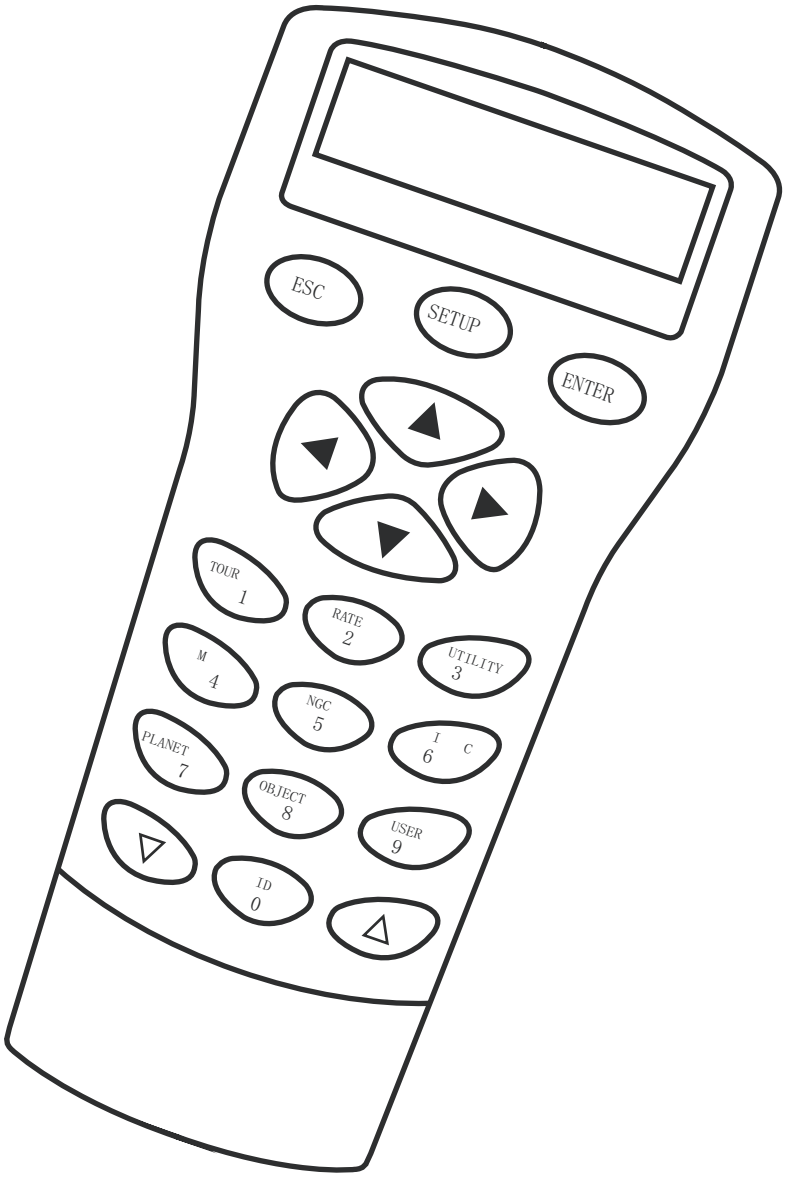
INSTRUCTION MANUAL

SynScan™



210305V1

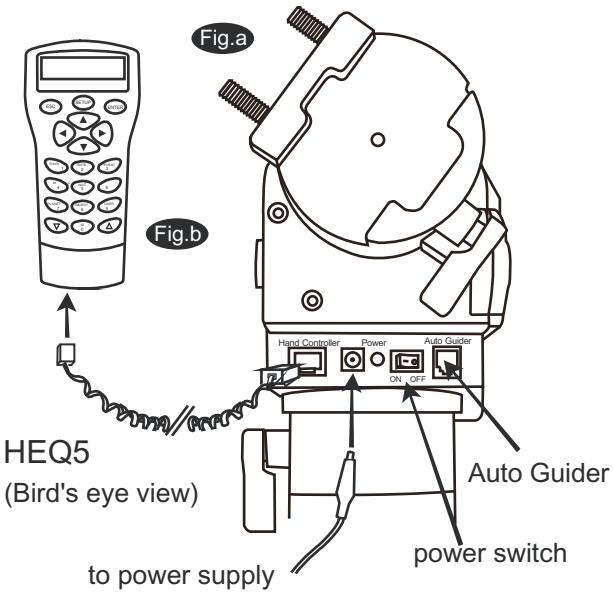
TABLE OF CONTENTS

NEVER USE YOUR TELESCOPE TO LOOK DIRECTLY AT THE SUN. PERMANENT EYE DAMAGE WILL RESULT. USE A PROPER SOLAR FILTER FIRMLY MOUNTED ON THE FRONT OF THE TELESCOPE FOR VIEWING THE SUN. WHEN OBSERVING THE SUN, PLACE A DUST CAP OVER YOUR FINDERSCOPE OR REMOVE IT TO PROTECT YOU FROM ACCIDENTAL EXPOSURE. NEVER USE AN EYEPIECE-TYPE SOLAR FILTER AND NEVER USE YOUR TELESCOPE TO PROJECT SUNLIGHT ONTO ANOTHER SURFACE, THE INTERNAL HEAT BUILD-UP WILL DAMAGE THE TELESCOPE OPTICAL ELEMENTS.

THE SynScan™

Introduction to the SynScan ™

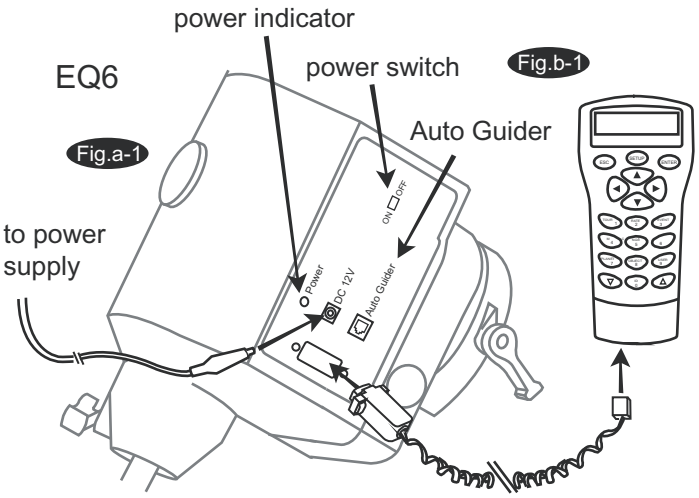
The SynScan™ is a precision-engineered instrument that will allow you to easily find and enjoy viewing night sky treasures, such as planets, nebulea, star clusters, galaxies and much more. The hand control allows you to point your telescope at a specific object or even tour the skies at the touch of a button. The user friendly menu system allows automatic slewing to over 13,400 objects. Even an inexperienced astronomer can master its variety of features in a few observing sessions. Below is a brief description of the individual components of the SynScan™ hand controller.



Powering the SynScan ™

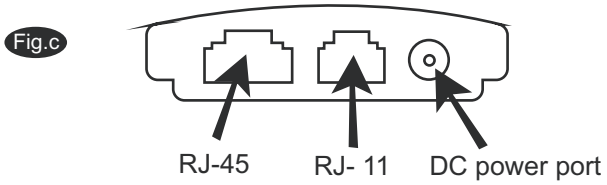
The SynScan™ should be powered by 11-15V DC power supply (tip-positive) capable of producing continuous current of minimum 2 amps. Correctly plug the power cord into the 12V DC outlet on the the mount (See Fig.a and b for HEQ5 mount, Fig.a-1 and b-1 for EQ6 mount). Flip the Power Switch to the "on" position to turn on the power.

The power indicator will flash when the power is low. Continue to use the battery at this point may damage the battery. The power indicator will flash rapidly when the power is extremely low. Continue to use the same battery may damage the SynScan system.



