

INSTRUCTION MANUAL

Meade® #1697 Computer Drive System

For LXD 650 and LXD 750 Equatorial Mounts



Meade Instruments Corporation



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#1697 COMPUTER DRIVE SYSTEM: INTRODUCTION

The Meade #1697 Computer Drive System (CDS) is easily installed in the Meade LXD 650 and 750 Equatorial Mounts. With a properly polar aligned mount, (see the instruction manual which accompanies the telescope), the #1697 Computer Drive System's advanced electronics permit the location and observation of the major planets as well as hundreds of deep-sky objects the very first night of use. Its 64,359-object library provides enough galaxies, nebulae, star clusters, and other deep sky objects for a lifetime of observing enjoyment.

Please take a few minutes to read this manual and become familiar with all of the #1697 Computer Drive System's capabilities.



Fig. 1 #1697 Computer Drive System.

INSTALLATION

For the #1697 CDS to function properly, there are two printed circuit boards that need to be installed into the Declination housing of the LXD Equatorial Mounts.

The CDS printed circuit boards are sensitive to static electricity and should be handled with care to avoid damage. Whenever handling the electronics, be sure to observe the following precautions:

- Leave the printed circuit boards in the static-resistant bags until ready to install them into the Declination housing.
- When making the installation, avoid standing on a carpeted floor. Instead, stand on a formica or wood floor surface when installing the boards.
- Limit your movements while installing the printed circuit boards, as unnecessary movement can increase the chance of static build-up and discharge.
- Discharge yourself by touching the metal of the telescope before you touch the printed circuit boards.
- Always handle the printed circuit boards by the edges; avoid touching any of the components.

Installing the CDS is a straightforward procedure, requiring only a phillips screwdriver, and hex wrench.

1. On the LXD Equatorial Mount, remove the rubber knurling on the Declination slow-motion knob (2), Fig. 2, and remove this knob by loosening the hex set screw.

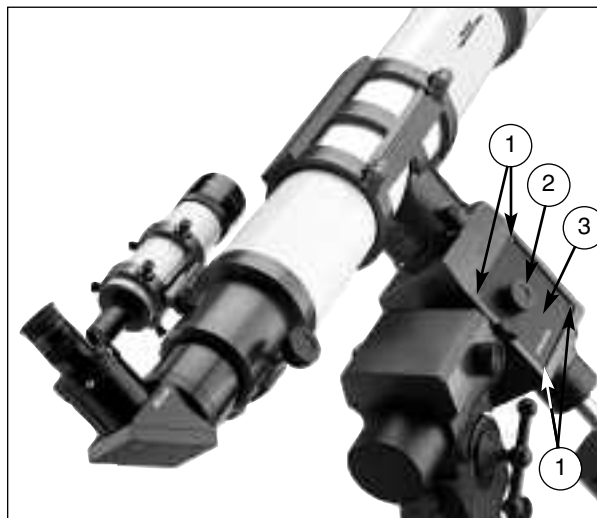


Fig. 2 Installing the Printed Circuit Boards. (1) Phillips-Head Screws; (2) Declination Slow-Motion Knob; (3) Cover Plate.

2. Remove the four screws (1), Fig. 2, holding the cover plate (3), Fig. 2, on the Declination slow-motion knob side of the mount. Discard this cover plate.
3. Inside the Declination housing, you will see the Declination motor and cord with connector. Attach the Dec motor cord, (3), Fig. 3, to the Driver printed circuit board (PCB), (2), Fig. 3. Note the correct orientation of the connector, as shown in Fig. 3.
4. On the Driver PCB, on the opposite side of the Dec motor cord (3), Fig. 3, look for a piece of electrical tape covering the circuitry. If the tape is not in place and the circuitry is visible, place a piece of electrical tape over this area to prevent the contacts from rubbing against the polar shaft during the installation process. Leave the electrical tape in place after the Driver PCB is installed.
5. The Driver PCB has a 16-pin ribbon cable (1), Fig. 3 already attached to the new cover plate. Feed this cable into the Declination housing as shown in Fig. 3.
6. Place the Driver PCB into the Declination housing and replace the four Phillips-head screws, (1), Fig. 2, to hold the new cover plate in place.

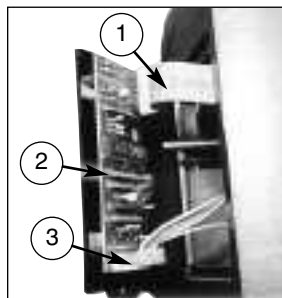


Fig. 3 CDS Driver Printed Circuit Board. (1) 16-Pin Ribbon Cable; (2) Driver PCB; (3) Dec Motor Cable.

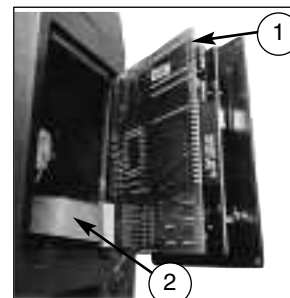


Fig. 4 CDS Printed Circuit Board. (1) CDS PCB; (2) 16-Pin Ribbon Cable

7. Replace the Declination slow-motion knob (2), Fig. 2. Lock in place by tightening the set screw, and replace the rubber knurling.
8. Remove the cover plate on the opposite side of the Declination housing, by removing the four Phillips-head screws holding it in place.
9. Route the 16-pin ribbon cable from the Driver PCB so that it exits the housing on the lower right-hand side. Be sure this cable does not cover the hole in the Declination shaft, which will block light from reaching the optional #814 Polar Alignment Finder should one be installed.
10. Connect the 16-pin ribbon cable (2), Fig. 4, to the CDS PCB (1), Fig. 4.
11. To position the CDS PCB into the Declination casting, first angle the top of the PCB into the opening, allowing it to clear the housing. Then, tilt the lower section of the CDS into the housing. Secure the CDS in place with the four screws.
12. Plug the RA motor coil cord into the R.A. motor port (8), Fig. 5 on the CDS Power Panel.
13. Plug the #1697 Keypad Hand Controller into the keypad port (7), Fig. 5, on the CDS Power Panel.
14. Plug in one of the provided power supplies: the AC Wall Adapter Power Converter, or the DC Cigarette Lighter Power Cord (used in an automobile's cigarette lighter outlet). The power supply plugs into the power port (9), Fig 5.

Installation of the #1697 CDS is now complete.

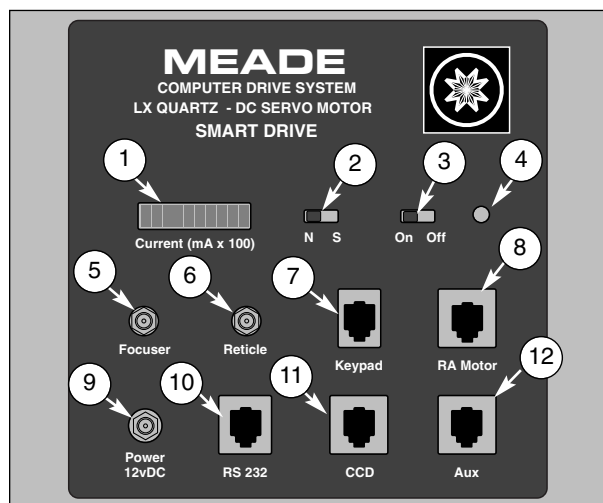


Fig. 5: #1697 Control Panel. (1) Current Indicator (Ammeter); (2) North/South Switch; (3) On/Off Switch; (4) LED Indicator Light; (5) Focuser Port; (6) Reticle Port; (7) Keypad Hand Controller Port; (8) R.A. Motor Port; (9) Power Port; (10) RS-232 Port; (11) CCD Port; (12) Aux Port.

QUICK START

Although the electronics within the #1697 Computer Drive System are advanced, the system is very straightforward to operate—even for the beginning observer. This section is designed as a "quick start" section for those observers anxious to begin. Be sure to come back and read the more detailed sections of this manual. Most of the system's features cannot be accessed without full knowledge of these details.

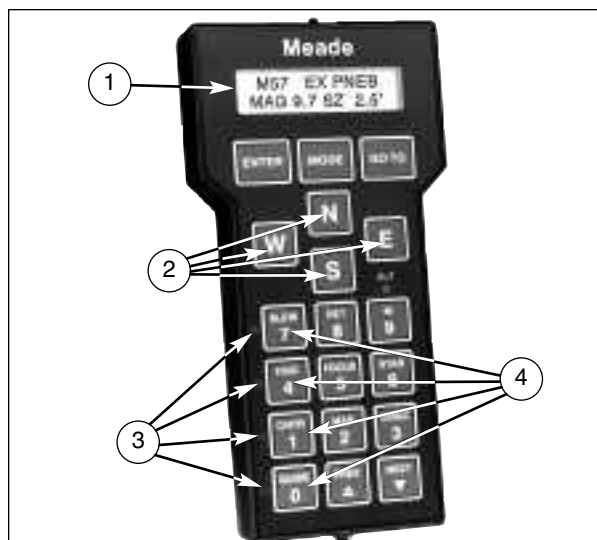


Fig. 6: #1697 Keypad Hand Controller. (1) Display; (2) Direction Keys; (3) Speed Indicator LEDs; (4) Speed Selection Keys.

Basic Telescope Setup:

1. **Polar align your telescope.** See the instructions that accompany the telescope.
2. Turn "on" the #1697 Control Box. The Keypad Display (1), Fig. 6, displays "MEADE" for several seconds as the micro-processor does a self-diagnostic test. When the self-diagnostic test is complete, the display shows "TELESCOPE" on the top line, and "OBJECT LIBRARY" on the lower line. The Speed Indicator LED (3), Fig. 6, next to the "SLEW" button is illuminated.
3. At this point, the #1697 Computer Drive System is ready to use. Select a speed at which to move the telescope by pressing the appropriate Speed Selection Key (4), Fig. 6. As a speed is selected, the red LED next to the selected speed lights up. Then press one of the four direction keys, (2), Fig. 6, to move the telescope in that direction at the selected speed.
4. With the CDS power turned on, the LXD mount can be moved in either of two ways: (1) By loosening the R.A. and Dec locks as described in the instruction manual supplied with your telescope; or (2) by using the N, E, W, or S keys (2), Fig. 6, on the Keypad.

