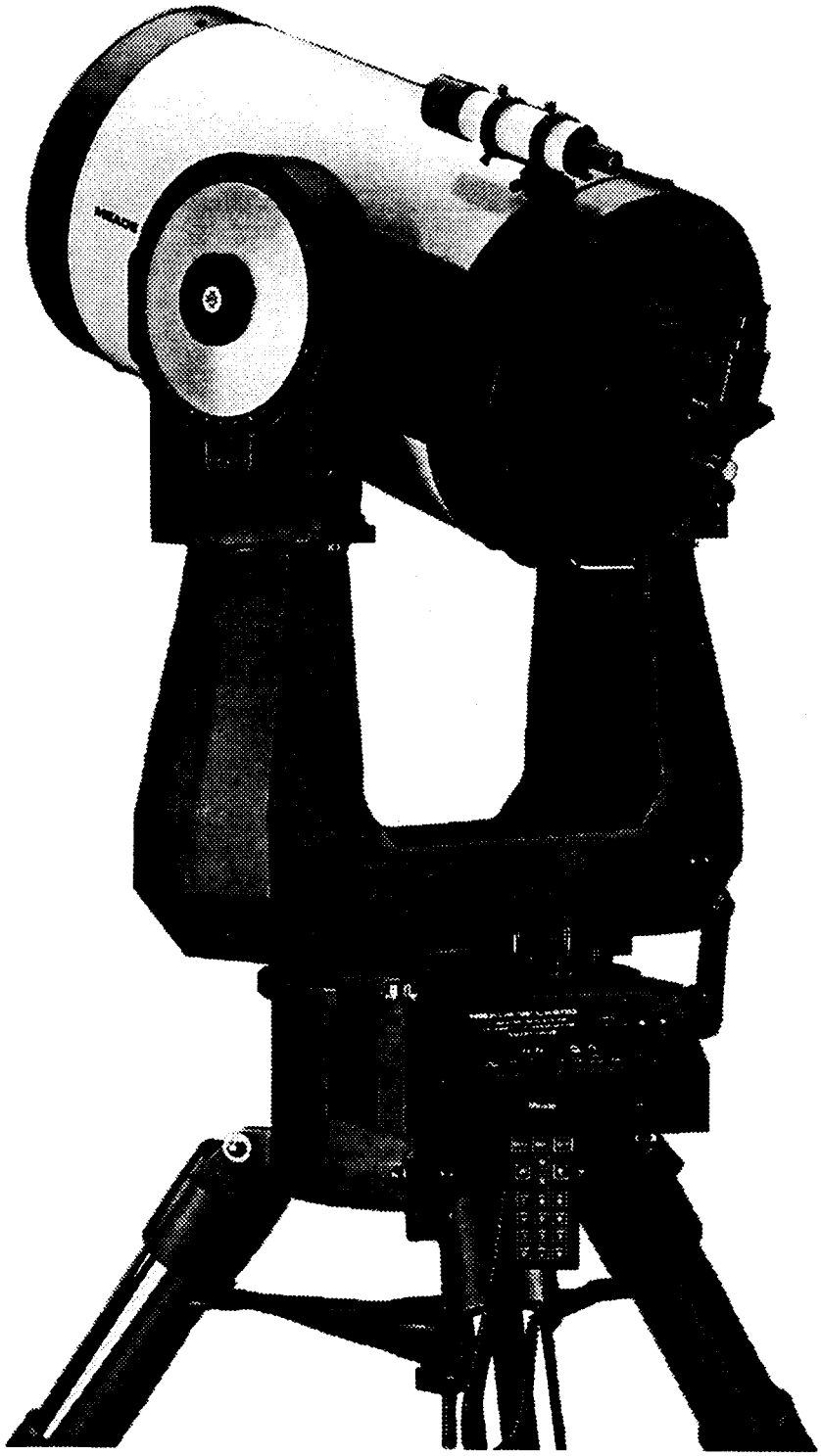
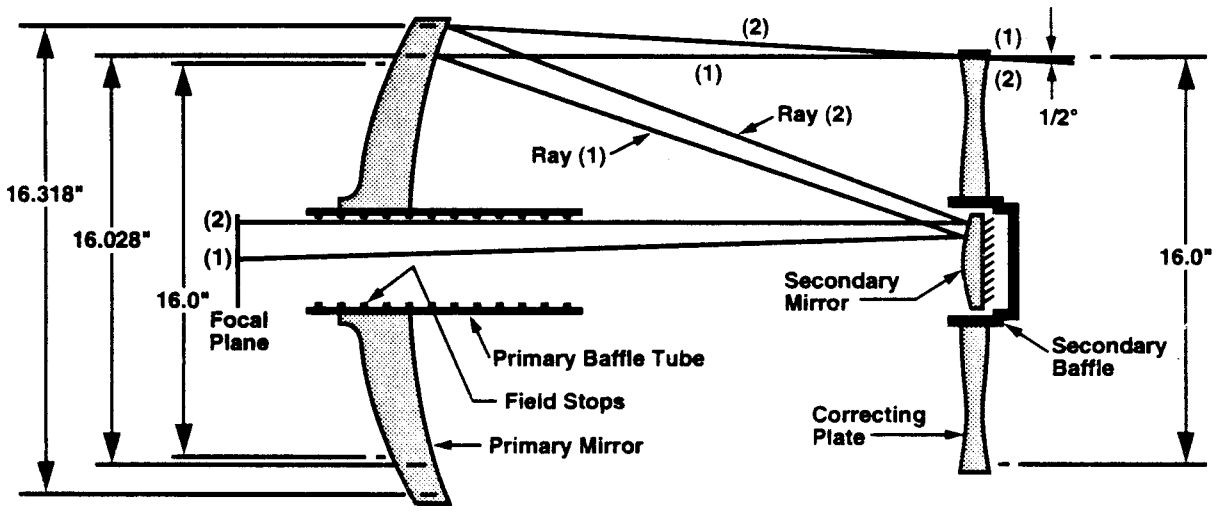
Instruction Manual

16" LX200 Schmidt-Cassegrain Telescope



Meade Instruments Corporation

NOTE: Instructions for the use of optional accessories are not included in this manual. For details in this regard, see the Meade General Catalog.



The Meade Schmidt-Cassegrain Optical System (Diagram not to scale)

In the Schmidt-Cassegrain design of the Meade 16" model, light enters from the right, passes through a thin lens with 2-sided aspheric correction ("correcting plate"), proceeds to a spherical primary mirror, and then to a convex aspheric secondary mirror. The convex secondary mirror multiplies the effective focal length of the primary mirror and results in a focus at the focal plane, with light passing through a central perforation in the primary mirror.

The 16" model includes an oversize 16.375" primary mirror, yielding a fully illuminated field-of-view significantly wider than is possible with standard-size primary mirrors. Note that light ray (2) in the figure would be lost entirely, except for the oversize primary. It is this phenomenon which results in Meade 16" Schmidt-Cassegrains having

WARNING!

Never use the LX200 telescope to look at the Sun! Looking at or near the Sun will cause *instant* and *irreversible* damage to your eye. Eye damage is often painless, so there is no warning to the observer that damage has occurred until it is too late. Do not point the telescope or its viewfinder at or near the Sun. Do not look through the telescope or its viewfinder as it is moving. Children should always have adult supervision while observing.

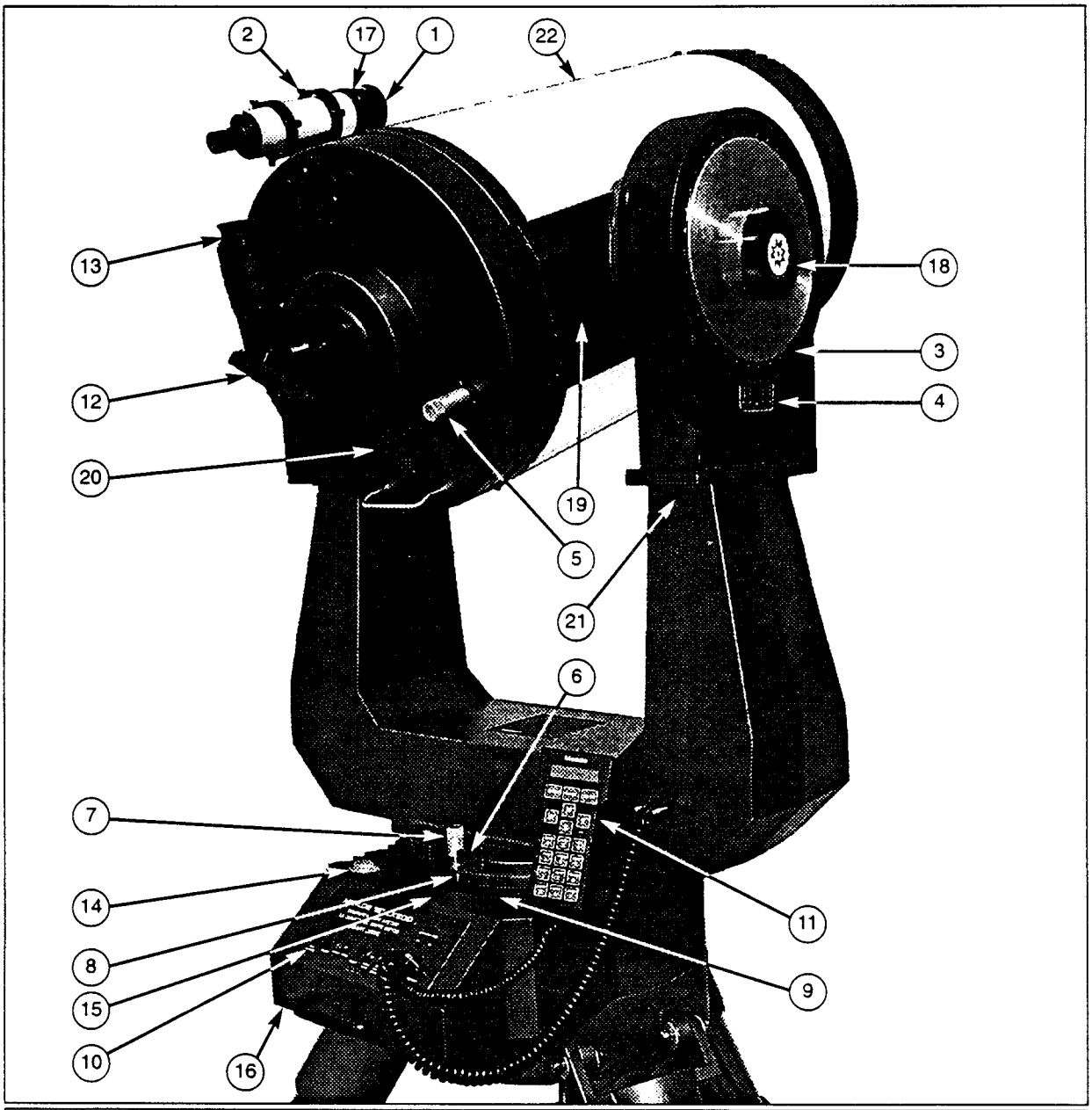


Fig. 1: Meade 16" LX200 Schmidt-Cassegrain Telescope.

Captions for Fig. 1

1. Viewfinder Dew Shield
2. Viewfinder Collimation Screws
3. Declination (Dec.) Setting Circle
4. Declination Vernier Pointer
5. Focus Knob
6. R.A. Lock
7. R.A. Slow-Motion Control Knob
8. R.A. Vernier Pointer
9. Right Ascension (R.A.) Setting Circle
10. Power Panel
11. Keypad Hand Controller
12. Diagonal Mirror
13. Eyepiece
14. Bubble Level
15. Hour Angle (HA) Pointer
16. Drive Base
17. Viewfinder Focus Lock Ring
18. Declination Lock Knob
19. Tube Adapter
20. Fan Filter
21. OTA Mounting Bolts (4)
22. Optical Tube Assembly (OTA)

Contents

16" LX200 Schmidt-Cassegrain Telescope

INTRODUCTION

As a new LX200 owner, you are preparing for a journey into the universe with the most advanced amateur telescope ever produced. The advent of this instrument is the culmination of twenty years of innovation and design at Meade Instruments. Never before have the features you have in your hands been available to amateur astronomers: from robotic object location to the revolutionary Smart Drive, along with the most stable mounting structure ever. Your telescope comes to you ready for adventure; it will be your tour guide and traveling companion in a universe of planets, galaxies, and stars.

Meade 16" LX200 Schmidt-Cassegrain Telescopes (SCT) are instruments of advanced mirror-lens design for astronomical and terrestrial applications. Optically and mechanically, the 16" telescope model is perhaps the most sophisticated and precisely manufactured telescope ever made available to the serious amateur. This telescope enables the visual astronomer to reach out for detailed observations of the Solar System (the planets: Jupiter, Saturn, Mars) and beyond to distant nebulae, star clusters, and galaxies. The astrophotographer will find a virtually limitless range of possibilities since, with the precision Meade worm-gear motor drive system, long exposure guided photography becomes not a distant goal, but an achievable reality. The capabilities of the instrument are essentially limited not by the telescope, but by the acquired skills of the observer and photographer.

IMPORTANT

If you are anxious to use your Meade LX200 Telescope for the first time, at the very least be sure to read TELESCOPE ASSEMBLY, and the QUICK START sections of this manual. Thereafter, we urge you to read the balance of this manual thoroughly at your leisure, in order that you may fully enjoy the many features offered by the instrument.

1. What Is the LX200? An Overview

Meade LX200 SCT's mark a new era in telescope technology for the amateur astronomer, whether beginner or seasoned veteran. For the beginner LX200 electronics permit the location and observation of the major planets as well as hundreds of deep-sky objects *the very first night you use the telescope.* For the experienced amateur the telescopes' pushbutton electric slewing, digital readouts, Smart Drive, and much more open up undreamed of visual and photographic capabilities.

a. Heavy-Duty Mounts with 4-Speed Dual-Axis Electronics

DC-servo-motor-controlled worm gear drives on *both* telescope axes permit observatory-level precision in tracking, guiding, and slewing. The 4-speed dual-axis drives cover every possible contingency of telescope positioning: Press the SLEW button on the keypad controller for rapid motion of the telescope across the skies at up to 4 degrees per sec. on both axes simultaneously; once near the target, switch instantly to the FIND speed for centering in the viewfinder at 1 degree per sec. Observing the object in the main telescope, use the CNTR speed (16x sidereal) to place the object in the center of the field. During long-exposure astrophotography press the GUIDE button for precise corrections at 2x sidereal speed.

b. Built-in 64,359-Object Library

Enter into the keypad any object from the following object libraries, press GO TO, and the telescope automatically slews, or moves, to the object at up to 4° per sec., centering it in the main telescope field.

- 15,928 SAO stars (Smithsonian Astrophysical Observatory) Catalog of Stars: All stars brighter than 7th magnitude.
- 12,921 UGC (Uppsala General Catalog) Galaxies: Complete catalog.
- 7,840 NGC (New General Catalog) objects*: Complete Catalog.
- 5,386 IC (Index Catalog) objects*: Complete catalog.
- 21,815 GCVS (General Catalog of Variable Stars) objects: Complete catalog.
- 351 Alignment Stars: LX200 Alignment Stars.
- 110 M (Messier) objects: Complete catalog.
- 8 major planets from Mercury to Pluto.

* NGC 2000 and IC databases are copyrighted by Sky Publishing Corporation and used with their permission.

c. Altazimuth Mode Operation

For all visual observing applications, and for lunar and planetary photography, Meade LX200's may be set up in the Altazimuth mode. Just attach the telescope's drive base directly to the tripod, use the fast 1-star alignment procedure, and the telescope's computer actuates 2-axis tracking that keeps objects precisely centered in the field, even at high powers, during the entire observing session.

For long-exposure astrophotography, the Meade 16" LX200 has an optional field de-rotator available which eliminates the image rotation caused by altazimuth tracking.

d. Terrestrial Operation

Meade LX200's make incredible land-view telescopes. Set the telescope up in the Altazimuth format, activate the Land menu option on the telescope's computer, and use the Keypad to track land objects on both axes at any of the same 4 drive speeds!

e. Keypad and Power Panel Functions

The multifunction capability of the 16" LX200 includes direct connection of popular CCD autoguider/imagers; RS-232 serial interface with a personal computer (PC), allowing the user to perform all of the Keypad functions through, or write custom telescope software for, a PC; brightness level control of an illuminated reticle eyepiece from the Keypad and special pulse-mode reticle operation; electric focuser controls; and HOME and PARK commands which allow true remote observations.