SynScan ™ Hand Control

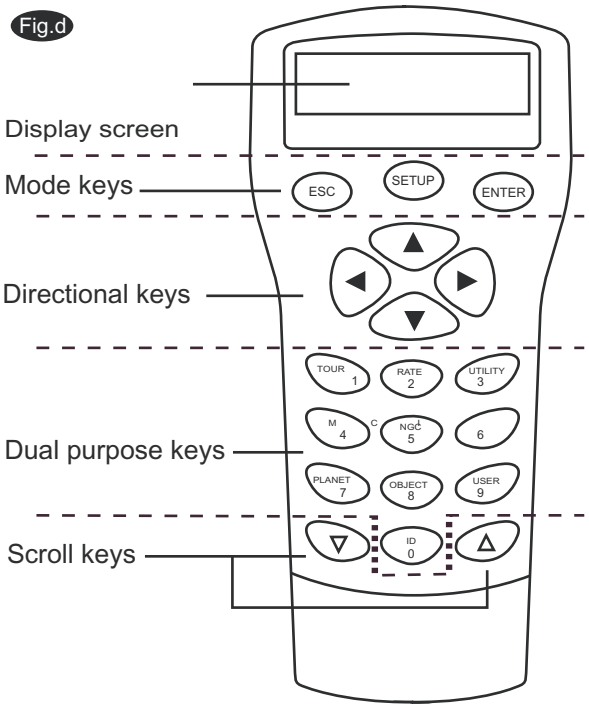
The SynScan™ hand control cable for the HEQ5 has a RJ-45 connector on both ends. Plug one end into the hand control (Fig.c) and the other into the outlet on the mount (Fig.b). Push the connector into the outlet until it clicks into place. The SynScan ™ cable for the EQ6 mount has a RJ-45 connector on one end and DB9 on the other. Plug the RJ-45 connector into the hand control (Fig.c). Push the connector into the outlet until it clicks into place. Plug the DB9 connector into the outlet on the mount. Tighten the screws to secure the connector in place (Fig.a-1). The RJ-11 4-pin port is used for RS-232 communications between the SynScan™ and a computer (see "Linking with a Computer"). The DC power port allows independent use of the SynScan™ hand control for users who wish to browse the database without connecting to the telescope (Fig.c).



The DC power port on the hand control is for hand control stand-alone applications only. For telescope applicaions, use the 12V DC outlet on the mount.

The SynScan™ Hand Control allows direct access to all the motion controls of the telescope and a database with a range of preset objects. The Hand Control comes with a dual-line, 16 character display screen that is backlit for comfortable viewing of the telescope information and scrolling text. To explore the many functions that the SynScan ™ has to offer, there are 4 main categories of control on the Hand Control (Fig.d):

Fig.d



Mode keys

The mode keys are located near the top, close to the LCD display. They include the ESC, ENTER, and SETUP keys:

ESC key is used to escape from a certain command or to go back a level in the menu tree.
ENTER key is used to select the functions and submenus in the menu tree, and to confirm certain functional operations.
SETUP key is a quick hot key that takes you to the Setup submenu.

Directional keys

The directional keys allow complete control of the telescope at almost any step in the SynScan's operation. These controls are locked out when the telescope is slewing to an object. They are normally used to initially align, center objects in the eyepiece, and manual guiding. The left and right directional keys can also be used to move the text curser when entering data to the hand control.

Scoll Keys (Fig.e)

The up and down scroll keys allow you to scroll up and down within the menu tree or selections.

Dual Purpose keys

These keys range from the middle to the bottom of the hand control. They serve two distinct purposes—data entry and quick reference hot keys.

TOUR key (Fig.f) takes you on a preset tour across the sky you are currently under.
RATE key (Fig.f) changes the speed rate of the motors when the direction keys are pressed. There are 10 speeds to choose from: 0 (slowest) to 9 (fastest).
UTILITY key (Fig.f) shows functions such as Show Position, Display Time...etc.
USER key (Fig.f) gives access to up to 25 user-defined coordinates.
ID key (Fig.f) identifies the object the telescope is currently pointing to.
NGC, IC, M, PLANET, and OBJECT keys (Fig.g) allow direct access to SynScan™ database of over 13,400 objects.

Fig.e

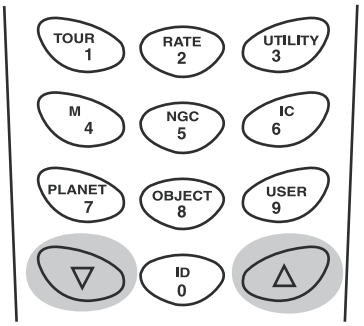


Fig.f

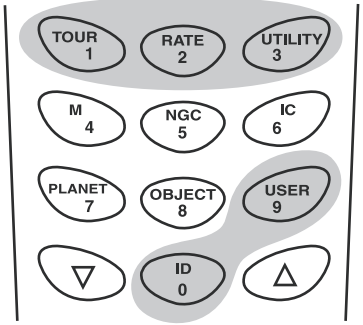
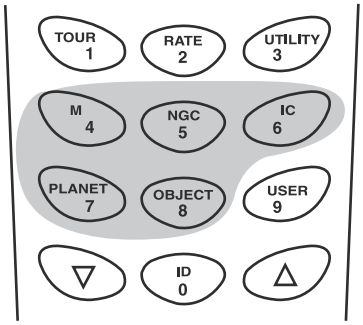


Fig.g



HAND CONTROL OPERATION

This section provides a step-by-step procedure on how to operate your SynScan ™ hand control.

Initial Setup

1. Perform the Polar alignment using the polarscope.
2. Point the telescope roughly to the North Celestial Pole (or Polaris) if you are in the Northern Hemisphere. Point to the South Celestial Pole if in Southern Hemisphere. Make sure the counterweight rod is pointed down as seen in Fig.h. This will be the home position of the telescope.
3. Flip the Power Switch on the mount to the "ON" position to turn on the power.
4. The initial screen displayed on the hand control is the Version Screen. Press ENTER to proceed.
5. The hand control will display "Begin Alignment?" Press ENTER to proceed to the alignment procedure. Press ESC will exit to the main menu (see SynScan ™ Menu Tree).

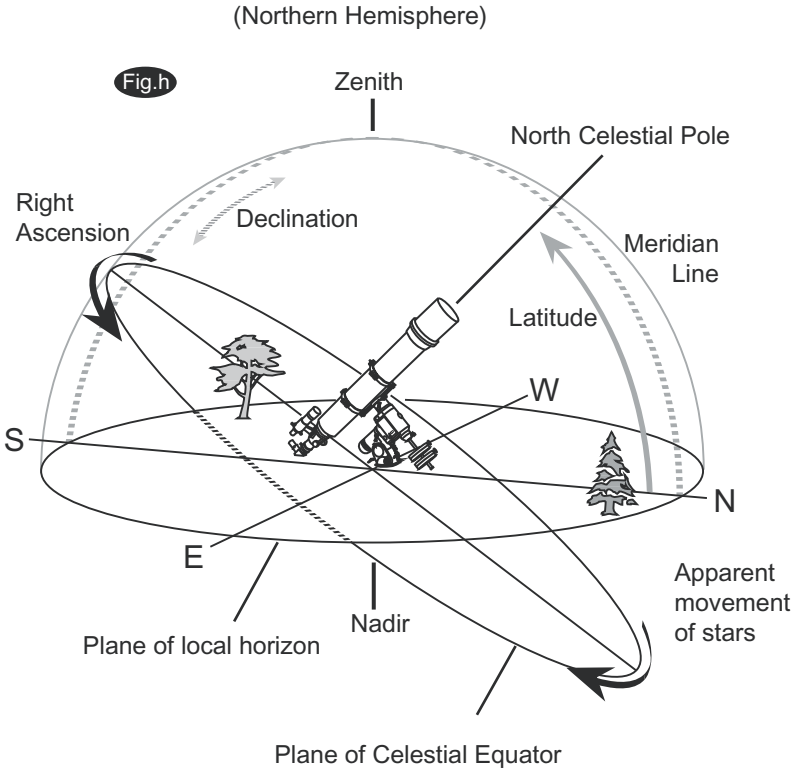


Fig.h

The hand control's red light will become dimmer and the key pads will turn off if idle for 30 seconds. Pressing any key turns it back on.

6. Enter the telescope's current latitudinal and longitudinal position using the numeric keypad. First enter the longitudinal coordinate, followed by the latitudinal coordinate.
7. Use the scroll keys to choose between W or E, and N or S. Pressing the left or right directional keys will move the cursor to the previous or next number. Press ENTER to confirm.
8. Enter your current time zone in hours (see Appendix B), using the scroll keys and numeric key pad (+ for East, - for West). Press ENTER to confirm.
9. Enter the date in the following format mm/dd/yyyy using the numeric keypad. Press ENTER to confirm.
10. Enter your current local time using the 24 hr time mode (e.g. 2:00PM=14:00). Press ENTER to view the time you entered. If it is incorrect, press ESC to go back to the previous screen. If correct, press ENTER again to proceed to the daylight saving setting.
11. Press ENTER if you are currently on Daylight Savings time. Using the scroll key to scroll down to "NO" and press ENTER if you are on regular time.
12. After setting the daylight saving, SynScan ™ will take you to the alignment menu.

If a mistake was entered into the SynScan ™ hand control, press the ESC key to go back to the previous menu, and press ENTER to start again.