NOTE: Telescope movement can only be seen in the SLEW and FIND modes; CNTR (center) and GUIDE motions can only be seen while looking through the telescope.

DO NOT attempt to adjust the LXD Equatorial Mounts with the manual R.A. or Dec slow-motion controls when the CDS Drive is turned on. Serious damage to the drive motor assemblies could result.

Please note that it is possible for the telescope to hit one of the tripod legs while manually moving the LXD Equatorial Mount with the Keypad direction keys. The CDS software is programmed, however to avoid hitting the tripod legs provided the proper time, date, and site information has been entered, and that the telescope has been properly aligned, as described on page 7.

The quick start method described above allows you to use the telescope, but does not make any use of the computer features available. To utilize all the features of the #1697 Computer Drive System, it is necessary to enter some information into the

system's computer memory. It is also necessary to learn the menu structure of the Keypad Hand Controller, which is described beginning on page 8.

Basic CDS Setup:

This section explains what keys to push to get the minimum data required into the computer system, without any detailed explanation. The detailed explanation can be found later in the manual. These steps will only take a few minutes and will allow immediate use of all of the CDS features.

In order for the CDS to utilize the stellar coordinate system, Right Ascension (R.A.) and Declination (Dec), the system needs to know three pieces of information: the location (latitude and longitude) of the observing site; the local time; and the date. This information only needs to be entered one time — the CDS remembers the data even when the power is off.

1) Entering the Latitude and Longitude of the Observing Site.

The position of your observing site should be determined as accurately as possible, to within 1 or 2 minutes of arc in both latitude and longitude. Many automobile, pilot, and topographical maps, as well as most atlases show latitude and longitude in 15 minute increments or better. The accuracy of the CDS depends on the accuracy of the data that is entered.

Once the above information is determined, it is easiest to enter the data into the system while the telescope and CDS are indoors where there is light—do not try to do it outside at night.

The following example is for an observing site in Costa Mesa, CA (LAT=33°35', LONG=117°42'). If a mistake is made during entry, simply turn off the telescope and restart this procedure. (A more detailed description of the procedure shown below can be found on page 11, "SITE".)

1. Turn "On" the #1697 CDS. After a few seconds (after the self-diagnostic test is complete), the display will look like Display 1.

→TELESCOPE
OBJECT LIBRARY

Display 1

2. Press the ENTER key to select the TELESCOPE functions. The display should look like Display 2.

→1) SITE
2) ALIGN

Display 2

3. Press the ENTER key to select the SITE functions. The display should look like Display 3.

→1) A A A ✓
2) A A A

Display 3

4. Press and Hold the ENTER key until the Keypad Hand Controller beeps. This selects the first site for editing. The display should look like Display 4, with the first "A" flashing

NOTE: To edit the letters "AAA", press the NEXT or PREV keys on the Keypad Hand Controller to cycle through the letters of the alphabet. Use the "E" and "W" keys to move between positions.

→1) A A A ✓
2) A A A

Display 4

5. Press the ENTER key. The display should look like Display 5. (Number values may vary.)

→LAT = +00° 00'
LONG = 000° 00'

Display 5

6. Use the number keys to enter your latitude. Mistakes may be corrected by moving the cursor back, using the "E" and "W" keys. A negative latitude may be entered by positioning the cursor under the "+" and hitting the NEXT key. When the latitude is correctly entered, press ENTER. The cursor moves to the LONG line. The display will look like Display 6.

LAT = +33° 35'
→LONG = 000° 00'

Display 6

7. Use the number keys (as described above) to enter your longitude. When complete, the display will look like Display 7.

LAT = +33° 35'
→LONG = 117° 42'

Display 7

NOTE: The longitude standard used in the CDS starts at 0 degrees in Greenwich U.K. and increases Westerly only to 359 degrees 59 minutes. Many maps will show Easterly longitudes which cannot be entered into the Keypad Display (e.g., if the map indicates an observing site at an Easterly longitude of 18 degrees 27 minutes, it is necessary to enter the position as 341 degrees 33 minutes).

The differences in longitude and latitude as they pertain to different map spheroid projections are minor differences that are too small to adversely affect the longitude and latitude data input.

8. Press ENTER to complete the site information input. The display will go back to Display 3.
9. Press MODE to go back to Display 2.
10. Press MODE again to go back to Display 1.

2) Entering the Local Time and Date.

The local time should be set as accurately as possible using the 24 hour format. The pointing accuracy of the telescope depends on the accuracy of the time entered because the local time and date are used to determine sidereal time (star time). Choose a reliable source as a reference for accurate time such as your local airport, or telephone company. In the U.S.A. you can double check the accuracy of the exact minutes by dialing WWV for the universal coordinated time at (303) 499-7111 (be sure to enter your local time hour information, not the U.T. hour).

The following example is for 4:25:00 P.M. on Jan. 15, 1998.

1. The display should look like Display 1. If it does not, press the MODE key until it does.

- Press the MODE key twice. The display will look like Display 8, but with random LOCAL and SIDE times.

→LOCAL = 11:24:30
SIDE = 21:38:02

Display 8

- Press and hold the ENTER key until the Keypad Hand Controller beeps (display like Display 9).

→LOCAL = 11:24:30
SIDE = 21:38:02

Display 9

- Using the number keys, enter the current local time to within 5 seconds. (Remember, 4:25:00 P.M. is 16:25:00 in the 24 hour format.) Corrections can be made by moving the flashing cursor using the "W" and "E" keys. The display should look like Display 10.

→LOCAL = 16:25:00
SIDE = 21:38:02

Display 10

- Press the ENTER key when the time is correct. The display will change to Display 11.

Hours from GMT:
+ 0 8

Display 11

- Enter the Greenwich Mean Time (GMT) time zone shift. (This procedure is a lot easier than it sounds.) For users in the United States, look up your time zone in the table below to find the GMT time zone shift.

TIME ZONE	Standard Time	Daylight Savings Time
Eastern	+ 5 Hours	+ 4 Hours
Central	+ 6 Hours	+ 5 Hours
Mountain	+ 7 Hours	+ 6 Hours
Pacific	+ 8 Hours	+ 7 Hours
Hawaii	+ 10 Hours	+ 9 Hours

For example: For the Pacific Time Zone on Daylight Savings Time, the GMT time zone shift is +7 hours.

- Use the number keys to enter the GMT time zone shift determined from the table above. Press ENTER when done; the display will go back to Display 8. If you are using the CDS East of Greenwich U.K., then you must enter a - (minus) GMT time zone shift by moving the blinking cursor backwards in the display with the "W" key and then pressing the NEXT key. The + (plus) sign will change to - (minus).

NOTE: The time keeping mechanism in the CDS is a standard clock chip. It may be necessary to confirm the time when first starting an observing run. However, once the system is aligned and the telescope knows its exact location in the sky, this information is used to calculate a very accurate sidereal time.

- Press the ENTER key. This will select the DATE display (Display 12), with a random date showing.

DATE = 11/28/97

Display 12

- Press and hold the ENTER key until the Keypad Hand Controller beeps. The display will look like Display 13, with the blinking cursor over the first number.

DATE = 11/28/97

Display 13

- Use the number keys to enter the current date. The display should look like Display 14. Use the "W" and "E" keys to move the blinking cursor left and right to correct any mistakes.

DATE = 01/15/98

Display 14

- Press the ENTER key when the date is correct.

After you press the ENTER key, the Keypad Hand Controller will display "Updating planetary data". The position of the planets depends on the date, so anytime the date is changed, the planet positions are recalculated.

This is all the information the CDS needs to make use of all its features. The next steps actually align the telescope with the night sky.

3) Telescope and CDS Alignment.

After the basic information has been entered into the system, the CDS is ready for use. With a telescope that has been properly assembled and balanced (as per the telescope's instruction manual), you are ready to begin. Following these steps:

- Face the field tripod leg (1), Fig. 7, that is centered under the Power Panel, so that the LXD mount points to the approximate North or South Pole star position in the sky (using a simple hand held compass may help). Then, use the Bubble Level located on the base of the LXD mount to level the telescope.
- Turn "On" the CDS electronics. After a few seconds (when the self-diagnostic test is complete) the display will look like Display 15.

→TELESCOPE
OBJECT LIBRARY

Display 15

- Press the ENTER key to select the TELESCOPE functions. The display should look like Display 16.

→1) SITE
2) ALIGN

Display 16

- Press the NEXT key to move the arrow to the lower line (see Display 17).

1) SITE
→2) ALIGN

Display 17

5. Press the ENTER key to activate the ALIGN function. The display will look like Display 18.

Move to 90 deg., dec.
and 00 H.A.

Display 18

6. Loosen the R.A. and Dec lock knobs on the LXJ Equatorial Mount. Position the optical tube assembly so that the Dec Circle reads 90°. Retighten the Dec Lock Knob. Then loosen the R.A. lock knob and rotate the telescope so that the R.A. pointer and the Hour Angle Pointer are approximately in line with each other. This will position the tube assembly and the counterweight so that they are parallel to the ground and the Power Panel is facing the sky, as shown in Fig. 7. This step is necessary for the CDS to work. The telescope has some "illegal" positions (places where the telescope will not go) and these two steps insure proper operation.

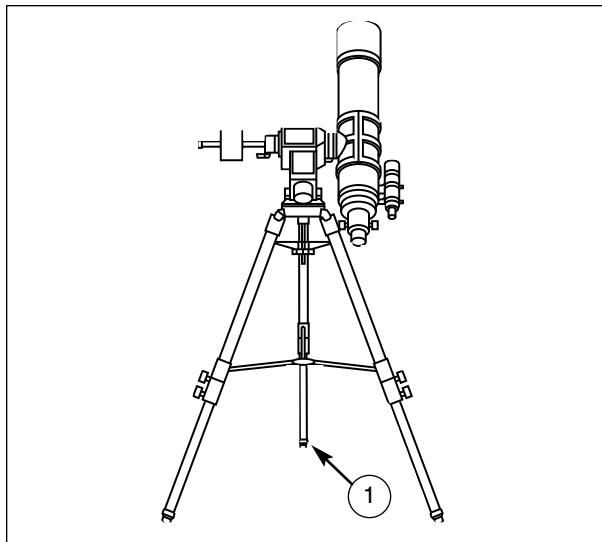


Fig. 7: Aligning the Telescope. (1) Alignment tripod leg.