2. Smart Drive

Smart Drive is included on all Meade 16" LX200 Schmidt-Cassegrain telescopes. This technology is used to correct periodic error (errors induced by tiny gear imperfections that tend to slightly speed up or slow down the drive tracking speed, that occur in a regular 4 minute pattern, or for every rotation of the worm) for enhancing the tracking characteristics of your LX200. This greatly simplifies guiding during astrophotography.

Most observing programs that the 16" LX200 will be used for, can be done with the telescope in an ALTAZ set-up (explained later in this manual). ALTAZ operation incorporates both the horizontal movement and the vertical movement motors when tracking celestial objects through the sky. Since both of these motor/gear systems can have periodic error, Smart Drive monitors both axes, continuously correcting periodic error during tracking, a first in commercial telescopes.

When used as an equatorial telescope (described later), the 16" LX200 uses only one motor to track, and in this case Smart Drive corrects for periodic error in one axis only.

Periodic error correction is accomplished by the use of a model of the gear system, which Smart Drive uses to make minute correction to the tracking rate of each motor. This model is created at the factory and stored in non-volatile memory. The activation of Smart Drive is automatic and totally transparent to the user.

3. Standard Equipment

Includes 16" Schmidt Cassegrain optical tube assembly (f/10) with super multi-coatings (D = 406.4mm, F = 4064mm - f/10); heavy-duty fork mount, with 6" diameter sealed polar

ball bearing, quartz-micro- processor-controlled 11" worm gears on both axes, and multi-function power panel display on the drive base; manual and electric slow-motion controls on both axes; setting circles in RA and Dec; Keypad Hand Controller with digital readout display, PPEC Smart Drive on both axes, 4-speed drive control on both axes, GO TO controller, and 64,359-object software library; 25 ft. power cords for telescope operation from 115vAC; 8 x 50mm viewfinder; #929 diagonal mirror (2"/1.25"); Series 4000 SP 26mm eyepiece; 16" field tripod with leveling legs; operating instructions.

UNPACKING AND INSPECTION

As you begin to unpack your telescope from its cartons, you will probably be interested in setting it up right away; we certainly understand your excitement but please take a few minutes to read this page before doing so. You should verify that you have all the proper equipment, and that it has arrived to you undamaged.

We strongly recommend that you keep your original packing materials. If it should ever become necessary for you to return your telescope to the Meade factory for servicing, these will help ensure that no shipping damage will occur.

Meade LX200 telescopes supplied to countries outside the U.S.A. are identical to those offered domestically, with the exception of the AC wall adapter.

1. What You Should Have

Carefully unpack and remove all the telescope parts from their packing material. Compare each part to the Packing Program (packed with the telescope) to verify each part. You may wish to place a check next to each item as you identify it. These Packing Programs represent the original specifications for this instrument. Each telescope has been inspected twice at the factory to confirm the inclusion of every item.

2. Please Look Everything Over

Meade Instruments and your shipper have taken precautions to ensure that no shipping damage will occur, but if your shipment has suffered severe vibration or impact damage (whether or not the shipping cartons show damage) then it is important that you retain all the original packing and contact the shipper to arrange a formal inspection of the package or packages. This procedure is required prior to any warranty servicing by Meade Instruments.

3. Inspecting the Optics

Note on the "Flashlight" Test: If a flashlight or other high-intensity light source is pointed down the main telescope tube, you may at first be shocked at the appearance of the optics. To the uninitiated, the view (depending on your line of sight and the angle the light is coming from) may reveal what would appear to be scratches, dark or bright spots, or just generally uneven coatings, giving the appearance of poor surface quality. These effects are only seen when a high intensity light is transmitted through lenses or reflected off the mirrors, and can be seen on any high quality optical system, including the giant research telescopes in use today. It should be pointed out, however, that optical quality cannot be judged by this grossly misleading "test," but through careful star testing. The Flashlight Test causes even the very best optics to look "terrible."

As the high intensity light passes through the Schmidt corrector plate, most of it is transmitted through (about 98%+) while the rest of the light scatters through the glass. As the light hits the mirrored surfaces, most of it is reflected back (about 94%) while the rest of it scatters across the coatings. The total amount of scattered light will be significant, and its effects allow you to see microscopic details that are normally invisible to the unaided eye. These anomalous details are real, but their combined effects will in no way impose limits on the optical performance, even under the most demanding observing or imaging criteria.

4. Caution: All LX200 Owners

CAUTION: Serious damage to the drive gears may result from shock in handling, while transporting or commercially shipping the LX200, should the R.A. Lock (6, Fig. 1), and/or the Dec. Lock (18, Fig. 1) be left engaged. Always release the locks when storing in the case, or when crating for commercial shipment to allow the telescope to give, if the case or crate is sharply jarred or dropped.

Also, the optical and mechanical axes of all LX200 telescopes have been carefully aligned at the factory to ensure accurate object pointing. Do not loosen or remove the optical tube assembly from the tube adapters (19, Fig 1); the resulting misalignment of the axes will result in inaccurate slewing of the telescope in the GO TO mode. Do not attempt to turn the focuser knob of the optical tube until you have read the following note!

NOTE: Next to the base of the focuser is a red-colored slotted head bolt. This bolt is used only for safety in shipment. Remove this bolt before attempting to turn the focuser knob. In its place, insert the rubber plug provided as a dust protector (this rubber plug is included with your hardware package).

Your focuser is now operational.

WARNING: The 16" LX200 should never be commercially shipped without this red bolt in place. This is essential during commercial transport where rough handling may occur. For your personal transport and storage, you will never have to use this bolt again.

a. Commercial Reshipment

To commercially re-ship the 16" LX200, be sure to follow this procedure:

1. Turn the focuser knob clockwise until it stops. This will bring the primary mirror all the way back in the tube.
2. Remove the rubber plug and insert the red-headed bolt. Thread it in to a firm snug feel. Do not overtighten. (If you have misplaced the red-headed bolt, you may use any other bolt that is 1/4-20x1" long.)
3. **When packaging the 16" LX200, be sure to release the R.A. Lock (6, Fig. 1), and Dec. Lock (18, Fig. 1), to prevent shock to the gears in the motor assemblies should the package suffer severe handling.**

Please note that commercial shipment of the 16" LX200 Telescope without the safety bolt in place and packed in the original factory supplied shipping containers as described above is done at the owner's risk and your warranty may be voided if shipping damage results.

TELESCOPE ASSEMBLY

Use the following steps to assemble your telescope:

1. The 16" Field Tripod

The 16" Field Tripod (Figs. 2 and 3) for Meade 16" LX200 telescope is supplied as a completely assembled unit, except for the spreader bar (4, Fig. 2) and the 6 lock knobs (5, Fig. 2) (2 knobs for each of the 3 tripod legs) used to adjust the level of the tripod. These knobs are packed separately for safety in shipment.

For most observations, the drive base (16, Fig. 1) of the telescope's fork mount is attached directly to the 16" field tripod. The telescope is then mounted in an "Altazimuth" ("Altitude-Azimuth," or "vertical-horizontal") format. The telescope in this configuration moves along vertical and horizontal axes, corresponding respectively to the Declination and Right Ascension axes (explained later in this manual) in an

astronomical observing mode.

Alternately, the telescope can be mounted onto a permanent pier set for the latitude of the observing location (see **APPENDIX A**, page 26, for instructions of the use of the telescope in Equatorial Mode). The Equatorial Mode permits alignment of the telescope's Polar Axis with the Celestial Pole (or North Star).

After removing the field tripod from its shipping carton, stand the tripod vertically, with the tripod feet down and with the tripod still fully collapsed (see Fig. 3). Remove the lower knob, releasing the tension hub (7, Fig. 2). (Note: this knob is only used in storage of the field tripod.) Moving one leg at a time, gently pull the legs apart. As the legs are opened, the tension hub will move down the threaded rod (2, Fig. 2) until it is free from the threaded rod. Continue to move the legs apart to a fully open position.

Thread in the 2 lock-knobs (5, Fig. 2) for each tripod leg, near the foot of each leg. These lock-knobs are used to fix the position of the inner tripod leg sections. These sections are used to level the telescope (described below).

NOTE: "Firm feel" tightening is sufficient; over-tightening may result in stripping of the knob threads or damage to the tripod legs and results in no additional strength.

Loosen the tension knob (3, Fig. 2) holding the spreader bar (4, Fig. 2) and slide the spreader bar down the threaded rod until it can be rotated so that the 3 arms are lined up with the 3 tripod legs. Tighten the tension knob; firm tightening of the tension knob is sufficient to result in rigid positioning of the legs. **It is not necessary to use extreme force in tightening this knob.**

To collapse the tripod (after removing the telescope) for storage follow these steps:

a. Loosen the tension knob and rotate the spreader bar 60° from its assembled position, so that one spreader bar arm is located between each adjacent pair of tripod legs.

b. Move the spreader bar to the top of the threaded rod. Tighten the tension knob, locking the bar.

c. Working one leg at a time, gradually collapse the legs of the field tripod until the tension hub is positioned onto the threaded rod. Use the second tension knob to secure the tension hub in place.

PRECAUTIONARY NOTES

- If the tripod does not seem to extend or collapse easily, do not force the tripod legs in or out. By following the instructions above, the tripod will function properly, but if you are unclear on the proper procedure, forcing the tripod into an incorrect position may damage the extension strut system.
- Do not overtighten the 6 lock-knobs (5, Fig. 2) used to fix the inner tripod leg sections at various heights. "Firm feel" tightening is sufficient and overtightening can damage the leg.
- Be sure the spreader bar (4, Fig. 2) is not upside-down on the threaded rod. Refer to Fig. 3 for proper orientation.

2. Attaching the 16" Drive Base

a. Rotate the field tripod so that one leg is pointing approximately South (it is not important that it point exactly South).

b. Position the 16" drive base (16, Fig. 1) onto the field tripod, with the power panel facing North, away from the South facing tripod leg. Secure the drive base using the three 1/2"-13x1-1/2" long bolts. These bolts thread up through the underside of the tripod head (1, Fig. 2) into the drive base. Firmly tighten these bolts.

c. Level the drive base by loosening the 6 lock-knobs (5, Fig. 2) and sliding out the inner tripod legs until the bubble level on the drive base reads level.

3. Attaching the Fork

a. Place the single piece fork onto the top of the drive base. One side of the base of the fork has a cut out to allow clearance for the RA lock (6, Fig. 1) and RA slow-motion control (7, Fig. 1), located on the top of the drive base.

b. Bolt the fork to the drive base using the four 3/8"-16x1" long bolts (6, Fig. 5). Tighten to a firm feel.

4. Mounting the Optical Tube Assembly

This step requires two people who can lift up to 70 pounds each. The Optical Tube Assembly (OTA) weights about 125-lbs, and has to be positioned accurately in order to mount to the fork.

a. Located on the two top surfaces of the fork are two shoulder bolts. These two bolts function as locating pins for the OTA. On the inside edge of the Dec castings are two matching holes (with slots). Before trying to mount the OTA, be sure to locate these two bolts and holes. Notice the bolts and holes are located on one side of the castings, requiring the OTA to be mounted one way only.

b. Be sure the Dec Lock Knob (18, Fig. 1) is tight. Standing on each side of the OTA and grasping the two handles on each side, lift the OTA onto the top of the fork. Position the holes over the shoulder bolts. When in place, slide the OTA back so that the shoulder bolts lock into the slots.

c. Lock the OTA in place using the four 3/8"-16x3/4" bolts (21, Fig 1). These four bolts thread up into the bottom of the Dec castings, two on each side. Tighten firmly.

5. Mounting the Viewfinder

The 16" LX200 is supplied as standard equipment with an 8 x 50mm straight-through viewfinder. The bracket for this viewfinder is packed separately from the finder itself, and 6 black nylon thumbscrews (2, Fig. 1) for collimation are pre-threaded into the viewfinder bracket. The viewfinder bracket mounts onto the telescope with a quick-release mount. See Fig. 1.

a. Attaching the Viewfinder

The viewfinder is shipped separately from the bracket and must be installed into the bracket. Slide the viewfinder into the bracket and lightly tighten the 6 collimation (alignment) screws (2, Fig. 1).

The quick-release mount allows the viewfinder to be easily attached or removed from the telescope. To attach the unit, simply slide the viewfinder with bracket into the front of the mating base on the telescope, then tighten the two thumbscrews.

b. Focusing the Viewfinder

The viewfinder has been pre-focused at the factory. However, should it become necessary to adjust the focus, follow these steps:

1. Loosen the Focus Lock Ring (17, Fig. 1).
2. While looking at a star, rotate the Dew Shield (1, Fig. 1) until the star is in focus. (This refocuses the objective lens.)

CAUTION: Take care when rotating counter clockwise. You are unthreading the dew shield and it may fall off if rotated too far. Refocusing the objective lens will only require a few turns of the Dew Shield at most.

3. When the Dew Shield is rotated to the sharpest focus for your eye, tighten the Focus Lock Ring against the Dew Shield to fix its position.

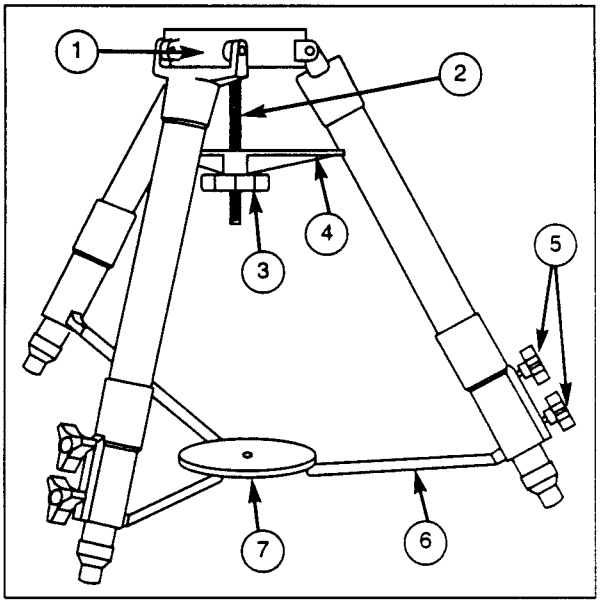


Fig. 2: LX200 Field Tripod. (1) Tripod Head; (2) Threaded Rod; (3) Tension Knob; (4) Spreader Bar; (5) Lock Knobs; (6) Extension Strut; (7) Tension Hub.

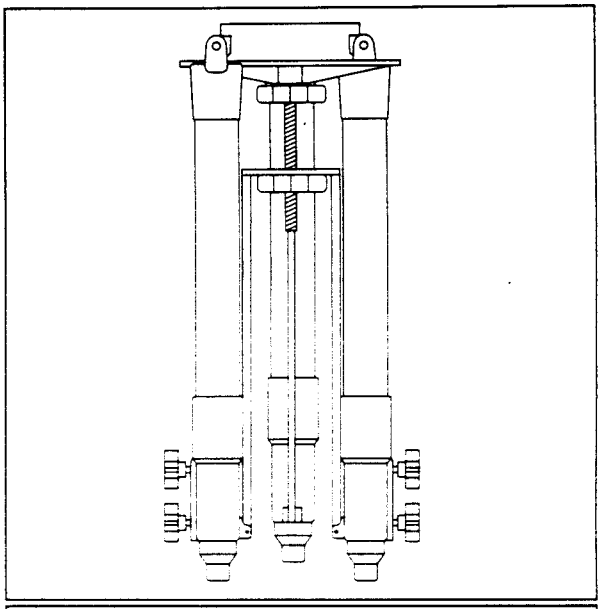


Fig. 3: Field Tripod (collapsed).

c. Collimating the Viewfinder

The viewfinder will require alignment (collimation) with the main telescope. Using the 26mm eyepiece, point the main telescope at some easy to find land object (*e.g.* the top of a distant telephone pole). Center the viewfinder in both the front and rear rings using the 6 thumbscrews. Next, looking through the viewfinder, adjust the 3 thumbscrews on the rear ring until the object centered in the telescope's main tube is likewise positioned in the center of the viewfinder's crosshairs. Now it is possible to quickly sight an object in the viewfinder first, then find that object approximately centered in the 26mm eyepiece of the telescope.