Star Alignment

In order for the SynScan™ to correctly point to objects in the sky, it must first be aligned to one to three known positions (stars) in the sky. As the Earth rotates on its axis every 24 hours, astronomical objects appear to move through the sky following an arc. With the supplied information, the telescope can replicate a model of the sky and the movements of astronomical objects.

There are three ways to align the SynScan™ depending on your demand for accuracy. If you are using the SynScan™ for the first time, we recommend that you begin with the Three Star Alignment. In most cases, this produces the most accurate alignment among the three methods. Before performing any of the alignment methods, be sure that your finderscope is well aligned with the telescope tube. Below describes a step-by-step procedure on how to perform the Three Star Alignment:

Three-Star Alignment

1. In the alignment screen, select 3-Star Align using the scroll keys. Press ENTER to confirm.
2. The SynScan™ will provide a list of stars available in your current sky for you to choose as the first alignment star. Using the scroll keys, choose a star you are most familiar with and press ENTER. The telescope will start slewing towards it. When the telescope stops slewing, adjust its position with the directional keys until the star is centered on the crosshairs in the finder scope. Now look through the eyepiece and adjust the telescope so that the object is centered in the field of view of the eyepiece. Press ENTER to confirm.

The slewing speed can be adjusted by pressing on RATE button. Then choose a number between 0 (slowest) - 9 (fastest).

SynScan™ will beep once when it has finished slewing to an object. Do not try to adjust the telescope before you hear the beep. SynScan™ will only respond to the ESC key while slewing.

3. SynScan™ will provide a list of objects for the second alignment star. Choose a star using the scoll keys and press ENTER. Repeat the centering procedure for the second star and press ENTER to confirm.
4. SynScan™ will once again provide a list of objects for the third alignment star. Choose a star from the list and press ENTER. Once again, repeat the centering procedure for the third alignment star.
5. Once completed, SynScan ™ will display "Alignment Successful".

Two-Star Alignment

Two-Star Alignment requires only two alignment stars but may produce lesser pointing accuracy than the Three-Star Alignment. Below describes a step-by-step procedure on how to perform the Two-Star Alignment:

1. In the alignment screen, select 2-Star Align using the scroll keys. Press ENTER to confirm.
2. The SynScan™ will provide a list of stars available in your current sky for you to choose as the first alignment star. Using the scroll keys, choose a star you are most familiar with and press ENTER. The telescope will start slewing towards it. When the telescope stops slewing, adjust its position with the directional keys until the star is centered on the crosshairs in the finder scope. Now look through the eyepiece and adjust the telescope so that the object is centered in the field of view of the eyepiece. Press ENTER to confirm.
3. SynScan™ will provide a list of objects for the second alignment star. Choose a star using the scoll keys and press ENTER. Repeat the centering procedure for the second star and press ENTER to confirm.
4. Once completed, SynScan ™ will display "Alignment Successful".

One-Star Alignment

One-Star Alignment is the easiest and quickest alignment method. It requires only one alignment star. Below describes a step-by-step procedure on how to perform the One-Star Alignment:

1. Make sure the telescope has been polar aligned.
2. In the alignment screen, select 1-Star Align using the scroll keys. Press ENTER to confirm.
3. The SynScan™ will provide a list of stars available in your current sky for alignment. Using the scroll keys, choose a star you are most familiar with and press ENTER. When the telescope stops slewing, adjust its position with the directional keys until the star is centered on the crosshairs in the finderscope. Now look through the eyepiece and adjust the telescope so that the object is centred in the field of view of the eyepiece. Press ENTER to confirm.
4. Once completed, SynScan ™ will display Alignment Successful".

NEVER USE YOUR TELESCOPE TO LOOK DIRECTLY AT THE SUN. PERMANENT EYE DAMAGE WILL RESULT. USE A PROPER SOLAR FILTER FIRMLY MOUNTED ON THE FRONT OF THE TELESCOPE FOR VIEWING THE SUN. WHEN OBSERVING THE SUN, PLACE A DUST CAP OVER YOUR FINDERSCOPE OR REMOVE IT TO PROTECT YOU FROM ACCIDENTAL EXPOSURE. NEVER USE AN EYEPIECE-TYPE SOLAR FILTER AND NEVER USE YOUR TELESCOPE TO PROJECT SUNLIGHT ONTO ANOTHER SURFACE, THE INTERNAL HEAT BUILD-UP WILL DAMAGE THE TELESCOPE OPTICAL ELEMENTS.

OBJECT CATALO

Object database in the SynScan™

The SynScan™ comes with a vast database with over 13,400 objects coordinates and information all available in the palm of your hand. The database contains the following catalogues:

Solar System - The other 8 planets of our solar system, plus the Moon.
Named Star - A list of 100 best known stars from the SynScan™ database.
*NGC - 7,840 of the brightest deep sky objects from the Revised New General Catalogue.
IC - 5,386 of standard stars and deep sky objects from the Indexed Catalogue.
Messier - Complete list of 110 Messier objects.
Others - There are also Single Stars, Double Stars, Globular Clusters, Uncertain Stars, Galaxies, Clusters, Nebulea, Reflection Nebulea, Planetary Nebulea, and Open Clusters.

Selecting an Object

Once the telescope has been aligned. You can now access and view the 13,400 different objects in the SynScan™ database. There are three methods of selecting a celestial object to view:

SHORTCUT KEYS
(Fig.i)

TOUR - Takes you on a preset tour across your current sky. It will automatically choose from the database the brightest and most beautiful deep-sky objects for your viewing pleasure. Use the down scroll key to view through the deep sky objects. Choose the desired object by pressing ENTER. It will show the coordinate of the chosen object. Pressing ENTER once more will cause the telescope to slew to the object.

M, NGC, IC - These shortcut keys give you access to the most popular celestial catalogues to date. Each Catalogue has a set number of objects to choose from. Use the numeric keys to select an object by entering its number. Pressing ENTER will display its coordinate. Primary information such as size, magnitude, and constellation are obtained by pressing the scroll keys. Pressing ENTER once more will cause the telescope to slew to the object.

PLANET - This shortcut key takes you straight to the Planets sub menu in the database. Use the scroll keys to scroll through the list of planets in our solar system. Press ENTER to view its coordinates, and ENTER once more to slew to the planet.

USER - This will take you to the database that you have defined for yourself. You can enter a new location or recall the objects that have been previously saved (see Using the User Defined Database).

Fig.i

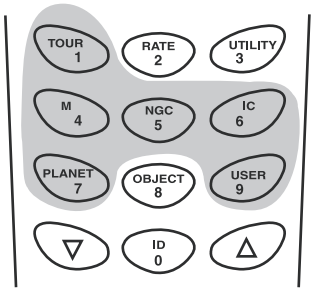
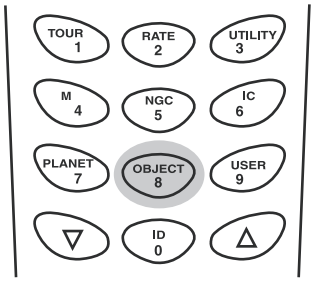


Fig.j



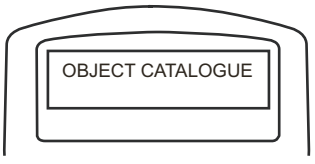
OBJECT KEY
(Fig.j)

The OBJECT key takes you to the Objects Catalogue, where you have complete access to over 13,400 celestial objects in the database. (See Object database in the SynScan and the menu tree.)

MENU
(Fig.k)

In the Main Menu, scroll down to OBJECT CATALOGUE and press ENTER. Similar to the OBJECT key, this gives you the complete access to all 13,400 celestial objects in the database. (See Object database in the SynScan and the menu tree.)

Fig.k



*NGC 2000.0 database, edited by Roger W. Sinnott, copyright by Sky Publishing Corporation. Used with permission.

OTHER FEATURES

Utility Functions

Utility Functions are useful tools that provide simple, one-step processes to your SynScan™

Show Position - This displays the coordinates of the location where the telescope is currently pointing.
Display Time - This displays the local time and local Sidereal time.
Park Scope - This moves the telescope to the Home position.
RS-232 mode - This allows linking to a computer. (See "Linking with a Computer".)
PEC Training - See Appendix D for information.

Setup Functions

The Setup functions allow you to change any system variable or information regarding location, time, date, and alignment configurations. To access the Setup Functions, either press SETUP key on the key pad or scroll to SETUP under menu option using the scroll keys. Below lists the different types of functions available to you, and their purposes.