7. Press the ENTER key. The CDS electronics will slew the LXJ Equatorial Mount to the calculated position of the pole star. The display will look like Display 19.

Center Polaris
then press ENTER

Display 19

8. Center the pole star in the eyepiece of the telescope by using the Azimuth adjustment knobs and the Latitude adjustment knob on the LXJ Equatorial Mount. **Do not use the R.A. or Dec controls.** Using the R.A. and Dec slow-motion controls will destroy the alignment procedures.
9. After centering the pole star, press the ENTER key. The telescope will slew to one of the 33 bright and well known stars as a second alignment star. Appendix B can be used

as a reference for the position and the catalog number of these prominent stars. The display will look like Display 20.

Center your star choice
then press ENTER

Display 20

10. Center the second alignment star in the telescope eyepiece using the "N", "E", "W", or "S" keys on the Keypad Hand Controller. Once the second star is centered, press the ENTER key to complete the alignment sequence.

Should the alignment star be hidden from the view of the telescope, do not manually move the telescope. Simply press the ENTER key and select another bright star from the Alignment Star List that appears in Appendix B. Look up the catalog number of the star. Then, press the STAR key and type in the star catalog number using the number keys. Press the ENTER key, and then the GO TO key. The telescope will then slew to the approximate position of the alternate star. Center the star with the "N", "E", "W", or "S" keys, then press and hold the ENTER key until the display reads "Coordinates matched". This method synchronizes the CDS computer to the sky.

The telescope is now polar aligned and fully functional, and will automatically track objects. From this point on, make all telescope movements by use of the Keypad Hand Controller. Manual movements by loosening the Dec or R.A. locks will cause the CDS to "lose" position, requiring realignment.

USING THE #1697 COMPUTER DRIVE SYSTEM

1) The MODE Key

The CDS has 5 basic Keypad Hand Controller displays, and the MODE key is used to move between them. The 5 modes are:

1. *Telescope Functions.* The TELESCOPE mode is where all telescope functions are changed or activated. The OBJECT LIBRARY is where the features of the object library are accessed.
2. *Telescope Position.* The first display shows the telescope's position in Right Ascension (R.A.) and Declination (Dec).
3. *Time and Date.* The first display shows local time and sidereal time. The second display (accessed by pressing the ENTER key) shows the date.
4. *Timer and Freq.* This display is a countdown timer and allows the user to change drive rates. These are advanced features.
5. *All Off.* This mode simply turns off all displays and backlighting. You can also adjust the backlighting brightness by pressing the ENTER key and using the PREV and NEXT keys to adjust the brightness.

2) Library Object Keys

The Library Object keys, ("M" - for Messier objects, "STAR" - for alignment stars, SAO and GCVS catalogs, and "CNGC" - for Computerized New General Catalog) may be directly accessed while in any of the 5 main Keypad displays. (See Appendix C of this manual for a listing of the 64,359-Object Library). Simply press a library object key, type in the number of the object desired, and press ENTER.

For example: during the first part of the year, a good object to begin with is M42—the Great Orion Nebula. Press: the "M" key, the "4" key, the "2" key, and then the ENTER key. The display

will show data on the object (name, rating, object type, brightness, and size). Now, press GO TO. The telescope will automatically slew to M42. If the desired object is not above the horizon, the Keypad Hand Controller will display the message "OBJECT BELOW HORIZON."

Other good objects to begin with (if above the horizon) are any of the M objects—from M1 to M 110, and the planets. To find a planet, press the STAR key, followed by the number of the planet you wish to view (see chart below). Then, press ENTER.

Planet	Star #
Mercury	901
Venus	902
Mars	904
Jupiter	905
Saturn	906
Uranus	907
Neptune	908
Pluto	909
The Moon	903

If the planet is too close to the Sun for safe viewing (closer than 15 degrees) the Keypad will display a message to that effect.

3) Daytime Slewing

You may want to use the slewing feature of the CDS to locate the planets or other astronomical objects during the daytime. If not done correctly, this can be very dangerous.

The CDS "knows" where the planets are in relation to the Sun, but the telescope does not "know" where the Sun actually is. When the GO TO button is pushed, the telescope will slew to the object by the most direct route, which may move directly over the Sun.

WARNING

Use extreme caution when using the GO TO feature of the telescope to locate objects in the daytime! Looking into the telescope or viewfinder, even for the shortest fraction of a second, with sunlight entering the optics, will cause instant and irreversible eye damage. The telescope itself may also suffer serious damage if it is pointed at or near the Sun.

A responsible adult should supervise every aspect of telescope operation when children are observing in the daytime.

Use the following procedure to safely locate objects during the daytime, whether by manually slewing the telescope, using the "N", "E", "W", "S" keys, or using the GO TO key:

1. Before allowing the telescope to move, place the dust covers on the main telescope and viewfinder (or remove the viewfinder from the telescope completely). This will keep the Sun's damaging light out of the telescope should it move across the Sun.
2. Select the desired object from the Object Library. Then, press the GO TO button or manually move the telescope by using the "N", "S", "E", or "W" keys.
3. After the telescope has stopped moving, visually check the telescope's position to be sure it is not pointing near the Sun. If there is any question in your mind that the telescope may be pointing at or near the Sun, do not look through the telescope. Only when you are absolutely convinced that the telescope is pointing away from the Sun should you remove the telescope's dust cover and observe the object.

Above all, be careful and use common sense. Observing the Sun, even for the shortest fraction of a second, will cause instant and irreversible eye damage.

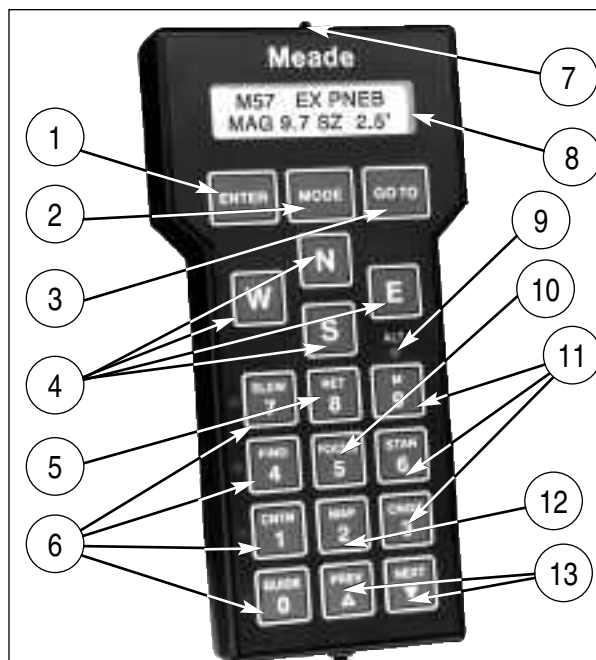


Fig. 8: CDS Keypad Hand Controller. (1) ENTER Key; (2) MODE Key; (3) GOTO Key; (4) Direction Keys; (5) RET Keys; (6) Speed Keys; (7) Red LED Map Light; (8) Display; (9) ALT LED; (10) Focus Key; (11) Object Keys; (12) MAP Key; (13) PREV & NEXT Keys.

THE CDS KEYPAD HAND CONTROLLER

The Computer Drive System gives an observer virtually every telescope function possible with all the controls in a compact hand-held console. The Keypad Hand Controller's tactile touch buttons are designed to have the right feel, even through gloves. Its red LED backlit display, key arrangement, and easy-to-understand information makes knowing where the telescope is pointing in the sky much easier than with most other systems.

Within a few minutes of powering up the Computer Drive System, the Keypad becomes warm. This is normal. The electronics within the CDS utilize a heat sink to provide the right operating environment temperature for the LCD display — even in very cold conditions. If you are indeed in these colder conditions, the display may not be visible until the Keypad has transferred enough heat. This process can take a few minutes upon powering up the telescope. While severe cold weather is not damaging to the electronics, it is advised to keep the Keypad in a warmer area to allow immediate proper display performance.

The Computer Drive System Keypad buttons are described below:

1. ENTER Key

The ENTER key (1), Fig. 8, is used to select a menu file, a file option, or to edit a value. To select a file or an option, press and release the ENTER key. The Computer Drive System will give a short beep tone and perform the action that you have requested. To edit a value, press and hold the ENTER key until a double beep tone is heard and a blinking cursor appears in the display. There are some other specific situations where the ENTER key is used. These are described in detail where necessary. From now on, the two types of presses will be called 'press' and 'press and hold'.

2. MODE Key

The MODE key (2), Fig. 8, cycles through the following five modes of the Computer Drive System: Telescope/Object Library; Coordinates/GO TO; Clock/Calendar; Timer/Frequency; Keypad Off/Brightness Adjust. The MODE key is also used to exit from specific menu files.

3. GO TO Key

The GO TO key (3), Fig. 8, causes the telescope to automatically slew to specific library entry coordinates. The GO TO key also produces a blinking cursor in the GO TO menu file of the COORDINATES/GO TO mode, to allow new Right Ascension and Declination coordinates to be entered. Pressing GO TO while the telescope is slewing to an object pauses the slewing process, pressing GO TO again resumes the slew.

4. Direction Keys

Labeled "N", "S", "E", and "W", (4), Fig. 8, these four keys make the #1697 Computer Drive System move, or slew, in a specific direction, at any one of four different speeds (explained below). During data entry, the E and W keys can be used to move the blinking cursor back and forth across the LCD display, so that if an error is made during entry, it can be erased and changed.