6. Attaching the Diagonal Mirror & Eyepiece

The diagonal mirror (12, Fig. 1) threads directly onto the rear-cell of the 16" telescope and, in turn, accepts the supplied 1.25" O.D. eyepiece. For astronomical observations, the diagonal mirror generally provides the most comfortable right-angle viewing position. With the diagonal prism, telescopic images appear correctly oriented up-and-down, but still reversed left-for-right. (For terrestrial applications, where a fully corrected image orientation is desired—both up-and-down and left-for-right—the optional eyepiece holder and #924 Erecting Prism or #928 45° Erect-Image Diagonal Prism should be ordered separately.) Eyepieces are held in place by a moderate tightening of the thumbscrew on the diagonal prism.

7. Attaching the Cords

Several power and data cords are supplied with the 16" LX200. These cords should all be attached before powering up the telescope.

CAUTION: Always turn the power OFF before connecting or disconnecting any cords.

a. Be sure the power switch on the power panel is OFF. Plug the 18 volt wall adapter into any 100vAC to 240vAC power source. Then plug the 25' power cord into the wall adapter and the other end into the 18 volt power connector on the power panel.

b. Connect the large coil cord to the Dec motor connector on the power panel and the Dec motor connector on the lower part of the fork. This cord uses a DB-9 type connector and should be locked in place with the two thumbscrews supplied. This coil cord is reversible and can be connected with either end in either connector.

c. A short DB-9 cord (8" long) is supplied to provide power from the fork to the Dec system. It is connected between the two DB-9 connectors located at the top of the right side of the fork and the Dec casting].

d. Connect the Keypad to the power panel using the small coil cord with the telephone connectors on each end.

e. If the fan will be used, connect the supplied coil cord from the Fan to the 12vDC Output jack.

8. Southern Hemisphere Operation

The 16" LX200 is shipped with the North/South jumper (1, Fig. 4) set for North (*i.e.* with the jumper on one pin only). For Southern Hemisphere operation, move the jumper to cover both pins.

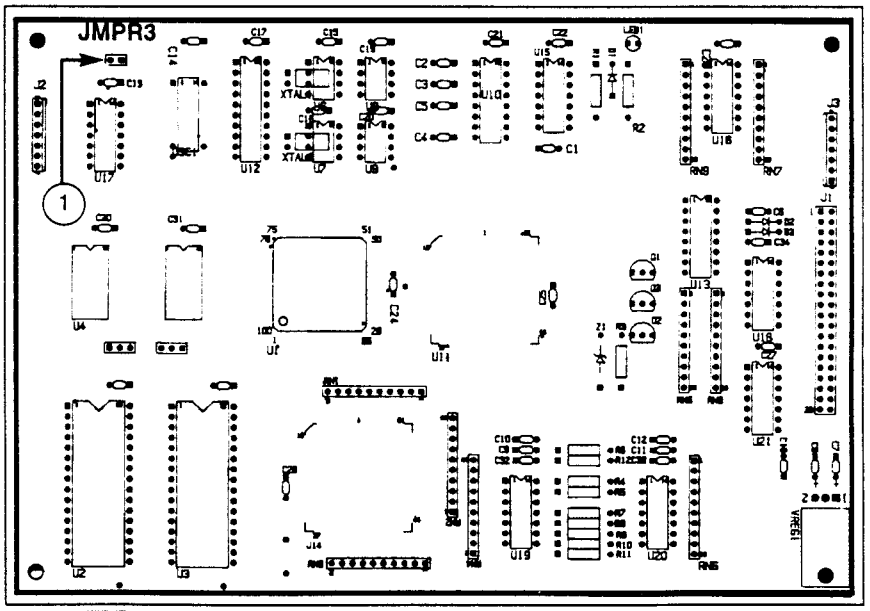


Fig. 4: 16" LX200 Printed Circuit Board. (1) North/South Jumper.

QUICK START

To utilize all the features of the telescope, it is necessary to enter some information into the telescope's computer memory, and learn the menu structure of the Keypad hand controller, which is described in the rest of this manual. As advanced as LX200 electronics are, the telescope is very straightforward to operate—even if you have no experience in using a personal computer.

If you are reading this manual for the first time and are anxious to "look through the telescope," this section will describe how to use the telescope without going through the rest of the manual. But be sure to come back and read the details, for most of the telescope's features can not be accessed without a full knowledge of these details.

1. Using the LX200 Manually

The easiest way to use the telescope is to simply operate it manually. With the telescope mounted on the Field Tripod (as described in **TELESCOPE ASSEMBLY**, page 6), and with the diagonal mirror and eyepiece in place, you are ready to make observations through the telescope. Even without the viewfinder (if not yet installed), terrestrial objects will be fairly easy to locate and center in the telescope's field of view with a low power eyepiece, simply by "gun sighting" along the side of the main telescope tube.

By unlocking the R.A. Lock (6, Fig. 1), the telescope may be turned rapidly through wide angles in Right Ascension (R.A.). The reason for the terminology "Right Ascension" and its complementary term, "Declination" will be made clear further on in this manual. For now, "Right Ascension" simply means "horizontal" and "Declination" means "vertical." Fine adjustments in R.A. are made by turning the R.A. Slow-Motion Control Knob (7, Fig. 1), while the R.A. lock is in the "unlocked" position.

CAUTION: Do not attempt to move the telescope manually in a horizontal direction when the R.A. Lock is in the "locked" position.

The R.A. Slow-Motion Control Knob may be turned, if desired, with the R.A. Lock in a "partially locked" position. In this way, a comfortable "drag" in R.A. is created. But do not attempt to operate the R.A. Slow-Motion Control Knob with the telescope fully locked in R.A., as such operation may result in damage to the internal gear system.

Releasing the Declination Lock Knob (18, Fig. 1), permits sweeping the telescope rapidly through wide angles in Declination.

With the above mechanical operations in mind, select an easy-to-find terrestrial object as your first telescope subject—for example, a house or building perhaps one-half mile distant.

Unlock the Declination Lock Knob (18, Fig. 1), and R.A. Lock (6, Fig. 1), center the object in the telescopic field of view and then re-lock the Dec. and R.A. locks. Precise image centering is accomplished by using the keypad arrow keys to move the telescope.

The Focus Knob (5, Fig. 1) is located at the "4 o'clock" position as you face the rear cell of the telescope. Focusing is accomplished internally by a precise motion of the telescope primary mirror so that, as you turn the focus knob, there are no externally moving parts. You will find that if you turn the focus knob counter-clockwise you are focusing towards the infinity setting, and turning clockwise is for close distance. There are about 45 complete turns to go from one end of focus to the other, and it is possible to focus past infinity. Be patient during focusing as images quickly go in and out of focus with only a slight amount of turning of the focus knob.

Before using the telescope manually during the daytime, be sure to read **Daytime Slewing**, page 13.

2. Using the LX200 In LAND

The 16" LX200 telescope is shipped with the microprocessor set to LAND, the align menu option you will wish to use to view terrestrial objects. In this menu option, 4 different motion speeds are active, allowing the telescope to be moved electronically by means of the Keypad. To use the telescope in LAND, follow these steps.

a. Loosen the Dec. Lock Knob (18, Fig. 1) and position the optical tube assembly approximately level, so that the Dec. Circle (3, Fig. 1) reads 0°. Retighten the Dec. Lock Knob.

b. Loosen the R.A. Lock (2, Fig. 5) and rotate the telescope so that the R.A. Pointer (4, Fig. 5) and the Hour Angle (HA) Pointer (5, Fig. 5) are approximately in line with each other. This will position the fork arms so that they are parallel to the Power Panel (10, Fig. 1).

The above two steps are not required for the telescope to work. The telescope has some "illegal" positions (places where the telescope will not go) and these two steps insure proper operation.

c. After setting up the telescope, connect all cords as described in **Attaching the Cords**, page 8.

d. On the Power Panel, turn on the LX200 power switch. The Keypad Display (1, Fig. 6) will show "Meade" for several seconds as the microprocessor does a self-diagnostic test. When the self-diagnostic test is complete, the display will show "TELESCOPE" on the top line, "OBJECT LIBRARY" on the lower line, and the red LED light next to the "SLEW" button will light up.

e. At this point, the LX200 is ready to use. Select the speed at which you want to move the telescope by pressing the appropriate Speed Selection Key (4, Fig. 6). Note that you will be able to "see" the telescope move only in the SLEW and MOVE modes; CNTR (center) and GUIDE motions can only be seen while looking through the telescope. The red LED next to that key (3, Fig. 6) will light, indicating the speed selected. Then press one of the four direction keys (2, Fig. 6) to move the telescope in that direction at the selected speed.

The LX200 can be moved manually with the R.A. and Dec. locks released, or as described above. When the power is "on," only use the N, S, E, and W keys on the Keypad Hand Controller.

Before using the telescope during the daytime, be sure to read **Daytime Slewing**, page 13.

3. Using the LX200 In ALTAZ (Altazimuth)

The two quick start methods described above allow you to use the telescope, but do not make use of any of the computer features available, including finding objects from the Object Library and automatic tracking of stars. In order for these features to work, the telescope's power needs to be "on," and the computer needs some basic information, which is entered

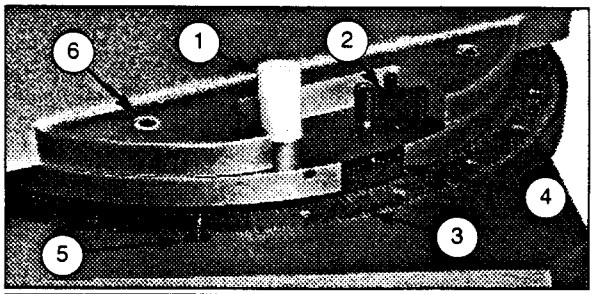


Fig. 5: 16" LX200 Azimuth System. (1) Slow-Motion Control Knob; (2) R.A. Lock Knob; (3) R.A. Setting Circle; (4) R.A. Vernier Pointer; (5) Hour Angle (HA) Pointer; (6) Fork Mounting Bolts.

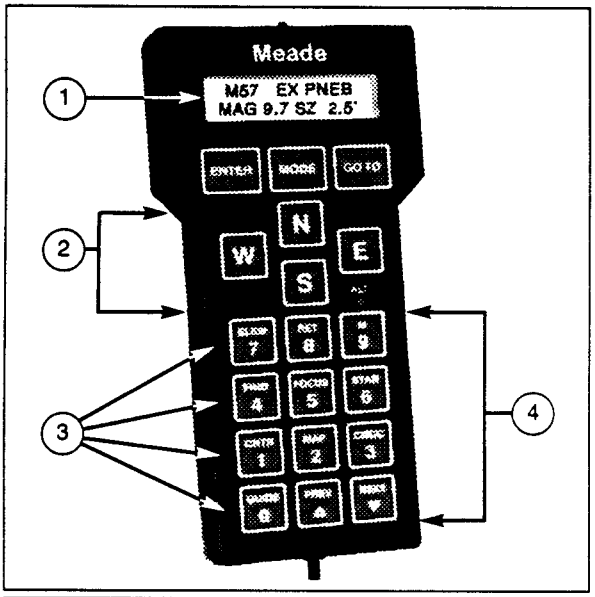


Fig. 6: Keypad Hand Controller. (1) Display); (2) Direction Keys; (3) Speed Indicator LEDs; (4) Speed Selection Keys.

Motion Speeds		
SLEW	(7) =	4°/sec
FIND	(4) =	1°/sec
CNTR	(1) =	240 arcsec/sec
GUIDE	(0) =	30 arcsec/sec

through the Keypad. Once entered, the information is permanently remembered by the telescope's computer and need never be entered again, even if the telescope is turned "on" and "off" many times.

This section will explain what keys to push to get the minimum data required into the computer, without any detailed explanation. (See **MODE FUNCTIONS**, page 17) The steps detailed here will only take a few minutes and will allow you to begin making use of all the LX200 features.

a. Entering Basic Information

In order for the LX200 to make the conversions between the stellar coordinate system (R.A. and Declination) and the Altazimuth coordinate system (Altitude and Azimuth), it needs to know three pieces of information. This information only needs to be entered one time—the LX200 remembers the data even when the power is off. Note, however, that the time should be checked and reset, if necessary, on each observing session.

b. Location of the Observing Site

NOTE: The SITE information cannot be entered if the telescope is in LAND mode.

If the telescope is in LAND mode, the SITE menu option (Display 2) will appear in lower case letters (see **Which Method to Use,** page 14). Follow steps 4 through 8 in **Setting Up the Telescope**, page 11, to change the telescope's operation to Altazimuth (ALTAZ) mode before proceeding.

You should find the position of your observing site 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 LX200 will depend on how close you get, so take a little time to get as accurate as you can.

Once the above information is determined, it can be entered into the telescope. It is easiest to enter the data with the telescope sitting on a table indoors—do not try to do it outside at night.

Each step below is given without any details or explanations to keep the process as simple and fast as possible. Next to each step will also be a sample of what the Keypad Hand Controller display (1, Fig. 6) should look like after each step.

As an example, we will enter the data for Irvine, CA (LAT = 33°35', LONG = 117°42'). If at any time you get "lost," simply turn off the telescope and restart this procedure.

1. Turn the telescope power on. After a few seconds (after the self-diagnostic test is complete), the display will look like Display 1.

Display 1

```
→TELESCOPE
 OBJECT LIBRARY
```

2. Press the ENTER key. This selects the TELESCOPE functions. The display should now look like Display 2.

Display 2

```
→1) SITE
 2) ALIGN
```

3. Press the ENTER key. This selects the SITE functions. The display should look like Display 3.

Display 3

```
→1) A A A  ✔
 2) A A A
```

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.

Display 4

```
→1) A A A  ✔
 2) A A A
```

5. Press the ENTER key. The display should now look like Display 5.

Display 5

```
→LAT  = +00° 00'
 LONG = 000° 00'
```

6. Use the number keys to enter your Latitude. The underline designates the current cursor position. Mistakes can be corrected by moving back (using the "E" and "W" keys). A negative latitude can be entered by positioning the cursor under the "+" and hitting the "NEXT" key (lower right-hand key). When the Latitude is correct, press ENTER. The display will look like Display 6.

Display 6

```
→LAT  = +33° 35'
 LONG = 000° 00'
```

7. Use the number keys to enter your Longitude as above. When complete, the display will look like Display 7.

Display 7

```
→LAT  = +33° 35'
 LONG = 117° 4
```

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.

It is important to note that the longitude standard used in the LX200 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. As an example, if your map indicates that you are at an Easterly longitude of 18 degrees 27 minutes, then you would enter 341 degrees 33 minutes.

Do not concern yourself with differences in longitude and latitude as they pertain to different map spheroid projections,

those minor differences are too small to adversely affect the longitude and latitude data input.

c. Local Time and Date.

NOTE: The Time function on the 16" LX200 telescope is a standard quartz clock. Like nearly any timepiece, the internal clock of the telescope should be periodically checked and updated to keep it as accurate as possible.

The local time should be set as accurately as possible, using the 24 hour format. The local time and date are used to determine sidereal time (star time) and the pointing accuracy of the telescope will depend on the accuracy of the time entered. 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). For the example, we will use 2:40:00 P.M. on August 5. 1998.

1. The display should look like Display 1. If it does not, press the MODE key until it does.
2. Press the MODE key twice. The display will look like Display 8, but with a random LOCAL and SIDE times.

Display 8

```
→LOCAL = 11:24:30
 SIDE  = 21:38:02
```

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

Display 9

```
→LOCAL = 11:24:30
 SIDE  = 21:38:02
```

4. Using the number keys, enter the current local time to within 5 seconds. (Remember, 2:40:00 P.M. is 14:40:00 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. (*NOTE: The time should be checked and reset about once a month.*)

Display 10

```
→LOCAL = 14:40:00
 SIDE  = 21:38:02
```

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

Display 11

```
Hours from GMT:
+ 0 8
```

The next step is to enter the Greenwich Mean Time (GMT) time zone shift. GMT is also known as Universal Time (UT). Simply look up your time zone in the table below to find the GMT time zone shift.

U.S.A. TIME ZONES		
TIME ZONE	**STANDARD TIME**	**DAYLIGHT TIME**
HAWAII	+10 Hours	+9 Hours
PACIFIC	+8 Hours	+7 Hours
MOUNTAIN	+7 Hours	+6 Hours
CENTRAL	+6 Hours	+5 Hours
EASTERN	+5 Hours	+ 4 Hours
ATLANTIC	+4 Hours	+3 Hours

For example: You live in the Pacific Time Zone and you are on Daylight Time. The GMT time shift is +7 hours.