Date - Allows you to change the date entered at the initial setup.
Time - Allows you to change the current time.
Observing site - Allows you to change the current location.
Daylight Savings - Allows you to change the Daylight Savings option.
Alignment - Allows you to perform the star alignment. (See "Alignment".)
Set Backlash - This feature allows you to insert a value for each axis to compensate for its backlash. For better pointing accuracy, it is important that the backlash value is set to be equal or greater than the real amount of backlash between the gears. If the real amount of backlash is unknown, we recommend that you set the value to 5000 (equivalent to approx. 0.2?. First set the value for R.A. Press ENTER to proceed to Dec.
Set Tracking
- Sid. Rate: This activates tracking in Sidereal rate (R.A. Tracking).
- Lunar Rate: This activates tracking in Lunar rate (R.A. Tracking).
- Solar Rate: This activates tracking in Solar rate (R.A. Tracking).
- PEC + Sidereal Rate: Sidereal rate with Periodic Error Compensation.
- Stop Tracking: This stops the tracking instantly.

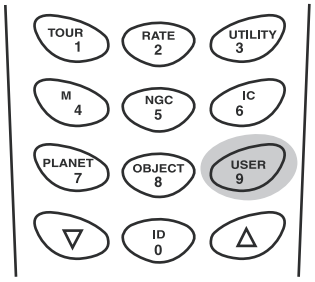
Auto Guide Speed - When using an autoguider, this sets the guiding speed to 1X, 0.75X, 0.5X, or 0.25X sidereal rate.

Using the User Defined Database

SynScan ™ allows you to save up to 25 objects in the user defined database.

Saving an object to the database

Fig.I



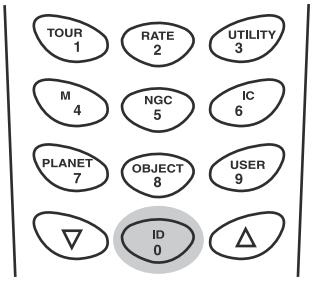
1. Press the USER key (Fig.I) or select USER DEFINED under the object catalogue. Press ENTER.
2. Choose INPUT COORDINATE and press ENTER to confirm.
3. You can choose to enter the location by its R.A. and Dec., or telescope altitude and azimuth coordinates. Press 1 (R.A. and Dec.) or 2 (Alt-Azimuth) to make your selection. By defalt SynScan will display the current R.A./Dec or Alt/Az coordinates. Change the coordinates using the numeric keypad and scroll keys. PressENTER to save.
4. The SynScan™ will ask you to choose a number between 1 to 25. Select the number you wish to represent the coordinate, using the scroll keys. Press ENTER to confirm.
5. Once a number is given to the coordinate, the hand control will display "View Object?". Pressing ENTER will cause the telescope to slew to the coordinate. Press ESC to exit.

Selecting an user defined object

1. Press the USER key or select USER DEFINED under the object catalogue. Press ENTER.
2. Choose RECALL OBJECT and press ENTER to confirm.
3. Select the number representing the object you wish to view, using the scroll keys. Pressing ENTER will show its coordinate. Press ENTER again to choose the object.
4. The SynScan™ will display "View Object?". Pressing ENTER will cause the telescope to slew to the coordinate. Press ESC to exit.

Identifying an Unknown Object

Fig.m



SynScan ™ has the ability to identify the unknown object the telescope is currently pointing at. To do so, simply:

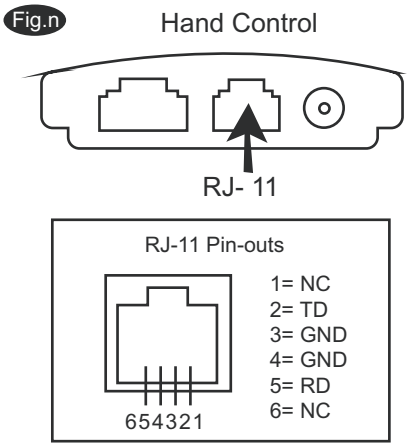
1. Press the ID key (Fig.m) or scroll down to IDENTIFY in the main menu and press ENTER to identify the object.
2. If it is a truly unknown object, the hand control will take you back to the IDENTIFY menu.
3. Press ESC to exit from this function.

Linking with A Computer

Another feature of the SynScan™ is the ability to connect to a computer via a serial cable. Many commercially available planetarium softwares can be used to control the SynScan ™. Look for softwares compatible with NexStar5. Below describes the procedure on how to connect and disconnect the SynScan™ to a computer:

1. Make sure that the telescope has been aligned.
2. Connect the RS-232 cable to the RJ-11 connector on the hand control and to the COM-port of your computer (Fig.n).
3. On your SynScan™ hand control, select RS232 under the UTILITIES menu. Press ENTER to go to RS-232 mode.
4. In the planetarium software of your choice, choose "Celestron NexStar5" in the driver setup and follow the instructions provided by your program to establish the connection to the telescope. The SynScan ™ should be under the full control of your computer once the connection is successfully established.

Fig.n



Disconnecting from the computer

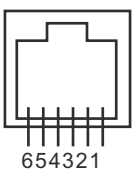
1. Follow the instructions provided by your software to close the connection to the telescope.
2. On the SynScan™ hand control, press ESC to resume normal hand control operations.

See Appendix C for more information on RS-232 connection.

Do not disengage the SynScan ™ unit before you disengage the program. Doing so may cause some programs to freeze.

Auto Guiding

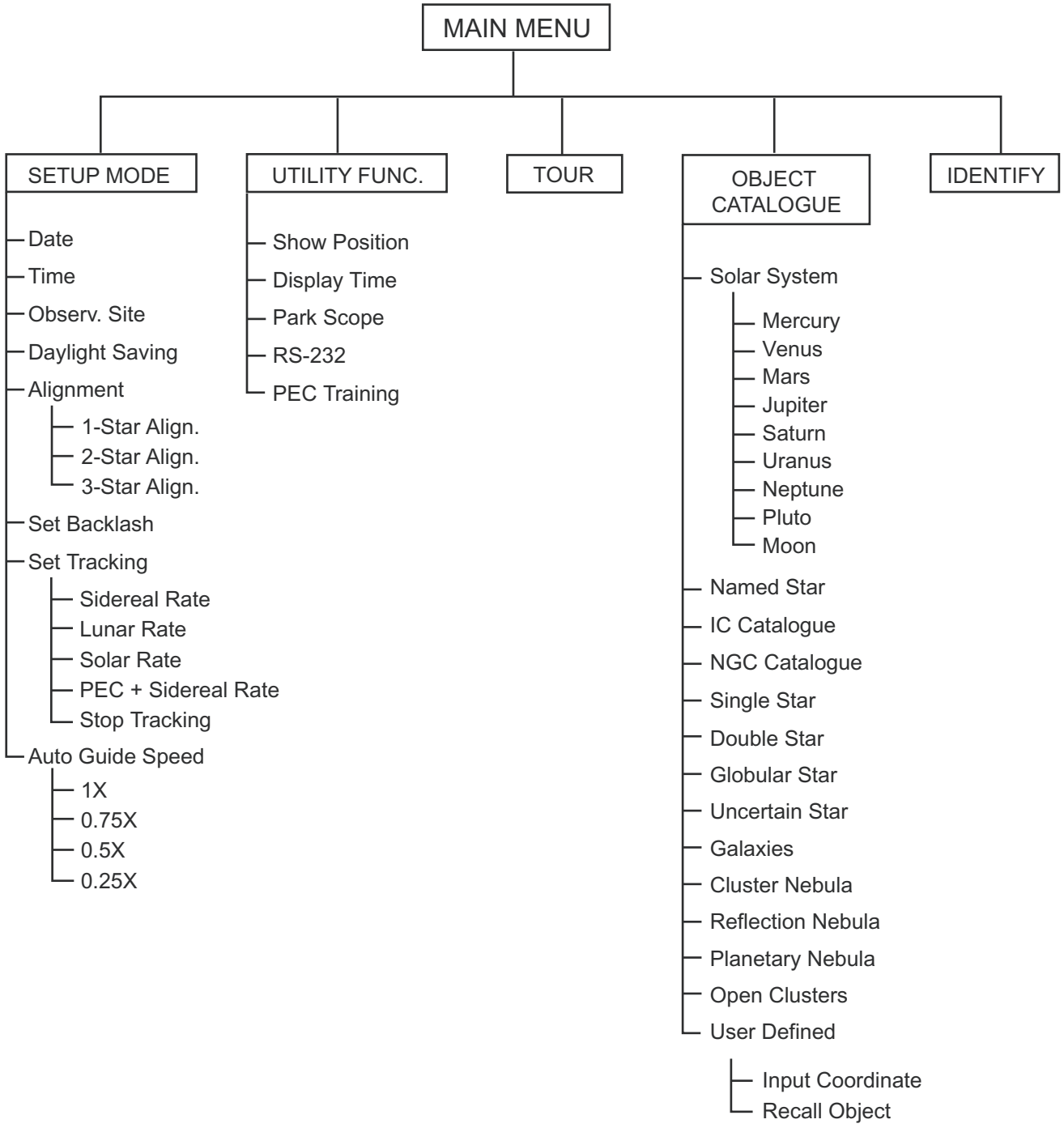
Fig.o



1= NC
2= Ground
3= +RA (left)
4= +DEC (up)
5= -DEC (down)
6= -RA (right)

The SynScan™ has a designated autoguider interface on the mount for use with an auto guider (see Fig.a, a-1). The pin-outs on the 6 pin modular connector is ST-4 compatible and can be used for most autoguiders on the market. Refer to Fig.o when connecting the autoguider cable to the SynScan™ and calibrating the autoguider. Relay box can be added for extra protection. Note that the four inputs are active-low, with internal pull-ups. Guiding speed can be adjusted using the Auto Guide Speed function in the Setup Menu.