The remaining twelve keys have multiple functions; there are up and down arrow keys and numbered keys from 0 through 9. Each one of these keys also has alternate functions listed above the arrow symbols and numbers. The ALT LED light (9), Fig. 8, is only visible when entering numerical data. A description of the individual keys follows:

5. RET Key

Typically used for guiding the telescope during an astrophotograph, the RET key (5), Fig. 8, is used to change the brightness and pulse rate of the optional corded, plug-in style illuminated reticle eyepiece, such as the Meade Modified Achromatic 12mm Illuminated Reticle Eyepiece, or the Meade Series 4000 Plössl 9mm Illuminated Reticle Eyepiece. (See Optional Accessories, page 18.) Pressing either the PREV and NEXT (up and down arrow) keys (13), Fig. 8, while holding down the RET key, alters the reticle brightness level up or down.

When guiding on very faint stars, it may be helpful to pulse the light from the LED so that the reticle crosshairs blink on and off. It is possible to adjust both the reticle brightness as well as the pulse rates. There are three pulse rates that can be used, all with a one second pulse interval. The continuous illumination control and pulse rates are set by holding down the RET key and pressing one of the following keys; GUIDE (100% on, no pulsing), CNTR (50% on, 50% off), MAP (25% on, 75% off), CNGC (10% on, 90% off).

6. Speed Keys (SLEW, FIND, CENTER, and GUIDE)

These keys (6), Fig. 8, allow an observer to set the rate of movement or slew speed in the drives of the #1697 CDS, as activated by the N, S, E, and W keys. The chosen rate is indicated by the speed indicator illuminated LED beside the rate key that you have pressed. The speed rates are SLEW (8 degrees per second), FIND (2 degrees per second), CNTR (32X sidereal rate), and GUIDE (2X sidereal rate).

NOTE: All of the slew speeds will drive the telescope in all four directions, except for GUIDE. The 2X sidereal speed in GUIDE has one difference in that it will not interrupt the Right Ascension tracking direction to make Easterly (for Northern hemisphere) or Westerly (for Southern hemisphere) adjustments; it merely stops the drive motor and allow Earth's natural rotation to make the correction.

SLEW, FIND, CENTER, and GUIDE keys also have numbers listed (7, 4, 1, and 0 respectively). When editing a value, the multiple function of each of these keys is realized. SLEW and FIND are also used to set the 'fast' focus speed for the electric focuser accessory option, while CNTR and GUIDE set the slow focus speed (see details below). There are other special functions for the CNTR and GUIDE keys that are discussed in the RET KEY (5), Fig. 8, operations.

7. FOCUS Key

The FOCUS key (10), Fig. 8, allows 2 speed electric focus control of the optional Meade #1207 Electric Focuser. (see Optional Accessories, page 18.) To activate, press either the SLEW or FIND key (for fast focusing), or the CNTR or GUIDE key (for slow focusing), press and hold the FOCUS key, and then press and hold the PREV or NEXT keys (13), Fig. 8, for near and far focus.

8. MAP Key

The Map key (12), Fig. 8, is used to activate the red LED Map Light (7), Fig. 8 on top of the Keypad. The deep red LED light protects your night vision while you search for a particular accessory or examine a star chart.

9. Object Keys (M, STAR, and CNGC)

These keys (11), Fig. 8, allow direct access to the #1697 CDS's Object Library any time that you are not editing a value, setting a parameter, or selecting a file menu. After pressing one of these keys, the Keypad displays a blinking cursor, allowing you to enter the catalog number for objects listed in the library (see Appendix C. 64,359-Object Library). After entry, press the ENTER key. To observe the entered object, press the GO TO key. A brief description of the catalog key symbols are; M (Messier objects), STAR (stars and planets), and CNGC (deep sky objects).

10. PREV and NEXT Keys

The PREV and NEXT (up and down arrow) keys (13), Fig. 8, move the display's LCD arrow up and down the menu files and menu file options, so that you may choose an individual selection to enter. These keys are also used when adjusting the RET brightness range, or when activating the electric focuser. PREV and NEXT are also used to select the objects from the Object Library when using START FIND (explained on page 15).

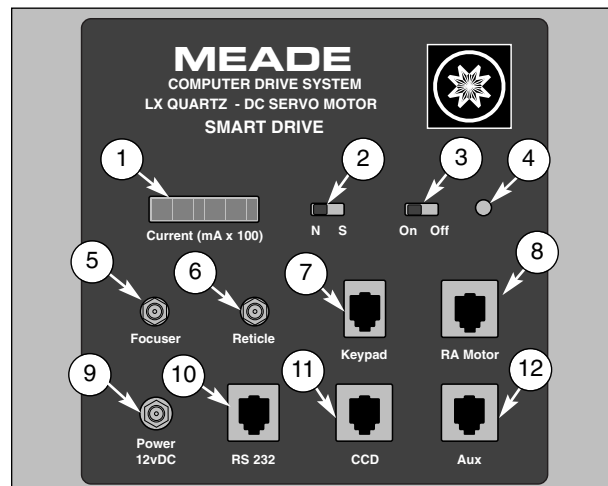


Fig. 9: #1697 CDS Control Panel. (1) Current Indicator (Ammeter); (2) North/South Switch; (3) On/Off Switch; (4) LED Indicator Light; (5) Focuser Port; (6) Reticle Port; (7) Keypad Hand Controller Port; (8) R.A. Motor Port; (9) Power Port; (10) RS-232 Port; (11) CCD Port; (12) Auxiliary Port.

THE CDS CONTROL PANEL

1. Current (mA x 100) (1), Fig. 9: The Current (Ammeter) display is a series of vertical red LED bars. Each fully lit bar represents 1/10 of an amp (or 100 milliamps) of current draw, with the lowest value on the extreme left of the scale. During normal tracking speeds, the Ammeter will show a few LED bars lit up. However, when a slew is initiated, the current draw will light up the entire LED display, momentarily showing the inertia load. This effect is entirely normal. The current draw

information can be useful if you are trying to calculate how much battery life is available during an observing run. As an example, if the ammeter has four bars lit, (indicating 0.4 amps) and the system is using a 12 amp hour battery, determine the approximate battery life by dividing 12 amp hours by 0.4 amps, resulting in a battery life of 30 hours.

2. N/S (2), Fig. 9: The N/S switch converts the CDS for operation in the northern or southern hemisphere, making the LXD drive reverse its tracking direction. The appropriate N or S switch position should be chosen before powering up. The CDS will not recognize a change made on the N/S switch after power has been turned on.

Note: If traveling across the equator, be sure to set the proper + or - latitude SITE entry for your final destination. (See page 6: Entering the Latitude and Longitude of the Observing Site).

3. On/Off (3), Fig. 9: This switch turns power to the CDS system on and off.

4. Red LED Indicator (4), Fig. 9: When illuminated, the red LED indicates power to the system.

5. Focuser (5), Fig. 9: The Focuser port accepts optional corded, plug-in style electric focusers, such as the Meade #1207 Electric Focuser, to allow electric focus adjustment control from the CDS Keypad.

6. Reticle (6), Fig. 9: The Reticle port accepts optional corded, plug-in style illuminated reticle eyepieces such as the Meade 12mm Illuminated Reticle Eyepiece, or the Meade Series 4000 Plössl 9mm Illuminated Reticle Eyepiece, to allow brightness control and on/ off pulsing rates which can be set from the CDS Keypad.

7. Keypad (7), Fig. 9: The Keypad port is a 4-pin phone jack connector socket, designed to accept standard 4-pin phone jack coil cords. One end of the supplied coil cord plugs into the Keypad port, the other end plugs into the CDS Keypad.

8. RA Motor (8), Fig. 9: The RA Motor port is an 8-pin phone jack connector socket, designed to accept standard 8-pin phone jack cable. One end of the supplied cable plugs in to the Control Panel and the other plugs into the RA Drive Motor.

9. Power 12vDC (10), Fig. 9: The Power 12v DC port is designed to accept the DC Power Cord that is supplied as standard equipment with the CDS. The acceptable input voltage range is 12 to 18 volts. Note that the center post of the Power port is positive.

10. RS-232 (11), Fig. 9: The RS-232 port allows a user to interface the CDS with a personal computer (PC). Communicating at a rate of 9600 baud, the RS-232 port allows a PC to access every feature of the CDS system. Appendix D provides a wiring schematic to make your own RS-232 connector cord, a cord test program, a demonstration program, and the CDS Command Set for writing programs. Meade Instruments supplies this information for professional programmers. Meade Instruments Corporation does not offer support or advice for writing software for the RS-232 option.

11. CCD (12), Fig. 9: The CCD port allows direct interfacing with Meade CCD autoguider/imaging equipment such as the Pictor 201XT, 216XT, 416XT and 1616XT to accomplish CCD autoguiding.

12. Aux (13), Fig. 9: The Auxiliary port is reserved for future product expansion. The output voltage through the Aux port equals the input voltage to the system.

MODE FUNCTIONS

To view the different modes within the CDS system, press the MODE button (2), Fig. 8, located between the ENTER and GO TO keys at the top of the Keypad. By entering and/or editing information in the different modes, you can customize the operation of your CDS to meet virtually any of your observing requirements. Better still, all of the critical information such as time, location, alignment type, and many other functions are kept in memory...even with the CDS turned off!

The type of alignment, the objects that you see, the location that you observe from, the tracking speeds of the drives, all of the clock and timing functions, the position information, and even the brightness level of the backlit Keypad are defined by the information that you give and/or the commands that you edit, through five different modes of the CDS computerized hand controller.

Once you have selected the desired mode (by pressing the MODE key), you can then select the individual file within the mode by pressing the PREV or NEXT key (13), Fig. 8, moving the LCD arrow up or down beside the file description. Although you can only see two menu selections at a time in the Keypad Display (8), Fig. 8, you can see more as you continue to press the PREV and NEXT keys.

When the desired file is chosen, press the ENTER key to view the file's menu. To choose an individual menu, again use the PREV or NEXT key to move the LCD arrow up or down the file's menu. To explore a menu selection, again press the ENTER key. In some modes there will be options for a file's menu selection, in others you will only enter data.

Any time you wish to return to the main file heading in a particular mode, just press MODE and it will behave as an exit key.

1. MODE ONE: TELESCOPE/ OBJECT LIBRARY

This is the default mode of the CDS. To explore either the TELESCOPE menu file or the OBJECT LIBRARY menu file, move the LCD arrow to the appropriate selection by using the PREV or the NEXT key and press the ENTER key.