6. 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 LX200 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). Use the number keys to enter the Westerly (+) GMT time zone shift determined from the table above or your calculated Easterly (-) time zone shift.
7. Press the ENTER key. This will select the DATE display (Display 12), with a random date showing.

Display 12

```
DATE = 07/11/91
```

8. 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.

Display 13

```
DATE = 07/11/91
```

9. 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.

Display 14

```
DATE = 08/05/98
```

10. 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 LX200 needs to make use of all features. The next steps actually align the telescope with the night sky.

d. Setting Up the Telescope

After the basic information has been entered into the telescope, the telescope is ready to actually set-up and use. Follow **TELESCOPE ASSEMBLY** (page 6) to set-up the telescope outside, and follow these steps:

1. Using the Bubble Level (14, Fig. 1) located on the telescope's drive base, level the telescope. This is a very important step because the telescope's pointing ability depends on the telescope being level. Make sure the bubble is precisely centered by adjusting the height of the three tripod legs.
2. Loosen the Dec. Lock Knob (18, Fig. 1) and position the optical tube assembly approximately level (so that the Dec. Circle (3, Fig. 1) reads 0°. Retighten the Dec. Lock Knob.
3. Loosen the R.A. Lock (2, Fig. 5) and rotate the telescope so that the R.A. Pointer (4, Fig. 5) and the Hour Angle (HA) Pointer (5, Fig. 5) are approximately in line with each other. This will position the fork arms so that they are parallel to the Power Panel (10, Fig. 1). Lock the R.A. lock.

Steps 2 and 3 above, are not required for the telescope to work. The telescope has some "illegal" positions (places where the telescope will not go) and these two steps insure proper operation.

4. Turn the telescope on. After a few seconds (after the self-diagnostic test is complete), the display will look like Display 15.

Display 15

```
→TELESCOPE
 OBJECT LIBRARY
```

5. Press the ENTER key. This selects the TELESCOPE functions. The display should look like Display 16.

Display 16

```
→1) SITE
 2) ALIGN
```

6. Press the NEXT key. This will move the arrow to the lower line (see Display 17).

Display 17

```
 1) SITE
→2) ALIGN
```

7. Press the ENTER key to select the ALIGN function. The display will look like Display 18. (If the display looks like Display 19—with a checkmark already next to ALTAZ, go to step 9.)

Display 18

```
→1) ALTAZ
 2) POLAR
```

8. Press the ENTER key to activate the ALTAZ mode. The Keypad Hand Controller will beep and display a checkmark next to the ALTAZ (see Display 19).

Display 19

```
→1) ALTAZ ✔
 2) POLAR
```

9. Press the ENTER key to use the checked mode (ALTAZ). The Keypad Hand Controller display will look like Display 20.

Display 20

```
1 Star or
2 Star Alignment
```

10. Press "1" to select "Star." The display screen will now look like Display 21.

Display 21

```
Level base, then
press ENTER
```

11. If you have not already leveled the telescope, do so now. When the telescope is level, press ENTER. The display will look like Display 22.

Display 22

```
Press ENTER, then
pick align star
```

12. This message simply reminds you what you should do next. Press ENTER to show a display like Display 23.

Display 23

```
→ACHERNAR
 ACRUX A
```

13. Using the monthly star charts in Appendix B, pick an alignment star. Look at the chart for the current month and face the direction indicated. The constellations shown are easily found—even in the city. The charts are approximately 90 degrees wide, with the top of the chart indicating straight up. If the time is after 9:00 P.M., then use the next month's chart. Once you identify the constellation, pick any of the labeled stars that is not within a 10 degree radius of overhead, but do not choose Polaris, for reasons made clear below. Polaris is also known as the North Star, and is shown for reference only.

    When aligning in ALTAZ, overhead stars can confuse the LX200 because of an illegal position that prevents the optical tube assembly from slewing past 90 degrees Altitude to protect the viewfinder from hitting the fork arm. The LX200 will track an overhead object, but it does so by moving higher in Altitude up to the illegal position, then the drive speeds up and move 180 degrees in Azimuth so that the optical tube assembly can now be lowered in Altitude to keep up with the overhead object. Confusion arises because the LX200 does not know which side of 180 degrees of Azimuth that it is on. Similarly, Polaris presents position problems in ALTAZ alignment because it is so close to the North Celestial Pole. In this region of the sky, the lines of Right Ascension are so close together that even the LX200's high-resolution encoders can yield ambiguous data.

    In our example of August 5, we would use the August chart, face North and look up about 45 degrees. Cygnus is probably the easiest constellation to recognize, and we will use the star Deneb for our example.

    Use the PREV and NEXT key to scroll through the list of alignment stars until the arrow is positioned on Deneb (Display 24).

Display 24

```
 CASTOR A
→DENEB
```

The TELESCOPE and OBJECT LIBRARY features are accessed through a series of menus, which are shown on the Keypad Hand Controller Display. You can scroll up or down through the list of choices by using the PREV and NEXT keys, and select the indicated menu option with the ENTER key. Menu choices that are shown in lower case letters are unavailable in the current operating mode (LAND, ALTAZ, or POLAR). If you try to select a lower case menu option, the Keypad Hand Controller will emit three warning beeps. Three beeps always indicate an attempt to perform an invalid telescope operation.

14. Press the ENTER key to select Deneb. The Keypad Hand Controller displays a message (Display 25).

Display 25

```
Center DENEB
then press ENTER
```

15. Center the alignment star (Deneb in our example) in the eyepiece of the telescope. You can manually move the telescope by loosening the Dec. Lock Knob and R.A. Lock or electrically by using the N, S, W, and E keys. If moving the telescope electrically, be sure to use the speed keys, SLEW to get close, FIND to center in the viewfinder, and CNTR to center the star in the eyepiece. When the star is centered, press ENTER.

The telescope is now aligned and fully functional, and will automatically begin to 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 LX200 to "lose" position, requiring realignment.

e. Using the MODE Key

The LX200 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 and the OBJECT LIBRARY is where the features of the object library are accessed.
2. **Telescope Position**. The first display shows the RA and DEC (telescope position in stellar coordinates) and the second display (accessed by pressing the ENTER key) shows the telescope position in ALTAZ coordinates.
3. **Time and Date**. The first display shows local and Sidereal

time and 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.

f. Library Object Keys

While in any of the 5 main Keypad display modes, you can directly access the library objects by using the M, STAR, or CNGC keys (see Appendix D of this manual for more information on the 64,359 Object Library). Simply press an object key, and type in the number of the object desired, followed by ENTER. For example, a good first object for the first part of the year is M42 - the Great Orion Nebula.

Press: the M key, the 4 key, the 2 key, and finally the ENTER key. The display will show data on the object (name, rating, object type, brightness, size). Now press GO TO. The telescope will automatically slew to M42.

If the object entered is not above the horizon, the Keypad Hand Controller will display the message "Object Below Horizon."

Other good first objects (if above the horizon) are any of the M objects—from M1 to M 110, and the planets. To find a planet enter: (*NOTE: 903 is the Moon.*)

OBJECT LIBRARY PLANET LEGEND			
PLANET	**STAR #**	**PLANET**	**STAR#**
MERCURY	901	**SATURN**	906
VENUS	902	**URANUS**	907
MARS	904	**NEPTUNE**	908
JUPITER	905	**PLUTO**	909

g. Daytime Slewing

Some amateurs may want to use the slewing feature of the LX200 to locate the planets or other astronomical objects during the daytime. **If not done correctly, this can be very dangerous.**

WARNING: The LX200 "knows" where the planets are in relation to the Sun, but the telescope does not "know" where the Sun actually is. When GO TO is pushed, the telescope slews to the object by the most direct route, which may move directly over the Sun. Use extreme caution before 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 manual slewing, 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. Press the GO TO button or manually move the telescope.
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.**
4. 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.
5. **Be careful and use common sense. Observing the Sun, even for the shortest fraction of a second, will cause instant and irreversible eye damage.**

4. Star Alignment

The 2-Star initialization routines provide three options for aligning the LX200 telescope when in the ALTAZ mode.

*NOTE: The 2-Star initialization routines only apply to the ALTAZ alignment mode. (See **MODE FUNCTIONS**, page 17, for POLAR and LAND mode initialization.)*

The first and second options require that you have entered the SITE and TIME information as described in **Entering Basic Information** (page 10) and the third option can be used when the SITE information is not known or has not been entered into the LX200's memory.

NOTE: In all alignment procedures, be sure the telescope is rotated so that the Power Panel is facing North.

a. 1-Star with Known SITE

The 1-Star alignment routine was explained in detail in **Setting Up the Telescope** (page 11).

b. 2-Star at Known SITE

To use the 2-Star alignment procedure at a known site, follow these steps:

1. Select the 2-Star alignment (by pressing the "2" key); the Keypad display will prompt you to level the base. This leveling step requires a rough level only and, unlike the 1-Star alignment routine, does not affect the pointing accuracy of the telescope. (See Section d. below for a summary of the differences in telescope operation when selecting each of the three alignment procedures.)
2. After leveling the base and pressing ENTER, follow the Keypad display prompts to select the first alignment star. Slew to that star using the N, S, E, W keys.
3. Follow the Keypad display prompts to choose and center the the second alignment star. Be sure to use the Keypad to slew to the second star. After pressing the ENTER key in the last step, the Keypad display should show the TELESCOPE/ OBJECT LIBRARY screen.

IMPORTANT

Whenever using either of the 2-Star alignment procedures (at a known SITE or at an unknown SITE), choosing the proper two stars will determine the pointing accuracy of the telescope. Choose two stars that are not too close together — try to use stars that are at least 90° apart. Do not use Polaris because RA changes very fast at the Pole and minor centering errors translate to large RA pointing errors. Also, avoid stars near the zenith (straight up) since azimuth changes very fast in this area. Generally speaking, choosing two stars as far apart as possible will yield very accurate pointing, often within a few arc minutes.

The LX200 calculates the distance between the two stars that you chose in the alignment steps and compares this to the distance that you actually slewed the telescope. This is a check to be sure you centered the correct stars during the alignment steps. Should the LX200 discover a discrepancy, the Keypad will display an "Align Mismatch—Check Stars" message. If you get this message after aligning the telescope, check that you are using the correct stars and align again.

c. Unknown SITE

To use the LX200 telescope at an unknown location, use the following procedure:

1. Select site #5 (UNKNOWN) from the SITE menu.

NOTE: This site cannot be edited like site numbers 1 to 4 as described on page19.

2. Follow the Keypad display prompts to select and center the two alignment stars.

As described above, the LX200 will check the accuracy of the two stars and give the "Align Mismatch—Check Stars" message if it detects an error.

d. Which Alignment Method To Use?

Each of the three method described above has advantages and disadvantages. The following table summarizes these properties.

	1-Star Known	2-Star Known	2-Star Unknown
Pointing Accuracy Determined By:	Level of Telescope	2-Star Alignment	2-Star Alignment
Atmospheric Refraction Correction*	Yes	Yes	No
Atmospheric Refraction Correction Determined By:	Level of Telescope	Level of Telescope	Not Applicable
When Best Used	Best used when the telescope is permanently mounted and accurately leveled	Best used on a transportable telescope with the SITE info is available	Best used when the SITE info is not available

* **Atmospheric Refraction Correction**: Light from an astronomical object is "bent," (refracted) as it passes through the atmosphere. This bending is more pronounced near the horizon because there is more atmosphere for the light to pass through, and it shifts the apparent position of the star. The LX200 calculates this bending and compensates for it when slewing to objects near the horizon.

=THE LX200 KEYPAD HAND CONTROLLER=

Designed to make you a better astronomer, the integration of optics, mechanics, electronics, and software in the LX200 Schmidt Cassegrain Telescope is easily mastered. So easy, in fact that the telescope becomes a natural extension of the observer.

The LX200 gives you virtually every telescope function possible with every control in a compact hand held console. The red LCD backlit Keypad has tactile touch buttons (some of which are brighter than others), designed to have the right feel even if you wear gloves. Its red LCD backlit display, key arrangement, and easy to understand information allow you to focus the telescope and your mind on the subject at hand.

The LX200 Keypad Hand Controller is a dual axis drive corrector with periodic error control; an information display center for the computerized library; a digital coordinate readout system; a pulsing, illuminated reticle eyepiece brightness controller; a two speed electric focuser controller, and a red LED flashlight!

You will find within a few minutes of powering up the LX200 that the Keypad becomes warm, which is normal for the system. The electronics utilize a heat sink as a means to provide the correct operating environment temperature for the LCD display even in sub-zero weather. If you are 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.

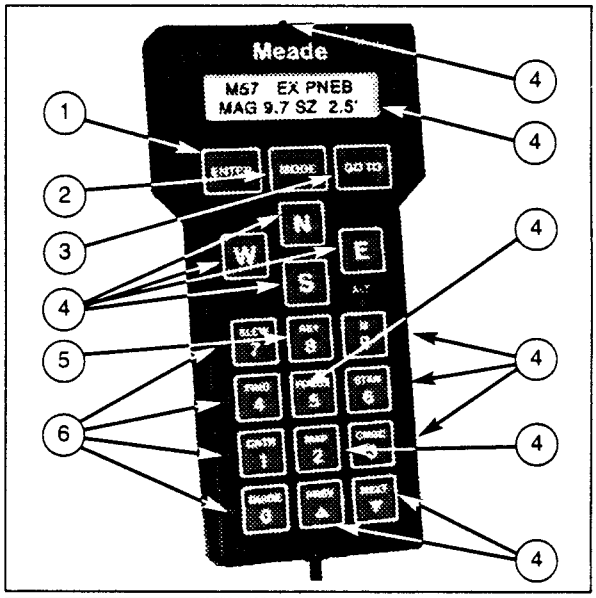


Fig. 7: Keypad Hand Controller. (1) ENTER Key; (2) MODE Key; (3) GO TO Key; (4) Direction Keys;(5) RETURN Key; (6) Speed Keys; (7) Red LED Light; (8) Display; (9) Focus Key; (10) Object Keys; (11) MAP Key; (12) PREVIOUS and NEXT Keys.

The LX200 Keypad buttons are described as follows:

1. ENTER Key

The ENTER key (1, Fig. 7) 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 LX200 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.7) cycles through the five modes of the LX200, and is used to exit from specific menu files.

3. GO TO Key

The GO TO key (3, Fig. 7) causes the LX200 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.

4. Direction Keys

Labeled N,S,E, and W, (4, Fig. 7) these four keys make the LX200 move, or slew, in a specific direction, with an option of four different speeds, explained later. During entry to change a value, 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 is only visible when entering numerical data. A description of the individual keys follows:

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

These keys (6, Fig. 7) allow you to set the rate of movement (slew) speed in the drives of the LX200, 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 (4 degrees per second), FIND (1 degrees per second), CNTR (16X sidereal rate), and GUIDE (2X sidereal rate).

NOTE: All of the slew speeds will drive the LX200 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 will merely slow down the tracking drive to one half its normal speed. You will find, however, that the slower drive will move the image opposite of the tracking direction, without disturbing the smooth drive action. This performance is absolutely essential when making astrophotographs.

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. There are other special functions for the CNTR and GUIDE keys that are discussed in the RET KEY operations.

6. RET Key

Typically used for guiding the LX200 during an astrophotograph, the RET key (5, Fig. 7) is used to change the brightness and pulse rate of the optional corded style illuminated reticle eyepiece. Pressing either the PREV and NEXT (up and down arrow) keys while holding down the RET key, alters the reticle brightness level up or down.

When guiding on very faint stars, you may find it helpful to pulse the light from the LED so that the reticle crosshairs blink on and off. You will be able to adjust the reticle brightness as well as adjust 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).

7. FOCUS Key

The FOCUS key (9, Fig. 7) allows 2 speed electric focus control of the optional Meade #1206 Electric Focuser (or equivalent corded electric focusers such as the Meade Model #1200A). 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 for near and far focus.

8. MAP Key

The Map key (11, Fig. 7) turns on and off the red LED 'flashlight' that is located at the top of the Keypad. The deep red LED light will protect your night vision while you search for a particular accessory or examine a star chart.

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

These keys (10, Fig.6) allow direct access to the LX200's Object Library any time that you are not editing a value or setting a parameter, or selecting a file menu. Use the Object keys when you are at a "top level" of a mode. After pressing one of these keys, the Keypad's display will give a blinking cursor, allowing you to enter the catalog number for objects listed in the library (see Appendix D. 64,359-Object Library). After entry press the ENTER key. To see 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 (Computerized New General Catalog).