SynScan™ MENU TREE



TECHNICAL SPECIFICATIONS

SynScan ™ SPECIFICATIONS

Power Supply:	11 to 15 V DC 2Amp (Tip positive)
Motor type and resolution:	Microstep driven 1.8?stepper motors.
	Resolution: 0.144 arc sec (or 9,024,000 steps/rev.)
Slew speeds:	Rate 0 = 0.5X
	Rate 1 = 1X
	Rate 2 = 8X
	Rate 3 = 16X
	Rate 4 = 32X
	Rate 5 = 64X
	Rate 6 = 400X
	Rate 7 = 500X
	Rate 8 = 600X
	Rate 9 = 800X
Gear Ratio:	705
Tracking Rates:	Sidereal, Lunar, Solar
Tracking Modes:	R.A. tracking
Alignment Method:	One-Star Alignment, Two-Star Alignment, Three-Star Alignment
Database:	25 user defined objects. Complete M, NGC, and IC catalogues,
	Total 13,436 objects
Pointing Accuracy:	Up to 1 arc min

APPENDIX A - ENHANCING THE PRECISION

Generally speaking the SynScan™ produces pointing and tracking accuracies edaquate for most applications. However, if higher precision is required, for example for astro-photography, accurate polar alignment and "cone" error calibration may be required. See the manual for HEQ5 and EQ6 mount for information on accurate polar alignment using the polarscope.

Cone Error Calibration

"Cone" error is a common inaccuracy found on all German equatorial mount. It is a result from the optical axis not being aligned to the R.A. axis of the mount. This affects the pointing accuracy of the SynScan ™. Three-Star Alignment automatically compensates for the "Cone" error. If you choose One-Star or Two-Star Alignment method, you will need to perform manual mount calibration to eliminate the "cone" error. The following calibration procedure should be performed before the initial use of the telescope and periodically thereafter to ensure the accuracy.

Testing for Cone Error

This test is done at night using two bright stars located on the opposite side of the sky. Make sure the telescope is properly polar-aligned using the polarscope. Perform the One-star Alignment using an eastern star as the alignment star (see One-star Alignment). After the star alignment, choose a bright star on the western sky from the SynScan™ object database and have the telescope slew to the star. If the optical axis is perfectly aligned to the R.A. axis, the telescope will accurately put the star in the center of the eyepiece. In this case, there is no "cone" error in your telescope setup and you will not need to perform the calibration. It is acceptable if the star is slightly off-center as long as it is in the eyepeiece view and close to the center. Many factors determine the pointing accuracy of the SynScan ™, for example incorrect star alignment, R.A. or Dec lock knob being lose, or "cone" error. If your telescope puts the star outside the eyepiece view, you need to first determine whether it is "cone" error that causes the pointing inaccuracy. To find out, simply move the telescope in R.A. axis by pressing the Left or Right direction key. If the star can be moved into the eyepiece view without adjusting the Dec axis, it is likely that "cone" error exists in your telescope setup.

Calibration Procedure

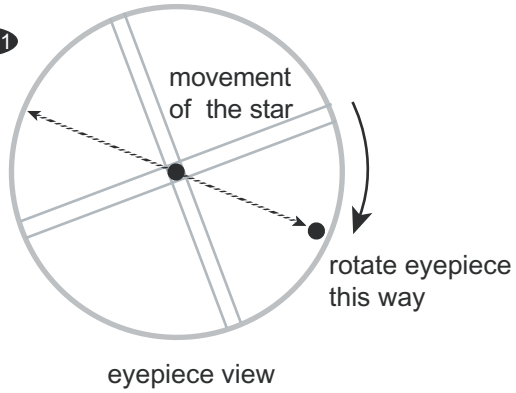
1. Insert the illuminated reticle eyepiece. Make sure that the telescope is properly set up and balanced, and the finderscope is perfectly aligned with the telescope tube.

Required accessory: Illuminated reticle eyepiece with double crossline pattern. Depending on the design of your mounting plate (dovetail bar), modifications may be required. (See step 10 for the required mechanism on the mounting plate.)

Step 2 to 4 is to identify R.A. and Dec movements in the reticle eyepiece. If you are already familiar with the movements, you may skip to step 5.

2. Find any bright star and place it in the center of the eyepiece view.
3. Look into the eyepiece. Move the telescope in R.A. axis using the R.A. direction keys on the hand control while carefully observing the movement of the star.
4. Keep moving the the telescope in R.A. axis back and forth to keep the star within the eyepiece view. Rotate the eyepiece until the movement of the star becomes parallel to (or matches) any set of the lines (Fig.A-1). This set of lines will represent R.A. movement in the course of this procedure, and the perpendicular lines will represent Dec movement. Tigthen the set screws to secure the eyepiece in place. Make sure that the eyepiece will remain stationary when the telescope is being rotated .

Fig.A-1



eyepiece view

5. Point the telescope to North and set the latitude scale to your local latitude using the altitude adjustment T-bolts, or place Polaris on the crosshair of the polarscope if your polarscope is perfectly aligned with the rotation axis of the mount.
6. Loosen the R.A. lock knob and rotate the telescope around the R.A. axis until the counterweight shaft is parallel to the ground. (Fig.A-2)
7. Using the Dec direction key on the hand control, adjust the telescope in Dec so Polaris sits on the R.A. lines of the reticle eyepiece (Fig.A-3).
8. Without moving the R.A. axis, adjust the azimuth control knobs to bring Polaris to the center of the eyepiece (Fig.A-4). Adjustment in Dec axis using the hand control may be necessary.

Fig.A-2

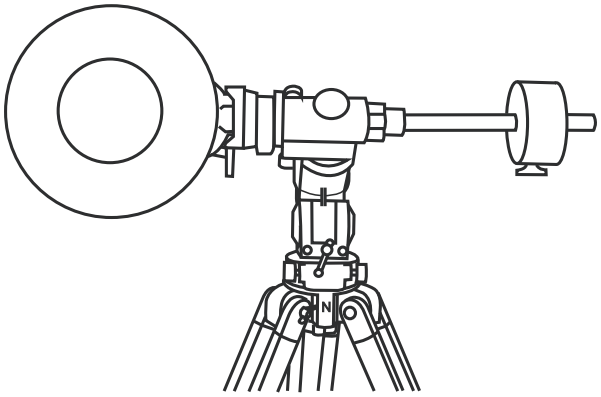
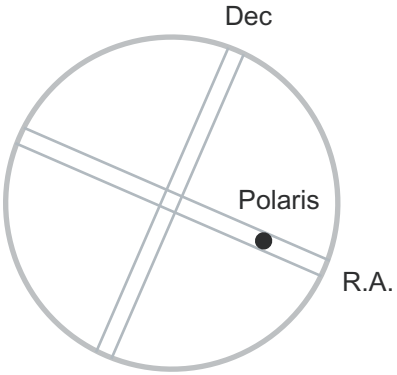
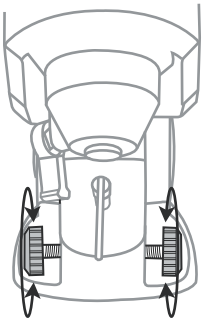


Fig.A-3



Place Polaris on the R.A. line

Fig.A-4



9. Loosen the R.A. lock knob and carefully rotate the telescope 180?in R.A. axis. (Fig.A-5). This should be done as accurate as possible using the R.A. setting circle.
10. Once again, adjust the telescope in Dec so Polaris sits on the R.A. lines of the reticle eyepiece (see Fig.A-3).
11. Now take a closer look at the mounting plate underneath the telescope tube. There should be a set of screws on each end, next to the tube ring locking screws (Fig.A-6). (If your mounting plate does not have these screws or screw holes, you will need to make modification to the plate.)