A. TELESCOPE Menu File

Below are descriptions of the eleven menu selections of the TELESCOPE menu file, including individual menu files and file options.

1) SITE: The SITE menu option allows a user to enter the latitude and longitude of up to four favorite viewing locations. The entered longitude and latitude is compared by the CDS's computer to the local time, GMT offset, and calendar date to accurately calculate celestial coordinates. Once entered, the information is stored in the telescope's internal memory, and need never be re-entered. To enter new site information or to change an old one, refer to page 6 (Entering the Latitude and Longitude of the Observing Site). Once the site is chosen, exit the SITE menu by pressing the MODE key.

2) ALIGN: Astrophotographers routinely require polar alignments of the highest accuracy for the finest guiding characteristics. The initial polar alignment may be refined by using the CDS's electronics. Be sure to enter the correct local time and the observing site's latitude and longitude before beginning.

The following procedure should be performed in two or three 15 minute intervals. At each interval the telescope will slew to the area where the pole star should be centered in the optics. The

pole star may be somewhat off-center in the eyepiece, showing that an alignment error was made during the initial setup. Using the Latitude adjustment knob and Azimuth control knob on the LXD Equatorial Mount, center the pole star during each interval exercise, then follow the rest of the routine.

1. From the ALIGN menu option in the TELESCOPE mode, press the ENTER key.
2. Ignore the Keypad display instructions to return the telescope to 90 degrees in Declination and 00 HA. Instead, press the GOTO key and the CDS will slew to the calculated position of where the pole star should be.
3. **Using only the Latitude and Azimuth adjustments on the LXD Equatorial Mount**, re-center the pole star in the field of view in the eyepiece.
4. Press the ENTER key, and the CDS will slew to a bright star overhead. **Center this star using the "N", "S", "E", or "W" keys and press ENTER.**
5. While waiting 15-20 minutes between alignment intervals, the telescope may be used to observe.
6. After 15-20 minutes, repeat the process, beginning with Step 1. This process may be repeated as often as desired to obtain the highest accuracy. After each 15 minute interval, the pole star becomes more accurately centered. An optional illuminated reticle crosshair eyepiece makes the job of centering the star easy.

NOTE: Pressing the MODE key at any point in the alignment routine will abort the routine and exit to the top menu.

There may be situations when it is impossible to see the pole star (e.g., something blocking your line of sight). In such an occasion, follow the Precise Polar Alignment instructions in Appendix A of this manual. You will require the use of an illuminated reticle crosshair eyepiece to complete the task. Once finished, follow the steps outlined below to access the Object Library.

3) SMART: The SMART menu file controls the CDS Smart Drive, a system designed to eliminate the small errors induced by tiny gear imperfections that tend to slightly speed up or slow down the drive tracking speed. These gear imperfections occur in a regular eight minute pattern, the time required for one rotation of the worm. The CDS can be trained to remember the pattern of these imperfections and automatically apply the corrections needed. Use of the Smart Drive greatly enhances the tracking characteristics of the CDS, thus simplifying guiding during astrophotography.

The menu also has provisions for correcting Declination drift. Smart Drive will retain its training, even after the telescope is turned off. (Of course, it is possible to retrain the system or erase the training, if desired.)

The SMART menu has five options. They are; LEARN, UPDATE, ERASE, DEC LEARN, and DEC CORRECT. To train the Smart Drive, the telescope must be equipped with an illuminated reticle eyepiece. Be sure to train the Smart Drive in the 60.1 Hz Quartz setting; the CDS is automatically set at 60.1 Hz at power up. Thereafter, you can adjust frequency setting in the TIMER/ FREQ mode and still enjoy the periodic error correction.

Training the SMART DRIVE:

Once polar alignment of your telescope has been completed, the CDS is pointing the telescope to a bright star overhead, near the Celestial Equator. This star may be used, or another, as long as the chosen guide star is near 0 degrees in Declination and more or less overhead in Right Ascension. Before beginning the

SMART DRIVE training, set the brightness and/or the pulse rate of the illuminated reticle (see page 10, The RET Key) on the chosen guide star and practice guiding (keeping the star exactly centered in the eyepiece) for a few minutes. Then, follow these steps:

1. While in the SMART menu, move the LCD arrow to LEARN by using the PREV or NEXT key and press ENTER.
2. Numbers appear next to the LEARN display. These numbers will begin counting down to zero. The highest number that can appear is 200. This number represents a sector of the worm wheel. The sector changes every 2.4 seconds. The SMART DRIVE needs to find its beginning sector before training can start. It will be necessary to wait until the system counts down to zero to begin.
3. As the Keypad display approaches its beginning sector, a beeping alerts you that training is about to commence. At this point, begin guiding on the chosen guide star, using the N, S, E, and W keys.

A tone will beep every few seconds throughout the training session. Try to keep the star in the same location on the crosshair during the ten minute training sequence.
4. After eight minutes, the beeping stops, indicating that the training is over. The Smart Drive immediately starts playing back your drive corrections automatically, dramatically improving the R.A. drive tracking characteristics.

If you wish to further refine the accuracy of the drive system, move the LCD arrow to UPDATE and press ENTER and follow the same instructions as above. This can be done in UPDATE as many times as you wish. With each training, the Smart Drive will average your training sequences.

If a mistake has been made in training (e.g. pushing E instead of W), you can eliminate the memory by moving the LCD arrow to ERASE and press ENTER.

DEC LEARN:

A star that drifts consistently North or South during guiding, can also be corrected for. With a guide star centered in the telescope's field of view, move the LCD arrow to DEC LEARN and press ENTER. Begin making drive corrections immediately by pressing any of the direction (N, S, E, W) keys to keep the star on the crosshair of the guiding eyepiece. It is suggested that you train in DEC LEARN for at least half of your intended exposure time for an astrophoto. The longer you train, the more accurate the DEC LEARN will be. Once the desired time is finished, press ENTER and the training will cease.

The Smart Drive then determines how many key pushes occurred in N and S and chooses the direction which received more commands. It then averages the time between key pushes in the chosen direction. In this way, the Smart Drive can correct for Declination drift (should your polar alignment be slightly off), or will allow you to more precisely guide on non-stellar objects, such as comets, asteroids, etc.

To play back your DEC LEARN training, move the LCD arrow to DEC CORRECT and press ENTER. To halt the play back press ENTER again. To erase the DEC LEARN training, either move the LCD arrow back to DEC LEARN and press ENTER twice or turn the CDS off.

4) 12/24 HR: This menu selection of the TELESCOPE file simply toggles between a twelve and twenty-four hour display of local time in the Time Mode.

To toggle between 12 and 24 hours displays, move the LCD arrow to 12/24HR and press ENTER. To return to the original setting, press ENTER again.

5) HELP: The HELP menu selection of the TELESCOPE file is an electronic mini-manual that briefly describes the function of each command key on the CDS Keypad.

To use this menu, move the LCD arrow with the PREV or NEXT key to HELP and press ENTER. To read the lines of text, use the PREV and NEXT keys. To exit, press MODE.

6) REVERSE NS: The REVERSE NS menu selection of the TELESCOPE file reverses the direction of the telescope in North and South movements (e.g. pressing the N key moves the telescope South, or down, instead of North, or up). This is especially useful during some guiding applications.

To use the REVERSE NS menu, move the LCD arrow to REVERSE NS and press ENTER. To return the direction commands to the original setting, press ENTER again.

7) REVERSE EW: The REVERSE EW menu selection of the TELESCOPE file reverses the direction of the telescope in East and West movements (e.g. when the W key is pressed, the telescope moves East). This is particularly useful during some guiding applications.

To use the REVERSE EW menu, move the LCD arrow to REVERSE EW and press ENTER. To return the direction commands to the original setting, press ENTER again.

8) BALANCING: When adding optional equipment to the telescope, like a heavy camera or Dewshield, it is often necessary to rebalance the telescope using Tube Balance Weight Systems.

Selecting option #8 from the TELESCOPE menu moves the telescope rapidly up and down in Declination. This provides an easy way to determine when the telescope is balanced in the Declination axis.

When the telescope is out of balance, the instrument will draw more current when slewing in the "heavy" direction. Also, the Declination motor will sound different.

After selecting option #8, watch the Ammeter and listen to the Declination motor to determine when the telescope is balanced. If needed, make the appropriate adjustments to the optical tube assembly and counterweights until the telescope is properly balanced.

9) High-Precision Pointing: The High-Precision Pointing feature of the CDS allows for very precise pointing of the telescope. By incorporating a unique Coordinate Match process with the 0.3 arc-sec resolution encoders and high-speed DC servo motors, observers can now place objects in the telescope's field of view with high accuracy, making critical image placement applications, such as CCD imaging, possible.

a) Pointing Accuracy

Normal telescope pointing accuracy is better than a few arc-minutes when doing a casual alignment, such as the polar alignment procedure discussed in the telescope's instruction manual. A casual alignment is more than accurate enough for many observing applications.

A "refined" alignment will improve the pointing accuracy of the telescope. This type of alignment requires:

- Entering accurate SITE information, time, and date.
- Proper selection of the two alignment stars.
- A reticle eyepiece (to exactly center the alignment stars.)

In addition, the High Precision Pointing feature requires the refined alignment procedure described in the "Align" section on page 11. Together, these alignment procedures will yield the best pointing accuracy possible, placing images of objects onto the active area of even the smallest CCD cameras available.

It should be stressed that for most applications, using the High Precision Pointing feature is NOT required to get maximum enjoyment out of the telescope. For an evening of simple visual observations, a "casual" alignment is all that is required. Don't let the pointing precision of the telescope become more important than the fun of observing the night sky!

b) Using High Precision Pointing

The High-Precision Pointing mode requires the "refined" alignment, described above, to maximize the telescope's pointing ability. The CDS default condition is with High Precision Pointing disabled. To activate the High Precision Pointing mode, select the "high-precision" option from the TELESCOPE menu (option #9). When selected, "HIGH-PRECISION" will change to all upper case letters.

