

The Block Autoguider Device

In December of 2000, I received a call from Adam Block, lead observer for the Advanced Observing Program at Kitt Peak. As a participant in the AOP, I have had the opportunity to discuss autoguiding issues with Adam on several occasions; on this occasion Adam asked about the feasibility of making an inline adapter to intercept autoguider commands and prevent reversals in the declination axis.

I told him that the easiest way would be to simply place a switch inline to shut off signals in the unwanted direction. Adam asked if I would be interested in working on such a project; I said that I would like to try, and the next day I built a prototype.

After several days of testing the device with my LX200 and two Meade Pictor autoguiders, I sent the prototype to Adam; his tests have yielded favorable results (see Appendix: Testimonials).

The following instructions cover the construction of the "Block Autoguider Device" (BAD) for the Meade LX200 and LX50. The general concept is presented first, then the specifics of construction, including Radio Shack part numbers. Substitution of alternate hardware is at the user's discretion. The device will also work with other mounts that use the same guiding interface (modular connector).

Standard disclaimer: although attempts have been made to assure that no damage can occur to the user's equipment, construction or use of such a device is entirely at the user's risk. Bob's Warranty is in full effect: You're a Big Boy Now.

General

Autoguiding of Meade LX200 and LX50 telescopes is controlled through a modular connector on the front panel of the LX200 labelled "CCD". This type of connector is sometimes known as RJ12, RJ25, or 6P6C; it is physically the same size as a standard RJ11 telephone modular connector, but contains six contacts.

Of the six contacts, five are used for autoguiding. Note that Meade uses a non-standard numbering system in the LX200 manual (142536) for both the serial and ccd autoguider ports.

The convention used in this document is as follows: the pins are numbered 1 through 6 from left to right looking at the front panel of the LX200 (this is consistent with the diagram in the Appendix of the Pictor autoguider manuals).

The functions of the pins using this numbering system are as follows:

- | | |
|---------------------------|-----------|
| 1 – NC contact (not used) | 4 – Down |
| 2 – Ground | 5 – Up |
| 3 – Left | 6 – Right |

Guide corrections are made by connecting the contact for the desired direction (3=left, 4=down, 5=up, 6=right) to the ground contact (pin 2). This can be accomplished with mechanical relays (e.g. the ST-4) or TTL gates (e.g. Pictor autoguiders, ST-7 or ST-8).

The Problem: Reversal in the Declination Axis

Guiding corrections in the Right Ascension axis are accomplished by speeding up or by pausing the drive motor; the drive does not change direction. As a result, backlash in the right ascension drive does not pose a significant problem.

The declination axis drive, however, must be able to move both up and down. When the drive changes direction, the telescope usually responds in a non-linear fashion.

Some of the factors that may cause a declination reversal are as follows:

- Over-aggressive guide settings
- Balance of the optical tube assembly and accessories
- Local atmospheric conditions (seeing or wind)

Regardless of the cause, a reversal of motion in the declination axis can ruin a ccd image.

Eliminating reversals in the declination axis

Recognizing that dec reversals can be problematic, our goal is to eliminate these reversals while imaging.

A popular technique to decrease the probability and amplitude of dec reversals is to misalign the equatorial mount slightly in azimuth so that all corrections in the declination axis occur in the same direction. Although many users have demonstrated outstanding results with this technique, dec reversals still occur occasionally (Note: field rotation increases with the degree of misalignment).

The BAD works in conjunction with this technique, and allows the user to turn off corrections in either the up (north) or down (south) direction, or both. This is accomplished by installing a SPST slide switch in each of the declination control lines. Both switches are turned on for calibration (the calibration routine will fail on some autoguiders if either line is off during calibration); the user then turns the desired switch off before initiating autoguiding.

Construction

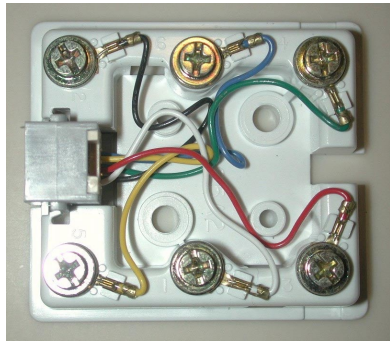
The BAD consists of a female six-conductor modular (socket) connector and two SPST slide switches mounted in a suitable enclosure, and a short length of flat, six-conductor cable terminating in a modular plug.