Fig.A-5

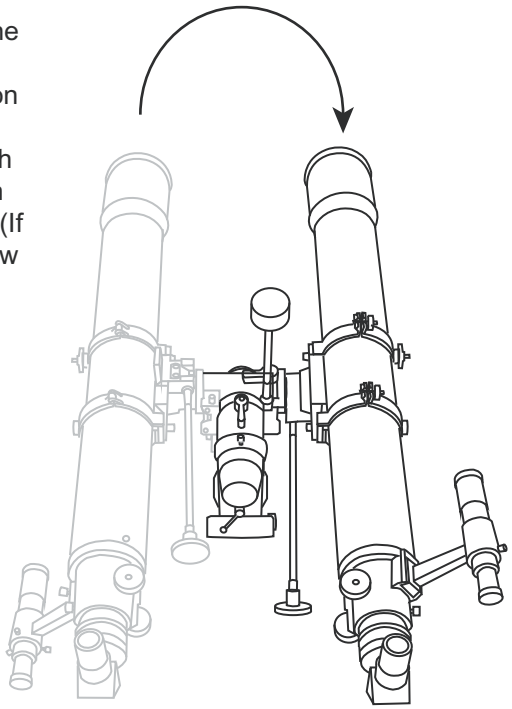
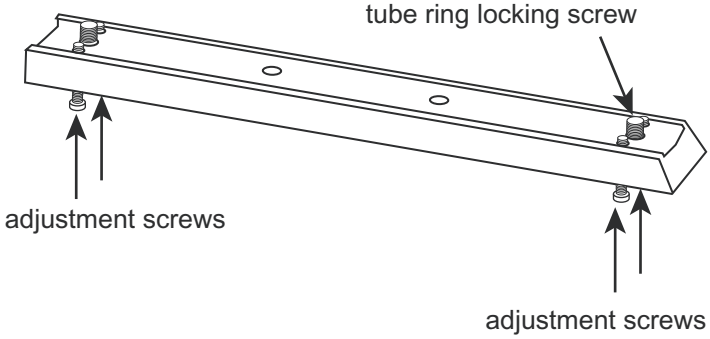


Fig.A-6



12. Carefully nudge the telescope in horizontal motion using only one finger while observing the movement of Polaris through the eyepiece (Fig.A-7). This is to determine which direction (left or right) moves Polaris closer to the center of the eyepiece.
13. Next step is to adjust the adjustment screws on the mounting plate according to your finding from step 12. If Polaris moves toward the center when the telescope is nudged toward your right hand side, You will need to loosen the adjustment screws near the front of the tube and tighten the ones closer to the back of the tube (Fig.A-8), and vise versa (Fig.A-9). Look into the eyepiece. Adjust the screws just enough to place Polaris HALF the distance back to the center (Fig.A-10).

Fig.A-7

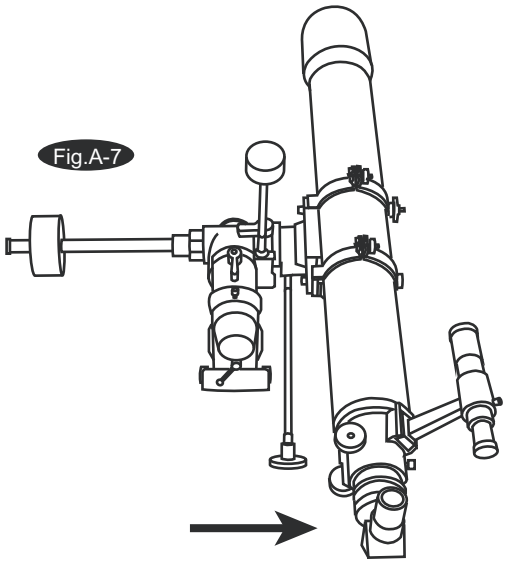


Fig.A-8

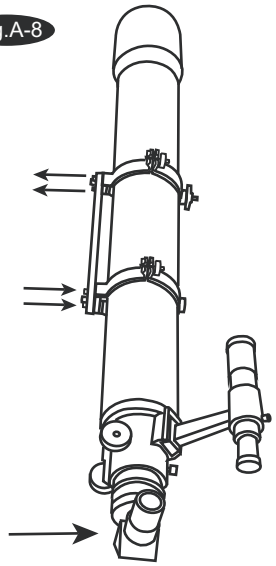


Fig.A-9

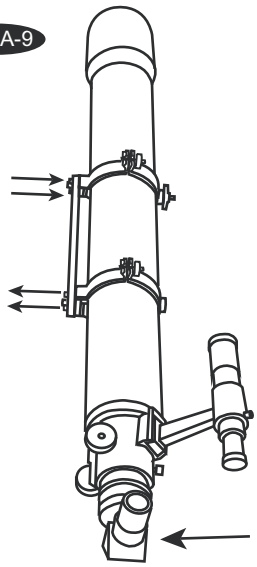
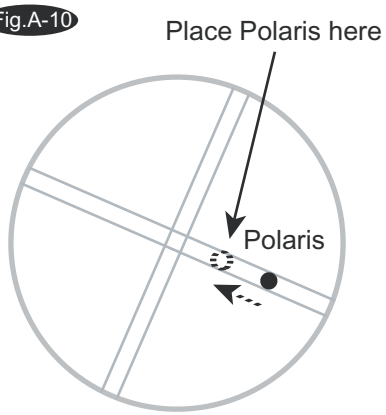


Fig.A-10



14. Repeat step 7 to 13 until Polaris remains in the center of the eyepiece, or moves slightly around the center, when the mount is rotate about the R.A. axis.

This calibration method can be applied on both refracting and reflecting telescopes. Optical path of different telescope designs does not affect how the telescope tube and tube rings should be adjusted on the mounting plate.

APPENDIX B - PERIODIC ERROR CO

Periodic Errors are found in almost all worm gears due to slight eccentricities and misalignments. The PEC (Periodic Error Correction) Training function provides a manual correcting method to reduce the amplitude of the worm errors. By recording a full cycle of guiding actions versus motor shaft angle, SynScan ™can work to compensate for the drifting in the RA sidereal tracking caused by the periodic errors. Below describes a step-by-step procedure on how to perform the PEC:

PEC Training function is recommended for advanced users interested in long-exposure astrophotograhy only. Careful guiding is required. Regular sidereal tracking is adequate for all casual visual use of the SynScan™ and PEC Training is not required.

Required accessory: Illuminated reticle eyepiece with double crossline pattern capable of producing at least 300X magnification in combination with your telescope. The true field of view should not exceed 10 arc min. See Choosing the appropriate eyepiece for more information on calculating the field of view.

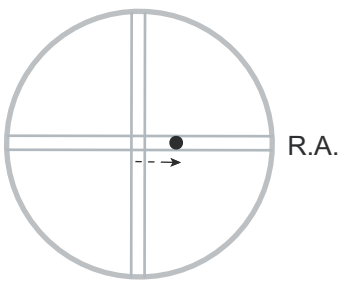
PEC Training

1. Perform the accurate Polar Alignment method (see HEQ5/EQ6 manual).
2. Slew or manually point the telescope to a star with smaller DEC coordinate. This object will be used as the guide star.
3. Activate Sidereal Tracking from the Setup Menu (see Setup Functions). Once the tracking has started, press ESC to go back to the Setup Menu.
4. Rotate the reticle eyepiece until one set of the lines becomes parallel to (or matches) the R.A. movement of the telescope (see step 2 to 4 of the Cone Error Calibration for more information on how this is done.)
5. Move the guide star back at the center of the eyepiece view using the direction keys.
6. On the hand control, select PEC Training in the Utility Functions and press ENTER.

Utility Functions can be easily accessed by pressing the UTILITY quick reference hotkey on The keypad.

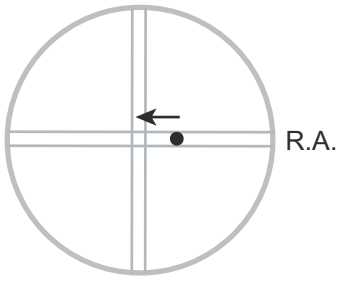
7. Select the R.A. guide speed for the PEC training.
8. The SynScan™ hand control will display the current time once the guide speed is selected, indicating that the recording has begun.
9. Using the LEFT or RIGHT direction key only, move the telescope so the guide star remains at the center of the eyepiece view (Fig.D, D-1). Repeat whenever necessary.

Fig.D



The Guide star drifts away from the center

Fig.D-1



Adjust the telescope to move the guide star back to the center

10. For 8 minutes (10 minutes and 30 seconds for HEQ5), the EQ6 SynScan ™ hand control records the manual guiding actions in order to characterize the periodic errors. Pressing ESC will stop the recording immediately and exit from the PEC training function.