The 16" LX200 has several object libraries which are accessed with the STAR and CNGC keys.

When you press the STAR or CNGC keys, the display will show which object library you are currently in and wait for a number entry, as described above.

To switch to a different library, press the ENTER key instead of entering a number.

The Keypad display will show a menu of libraries available. Move the cursor to the desired library and press ENTER to select.

The 16" LX200 will "remember" the database you last accessed. Each time you press the STAR or CNGC keys, the same object database will be displayed on the first line of the Keypad display.

10. PREV AND NEXT Keys

The PREV and NEXT (up and down arrow) keys (12, Fig. 7) move the display 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 work as well to select the objects from the Object Library when using START FIND.

THE LX200 POWER PANEL

The power panel incorporates a power switch and LED indicators showing power on with a current ammeter to show power draw.

The Power Panel has all of the connectors for the AC or DC power input, the DEC Motor, and the Keypad. There are connectors designed to accept optional accessories such as a CCD autoguiding camera, the optional Meade Field De-Rotator, the Meade #1206 Electric Focuser, and an illuminated reticle eyepiece. There is even a connector for RS-232 communication that will allow you to perform every function of the Keypad from your personal computer. An illustration and a description of the 16" LX200 Power Panel features follows:

1. ON/OFF Switch

When the ON/OFF Switch (7, Fig. 8) is moved to the ON position, the power light indicator, the Current Ammeter, and the Keypad all light up. You will hear the drive motors rev which momentarily pegs the Ammeter, then the drive motors shift to a slower speed which allows the RA worm gear to find its centering position for calibrating the Smart Drive, then resuming to an even slower tracking speed. The Keypad Display reads "Meade," then the version of the software is indicated briefly before defaulting to the TELESCOPE/OBJECT LIBRARY. Within 15 seconds, the planetary orbital calculations with their corresponding apparent sizes and magnitudes, and current stellar precession calculations are made. Every computer function is checked, and the LX200 diagnostics are complete.

2. Ammeter

The Ammeter display (1, Fig. 8) is a series of vertical red LED bars. Each bar that is fully lit represents 0.3 ampere (300 milli-amperes) of current draw. The LED Ammeter represents its lowest value on the extreme left of the scale. During normal tracking speeds, the Ammeter will show about three fully lit LED bars and at times a fourth that is partially lit, indicating about 900 to 1000 milli-amps or 0.9 to 1.0 amps of current draw (when a slew is initiated, the ammeter will peg the scale 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 you will have during an observing session. As an example, if the ammeter has four bars lit, indicating 1.2 amps and you are using a 12 amp hour battery, then to know the approximate number of hours of life the battery would yield by dividing 12 by 1.2. This indicates a battery life of 10 hours.

3. DEC Motor Connector

The DEC Motor Port (11, Fig. 8) is a DB-9 socket, designed to accept the supplied coil cord. One end of the supplied coil cord plugs in to the Power Panel and the other plugs into the DEC MOTOR socket in the right fork arm to power the declination motor.

4. CCD Connector

The CCD Port (10, Fig. 8) allows direct interface from popular aftermarket CCD autoguiding/imaging cameras with their compatible connecting cables to accomplish autoguiding for non-attended astrophotography. The CCD cameras effectively watch a star and detect slight movements. When star movements are detected, signals from the CCD electronics make drive corrections in the LX200, to bring the star to a home position.

Most CCD autoguiding/imaging cameras are supplied with a cable which is compatible with the LX200 port. If your CCD unit does not have a cable, one can be obtained from the CCD manufacturer, or you can make your own cable using the following table of information.

CCD Connector Pin	LX200 Assignment
#1	Normally Closed
#2	West
#3	North
#4	Ground
#5	South
#6	East

5. Power 18 vDC Connector

The Power 18 vDC connector (9, Fig. 8) is designed to accept either the AC Converter or the optional DC Power Cord that is supplied as standard equipment with the LX200. The acceptable voltage range (under load) is from 12 to 18 volts.

6. Keypad Connector

The Keypad connector (6, Fig. 8) 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 LX200 Keypad.

7. Reticle Connector

The Reticle connector (5, Fig. 8) accepts optional accessory corded, plug-in style illuminated reticle eyepieces such as the optional Meade 12mm Illuminated Reticle Eyepiece, or the Meade Series 4000 Plössl 9mm Illuminated Reticle Eyepiece (corded style), to allow brightness control and on/off pulsing rates to be set from the LX200 Keypad.

8. Focuser Connector

The Focuser connector (4, Fig. 8) accepts optional accessory corded, plug in style electric focusers such as the Meade #1206 Electric Focuser, to allow electric focus adjustment control from the LX200 Keypad.

Fig. 8: 16" LX200 Power Panel. (1) Current (mA x 300) Ammeter; (2) RS-232 Connector; 3) Field De-Rotator Connector; (4) Focuser Connector; (5) Reticle Connector; (6) Keypad Connector; (7) ON/OFF Switch, (8) 12v DC Output (Fan); (9) 18v DC Power Connector; (10) CCD Connector; (11) DEC Motor Connector.

9. RS-232 Connector

The RS-232 connector (2, Fig. 8) allows personal computer interface to allow communications at 9600 baud to access every feature of the LX200 Keypad. Many popular astronomy programs are available which directly interface with Meade LX200 telescopes, including AstroSearch by Meade Instruments Corp. In **APPENDIX F: LX200 SPECIFICATIONS** (page 60) of this manual is a wiring schematic to make your own RS-232 connector cord, a cord test program, a demonstration program, and the LX200 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.

10. Field De-Rotator Connector

For use in ALTAZ, the optional #1222 Field De-Rotator allows long exposure astrophotography by eliminating image rotation inherent in Altazimuth tracking.

11. 12 vDC Output (Fan)

This connector is used to power the Fan located on the Optical Tube Assembly (OTA). This fan is used to evacuate the warm air trapped inside the tube, allowing for faster temperature cool-down.

This fan is controlled from the Keypad, under TELESCOPE functions, which permits the fan to be operated from PC remote operation.

CAUTION: This connector can be used to power other 12 volt accessories, but maximum current output is 250mA. Do not attempt to use devices, such as heated dew shields, which draw more current than 250mA, or damage to the LX200 electronics may result.

The Fan sucks warm air out from inside the OTA. Cool air is drawn into the OTA through the filtered hole at the bottom of the OTA (20, Fig 1). The input filter is designed to keep dust from being pulled into the OTA and should periodically be replaced by removing the four bolts holding the grill. The fan also has a filter, but this filter is design to keep dust out of the OTA while the fan is off, and should not need replacing.

MODE FUNCTIONS

To view the separate modes within the LX200 system, press the MODE button located between the ENTER and GO TO keys at the top of the hand controller. Simple entry and editing of information in the different modes contained within the system, will customize the operation of your LX200 to perform 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 LX200 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 the five different modes of the LX200 computerized hand controller.

Once you have selected the desired mode, you can then select the individual file within the mode by pressing the PREV or NEXT key (up or down arrow key) as shown in Fig. 7. This scrolls the arrow up or down next to the file description. Although you will only be able to see two menu selections at a time on the Keypad Display, you will 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 menu. To choose an individual menu, again use the PREV or NEXT key to run the arrow up or down the file menu. To explore a menu selection, again press the ENTER key. In some modes there will be options for a file menu selection, in others you will only enter data.

At any time that you wish to return to 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 mode that the LX200 will default to after the instrument completes its self-check, when the LX200 is first turned on. The TELESCOPE/OBJECT LIBRARY mode can be thought of as command central. It is here that we can select the way that we want the LX200 to perform mechanically, and where we can explore and select from its extensive library of stored objects.

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 the 14 selections of the TELESCOPE menu file, illustrating the individual menu files and file options.

1. **SITE:** The SITE menu option allows you to enter up to four of your favorite viewing locations in longitude and latitude. The entered longitude and latitude is compared by the LX200's computer to your local time, GMT offset, and calendar date to accurately calculate celestial coordinates. Once entered, the information is stored in the telescope's internal memory, you need never re-enter the same information. To enter new site information or to change an old one, see **QUICK START**, page 9.

   You can choose any one of the four site options (or the UNKNOWN site) at your convenience, without the bother of entering longitude and latitude every time you use the LX200. Once the site is chosen, exit the SITE menu by pressing the MODE key.

2. **ALIGN:** The Align menu selection of the TELESCOPE file demonstrates the unique ability to transform the LX200 into an Altazimuth, celestial tracking telescope, a polar-equatorial celestial tracking telescope, or land spotting scope with electric Altazimuth movements within three options, which are; ALTAZ, POLAR, and LAND.

Assuming that you have already entered correct local time, latitude, and longitude (see **QUICK START**, page 9) you are ready to choose a particular type of alignment, by pressing the NEXT or PREV key to run the arrow beside the desired option of ALTAZ, POLAR, or LAND, and then pressing the ENTER key. The display will then give you specific instructions from this point that will literally walk you through the chosen alignment type.

a. **ALTAZ:** ALTAZ (Altazimuth) requires that you mount the LX200 directly to the top of the Field Tripod (with the Power Panel facing North), and adjust the leg extensions of the tripod until the instrument is level. You are then required to align on one or two of the bright stars in its look up table of 33 alignment stars. This allows your LX200 to track in Altitude and Azimuth simultaneously for visual observations, or very brief (under five minutes) exposure astrophotography or CCD imaging (longer exposures will require the Field De-Rotator). ALTAZ allows you to fully access the Object Library as well as all other telescope functions, including the Smart Drive. Complete instructions for using ALTAZ are in the **QUICK START** (page 9).

b. **POLAR:** POLAR allows you to use the 16" LX200 (mounted on a permanent pier set to your latitude) as an equatorial telescope. With the LX200 powered up, the POLAR file option selected, and the Field Tripod leveled, the telescope should be adjusted so that the Declination Setting Circle (3, Fig. 1) is set to 90 degrees (see Fig. 13), and the telescope is rotated to the 00 hour angle (HA) position in Right Ascension. In this position, the Viewfinder (Fig. 1) is up-side down, and the R.A. Pointer (4, Fig. 5), the 00 line of the R.A. Setting Circle (3, Fig. 5), and the Hour Angle Pointer (5, Fig. 5) all line up. (If you do not start at the 00 H.A. position, the telescope will point to the ground instead of the sky, when the Keypad display chooses its second star.) Press the ENTER key and the LX200 will determine and slew to the precise offset of the pole star in Declination and Right Ascension.

   At this point you need only aim the instrument at the pole star (see **APPENDIX B**, page 28) if the pole star is not visible) and center it in the eyepiece field using only the Altitude and Azimuth adjustments on the pier. Once done, you again press the ENTER key and the LX200 will choose and slew to a very bright star that is overhead and can usually be seen in the field of view of the viewfinder. At this point, center the bright star using only the Right Ascension and Declination adjustments of the telescope (either manually by loosening the locks only or electrically), then press ENTER. You can now access every every function of the LX200.

c. **Refined Polar Alignment**: Astrophotographers routinely require polar alignments of the highest accuracy for the finest guiding characteristics. Your initial polar alignment can be refined by using the LX200's electronics by using a slightly different method in the POLAR menu option. The steps outlined below 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. You may find that the pole star is somewhat off-center in the eyepiece showing the alignment error that may have been made during your initial setup. Re-center the pole star during each interval using the pier adjustments only (see **APPENDIX A**, page 26 in Altitude and Azimuth, then follow the rest of the routine.

   Return to the POLAR menu option in the TELESCOPE mode and press the ENTER key.

   Ignore the Keypad display instructions to return the telescope to 90 degrees in Declination and 00 HA. Instead, press the GO TO key and the LX200 will slew to the calculated position of where the pole star should be.

   Re-center the pole star in the field of view in the eyepiece using only the adjustments on the pier in Altitude and Azimuth.

   Press the ENTER key, and the LX200 will once again slew to a bright star overhead. Center this star using the N, S, E, or W keys, then press ENTER.

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

   After each 15 minute interval you will find that the pole star becomes more accurately centered each time. You can repeat the intervals as often as you like to obtain the highest accuracy. An optional illuminated reticle crosshair eyepiece makes the job of centering the star easy.

   There may be situations when it is impossible to see the pole star due to something blocking your line of sight. On such an occasion, just press the ENTER key for the POLAR option so that it has a check next to it, then follow the instructions in **Precise Polar Alignment**, page 27. You will require the use of an illuminated reticle crosshair eyepiece* to complete the task. Once finished, follow the steps below for a permanently mounted LX200 section to access the Object Library.

d. **The Permanently Mounted, Polar Aligned LX200:** For those who will permanently mount the LX200 in an observatory, or wish to use the already polar aligned telescope for several nights in succession, it is recommended that a high precision polar alignment be made with one of the methods described above. Once done, however, you need not bother yourself to go through a polar alignment routine on successive nights (provided that you do not move the instrument on the pier) to access the Object Library and enjoy near perfect tracking.

   To bypass the polar alignment sequence, follow the steps outlined below:

- Return to the POLAR menu option and place a check next to it by pressing the ENTER key.
- Then directly enter the catalog number of an object that you are familiar with in the sky by pressing the M, STAR, or CNGC key (see **APPENDIX C**, page 31, for information on the Object Library) and press the ENTER key again.
- Manually center the familiar object in the eyepiece of the telescope.
- Press and hold the ENTER key until the display reads 'Coordinates matched'.

   You have now synchronized the Object Library and the LX200 will correctly access every other object in the sky.

e. **LAND**: The LAND menu option transforms the ALTAZ (Altazimuth) mounted LX200 into an electric slewing spotting scope. In this mode, continuous tracking is canceled and all of the celestial modes and menus are non-functional, showing lower case lettering in the displays and a beep tone if you try to enter one of them.

   The LX200 will slew at any one of the four speeds of SLEW, FIND, CNTR, and GUIDE as activated by

pressing the appropriately marked keys on the left side of the Keypad. Altazimuth coordinate readings can still be displayed in the coordinates mode (see **MODE 2**, page 23). Refer to **QUICK START** (page 9) for the LAND menu option, for full operating procedures. You will also find that the addition of the Meade #928 45-Degree Erect Image Prism or the Meade #924 Porro Prism instead of the standard supplied star diagonal prism, will give the normal right-side-up and left-to-right views that you are accustomed to when using a spotting scope.

3. **HOME:** The HOME functions allow the 16" LX200 to be operated from a remote location, or to start the telescope without having to align it. After setting the HOME point, the telescope can determine all alignment parameters by simply finding the HOME point. This procedure is called "HOME Alignment" and requires the following three things to function correctly:

- One of the known SITES (1 to 4)
- Either an accurately leveled telescope or accurately Polar aligned telescope
- Accurate Sidereal time

Since the HOME Alignment routine will almost always be used on telescopes that are permanently mounted, the first two requirements are already satisfied. For transportable situations, the HOME Alignment procedure is only practical when the telescope will be left set-up for several nights. In this case, be sure to use the 1-Star/Leveled alignment if you want to do a HOME Alignment.

The Sidereal time is calculated every time an alignment is performed. Then, an on-board Sidereal clock keeps Sidereal time. Theoretically, every time you turn on the telescope, the Sidereal time is correct, satisfying the third requirement for HOME Alignment.

However, the on-board clocks are only accurate to a few minutes per month. So if you do HOME Alignments every night, the Sidereal time will be accurate enough. But if you only operated the telescope once or twice a month, you should make a habit of resetting the Sidereal time before performing the HOME Alignment.

a. **Setting the HOME Point**: Before the HOME Alignment procedure can be used, the HOME point must be set. This step only needs to be performed once on permanently mounted telescopes, or anytime the telescope is moved.

- Do a complete alignment, either the 1-Star/Leveled ALTAZ or the POLAR.
- Using the Keypad, move the telescope to 0° Dec and 00 HA.
- Go to the HOME menu option and press ENTER. This will bring up the HOME menu.
- Select the SET option by pressing the NEXT key twice, and then pressing ENTER.

The telescope will move back and forth in R.A. searching for the HOME sensor located inside the Drive Base. When it finds that sensor, it performs the same task in Dec. When complete, the message "Home search complete" is displayed. The SET routine only looks at 30° sections of the gears, and if the second step, above, is skipped or done incorrectly, the telescope will not find the sensors and "Home search failed" will be displayed.

b. **Using the HOME Alignment Routine**: Using the HOME Alignment routine only requires two steps (assuming the SET has been performed). First, before turning off power to the telescope, park the telescope by selecting PARK from the HOME menu. This will position the telescope to a known position which the telescope remembers even when the power is off. Then turn off the power.