When the High Precision Pointing is activated, the following procedure is used to locate an object:

- (1) Choose an object from the Object Library. With the object's information displayed, press GO TO.
- (2) Instead of immediately slewing to the chosen object, the High Precision Pointing searches the star catalog and finds the three closest alignment stars to the object (or position) entered. This process takes about 10 seconds and the keypad displays:

HIGH PRECISION
Searching

Display 21

- (3) The telescope will slew to the nearest of three bright stars. These three stars are brighter than 3rd magnitude, and are far enough apart to insure that there will only be one in the field of view. The keypad display will display:

Center STAR XXXX
then press GO TO

Display 22

Using a reticle eyepiece and the "N", "S", "E", and "W" keys, center the bright star in the field of view. (Or center the star on the CCD chip if using a CCD camera.) When the star is centered, press GO TO. The CDS will now slew to the chosen object.

Note: If the first alignment star is not in the field of view or if it is obstructed by a land object, the other two stars are available. Use the PREV and NEXT keys to cycle through the three closest stars.

- (4) With the High Precision Pointing activated, the CDS always slews to the closest alignment star first. After the star is centered, then the CDS slews to the desired object.
- (5) To de-activate the High Precision Pointing option, select the "HIGH PRECISION" option from the Telescope menu

and press ENTER. The letters will revert to lower case, indicating the High Precision Pointing option is now "off".

10) SLEW RATE: Option #10 in the TELESCOPE menu is for changing the slew rate of the CDS telescope. Slowing down the slew rate will result in less noise as the telescope moves and will also use a little less power. To change the slew rate, follow these steps:

1. Press the MODE key on the Keypad until the TELESCOPE/OBJECT LIBRARY menu appears on the display. The cursor should be next to the TELESCOPE option - if not, then press the PREV key to move the cursor up one space.
2. Press ENTER to select the TELESCOPE functions.
3. Press the PREV or NEXT keys to move the cursor to option #10: SLEW RATE. On the right hand part of the display, the number 8 is visible. This represents the current slew rate in degrees per second.

Press the ENTER key to change the slew rate. Each successive ENTER key press increments the slew rate by 1 degree per second.

After setting the desired rate, press the MODE key to return to the TELESCOPE / OBJECT LIBRARY menu.

Note: The slew rate is NOT stored in permanent memory and needs to be reset each time the telescope is powered up. The default slew rate is 8 degrees per second.

11) DEC BACKLASH COMPENSATION: When taking long exposure astrophotographs, it is necessary to "guide" the photograph to make sure the telescope is tracking perfectly, otherwise stars will appear as ovals instead of pinpoints. This is done by setting the CDS Keypad to the GUIDE speed, monitoring the star location (e.g., with an off-axis guider and illuminated reticle eyepiece), and making small corrections to the telescope position by using the "N", "S", "E", and "W" keys.

When making these corrections, the R.A. motor will speed up or slow down (by pressing the "E" and "W" keys). The Declination motor, however, when activated (by pressing the "N" and "S" keys) will actually stop and reverse direction. Because of backlash in the Declination motor gearbox, there will be a few seconds delay before the telescope begins to move when reversing direction.

The Dec backlash feature compensates for the Dec motor gearbox backlash and provides instant telescope movement when the motor direction is reversed. To program the Dec backlash, use the following procedure:

1. Move to option #11 from the TELESCOPE menu. The Keypad display will show:

11) BACKLASH 00

Display 23

The "00" in the display shows the number of arc-seconds of backlash the CDS is set to compensate for (the default setting is 0 arc-seconds).

2. While observing a star at high power, time the Declination movement delay when reversing the motor directions (by pressing the "N" and "S" keys). Typical values are 2 to 4 seconds.

3. The GUIDE speed for the Declination motor is 15 arc-seconds per second. Therefore, multiply the number of seconds delay by 15.
4. Press and hold the ENTER key for 1 second. The Keypad will beep and a blinking cursor will appear on the Keypad display. Enter the number determined in step 3, above. Press ENTER when the number is entered.
5. Check the time delay as described in Step 2, above. If there is still a time delay, then increase the compensation number. If there is a slight jump when reversing direction, then the number is too large.

When the compensation number is correct, the CDS telescope will move almost instantly when reversing the direction in Declination. This number is stored in permanent memory and should never need to be set again.

12) PIER: When the telescope is mounted on the Standard Field Tripod, areas of the sky straight up are restricted because the tube may hit the tripod legs. Selecting "Pier" will turn off this restriction, allowing the telescope to slew to the zenith (straight up) when the telescope is mounted on a pier.

B. OBJECT LIBRARY Menu File

The OBJECT LIBRARY menu file is the other half of the TELESCOPE/OBJECT LIBRARY mode. With it, you can become a tourist of the sky, or conduct research surveys of the 64,359 library objects. The CDS Object Library is accessible in the most user friendly system ever designed for observers and astrophotographers.

The position epoch of these objects is for real time, updated every time you turn on your CDS. Even the planet's positions have their orbits calculated! This not only qualifies the CDS as the most accurate integrated object library available, it will never require updated software for precession of the stars or planetary orbital changes.

There are three primary ways to use the Object Library: directly accessing the library by using the M, STAR, or CNGC keys and entering a specific catalog number; the START FIND option to logically find a custom-tailored list of objects in organized strips of the sky; or scanning the sky and have the Object Library tell you what is in the field of view of the eyepiece by using the FIELD option. Below is a description of the four OBJECT LIBRARY menu files and file options.

To access the OBJECT LIBRARY menu file, move the LCD arrow to the OBJECT LIBRARY display by pressing the PREV or NEXT key while in the TELESCOPE/OBJECT LIBRARY mode and press the ENTER key. Any of the four menu selections within the OBJECT LIBRARY may be accessed by moving the LCD arrow to the desired menu selection (using the PREV or NEXT keys) and following these procedures:

1) OBJECT INFO

Press the ENTER key to read the type, brightness, size, and visual quality of a chosen object. Press ENTER again to read the R.A. and Dec coordinates. Press ENTER once more to determine how far off the telescope is pointing from the chosen object. The distance from the object is represented by a series of LCD bars (each bar represents 10 degrees.) As the telescope moves closer to the target object, the number of visible bars decrease. When the telescope is pointing at the selected object, all the bars disappear. The object information can also be accessed at any time by entering the object's library number

using the M, STAR, or CNGC keys, and pressing the ENTER key. Press MODE to exit to the main menu file.

2) START FIND

The START FIND option utilizes the CNGC objects within the Object Library and begins a logical search beginning where ever the telescope is positioned when activated. To cover the entire visible sky it will make 31 strip divisions about 12 degrees wide, moving from West to East, from the North Pole to the South Pole, then South to North. Once it has found all of the deep sky objects, it will repeat its sequence until new objects are visible.

Press the ENTER key and the keypad display will show the first object in its finding sequence. This first object is selected by the CDS, based on where the instrument is pointing in the sky when you entered START FIND. To point the CDS to the object displayed, press the GO TO key. The CDS will slew to the object.

While in the START FIND option, you can either choose the next object in line or skip it as you wish. In order to find the next object in sequence, press the NEXT key. The display will read the new CNGC object. If you do not wish to view this object, the object may be skipped by pressing NEXT. If you wish to return to a previously viewed object, press the PREV key until the desired catalog number is displayed. Then, press the GO TO key. If any parameters have been set within the PARAMETERS option, the CDS will find only those objects within the chosen confines.

a) Coordinate Matching Feature

If the object is not well centered in the eyepiece after executing a GO TO (due to poor leveling, improper time input, or errors in site location), center the object; then press and hold the ENTER key until the display reads "Coordinates Matched." This feature "synchronizes" or updates the CDS's information for an area of the sky, so that the next object (if the leveling, time input, or site location information is not corrected) will be better centered.

To exit the START FIND menu selection (and cease its operation) and return to the main menu, press the MODE key.

3) FIELD

Press the ENTER key to identify objects in the field of view of the telescope. The CDS will display the object centered in the eyepiece field, and how many other NGC objects are in the field at the same time (defined by the RADIUS parameter setting) as shown in Display 24:

Objects: 5
Center: CNGC 4438

Display 24

Press the ENTER button to reveal information about the object as shown in Display 25:

CNGC 4438 VG GAL
MAG 10.1 SZ 9.3'

Display 25

Display 25 is interpreted; Computerized New General Catalog #4438, Very Good, Galaxy, Magnitude 10.1, Size (in arc minutes) 9.3'. Press ENTER again to read the coordinate location of the object (notice the * legend next to R.A. coordinate number, indicating the catalog coordinates of the object, not necessarily where the telescope is pointing) as shown in Display 26:

RA = 12:27.2*
DEC = +13'03

Display 26

Press ENTER once more to see how far your telescope needs to be moved to acquire the object. The display will show LED bars, each bar represents ten degrees of movement as shown in Display 27:



Display 27

If the object is already centered in the telescope, Display 27 will be blank.

To review any of the data of an object, continue to press the ENTER button until the desired field appears. You can use the above commands at any time that you have an object entered in the Keypad, while directly entering in specific objects by pressing the M, STAR, or CNGC keys, in the START FIND menu selection, the OBJECT INFORMATION menu selection, or the FIELD menu selection.

4) PARAMETERS

To set observing parameters (e.g., the CDS will only GO TO objects of a certain type, brightness, etc.), press ENTER to enter the Parameters Menu. There are eight parameter options which can be reviewed using the PREV or NEXT key. To edit one of the options, move the arrow to the desired option and press and hold the ENTER key until a double beep is heard. A blinking cursor appears (except in the BETTER option). Where numerical values are required, type them in using the Keypad. If a mistake is made, move the cursor backward using the "W" key, then re-enter the data. To exit to the main option menu, press the ENTER key once again. A description of the eight options and how to set them is below:

a) TYPE GPDCO

This option allows a user to select the type of CNGC objects to be located. The symbols GPDCO represent:

Object	Symbol	Symbol	Description
G			Galaxies
P			Planetary Nebulae
D			Diffuse Nebulae
C			Globular Star Clusters
O			Open Star Clusters

Initially, the blinking cursor appears over the G symbol. If you decide not to look for galaxies, press the NEXT key and the symbol will change from an upper case letter (G) to a lower case letter (g), to deselect the GALAXIES category. If you wish to leave GALAXIES selected, then move the blinking cursor over to one of the other category symbols by pressing the "W" or "E" key on the Keypad. Deselect any undesired categories.