Guiding actions are recorded even when the PEC training is stopped midway. In this case, the PEC+Sidereal tracking will not be accurate until a full cycle of the PEC training is performed.

11. The SynScan™ will beep and display "Record completed" when the training time is up. Press any key to exit from the PEC training.

Play back the PEC record

PEC tracking can be activated under the Setup Menu or pressing the SETUP quick reference hotkey on the keypad when needed. In the Setup Menu, choose Set Tracking, then PEC+Sidereal. SynScan™ will play back the corrections you made during the PEC training cycle and start tracking with periodic error compensated.

The SynScan™ will continue to track in the PEC+Sidereal mode until another tracking mode is selected. If the power is turned off while the SynScan™ is under the PEC+Sidereal mode, the hand control loses synchronization with the R.A. worm gear and the PEC Training will have to be performed again when the power is turned back on. To avoid this, be sure to return the telescope to its home position by selecting PARK SCOPE under the UTILITY FUNCTIONS before turning off the power.

APPENDIX C - RS-232 CONNECTION

The SynScan™ hand control must be set to RS-232 mode in order to establish a RS-232 connection with a PC. Under the UTILITIES menu in the SynScan™ hand control, select RS232 and press ENTER will launch the RS-232 mode. Once in the RS-232 mode, the SynScan™ hand control will communicate with the PC at 9600 bits/sec, no parity and stop bit. All angles are communicated with 16 bit numbers.

INITIALIZATION

1. PC sends one byte (63 = ASCII "?") to check whether the SynScan™ is ready.
2. SynScan™ responds with one byte (35 = ASCII "#") when SynScan™ is ready to respond.

All INITIALIZATION steps are recommended but not necessary.

GoTo R.A.-Dec positions

1. INITIALIZATION
2. PC sends (82 = ASCII "R")
3. PC sends the R.A. high byte, RA low byte, Dec high byte, Dec low byte.
4. When the scope is finished slewing, it will send back a "@"

GoTo Alt-Az positions

1. INITIALIZATION
2. PC sends (65 = ASCII "A")
3. PC sends the Azm high byte, Azm low byte, Alt high byte, Alt low byte.
4. When the scope is finished slewing, it will send back a "@"

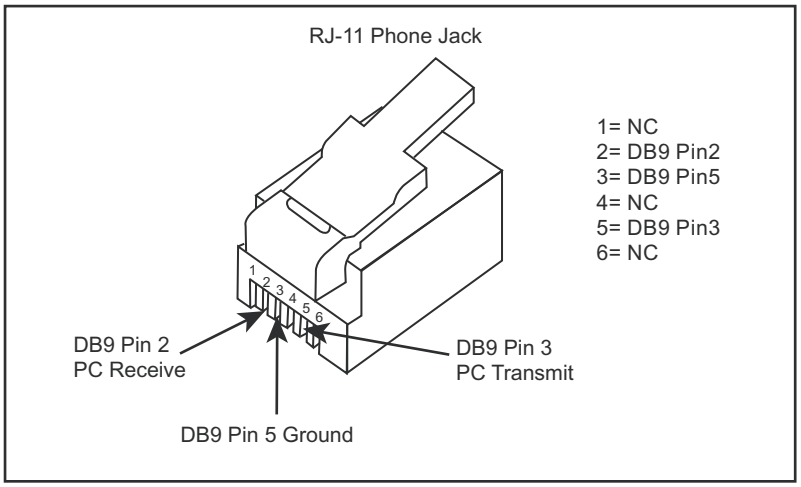
Get R.A.-Dec positions

1. INITIALIZATION
2. PC sends (69 = ASCII "E")
3. SynScan ™ sends the R.A. high byte, RA low byte, Dec high byte, Dec low byte

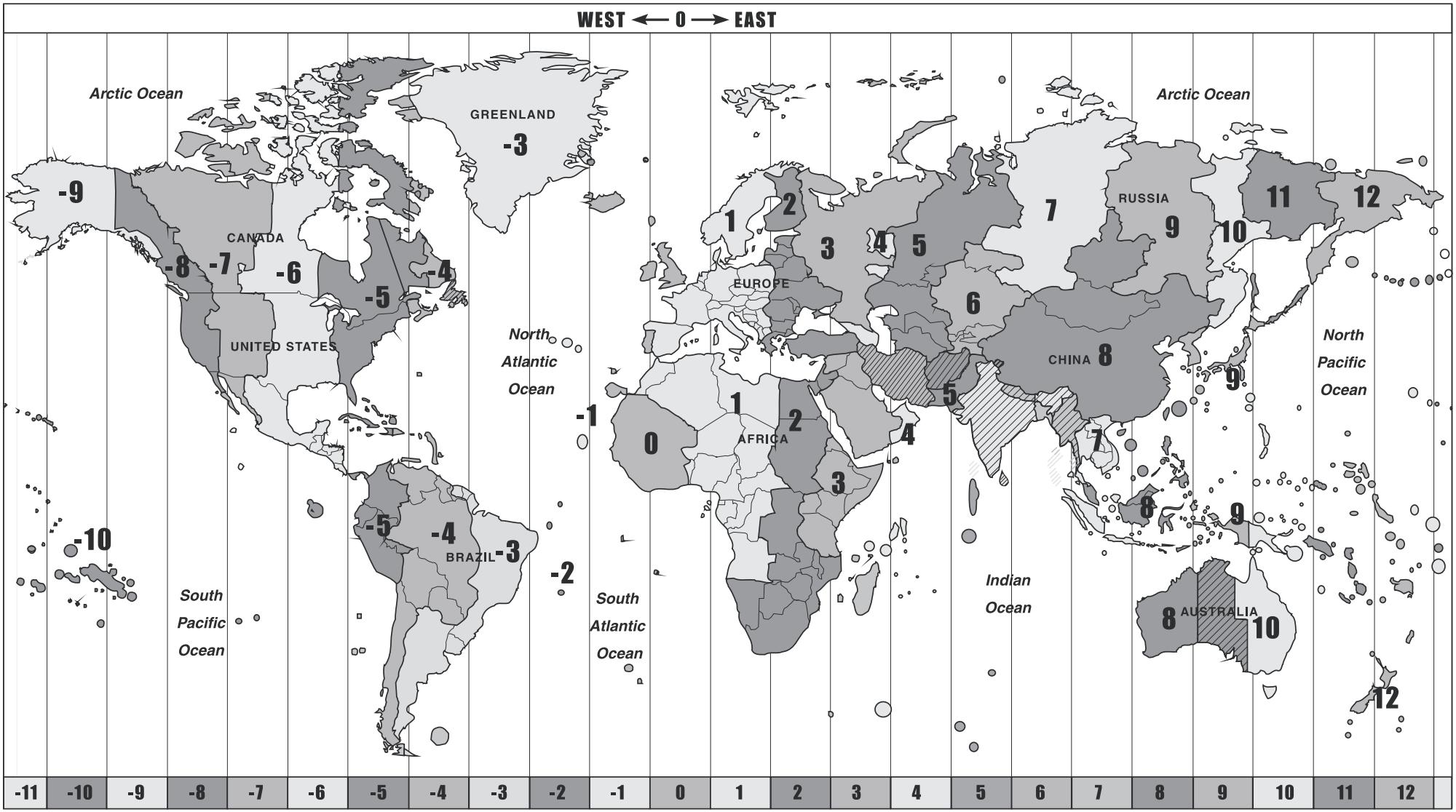
Get Alt-Az positions

1. INITIALIZATION
2. PC sends (90 = ASCII "Z")
3. SynScan ™ sends the Azm high byte, Azm low byte, Alt high byte, Alt low byte.

Physical Connection Diagram



APPENDIX D - STANDARD TIME ZONES OF THE WORLD



SynScan™

Visit:

http://www.SkywatcherTelescope.net/WhatsNew.html for SynScan updates.
http://www.SkywatcherTelescope.net/FAQ.html for frequently asked questions and answers.
http://www.SkywatcherTelescope.net/EducationTBOD.html for general information on telescopes and viewing tips.
http://www.SkywatcherTelescope.net/Support.html for manual download.
http://www.SkywatcherTelescope.net/Gallery.html for pictures taken with Sky-Watcher Telescopes
http://www.SkywatcherTelescope.net/ProductsTREFR.html for more products available by Sky-Watcher.