When turning the power back on, perform the FIND from the HOME menu. That's all there is to it! The telescope will look for the HOME sensors in both axes. When complete, the telescope is ready for operation.

As in the SET routine, the telescope only searches 30° sections of the gears. If you forgot to PARK the telescope, or if it has been manually moved in R.A. and/or Dec. then the second step in paragraph a) will need to be performed before the FIND home can be done.

4. **12/24 HR**: The 12/24 HR 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 will briefly describe the function of each command key on the LX200 Keypad.

To use this menu, move the 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 N/S**: The REVERSE N/S menu selection of the TELESCOPE file reverses the direction of the telescope in North and South movements (*e.g.* when you press the N key the scope will move South or down instead of North or up). This is especially useful during some guiding applications in imaging and observing.

To use the REVERSE N/S menu, move the arrow to REVERSE N/S and press ENTER. If you wish to return the direction commands to the original setting, press ENTER again.

7. **REVERSE E/W:** The REVERSE E/W menu selection of the TELESCOPE file reverses the direction of the telescope in East and West movements (*e.g.* when you press the W key, the telescope will move East instead of West).

To use the REVERSE E/W menu, move the arrow to REVERSE E/W and press ENTER. If you wish to return the direction commands to the original setting, press ENTER again.

8. **BALANCE:** When adding optional equipment to the LX200, like a heavy camera, it is often necessary to rebalance the telescope using the Meade #1404 Tube Balance Weight Systems.

Selecting option #8 from the TELESCOPE menu moves the LX200 telescope rapidly up and down in Declination. This provides an easy way to determine when the telescope is balanced in the Declination axis. (Remember, loosening the Dec. lock to check the balance will cause the LX200 to lose alignment.)

When the telescope is out of balance, the LX200 will draw more current when slewing in the "heavy" direction and the Dec. motor will sound different.

After selecting option #8, watch the Ammeter and listen to the Declination motor to determine when the LX200 is balanced.

9. **HI-PRECISION:** The High-Precision Pointing feature of LX200 allows for very precise pointing of the telescope. By incorporating the unique LX200 SYNC command, 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 1 arc-minute or better pointing accuracy. This makes critical image placement applications, such as CCD imaging, possible.

Normal telescope pointing accuracy is better than 5 arc-minutes when doing a casual alignment, which is more than accurate enough for most observing applications. (A "casual" alignment is one that uses the UNKNOWN SITE or one that is done without the use of a reticle eyepiece to exactly center the alignment stars.) This type of alignment will put objects into the field of view of most eyepieces and is more than adequate for almost any visual observing application.

A "critical" alignment will improve the pointing accuracy of the telescope to 2 arc-minutes or better. This type of alignment requires accurate SITE information, time, date, proper selection of the two alignment stars, and a reticle eyepiece to exactly center the alignment stars. These steps generally require only a few extra seconds to accomplish, and will improve the telescope's positioning by a substantial amount. Using the "critical" alignment will provide telescope positioning suitable for all but the most demanding pointing applications—including CCD imaging with larger chip cameras, like the Meade Pictor 416 and Pictor 1616 CCD cameras.

The HI-PRECISION feature increases the pointing accuracy of the LX200 to 1 arc-minute or better and also requires the "critical" alignment described above. This will yield the best pointing accuracy possible, placing objects onto the active area of the even the smallest CCD cameras available.

It should be stressed that for most applications, using the HP feature is NOT required to get maximum enjoyment out of the telescope. For an evening of simple visual observations, the "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!

The High-Precision Pointing mode requires the "critical" alignment, described above, to maximize the telescope's pointing ability. The LX200 default condition is with HP disabled. To activate the HP mode, select the "hi-precision" option from the TELESCOPE menu (option #9). When selected, "HI-PRECISION" will change to upper case letters.

When HP is active, the LX200 automatically does several things whenever a GO TO is initiated.

a. HP will search the alignment star database and find the three closest stars to the object (or position) entered. This process takes about 10 seconds and the keypad will show Display 26:

Display 26

```
HI-PRECISION
Searching. . .
```

b. The telescope will slew to the nearest alignment star. These are all bright (brighter than 3rd magnitude) stars and far enough apart to insure that there will only be one in the field of view. The keypad display will show Display 27:

Display 27

```
Center STAR XXX
then press GO TO
```

Using a reticle eyepiece, center the star in the field of view. (Or center the star on the CCD chip if using a CCD camera.) Press GO TO when the star is centered.

NOTE: If this 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.

c. The telescope will slew to the selected object or position.

10. **SLEW RATE:** Option #10 in the TELESCOPE menu is for changing the slew rate of the LX200 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:

    a. Press the MODE key on the Keypad until the TELESCOPE/OBJECT LIBRARY menu appears. The cursor should be next to the TELESCOPE option—if not, press the PREV key to move the cursor up one space.

    b. Press ENTER to select the TELESCOPE functions.

    c. 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 4 is displayed. This represents the current slew rate in degrees per second.

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

    e. 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 4 degrees per second.

11. **BACKLASH:** The Backlash feature is only available in the POLAR mode.

    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 LX200 Keypad to the GUIDE speed, monitoring the star location (*e.g.* with an off-axis guider), 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 is reversed.

    To program the Dec. backlash, use this procedure:

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

    "11) BACKLASH 00"

    The "00" in the display shows the number of arc-seconds of backlash the LX200 is set to compensate for (the default setting is 0 arc-seconds).

    b. 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.

    c. The GUIDE speed for the Declination motor is 15 arc-seconds per second. Therefore, multiply the number of seconds delay by 15.

    d. 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 c, above. Press ENTER when the number is entered.

e. Check the time delay as described in Step b. If there is a delay, increase the compensation number. If there is a slight jump when reversing direction, then the number is too big.

When the compensation number is correct, the LX200 telescope will move almost instantly when reversing the direction in Declination. This compensation feature also works in conjunction with popular CCD autoguiders, allowing for more accurate autoguiding.

This number is stored in permanent memory and should never need to be set again.

12. **FDR**: The Field De-Rotator option is only available in the ALTAZ mode.

Selecting this option activates the Field De-Rotator socket on the Power Panel. When activated, the display will show the number of arc-seconds of field rotation for the part of the sky the telescope is currently pointing to. When not using the De-Rotator, this function should be turned off.

Field rotation can range from almost no rotation (at certain parts of the horizon) to infinity at the exact zenith (straight up). The #1222 Field De-Rotator has a practical limit of 120 arc-seconds per second. This creates a cone of a little less than 10° where the De-Rotator cannot keep up with the field rotation. When taking exposures near the zenith, this number should be monitored and the exposure stopped should the field rotation approach 120 arc-seconds per second.

13. **FAN**: When the fan is plugged into the Power Panel, this switch will turn the fan on and off.

The fan will aid in the temperature stabilization of the telescope. Extreme temperature variations will require about 30 minutes of fan operation to stabilize. During observations, the fan should be turned off to minimize any vibrations.

14. **DEC LEARN and**
15. **DEC CORR:** These two options are only available in the POLAR mode.

A star that drifts consistently North or South during guiding, can also be corrected for. Move the 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 astrophoto exposure time. The longer that you train, the more accurate the DEC LEARN will be. Once the desired time is finished, press ENTER and the training will cease. The telescope will then determine how many key pushes that you gave in N and S and choose the direction based from which direction received more commands. It then averages the time between key pushes in the chosen direction. In this way, the telescope 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 arrow to DEC CORRECT and press ENTER. To halt the play back press ENTER again. To erase the DEC LEARN training, either move the arrow back to DEC LEARN and press ENTER twice or turn the LX200 off.

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 objects. The LX200 Object Library is accessible in the most results-getting, user friendly system ever designed for observers and astrophotographers.

The core library, essentially a "greatest hits of the sky," encompasses eight planets of our solar system from Mercury to Pluto, 351 stars (doubles, variables, pole stars), the entire Messier catalog of 110 objects, 7840 of the finest galaxies, diffuse and planetary nebulae, and globular and open star clusters

The position epoch of these objects is for real time, updated each time you turn on your LX200. Even the planet's positions have their orbits calculated! This not only qualifies the LX200 as the most accurate integrated object library available, it will never require updated software for star and planet orbital precession.

There are three primary ways to use the Object Library. You can directly access the library by using the M, STAR, or CNGC keys (see **THE LX200 KEYPAD HAND CONTROLLER**, page 14) and entering a specific catalog number, the START FIND option can be used to logically find objects in organized strips of the sky that can be custom tailored to only show the objects you wish to see with a selection of object types, size brightness, etc., or you can scan the sky and have the Object Library tell you what is in the field of view in 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 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. Now you can access the four menu selections within the OBJECT LIBRARY by moving the arrow to the desired menu selection by using the PREV or NEXT keys and doing the following steps.

1. **OBJECT INFO**: Press the ENTER key to read the type, brightness, size, and quality. Press ENTER again to read the coordinates. Press ENTER once more to determine how far off the telescope is pointing from the entered object (this is displayed in LCD bars, each bar is ten degrees, or if it is on the object, no bars). This same information can also be accessed at any time by pressing the ENTER key for any object entered by the M, STAR, or CNGC keys. Press MODE to exit to the main menu file.
2. **START FIND**: The START FIND option resources the CNGC objects within the Object Library and begins a logical search starting wherever the telescope is positioned when activated. To cover the entire visible sky it will make 31 strip divisions about 12° 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 CNGC objects it will repeat its sequence until new objects are visible.

Press the ENTER key and the hand control will display the first object in its finding sequence. This first object is selected by the LX200, based off of where the instrument is pointing in the sky when you entered START FIND. To point your LX200 to the object displayed, press the GO TO key and it 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, and the display will show the new CNGC object. If you do not wish to view this object, press NEXT again. If you wish to return to a previously viewed object, press the PREV key until the desired catalog number is displayed and press the GO TO key. If you have set some limitations in the PARAMETERS option, it will only find those objects within your chosen confines.

If you find that 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 in essence synchronizes the LX200 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, provided it is not too far away from the object that you matched coordinates to.

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

3. **FIELD**: Press the ENTER key to identify objects in the field of view of the telescope. The LX200 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 28:

Display 28

```
Objects: 5
Center: CNGC 4438
```

Press the ENTER button to reveal information about the object as shown in Display 29:

Display 29

```
CNGC 4438 VG GAL
MAG 10.1 SZ 9.3'
```

Display 29 is interpreted; **C**OMPUTERIZED **N**EW **G**ENERAL **C**ATALOG Object **#4438**, **V**ERY **G**OOD, **GAL**AXY, **MAG**NITUDE **10.1**, **SIZ**E **9.3'** (in arc minutes). Press ENTER again to read the coordinate location of the object (notice the * legend next to RA coordinate number, it indicates the catalog coordinates of the object, not necessarily where the telescope is pointing) as shown in Display 30:

Display 30

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

Press ENTER once more to see physically how far your telescope will have to move to acquire the object entered. The display will show LED bars, each bar represents ten degrees of movement as shown in Display 31:

Display 31

If you are centered on the object already, such as if you are in the FIELD menu selection, or if you have already made a GO TO command in one of the other methods for finding an object, the above display will be blank.

To review any of the data of an object, continue to press ENTER until the desired field appears. You can use these 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**: It is here that you can edit the Press ENTER to find eight options which can be reviewed by scrolling through this menu selection using the PREV or NEXT key. To edit an option, move the arrow to the desired option and press and hold ENTER until a double beep is heard and a blinking cursor appears (except in the BETTER option) Where numerical values are to be input, simply type them in from the Keypad. If you make a mistake, you can 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 menu file option allows you to select the type of CNGC objects that you wish to locate. GPDCO represent:

OBJECT SYMBOL LEGEND	
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 NEXT 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. You can then deselect the undesired categories.

If you wish to recall a category symbol, move the blinking cursor over the symbol and press the PREV key. After your selections are made, press ENTER.

b. **BETTER**: The BETTER menu file 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, it will select all objects that are very poor through super or what could be considered an "ALL" setting. The object quality symbols are:

QUALITY SYMBOL LEGEND	
SYMBOL	**DESCRIPTION**
SU	SUPER
EX	EXCELLENT
VG	VERY GOOD
G	GOOD
FR	FAIR
PR	POOR
VP	VERY POOR

If you wish to define the 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 LX200 will now select objects that look Very Good through Super.

c. **HIGHER:** The Higher menu file option sets the horizon setting for the telescope. At power up, the setting is 00 degrees, which assumes that you have an unobstructed line-of-site 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, you can set an artificial horizon level so that your LX200 will not try to find objects below your setting.

Enter the number of degrees above the horizon that will clear the obstructions in the sky. To roughly judge how many degrees the obstruction is taking up of the sky, merely hold your fist at arms length. Each fist diameter is approximately 5 degrees. So, if a tree is three fists high, you would make a setting of 15 degrees in the HIGHER setting. Once the setting is finalized, press ENTER.

d. **LOWER:** The LOWER menu file option sets the zenith limit setting for the telescope. At power up, the setting is 90 degrees, which assumes that you point the telescope straight up. If, however, you have instruments on the telescope which will not clear the fork arms, or if you want to avoid the 10° Field De-Rotator limit, this setting can be used.

Enter the number of degrees from the zenith that you want to limit. Once the setting is finalized, press ENTER.

e. **LARGER:** The LARGER menu file option allows settings of the lower apparent size limit of the objects you wish to see. At power up it is set to 000' (arc minutes). In order to make a decision as to the size limits that you may 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 the desired image scale coverage that would be most impressive with different types of films or CCD cameras. Enter the new value in arc minutes, then press ENTER to exit to the option file.

f. **SMALLER:** This menu option is the upper size object limit. At power up the setting is for 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 value in SMALLER is for astrophotographic or CCD imaging requirements where we don't want the object to exceed the imaging area of the film or the CCD chip.

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

You may want to adjust the magnitude level to a brighter value starting at perhaps the limiting visual magnitude of your LX200, which is approximately 15.5 for the 16" LX200. If you are taking astrophotographs, the limiting magnitude is about 18.0. Sky conditions also greatly affect the limiting magnitude due to atmospheric haze, high clouds, light pollution, or combinations thereof.

h. **FAINTER:** The upper level of brightness may also be adjusted with the FAINTER menu file option, although you may find few applications for limiting it to a lower value.

i. **RADIUS:** The RADIUS value sets the boundaries of what and how many objects the LX200 recognizes is in a given eyepiece while in the FIELD menu. At power up the RADIUS menu file option is set to 15 arc minutes.

To calculate the true field of an eyepiece, first divide the focal length of the telescope (*e.g.* 4064mm for a 16" f/10) by the focal length of the eyepiece (the standard supplied eyepiece is a 26mm Super Plössl, 4064 divided by 26 equals 156x 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 156 equals 0.33 degrees, multiplied by 60 equals 20 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, 20 arc minutes divided by 2 equals 10 arc minutes.

2. Mode Two: COORDINATES/GO TO

Mode Two allows you to see where you have pointed the LX200 in two celestial coordinate formats, either R.A. and Dec. or Altazimuth. Also in this mode you can enter new Right Ascension and Declination coordinates for any sky position, perhaps to locate objects not in the LX200 library such as comets or asteroids and have your telescope slew to the new coordinates.

a. Coordinates Menu File

You will at first see the RA = and DEC = coordinates of where the telescope is pointing. If you move the LX200 with the N, S, W, or E keys, the coordinates display will immediately update the new position in Right Ascension and Declination.

You can also display computed information of the Altazimuth coordinates (ALT = and AZ =) by pressing the ENTER key. To return to RA = and DEC =, press the ENTER key again.