To recall a category symbol, move the blinking cursor over the symbol and press the PREV key, changing the letter to uppercase. After your selections are made, press ENTER.

b) BETTER

The BETTER option allows you to define the visual object quality range. At power up, the range is set at the bottom of the scale on VP. When using the START FIND menu selection, The CDS

selects all objects from very poor through super — what could be considered an "ALL" setting. The object quality symbols are:

Quality Symbol	Symbol Description
SU	Super
EX	Excellent
VG	Very Good
G	Good
FR	Fair
PR	Poor
VP	Very Poor

For example: to define the visual object quality range to very good and better, press the ENTER key until the symbol VG is displayed. From the VP setting to VG requires three ENTER key presses. The CDS will now select objects that look Very Good through Super.

c) HIGHER

The Higher option sets the horizon setting for the telescope. At power up, the setting is 00 degrees, which assumes the CDS system has an unobstructed, line-of-site view to the horizon in every direction. If, however, there are things obstructing a level horizon, or if the sky quality is poor due to haze or light pollution, an artificial horizon level may be set to avoid the "undesirable" area.

To roughly judge how many degrees of the sky is "undesirable" for viewing, or is being obstructed, hold your fist at arm's length and attempt to cover the obstruction with your fist. Each fist diameter is approximately 5 degrees. So, if a tree is three fists high, enter a setting of 15 degrees in the HIGHER setting. Once the setting has been entered using the keypad, press ENTER.

d) LARGER

The LARGER option allows an observer to set the lower apparent size limit of the objects to be observed. At power up the LARGER option is set to 000' (arc minutes). To decide what size limits to impose, it helps to have a clear understanding of exactly what an arc minute of sky is. A good example is the apparent size of the Moon, which could be expressed as 1/2 of a degree, 30 arc minutes, or 1800 arc seconds. Each arc minute is 60 arc seconds, and there are 60 arc minutes for each degree of sky.

Some beginning observers have a tough time discerning objects less than about 1 arc minute in size unless it is a double star or a planet. Astrophotographers and those involved with CCD imaging may want to set a higher value based on desired image scale coverage that would be most impressive with different films or types of CCD cameras. Enter the new value in arc minutes using the Keypad, then press ENTER.

e) SMALLER

The SMALLER option is the upper size object limit. At power up the SMALLER setting is 200' arc minutes or 3.33 degrees. This setting is high enough to cover the largest objects in the OBJECT LIBRARY. You may want to lower the value because of true field-of-view limitations of a particular eyepiece (see the RADIUS parameter option for calculating true field).

Other reasons for limiting the SMALLER value is for astrophotographic or CCD imaging requirements where a user does not want an object to exceed the imaging area of the film or the CCD chip.

f) BRIGHTER

The lower brightness limits based on stellar magnitude can be limited in the BRIGHTER option. At power up, the magnitude value is set to a very faint level of +20.0.

A user may wish to adjust the BRIGHTER (magnitude) level to a brighter value, perhaps the limiting visual magnitude of the telescope being used, (approximately 14.0 for an 7" and 12.0 for a 4"). Sky conditions also greatly affect the limiting magnitude due to atmospheric haze, high clouds, light pollution, or combinations thereof.

g) FAINTER

The upper level of brightness may be adjusted with the FAINTER option, although there are few applications for limiting the CDS to a lower value.

h) RADIUS

The RADIUS value sets the boundaries of what and how many objects the CDS recognizes within a given eyepiece while in the FIELD menu selection. At power up the RADIUS option is set to 15 arc minutes, the radius of 1/2 a degree (30 arc minutes).

To calculate the true field of an eyepiece in the telescope, first divide the focal length of the telescope (e.g. 1140mm for an 5" 127ED) by the focal length of the eyepiece (for example, a 26mm Super Plössl eyepiece: 1140 divided by 26 equals 44X magnification). Then, find the apparent field of the eyepiece (which is 52 degrees for the 26mm Super Plössl) and divide it by the magnification (52 divided by 44 equals .1.18 degrees. To convert degrees to arc minutes, multiply the amount by 60, which equals 70.8 arc minutes.

To get the radius of the true field of view, divide the true field by 2. In the case of the above equation, 70.8 arc minutes divided by 2 equals 35.4 arc minutes.

2. MODE TWO: COORDINATES/GO TO

Mode Two allows a user to see where the CDS is pointing in two celestial coordinate formats, either Right Ascension and Declination or Altazimuth. Also in this mode it is possible to enter new Right Ascension and Declination coordinates for any sky position, perhaps to locate objects not in the CDS library (e.g., comets or asteroids) and have the telescope slew to the new coordinates.

A. Coordinates Menu Option

This option displays the R.A. and DEC coordinates of where the telescope is pointing. If the CDS is moved using the "N", "S", "W" or "E" keys, the coordinate display immediately updates the new position in Right Ascension and Declination.

Pressing ENTER displays the Altazimuth coordinates (ALT = and AZ =). This data is for general information only. With the ALT AZ information displayed, pressing the GO TO key will not move the telescope. Return to the R.A. and DEC coordinates by pressing the ENTER key again.

The R.A. coordinates are displayed in hours, minutes, and seconds. The DEC coordinates are displayed in degrees, minutes and seconds. The "+" represents North Declination and "-" represents South Declination. See Display 28:

RA = 02:45.54
DEC = +22°54:02

Display 28

B. GO TO Menu Option

The GO TO option allows a user to enter Right Ascension and Declination coordinates of any object in the sky. With this ability,

the CDS knows no bounds — any celestial object, including comets, asteroids, etc., are easily found, provided accurate coordinate data has been entered.

To enter a new pointing position in Right Ascension and Declination, press and hold the GO TO key until a double beep is heard. A blinking cursor appears over the R.A. coordinate numbers. Using the numbers on the keypad, type in the new Right Ascension coordinate numbers. Then, press the ENTER key. The blinking cursor is now over the DEC coordinate numbers. Enter the new Declination coordinate numbers, then press the ENTER key. At this point the CDS slews to the new coordinate position.

When it is necessary to enter a negative Declination setting, move the blinking cursor over the + symbol with the W key and then press the NEXT key to get the - (minus) symbol, then move the blinking cursor to the first number with the E key and enter the new coordinate numbers. If there is already a minus (-) Declination setting, follow the same instructions as above but press the PREV key instead to get the + symbol.

3. MODE THREE: CLOCK/CALENDAR

The continuously operating clock and calendar is the heart of the CDS. At power up, the telescope's accurate sidereal clock automatically performs orbital calculations of the planets, and figures the correct stellar precession for the CDS's superior pointing ability.

The CDS comes with a long-life lithium battery back-up, making it unnecessary to enter the local time and date every time the system is powered up, thus enhancing the user friendly aspects of the instrument.

To set the local time and date and to enter the correct GMT offset, refer to page 6, Entering the Local Time and Date.

The long-life lithium battery (Panasonic CR2032 3 volt or Duracell DL2032B) is stored behind the #1697 Control Panel, Fig. 5. See Appendix E (page 50) for battery replacement information.

4. MODE FOUR: TIMER/ FREQ

A. TIMER Option

The TIMER option is designed for accurately timing different observing or imaging tasks for up to twelve hours. Counting down to zero, in the hours, minutes, and seconds format, the CDS beeps to notify an observer that the time is up.

To set the TIMER, move the LCD arrow to TIMER= 00:00:00. Then press and hold the ENTER key to get the double beep tone and the blinking cursor. Enter the number of hours, minutes, and seconds that you require. If it is necessary to correct an error in entry, use the "E" and "W" keys to move the blinking cursor and then type in the correct information. After entry, press the ENTER key again. When you are ready to start the count-down, press the ENTER key once more. To pause the count-down press ENTER again, and then again to resume.

If an automatic 12 hour count-down is desired, press, but do not hold, the ENTER key. Then press ENTER to begin the count-down.

B. FREQ Option

The FREQ (Frequency) option allows a user to digitally adjust the tracking speeds (not slew speeds) of the CDS in tenths of a hertz

from 55.0 Hz to 65.0 Hz. With this option, it is possible to match virtually every celestial motion in the sky, including the King rate (for tracking objects within 20 degrees of the horizon). Some popular drive rate settings are:

Frequency Rate	Description	Notes
60.1 Hz Q	Sidereal rate; Quartz setting	Default rate at power up. Gives sidereal frequency accuracy to +/- .005%, also Smart Drive training rate; Best for most astrophotography.
60.0 Hz	Solar and planetary rate	Average rate for tracking planets; actual rates vary due to retrogrades, oppositions, etc.
57.9 Hz	Lunar rate	Best rate for tracking the Moon.

Note: It is best to train the Smart Drive in the 60.1 Hz Q setting (see SMART menu file on page 12). The Smart Drive gives periodic error corrections in all of the other frequency settings.

There are three menu file options in the FREQ option. To view or set the options, move the LCD arrow to FREQ= and press the ENTER key. At power up, the FREQ= default is the 60.1Hz Q setting. The quartz rate is precisely fixed and cannot be altered. To choose a rate other than the quartz setting, press the ENTER key to see 60.1 M (Display 29) and then again to see 60.1 M with the up and down LCD arrow (Display 30). These two options can adjust the tracking speeds. The adjustment techniques are described below:

FREQ = 60.1 M

Display 29

Display 29 shows the manual rate menu file option that can be adjusted by pressing and holding the ENTER key to get the double beep tone and the blinking cursor. Type in the new rate, then when finished, press the ENTER key again.

FREQ = 60.1M ↑↓

Display 30

Display 30 shows the menu file option allows you to step the drive tracking frequency setting in tenths of a hertz, by using the PREV and NEXT (up and down arrow) keys. This is a convenient feature if you are trying to match the precise speed of a planet, comet, or any other non-stellar object. To exit this option, press the MODE key.