The cable from the autoguider plugs into the (input) socket on the BAD, and the (output) pigtail plugs into the autoguider port on the telescope.

We used a Radio Shack "6-Wire Surface-Mount Modular Jack", part number 279-419 (in white) or 279-420 (in beige). This part contains the modular (socket) connector with color-coded wires and terminals in a small plastic enclosure. The jack also has enough space to install the two slide switches (image to right):

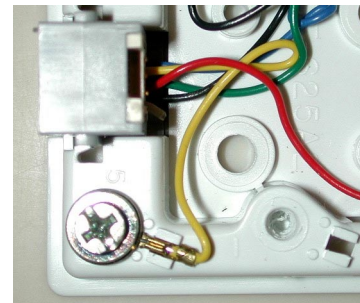


Removing the cover reveals six numbered terminals and color-coded wires:



- | | |
|-----------|------------|
| 1 - white | 4 - green |
| 2 - black | 5 - yellow |
| 3 - red | 6 - blue |

The first terminal (#1 - white) is not used; in the image to the right, the terminal screw has been removed, and the wire has been clipped at the back of the modular jack:



The Output Pigtail

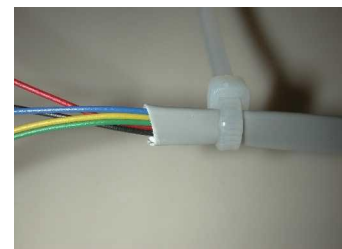
If you have access to a modular crimping tool and want to make a pigtail, see *Making the Output Pigtail* in the Appendix. The alternative is to buy a six-conductor modular cord and to cut off one end.

Fry's Electronics also has a six-foot "rollover" cable that has the correct connections on both ends for about \$3; the user can make two BADs following these instructions (i.e. the color references will match).

Radio Shack sells a six-conductor cable as part number 279-422: "25-foot (7.6m) Modular 6-Wire Line Cord" for about \$8, but only one end will correspond to (i.e. color match) these instructions.

Select the proper end as follows: hold the cable as if you were preparing to insert it into the ccd connector on the front panel of the LX telescope (wire in your hand, connector away from you, tab down). Choose the end that has the white wire on the left and cut off a suitable length of cable from this end; we used 18" (45 cm).

Remove the sheath approximately 1½" (4 cm) from the other end of this cable and cut off the white wire even with the sheath. Strip off about ½" (1 cm) of insulation from the end of each of the other wires. Place a nylon tie-wrap around the cable sheath as a strain relief about ½" (1 cm) up the sheath, as shown here:





Place the output pigtail into the modular phone jack base using the provided slot, and secure the pigtail in place with another nylon tie-wrap, using the screw-mount holes as shown here (to the left):

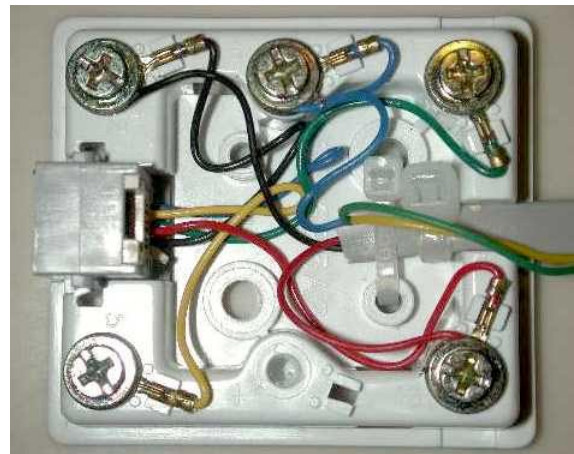
Making the Connections:

Three wires are connected straight-through, which means that the wire from the output pigtail is connected to the terminal with the same-colored wire:

- Terminal 2 - black wire
- Terminal 3 - red wire
- Terminal 6 - blue wire

Attach each of these wires from the pigtail to the corresponding terminal in the modular phone jack as shown here (to the right):

This leaves two wires to be connected: line 4 (green), which controls downward (south) motion, and line 5 (yellow), which controls upward (north) motion; these wires are connected to the slide switches.