The RA = display is broken down into hours, minutes, and tenths of a minute, and the DEC = display is broken down into + for North Declination and - for South Declination into degrees and minutes as shown in Display 32:

Display 32

```
RA = 02:45.9
DEC = +22'54
```

If you have made an ALTAZ style of alignment, the ALT = and AZ = coordinate display is formatted so that 0 degrees Azimuth (AZ =) is due South that increases to up to 359 degrees and 59 minutes moving clockwise, or from due South moving Westerly. Altitude (ALT =) is formatted so that straight overhead is +90 degrees and 00 minutes, decreasing to +00 degrees, and 00 minutes as you move the telescope level with the horizon, and then as the LX200 moves below +00.00 it will give minus Altitude readings. The Altazimuth coordinate display is shown in Display 33:

Display 33

```
ALT = +72'50
AZ =   158'10
```

While in ALTAZ, you will find during slewing in one direction, that both the RA = and DEC = display will change at the same time, while the ALT = and the AZ = display will only change in the direction that the telescope is being slewed. It is also important to note that only the Declination Setting Circle (3, Fig. 1) will give a correct reading. The R.A. Setting Circle (9, Fig. 1) will only give correct readings in the POLAR setting (see **APPENDIX A**, page 26).

b. GO TO Menu Option

The GO TO menu option, allows you to enter new Right Ascension and Declination coordinates of any object in the sky, so that the LX200 will slew to the new position. With this ability, your LX200 knows no bounds, any celestial object, including comets, asteroids, etc. are easily found, provided you have accurate coordinate data to refer to.

To enter a new pointing position in Right Ascension and Declination, press the GO TO key and a double beep will be heard followed by a blinking cursor that will appear over the RA = coordinate numbers. At this point, type in the new Right Ascension coordinate numbers, then press the ENTER key. You will then notice that the blinking cursor is over the DEC = coordinate numbers. Enter the new Declination coordinate numbers, then press the ENTER key and the LX200 will slew to the new coordinate position.

You can also slew to ALTAZ coordinates from the ALTAZ display as described above.

If you need to enter a minus 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 you are already at a minus (-)

Declination setting and wish to enter a plus (+) 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 life pulse of your LX200. At power up, the telescope's sidereal clock automatically allows the system computer to make orbital calculations of the planets, and correct stellar precession for superior pointing ability.

Your accurate initial input of local time and date, with its long-life lithium battery back-up, need not be re-entered every time you use the LX200, thus enhancing the user friendly aspects of the instrument.

To set the local time and date and to enter the correct GMT offset (see **QUICK START**, page 9). Be sure to use your local hour setting appropriately in either 12 hour or 24 hour format as predetermined by the 12/24 HOUR TELESCOPE menu file option.

The long-life lithium battery (Panasonic CR2032 3 vDC or Duracell DL2032B) is stored behind the Power Panel of the Drive Base (see **APPENDIX D: Behind the Power Panel**, page 50 for battery replacement information).

4. Mode Four: TIMER/FREQ

a. TIMER = Menu Option

The TIMER = menu option is for accurately timing different observing or imaging tasks for up to 12 hours long. Counting down to zero, in the hours, minutes, and seconds format, it will give a pleasant beeping tone to notify you that the time is up.

To set the TIMER, move the 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 you need 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 and the cursor will delete. When you are ready to start your time count-down, press the ENTER key once more. To pause the count-down press ENTER again, and then again to resume.

If you want an automatic 12 hour countdown, press the ENTER key without holding. Then press ENTER to countdown.

b. FREQ = Menu File

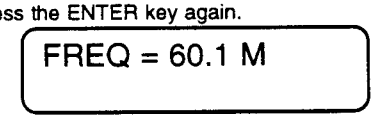
FREQ = (Frequency) allows you to adjust the tracking speed (not slew speed) of the LX200 in tenths of a hertz from 56.4 Hz to 60.1 Hz, so that you can match virtually every celestial motion in the sky. Some popular drive rate settings are:

FREQ RATE	DESCRIPTION	NOTES
60.1 Hz Q	Sidereal rate; Quartz setting	Default rate at power up. Gives sidereal frequency accuracy to ±.005%; Best for astrophotos
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

There are three menu file options in FREQ =. To see or set the options, move the arrow to FREQ = and press ENTER. 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 different rate, press the ENTER key to see 60.1 M and then again to see 60.1 M with the up and down arrow. These two menu file options can adjust the tracking speeds. The adjustment techniques are described below:

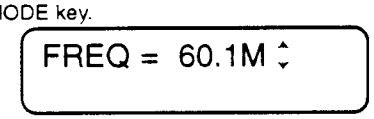
Display 34 shows the manual rate menu file option that can be adjusted by pressing and holding the ENTER key to get the double beep tone and the blinking cursor. Type in the new rate, then when finished, press the ENTER key again.

Display 34



Display 35 shows the menu file option that 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.

Display 35



5. Mode Five: KEYPAD OFF/BRIGHTNESS ADJUST

In order to see very faint objects, it will sometimes be necessary to either dim or completely turn off the Keypad red LCD 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.

This brightness setting also dims the Power Panel power LED and Ammeter.

NOTE: The backlighting is done by edge lighting a plastic light bar underneath the Keypad. Four LEDs 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.

MAGNIFICATION AND FIELD OF VIEW

1. Magnification

The magnification (power) of the telescope depends on two characteristics: the focal length of the main telescope and the focal length of the eyepiece used during a particular observation. For example, the focal length of the 16" LX200 f/10 telescope is fixed at 4064mm. To calculate the power in use with a particular eyepiece, divide the focal length of the eyepiece into the focal length of the main telescope.

Example: The power obtained with the LX200 with the SP 26mm eyepiece is:

$$\text{Power} = \frac{4064\text{mm}}{26\text{mm}} = 156\text{X}$$

The type of eyepiece (whether MA "Modified Achromatic," PL "Plössl," SP "Super Plössl," etc.) has no bearing on magnifying power but does affect such optical characteristics as field of view, flatness of field and color correction.

The maximum practical magnification is determined by the nature of the object being observed and, most importantly, by the prevailing atmospheric conditions. Under very steady atmospheric "seeing," the 16" LX200 may be used at powers up to about 800x on astronomical objects. Generally, however, lower powers of perhaps 300x to 400x will be the maximum permissible, consistent with high image resolution. When unsteady air conditions prevail (as witnessed by rapid "twinkling" of the stars), extremely high-power eyepieces result in "empty magnification," where the object detail observed is actually diminished by the excessive power.

When beginning observations on a particular object, start with a low power eyepiece; get the object well-centered in the field of view and sharply focused; then try the next step up in magnification. If the image starts to become fuzzy as you work into higher magnifications, then back down to a lower power—the atmospheric steadiness is not sufficient to support high powers at the time you are observing. Keep in mind that a bright, clearly resolved but smaller image will show far more detail than a dimmer, poorly resolved larger image.

Because of certain characteristics of the human eye (in particular, eye pupil diameter) and because of optical considerations inherent in the design of a telescope, there also exist minimum practical powers. Generally speaking, the lowest usable power is approximately 4x per inch of telescope aperture, or about 64x in the case of the 16" telescope. During the daytime, when human eye pupil diameter is reduced, the minimum practical power with the 16" LX200 is increased to about 120x; powers lower than this level should be avoided during daytime observations. A reasonable magnification range for daytime terrestrial observations through the 16" LX200 is from about 150x to 200x. It should be noted, however, that the higher magnifications may not be used due to atmospheric distortion caused by heat, moisture, and particulate matter suspended in the air.

Accessories are available both to increase and decrease the operating eyepiece power of the telescope. See your Meade dealer and the latest Meade Catalog for information on accessories.

2. Apparent Field and Actual Field

Two terms that are often confused and misunderstood are "Apparent Field" and "Actual Field." "Apparent Field" is a function of the eyepiece design and is built into the eyepiece. While not totally accurate (but a very good approximation), "Apparent Field" is usually thought of as the angle your eye sees when looking through an eyepiece. "Actual Field" is the amount of the sky that you actually see and is a function of the eyepiece being used and the telescope.

The "Actual Field" of a telescope with a given eyepiece is calculated by dividing the "Apparent Field" of the eyepiece by the power obtained using that eyepiece.

The table below lists the most common eyepieces available and the "Apparent Field" for each. The power and "Actual Field" of view that each eyepiece yields is listed for each basic telescope optical design.

	8" f/10	10" f/10	12" f/10	16" f/10
Eyepiece/Apparent Field	Power/Actual Field	Power/Actual Field	Power/Actual Field	Power/Actual Field
Super Plössl Eyepieces (5-elements; 1.25" O.D., except as noted)				
6.4mm/52°	313/0.17°	391/0.13°	476/0.11°	635/0.08°
9.7mm/52°	206/0.25°	258/0.20°	314/0.17°	419/0.12°
12.4mm/52°	161/0.32°	202/0.26°	246/0.21°	328/0.16°
15mm/52°	133/0.39°	167/0.31°	203/0.26°	271/0.19°
20mm/52°	100/0.52°	125/0.42°	152/0.34°	203/0.26°
26mm/52°	77/0.68°	96/0.54°	117/0.44°	156/0.33°
32mm/52°	63/0.83°	78/0.67°	95/0.55°	127/0.41°
40mm/44°	50/0.88°	63/0.70°	76/0.53°	102/0.43°
56mm/52° (2" O.D.)	36/1.46°	45/1.16°	54/1.04°	73/0.71°
Super Wide Angle Eyepieces (6-elements; 1.25" O.D., except as noted)				
13.8mm/67°	145/0.46°	181/0.37°	221/0.30°	294/0.23°
18mm/67°	111/0.60°	139/0.48°	169/0.40°	226/0.30°
24.5mm/67°	82/0.82°	102/0.66°	124/0.54°	166/0.40°
32mm/67° (2" O.D.)	63/1.07°	78/0.86°	95/0.71°	127/0.53°
40mm/67° (2" O.D.)	50/1.34°	63/1.07°	76/0.88°	102/0.66°
Ultra Wide Angle Eyepieces (8-elements; 1.25" O.D., except as noted)				
4.7mm/84°	426/0.20°	532/0.16°	649/0.13°	865/0.10°
6.7mm/84°	299/0.28°	373/0.23°	455/0.18°	607/0.14°
8.8mm/84° (1.25" - 2" O.D.)	227/0.37°	284/0.30°	346/0.24°	462/0.18°
14mm/84° (1.25" - 2" O.D.)	143/0.59°	179/0.47°	218/0.39°	290/0.29°

APPENDIX C:
LX200 64,359-OBJECT LIBRARY

1. The LX200 64,359-Object Library

The LX200 64,359-Object Library is a collection of the most studied and fantastic objects in the sky. It includes:

- 15,928 SAO (Smithsonian Astrophysical Observatory) Catalog of Stars: All stars brighter than 7th magnitude.
- 12,921 UGC (Uppsala General Catalog) Galaxies: Complete catalog.
- 7,840 NGC (New General Catalog) objects: Complete Catalog.
- 5,386 IC (Index Catalog) objects: Complete catalog.
- 21,815 GCVS (General Catalog of Variable Stars) objects: Complete catalog.
- 351 Alignment Stars: LX200 alignment stars.
- 110 M (Messier) objects: Complete catalog.
- 8 major planets from Mercury to Pluto.

This appendix has three object listings in sections 2, 3, and 4. Section 2 is a partial list of 278 of the best NGC objects. These are most of the best objects in the sky, and as such, make good first targets. Section 3 is a list of the 250 brightest stars and 100 double stars. The complete Messier list is shown in Section 4.

The above databases are accessed through the M, STAR, and CNGC keys. The M key accesses the M object database only; the STAR key the SAO, STAR, GCVS, and planet databases; and the CNGC key the UGC, NGC, and IC databases.

When the STAR or CNGC key is pressed, the display will show which database is currently active. At this point you can enter the object number for that database, or hit ENTER to bring up the menu to change databases. The LX200 will remember which database was last used.

a. SAO Catalog

The standard Star catalog used in astronomy, this catalog includes all stars brighter than 7th magnitude.

b. UGC Catalog

This catalog of galaxies includes objects as faint as 15th magnitude.

c. CNGC Catalog

The CNGC is enhanced from the RNGC in many ways. Angular sizes are given in arc-seconds on the CNGC listing, and in a convenient scaled format on the LX200 display. Magnitudes are given to 0.1 magnitude where possible.

The coordinates in the CNGC listing are listed for the year 2000. The LX200 calculates object positions upon power up to the current date (as shown on the time/date display). This makes the LX200 pointing more accurate.

Objects have been assigned a "Visual Quality Rating" (VQ). A large number of VQs have been obtained by observing the objects. To make the VQs as useful as possible, all observations have been made with the same telescope and eyepiece under substantially identical observing conditions. Only for very small objects was a higher power eyepiece used. Your "Visual Quality Rating" of a particular object will vary, largely due to sky conditions.

If the object has been rated by observation, an upper-case character (ABCDEFG) is used for the VQ on the CNGC listing. If the object has not been observed, the VQ has been estimated by a computer program from the object type, size, and brightness and the VQ is specified in lower-case characters (abcdefg). The VQs for visually-rated objects are a considerably more consistent guide to observability and appearance than either the computed VQs or an examination of the type, magnitude, and size data.

The following guide to VQs was used in the visual observation process:

SUPER	Very bright object with very interesting shape or structure.
EXCEL	Bright object with very interesting shape or structure. OR Very bright object with moderately interesting shape or structure.
V GOOD	Bright object with moderately interesting shape or structure. OR Very bright object with little or no interesting shape or structure.
GOOD	Easy to see without averted vision with some interesting shape or structure. OR Bright object, but little or no interesting shape or structure.
FAIR	Easy to see without averted vision, but little or no interesting shape or structure.
POOR	Easy to see with averted vision. Often borderline visible without averted vision.
V POOR	A struggle to see with careful use of averted vision.
(none)	Not yet rated AND missing information for computer estimate. OR Could not see despite careful use of averted vision.

Most of the objects in the CNGC are visible with standard instrumentation and observing conditions used to obtain the visual quality ratings. It is a good indication of what to expect with similar equipment by experienced deep-sky observers in excellent conditions. Naturally smaller telescopes and/or less optimal observing conditions will lower the apparent quality of all objects.

The following is a description of the format of the optional **CNGC** listing for each object:

COLUMN	NAME	DESCRIPTION
1	**CNGC #**	CNGC 0001 - CNGC 7840
2	**RA**	Right Ascension
3	**DEC**	Declination
4	**SIZE**	Size of object (arc-seconds)
5	**MAG**	Magnitude (-5.5 through 19.9)
6	**TYPE**	Type of object
7	*	* object is not in the RNGC
8	**ALT CAT**	Alternate catalog name & number
9	**VQ**	Visual Quality Rating (abcdefg) or (ABCDEFG)
10	**TAGS**	Object Type # (0-F): S = Sky-Cat : T = Tirion
11	**COMMENTS**	Name, comments, other info

The following types are distinguished in the **CNGC.**

TYPE	LEGEND	DESCRIPTION
0	**None**	Unverified Southern Object
1	**OPEN**	Open Cluster
2	**GLOB**	Globular Cluster
3	**DNEB**	Diffuse Nebula
4	**PNEB**	Planetary Nebula (or SN Remnant)
5	**GAL**	Galaxy
6	**OPEN + DNEB**	Open Cluster + Diffuse Nebula
7	**None**	Non-Existent Object
8	**STAR**	Star
9	**MULTI+STAR**	Multiple Star
A	**MULTI+GAL**	Multiple Galaxy (Usually Interacting)
B	**DNEB**	Dark Nebula in front of Diffuse Nebula
C	**GAL+OPEN**	Open Cluster in External Galaxy
D	**GAL+GLOB**	Globular Cluster in External Galaxy
E	**GAL+DNEB**	Diffuse Nebula in External Galaxy
F	**GAL+OPEN+DNEB**	Open Cluster + Diffuse Nebula in Galaxy
S		Object is also listed in the *Sky Catalogue 2000*
T		Object is also listed in the *Tirion Sky Atlas 2000*

d. IC Catalog

This is the complete IC catalog of a variety of objects that the standard NGC catalog missed.

e. GCVS Catalog

This is a complete catalog of variable stars.

Variable stars from the GCVS are entered using a six digit number. The first two digits, refer to the constellation where the variable star is located and is listed in the table below.

The next four digits are assigned sequentially within each constellation according to the standard sequence of variable-star designations (R, S, ...).

