliable and are cheap insurance against the potential problems of ground loops.