5. MODE FIVE: KEYPAD OFF/ BRIGHTNESS ADJUST

In order to see very faint objects, it is sometimes necessary to either dim or completely turn off the Keypad red LED backlighting. To do so, press the MODE button until the display goes blank. This is the OFF option.

To set the Keypad brightness, press the ENTER button and adjust the brightness to your satisfaction with the PREV and NEXT keys. To exit, press the MODE key.

Note: The backlighting is done by edge lighting a plastic light bar underneath the Keypad. Four LED's are used and do not give a perfectly even backlighting of the keys as keys closer to a LED will be a little brighter than those keys further away.

OPTIONAL ACCESSORIES

An assortment of professional Meade accessories is available to enhance the performance of the Meade LXD Equatorial Mount and #1697 Computer Drive System.

#814 Polar Alignment Finder

This borescope device facilitates quick, precise polar alignment of the telescope. An internal reticle contains an etched clock-like scale while a separate Polar Reference Circle shows the correct position of the North Star on the Finder's reticle scale at any time and day of the year.



EPOCH 2000sk Sky Software

Epoch 2000sk is the most powerful, most realistic sky software ever made available, allowing users to remotely control their telescope from a PC. Also, click on any one of 281,000 database objects displayed on a starfield to see the object's name, coordinates, magnitude, object type and description. Other features allow a user to zoom-in on telescope fields smaller than one arc second, locate planets to a precision of 0.1 arc seconds, print professional-quality star charts in either black and white or color and much more.

EPOCH 2000ip Imaging Software

Epoch 2000ip is an image processing software that includes virtually every technique available for the professional-level enhancement of your CCD images including: advanced image scaling; enhanced convolution functions; unsharp masking; image blinking and much more. Available on 3 1/2" disks or CD-ROM, fully compatible with Windows 95.



Illuminated Reticle Eyepieces

Meade Illuminated Reticle Eyepieces are used for precise centering of stars in the telescope's field of view to aid in the CDS alignment process. Two optical designs are available: Series 4000 Plössl 9mm or Modified Achromatic 12mm.



#1207 Electric Focuser

Meade Electric Focusers are uniquely designed to yield extremely smooth, precise microfocusing of the image, without disabling the manual focus knob, which may be used for rapid coarse focusing. The #1207 Electric Focuser plugs directly into the CDS control panel.

Meade CCD Autoguider/Imagers, including:

Pictor 201XT



With the Pictor 201XT in place on your telescope, tedious photographic guiding is a thing of the past. Now you can take long exposure astrophotographs, knowing that the telescope will precisely track the object being photographed, even during the longest exposures.

Pictor 208XT

The Pictor 208XT CCD Autoguider/Imager produces fine, high-resolution 8-bit images of the Moon and planets *in seconds* on your computer screen. Two or three minutes is all that is required to capture an image of any one of thousands of deep-space objects.



Pictor 216XT

The Pictor 216XT enables advanced 16 bit imaging and is by far the finest autoguider/imager ever made available for its cost.



Pictor 416XT

The Meade Pictor 416XT permits professional-level imaging capability for the amateur astronomer. The Pictor 416XT electronic camera is capable of producing with amateur telescopes, images of the Moon, planets, and deep-space objects that match or exceed the photographic images obtained with many observatory telescopes.



Pictor 1616XT

The Meade Pictor 1616XT imaging system utilizes one of the largest microchips currently in commercial production. The 1616XT has the same pixel density, ultra low dark current (less than one electron per 5 seconds) and ultra low readout noise (less than 15 electrons rms) as the Pictor 416XT, but with four times the pixel quantity and chip area. This permits professional-quality imaging of very large sky areas.

MEADE CUSTOMER SERVICE

If you have a question concerning your Meade #1697 Computer Drive System, call Meade Instruments Customer Service Department at the phone number listed below. Customer Service hours are 8:30 AM to 4:00 PM, Pacific Time, Monday through Friday.

Meade General Catalog

For your free copy of the Meade General Catalog write, call, or fax Meade Instruments:

Meade Instruments Corporation
6001 Oak Canyon
Irvine, CA 92620-4205
Phone: (949) 451-1450
Fax: (949) 451-1460

APPENDIX A: PRECISE POLAR ALIGNMENT

Precise polar alignment is essential for long-exposure astrophotography (typically defined as photo-exposures of 10 minutes or longer). Fewer tracking corrections are required during the duration of the exposure when the telescope is precisely polar aligned.

Precise polar alignment requires the use of a crosshair eyepiece — such as the Meade Illuminated Reticle Eyepiece — and a 2x Barlow lens for increased magnification.

The method for precise polar alignment — commonly referred to as the “drift” method — is as follows:

1. Obtain a rough polar alignment as described in the telescope's instruction manual. Once approximate alignment has been accomplished, insert the 2x Barlow lens and the illuminated reticle eyepiece into the telescope's eyepiece holder.
2. With the motor drive running, point the telescope at a moderately bright star near where the meridian (the north-south line passing through your local zenith) and the celestial equator intersect. For best results, the star should be located within ± 30 minutes in R.A. of the meridian and within $\pm 5^\circ$ in Dec of the celestial equator. Pointing the telescope at a star that is straight up, and then moving the telescope in Dec to read 0° Dec, will point the telescope to the correct position.
3. Disregarding the drift in R.A., note the star's drift in Declination:
 - a. If the star drifts South, the telescope's polar axis is pointing too far East (Fig. 10).
 - b. If the star drifts North, the telescope's polar axis is pointing too far West (Fig. 11).

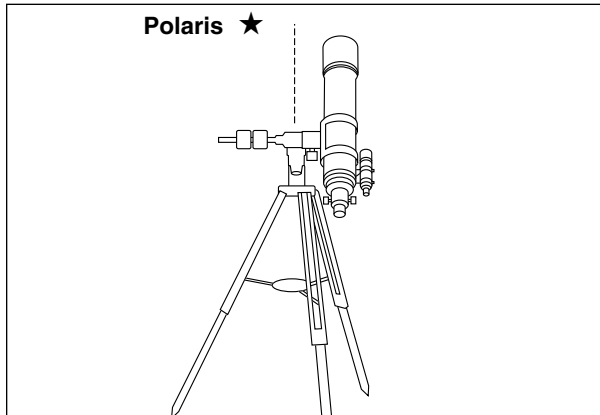


Fig. 10: Telescope aligned too far East.

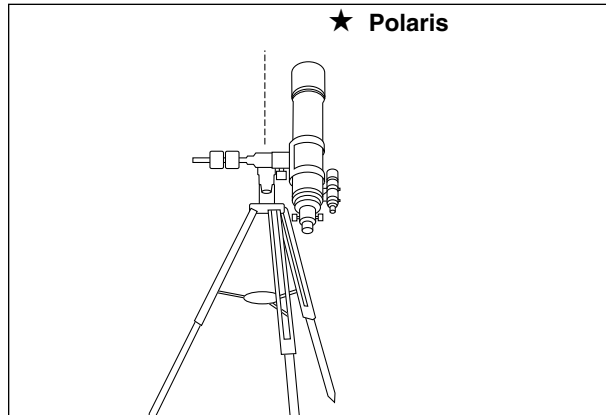


Fig. 11: Telescope aligned too far West.

4. Use the Azimuth Control knob to adjust the LXD Equatorial mount in azimuth, so there is little or no north-south drift by the star. *Note:* Many advanced astrophotographers prefer a slight, steady drift in Declination so the Dec gear remains under a constant load. A slight load on the gear prevents gear lash that normally occurs when changing directions. In this way, a slight "misalignment" is actually beneficial.
5. Next, point the telescope at another moderately bright star near the Eastern horizon, but still near the celestial equator. For best results, the star should be about 20° or 30° above the Eastern horizon and within $\pm 5^\circ$ of the celestial equator (i.e., still at about 0° Dec). Once again, note the star's drift in Declination:
 - a. If the star drifts South, the telescope's polar axis is pointing too low (Fig. 12).
 - b. If the star drifts North, the telescope's polar axis is pointing too high (Fig. 13).

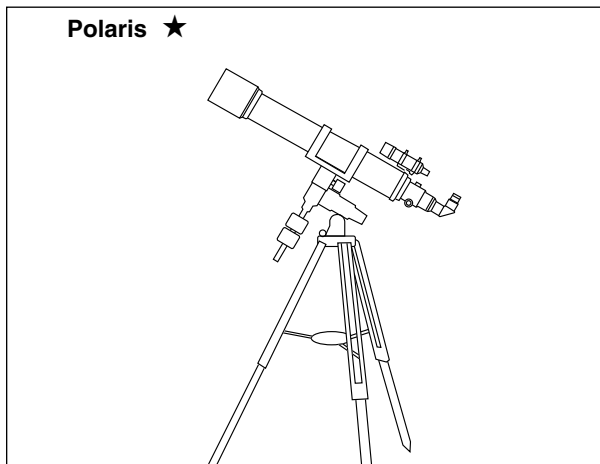


Fig. 12: Telescope aligned too far low.

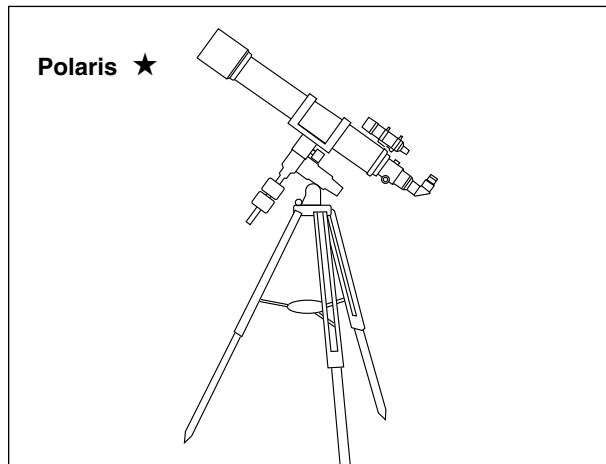


Fig. 13: Telescope aligned too high.

6. Use the latitude adjustment knob on the LXD Equatorial Mount to change the latitude angle based on your observations above. Again, track the star for a period of time to verify that Declination drift has ceased.

After completing these procedures your telescope is precisely polar aligned, minimizing the need for tracking corrections during long-exposure astrophotography.