Installing the Switches

The two slide switches are installed in the snap-on cover; any small SPST switches that will fit into the enclosure will work (we have also used toggle switches).

Note: for increased reliability, (and because it's what we had on the shelf), we used DPDT switches on the prototype, ganging both poles together; this technique is used in marine environments where switches are exposed to harsh weather conditions. If you use double-throw switches, the alternate contact(s) are not used. For further details, contact the author.

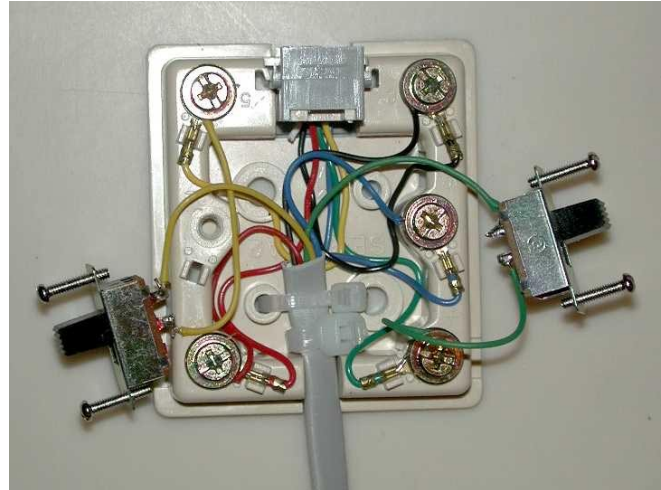


Select suitable locations for the two slide switches; they must be installed away from the edges of the cover so that the switch terminals and mounting screws do not come in contact with the modular jack terminals. Drill holes for the mounting screws and cut the openings for the switches as shown in the image to the left:

Connect the green and yellow wires from the output pigtail to one of the terminals on each slide switch; these connections will require the use of a soldering pencil.

Although the green and yellow wires from the modular jack base can be connected directly to the switches, we elected to use short pieces of hook-up wire from the modular jack terminals to the remaining contacts on each switch.

The image to the left shows all connections completed in preparation for installing the cover.



Verifying the Connections

Before you subject your telescope and autoguider to the BAD, it would be reasonable and prudent to check all of the connections. Turn on both switches, and check all leads with a continuity tester. The first lead will be open, since we cut the white wire. The other five wires should show continuity straight through (e.g. line 2 to pin 2, line 3 to pin 3, etc.), with no cross talk. Turn off each switch and confirm that the corresponding line (4 or 5) is open.

BAD Care and Feeding

To use the BAD, plug the autoguider cable (that normally would be plugged into the front panel of the telescope) into the BAD modular phone jack, and plug the output pigtail into the autoguide connector on the telescope ("CCD" port on the LX200). Prepare for autoguiding as usual, and perform the calibration routine with both switches in the "on" position. After the calibration routine is completed, turn the desired line "off" before initiating autoguiding.

Appendix - Making the Output Pigtail

To make your own pigtail, you will need a crimping tool, a piece of flat, six-conductor wire cable, and a 6P6C (six-pin) modular connector. Use the crimping tool to strip off the cable sheath as shown to the right:





Insert the conductors into the modular connector so that the white wire is on the left with the modular connector positioned for insertion into the autoguider socket on the LX200 panel (locking tab down). After crimping, the end of the cable should look like the image to the left:

Appendix - Testimonials

Adam Block, Lead Observer for the Advanced Observing Program at Kitt Peak:

I wanted to let you know how wonderful the switch is... it is PERFECT.
With this switch my technique of guiding reaches new heights!

Adam Block again, after a month of use:

Thanks again... you cannot imagine how well things are working with your switch and this technique! Here is an example, an image I took was used as a ground-based example for an HST image!

> <http://hubble.esa.int/hubble/news/index.cfm?aid=31&cid=630&oid=26173>
> From the link to "Images and Captions," see "Overview of NGC 2903 (ground-based)"

From Al Brockman, of the Shoklo Malaria Research Unit in Thailand:

Wow! I am absolutely delighted with this. I am currently imaging M100... I am waiting to see now how the tracking will go with DEC now switched on but so far I see the guide star stay put in the centre of the track window.

Contact Information

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