Therefore, the first star in the constellation of Virgo would be entered as: 860001.

f. Star Catalog

The STAR catalog contains the 250 brightest stars (STAR 1 through STAR 250), 100 interesting double stars (STAR 251 through STAR 350), plus Sigma Octantis, the southern pole star (STAR 351).

g. M (Messier) Catalog

The M catalog has been the benchmark deep-sky catalog for years. Recently expanded to 110 objects, the M (Messier) catalog contains most of the best deep-sky objects.

h. Planet Catalog

The LX200 calculates the orbital positions of the eight major planets for the current calendar date. To access a planet, use the STAR key and enter the appropriate number as indicated below: *(NOTE: 903 is the Moon.)*

OBJECT LIBRARY PLANET LEGEND			
PLANET	**STAR #**	**PLANET**	**STAR#**
MERCURY	901	**SATURN**	906
VENUS	902	**URANUS**	907
MARS	904	**NEPTUNE**	908
JUPITER	905	**PLUTO**	909

Code	Const	Code	Const	Code	Const	Code	Const
01	AND	23	CIR	45	LAC	67	PSA
02	ANT	24	COL	46	LEO	68	PUP
03	APS	25	COM	47	LMI	69	PYX
04	AQR	26	CRA	48	LEP	70	RET
05	AQL	27	CRB	49	LIB	71	SGE
06	ARA	28	CRV	50	LUP	72	SGR
07	ARI	29	CRT	51	LYN	73	SCO
08	AUR	30	CRU	52	LYR	74	SCL
09	BOO	31	CYG	53	MEN	75	SCT
10	CAE	32	DEL	54	MIC	76	SER
11	CAM	33	DOR	55	MON	77	SEX
12	CNC	34	DRA	56	MUS	78	TAU
13	CVN	35	EQU	57	NOR	79	TEL
14	CMA	36	ERI	58	OCT	80	TRI
15	CMI	37	FOR	59	OPH	81	TRA
16	CAP	38	GEM	60	ORI	82	TUC
17	CAR	39	GRU	61	PAV	83	UMA
18	CAS	40	HER	62	PEG	84	UMI
19	CEN	41	HOR	63	PER	85	VEL
20	CEP	42	HYA	64	PHE	86	VIR
21	CET	43	HYI	65	PIC	87	VOL
22	CHA	44	IND	66	PSC	88	VUL

APPENDIX D:
MAINTAINING YOUR LX200

1. Keeping Your Telescope Clean

Prevention is the best recommendation that a telescope owner can follow to keep astronomical equipment in top working order. Proper measures taken during observation and when storing equipment between observing runs can add many years of trouble free use.

Dust and moisture are the two main enemies to your instrument. When observing, it is advisable to use a proper fitting dew shield. The dew shield not only prevents dew from forming, and dust from settling on the corrector plate lens, it prevents stray light from reducing image contrast.

Although dew shields go a long way to prevent moisture build-up, there can be times when the telescope optics will have a uniform coating of moist dew. This is not particularly harmful, as long as the instrument is allowed to let the dew evaporate. This can be done with a hair dryer, or just setting up the telescope indoors with the dust covers removed. It is also advisable that you let the foam lined case for the LX200 dry out indoors for a day if the night was moist. Packing your telescope away in a moist case can result in giving it a steam bath later.

CAUTION: Anytime the LX200 is being stored or transported, be sure to release the R.A. and Dec. Locks, to prevent serious damage to the drive gears.

CAUTION: Never attempt to wipe down optics that are covered with dew. Dust and dirt may be trapped with the collected dew, and upon wiping the optics you may scratch them. After the dew has evaporated you will most likely find them in fine condition for the next observing session.

If you live in a very moist climate, you may find it necessary to use silica desiccant stored in the telescope's case to ward off moisture and the possibility of fungus growing on and within the coatings of the optics. Replace the desiccant as often as necessary.

Those living in coastal areas or tropic zones should also cover the electronic ports on the Power Panel and the Keypad with gaffers tape to reduce corrosion on the metal contacts. Apply a dab of a water displacement solution (*i.e.* WD-40) with a small brush on all interior metal contacts and the input cord metal contacts. The Keypad and all separate accessories should be kept in sealable plastic bags with silica desiccant.

A thick layer of dust will attract and absorb moisture on all exposed surfaces. Left unattended, it can cause damaging corrosion. To keep dust at bay when observing, the telescope can be set up on a small section of indoor/outdoor carpet. If you are observing for more than one night in a row, the telescope can be left set up but covered with a large plastic bag (such as the one supplied with the telescope). The rear cell opening of the LX200 can also be sealed off to the elements by threading on the optional accessory Skylight 1A Dust Seal. Eyepieces, diagonals, and other accessories are best kept in plastic bags and stored in cases, such as the Meade #50 Accessory Case.

All of the non optical surfaces of the LX200 should be cleaned routinely with a soft rag and alcohol to prevent corrosion. The cast metal surfaces and the individual exposed screws can also be kept looking new and corrosion free by wiping them down with a water displacement solution. Take care not to smear the solution onto any optical surface, and to wipe up any excess solution with a clean dry cloth. The painted tube can be polished with a liquid car polish and a soft rag.

Surprisingly, **the most common telescope maintenance error is cleaning the optics too often.** A little dust on any of the optical surfaces causes virtually zero degradation of optical performance. It should be of no concern whatsoever to see some small particles on the inside or outside of telescope optics. Should the optics get more dust on them than you would care for, simply use a photographic grade camel hair brush with very gentle strokes. You can also blow off dust with an ear syringe (available from a local pharmacy).

There is a point, however, when the optics must be cleaned. This is when you can easily tell that there is a thin layer of fine particulates that make the optics look very slightly hazy. To clean the optics we must suggest that you make your own lens cleaning solutions, since it is impossible to know all of the ingredients used in commercial lens cleaners. Pure isopropyl alcohol (90% or better) will clean most residual film build-up on optical surfaces (and metal surfaces too).

Organic materials (*e.g.*, fingerprints) on the front lens may be removed with a solution of 3 parts distilled water to 1 part isopropyl alcohol. A single drop of biodegradable dishwashing soap may be added per pint of solution. Use soft, white facial tissues and make short, gentle strokes. Change tissues often.

CAUTION: Do not use scented, colored, or lotioned tissues or damage could result to the optics.

Sprayer bottles are a convenient dispenser of lens cleaning solutions onto the tissues. Use soft, white facial tissues and make short, gentle strokes. Change tissues often. If the optics are small (such as viewfinders or eyepieces), the tissue can be rolled to the appropriate thickness and then broken in half to create two cleaning wands. It is advised that you avoid many of the so-called lens cleaning papers (many which contain fiberglass), lens cloths, or chamois.

Before attempting to clean an optical surface with a liquid solution, it is very important that as much dust as possible is removed by using forced air and/or gentle strokes with a photographic grade camel hair brush. The forced air can come from a rubber ear syringe, or canned compressed air from a photographic supply store. Be sure to hold the canned air in a vertical position and try spraying compressed air on your hand before aiming at the optics to see if any of the propellant (solid material) comes out. Propellant is very difficult to remove from optics, so take care not to tip the can when using it. If you have access to a compressor hose, be sure that it is filtered to prevent oil from being sprayed on the optics.

Once you are confident that you have removed most of the dust and large particles, begin cleaning with the mixture described above. Pour or spray enough solution onto a pillow or wand of tissue until it is quite wet. If you are cleaning a corrector plate, use radial strokes with a smooth pillow of tissue, starting from the center out, using no pressure. If you are cleaning small optical surfaces, use the rolled wands of tissue starting from the edges then spiraling in to the center, again using no pressure. Never pour or spray the solution onto the corrector plate or eyepieces themselves, as the liquid may go behind or in between lenses, where it is difficult or impossible to reach. Never attempt to disassemble an eyepiece to clean the inner elements, as you will certainly not be able to properly center and re-assemble the optical train.

Use dry tissue to make the final clean up, again using no pressure. If there is still some sort of residue, repeat the procedure using the three part formula described above, again using the same cleaning techniques.

The inside surface of the corrector plate and secondary mirror may at some point become dirty due to particles falling inside the tube when removing or replacing the rear dust cover or threading on accessories. To reduce the chance of interior contamination, the Meade Skylight 1A Dust Seal is very effective. If the Dust Seal is not used, it helps to have the rear cell pointed downward when replacing the rear dust cover or attaching accessories.

Another more serious, but not damaging problem is the possibility of a hazy (usually uneven) film building up on the inside of the corrector plate. This can be caused by

environmental pollutants, or temperature changes reacting with the interior paint, causing outgassing or water condensation, or combinations thereof.

It is possible to clean the interior of the optical system yourself or to have it done professionally. In the case of the former, take great care in handling the optics. Any impact or rough handling can damage the surfaces, which may require complete optical replacement at Meade Instruments at substantial cost. Meade Instruments assumes no liability for damage incurred to the telescope by the customer.

The cleaning techniques described above are used while cleaning the interior of the optical system, with one exception: **Do not apply cleaning solutions to the front surface mirrored optics. Only use the soft camel hair brush and the suggested ear syringe for removing particles.** The corrector plate can be cleaned in the normal manner.

To remove the corrector plate, follow the instructions below:

a. Remove the six stainless steel screws that hold the corrector plate retaining ring with the raised white lettering in place. This should be done with the Drive Base placed flat on a work bench, and the optical tube assembly pointed up at a 45-degree angle with the declination lock secure to prevent accidental dislodging of the corrector plate.

b. Remove the retaining ring and locate the two white alignment marks, one at the edge of the corrector plate lens and one beside it on the black metal front cell. These two marks line up and serve as the precise rotational position of the corrector plate in the optical train. If no marks exist, make them yourself with a small paintbrush and some white paint, so that when you return the corrector plate to the front cell you are putting it back in the same position that you took it off.

c. Remove the corrector plate from the telescope, holding it by the plastic central secondary housing. Gently flip it over so that the secondary mirror is facing you, then reinsert the corrector plate back into the front cell. This will allow you full access to clean the interior optical surfaces without touching them with your fingers.

   When cleaning is complete, replace the corrector plate in it's original position, carefully lining up the rotational index marks described in paragraph b, above. Then replace the retainer. Partially thread in all of the stainless steel screws, then, one at a time, snug the screws down to prevent the corrector plate from rotating in the front cell. Take care not to overtighten the screws as it will stress the corrector plate lens.

d. A final check of the optical system is to inspect for proper collimation (alignment) of the optics.

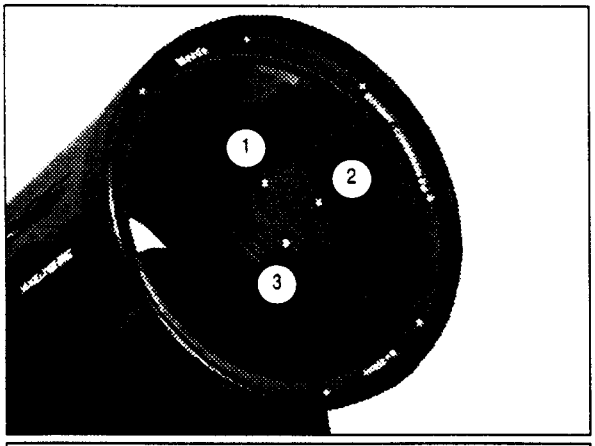


Fig. 15: Collimation of the Optical System. (1), (2), (3) Set screws for adjusting collimation.

2. Collimation of the Optical System

The optical collimation (alignment) of any astronomical telescope used for serious purposes is important, but in cases of the Schmidt-Cassegrain design of the 16" LX200, such collimation is absolutely essential for good performance. Take special care to read and understand this section well so that your LX200 will give you the best optical performance.

For final optical tests, every Meade Schmidt-Cassegrain is precisely collimated at the factory before shipment. Our company is well aware that through shipment and normal handling, the optical alignment can be degraded. The design of the optical support system make the method of collimation easy to do. Even the uninitiated can make an alignment of the optics to the same high precision that is performed at the Meade Instruments Optical Laboratories.

To check the collimation of your LX200, center a bright star that is overhead, or use a reflected "hot spot" of reflected sunlight from a chrome car bumper or a telephone pole insulator, with the supplied 26mm eyepiece. To make a correct evaluation of the alignment it helps if the telescope has been allowed to either cool down or warm up to the ambient temperature where the instrument is set up. Temperature differences between the optics and the outside air can cause distortion in the images.

With the star or hot spot centered, de-focus the image. You will notice that the out of focus star image looks like a ring of light (the dark center of the ring is the shadow of the secondary mirror). Turn the focus knob until the ring of light fills about 1/8th of the eyepiece field. Take note that if you keep de-focusing the star past about 1/8th of a field, that the ring will look perfectly concentric (even on all sides) even if the optics are out of alignment, thus preventing you from seeing any misalignments. If the ring of light does not seem to be even on all sides, or if the dark center seems to be offset in the in the ring of light, follow the method below:

a. To make collimation easy, the only adjustments possible on the 16" LX200 come from the three set screws (shown in Fig.15) located at the edge of the outer surface of the secondary mirror housing.

WARNING: DO NOT FORCE THE 3 COLLIMATION SCREWS PAST THEIR NORMAL TRAVEL AND DO NOT LOOSEN THEM MORE THAN 2 FULL TURNS (COUNTER-CLOCKWISE DIRECTION), OR THE SECONDARY MIRROR MAY COME LOOSE FROM ITS SUPPORT. YOU WILL FIND THAT THE ADJUSTMENTS ARE VERY SENSITIVE: USUALLY, ONLY TURNING A COLLIMATION SCREW 1/2 A TURN WILL GIVE DRAMATIC RESULTS.

b. While looking at the de-focused star image and noticing which direction the darker shadow is offset in the ring of light or noticing which part of the ring is the thinnest (a, Fig. 16), place your index finger in front of the telescope so that it touches one of the collimation set screws. You will see the shadow of your finger in the ring of light. Move your finger (or an assistants finger) around the edge of the black plastic secondary mirror support until you see the shadow of the finger crossing the thinnest part of the ring of light. At this point, look at the front of the telescope where your (or your assistants) finger is aiming. It will either be pointing directly at a set screw, or it will be between two set screws aiming at the set screw on the far side of the black plastic secondary mirror support. This is the set screw that you will adjust.

c. Using the telescope's slow motion controls, move the de-focused image to the edge of the eyepiece field of view (b, Fig. 16), in the same direction as the darker shadow is offset in the ring of light.

d. Turn the set screw that you found with the pointing exercise while looking in the eyepiece. You will notice that

APPENDIX F:
LX200 SPECIFICATIONS

Telescope	16" LX200 f/10
Optical Design	Schmidt-Cassegrain Catadioptric
Clear Aperture	406mm (16")
Primary Mirror Diameter	415.9mm (16.375")
Focal Length	4064mm (160")
Focal Ratio	f/10
Resolution	28 arc sec
Super Multi-Coatings	Standard
Limiting Visual Magnitude (approx)	15.5
Limiting Photographic Magnitude (approx)	18.0
Image Scale (°/inch)	0.36°/inch
Maximum Practical Visual Power	800X
Near Focus	100'
Optical Tube Size	17.5" Dia. x 33" Long
Secondary Mirror Obstruction	5.0" (9.8%)
Telescope Mounting	Heavy-Duty Fork-Type One-piece
Setting Circle Diameters	Dec.: 12"; R.A.: 17"
RA Motor Drive System	4-Speed, microprocessor controlled 18v. DC servo motor; 11.0" worm gear with Smart Drive
Hemispheres of Operation	North and South - switchable
Declination Control System	4 speed, DC servo controlled 11.0" worm gear with Dec drift software & Smart Drive
Motor Drive Gear Diameter	11.0" Worm Gear
Manual Slow-Motion Controls	Dec. and R.A.
Hand Controller	Motorola 68HC05 microcontroller; 2 line x 16 alphanumeric character display; 19 button keypad, red LED backlit
Main Controller microprocessor; volatile	16 MHz 1 Meg program memory ; 64K RAM; 4096 byte no memory (EEROM)
Telescope Size, Swung Down	18" x 26" x 51"
Maximum Slew Speed	4° per Second
35mm Angular Film Coverage	0.49° x 0.34°
35mm Linear Film Coverage @:	
50'	3.1" x 4.4"
500'	3.0" x 4.3"
3000'	18.0' x 25.5'
Tele-Extender Used Without Eyepiece @:.	
50'	2.9" x 4.3"
500'	2.5' x 3.6'
3000'	15.5' x 22.5'
Carrying Case Dimensions	N/A
Net Telescope Weights (approx)	
Telescope	215#
Optional Equatorial Wedge	N/A
Optional Super Wedge	N/A
Field Tripod	90#
Accessories	8#
Shipping Weights (approx)	
Telescope	250#
Equatorial Wedge (optional)	N/A
Super Wedge (optional)	N/A
Field Tripod	95#
Accessories	10#

NOTE: All Meade telescope are under continuous technical review, and specifications may change without notice. We reserve the right to ship our latest models.