NEVER USE YOUR TELESCOPE TO LOOK DIRECTLY AT THE SUN. PERMANENT EYE DAMAGE WILL RESULT. USE A PROPER SOLAR FILTER FIRMLY MOUNTED ON THE FRONT OF THE TELESCOPE FOR VIEWING THE SUN. WHEN OBSERVING THE SUN, PLACE A DUST CAP OVER YOUR FINDERSCOPE OR REMOVE IT TO PROTECT YOU FROM ACCIDENTAL EXPOSURE. NEVER USE AN EYEPIECE-TYPE SOLAR FILTER AND NEVER USE YOUR TELESCOPE TO PROJECT SUNLIGHT ONTO ANOTHER SURFACE, THE INTERNAL HEAT BUILD-UP WILL DAMAGE THE TELESCOPE OPTICAL ELEMENTS.

目 录

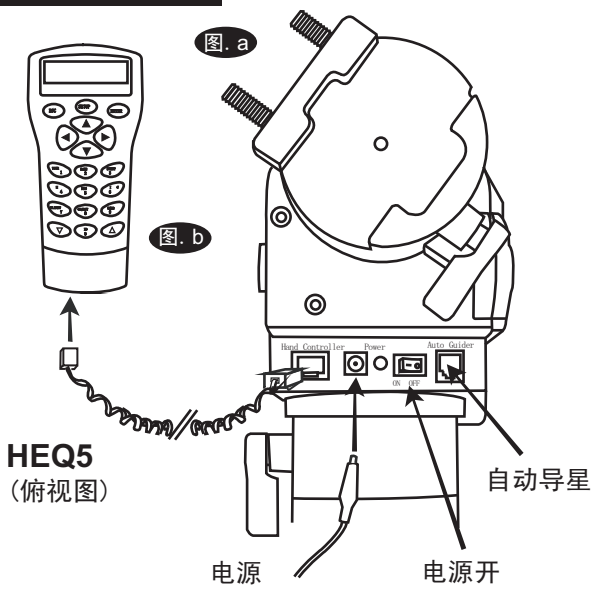
注意：

请不要用望远镜直接观测太阳，否则会造成眼睛永久性的伤害。如需观测，请在镜筒前方安装一个紧固且适当的太阳滤纸。同时在观测太阳时候还要注意，请取下寻星镜或盖上防尘盖，以免眼睛偶然的暴露。另外需注意：不要使用目镜类型的太阳滤纸；不要利用您的望远镜聚焦太阳光于其他物体表面，否则会导致镜筒内部过热而损害望远镜的光学系统。

SynScan™产品介绍

概述

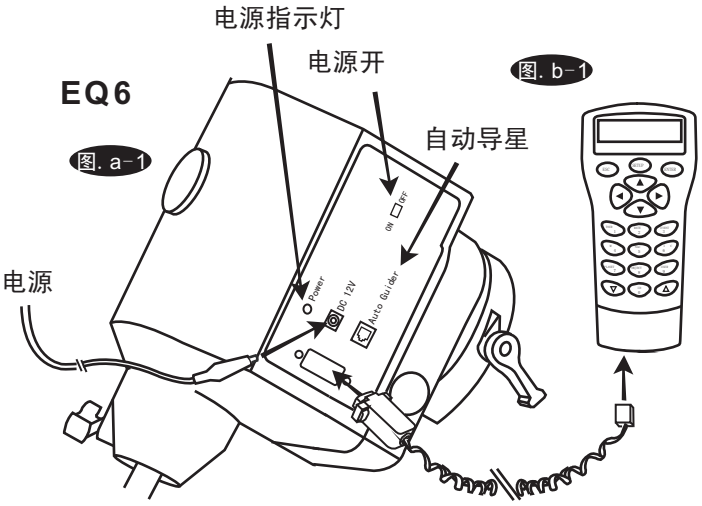
Synscan是一个精确的工具，可以使你很容易的搜寻夜空并享受其中，如行星、nebulea、星云团、银河系等等。通过手控器的按键控制，可以使您的天文望远镜指向您所指定的特定天体目标，同样可以带您遨游太空。用户菜单系统可以使您方便跟踪超过13,400个天文物体，甚至一个毫无经验的天文学者也能很快掌握它的各种特征，通过一些小范围的初测。下面我们将对Synscan手控器的各个组件进行简单的介绍。



充电

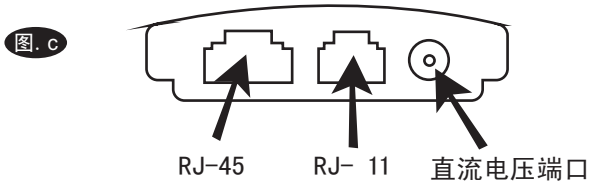
Synscan需接11－15伏(尖端正极)，最小2安培的的充电器。正确充电办法为:将充电器的充电端插入基座上的12V DC接口(如图a和b为HEQ5的示意图，图a-1和b-1为EQ6的示意图)，同时将充电开 打为″on″即可充电。

注意事项：当电量不足时，指示灯会闪。这时如果使用干电池则会对干电池的寿命产生影响。当电量严重不足时，指示灯会突然闪。这时如果使用干电池会损坏Synscan系统。



Synscan手控器

HEQ5的Synscan手控器线缆两端都有RJ－45连接器。将其中的一端连接手控器(见图c)，另一端连接基座(见图b)。把连接器插入槽口直到完全插好并听到滴答声为止。EQ6的Synscan手控器线缆一端是RJ－45连接器，另一端是DB9。 将RJ－45连接器插入手控器中(见图c)，将DB9连接器插入基座上的接口，并拧紧螺丝(见图a-1)。RJ-11为6针头端口，是用RS－232线缆来连接电脑或其他装置(详见连接″电脑″章节内容)。当Synscan手控器没有接上天文望远镜，而您又想浏览手控器中的数据库，这时DC电源端口可以很好的帮您实现这一要求。

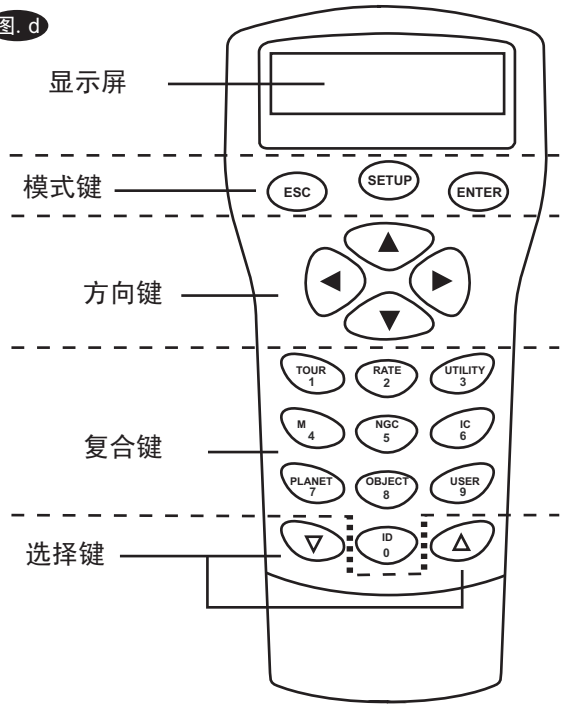


注意:手控器上的DC电源端口仅供您单独操作手控器时使用。而基座上的12V Dc输出端口才是操作望远镜时候使用。

另外:如果您打算将Synscan与电脑连接，利用基座配套提供的RS－232线缆。

通过Synscan手控器，可以直接的控制望远镜进行全方位的运动，并方便查找预先输入的目标天体数据库。手控器的显示屏是双行显示，16（character）字体容量，内置灯，可以很舒服的进行一般信息浏览以及屏幕滚动浏览。为了了解Synscan更多的功能，可以把手控器的控制过程分为4大类（见图d）。

图. d



模式键

模式键设在控制器顶端，靠近液晶显示屏。它们主要包括ESC键，ENTER键，和SETUP键。

ESC键：为退出键或返回上一级菜单键。

ENTER键：为选择功能键或进入下一级菜单键

SETUP键：为快速进入设置菜单键

方向键

方向键可以在Synscan的任何操作阶段都可以使用，实现您对望远镜的完全控制。当望远镜在寻找目标时，可以锁定这些控制。它们通常用来初始对准目镜中心，通过手工向导。当输入数据后，手控器的左右键都可以用作移动文本换行。

滚动键

上、下滚动键可以使你在菜单或选择的某菜单板块里自由的上下滚行。

双重目的键

这些键分部在控制器的中部到底部。它们有两个明显的目的数据输入和快速参考键

Tour key（见图 f）：漫游键。带您漫游预先设置好的星空漫游。

Rate key（见图f）：速度键。可以更改马达的运转速度。共有10档速度可以选择：从0档（最慢档）到9档（最快档）

Utility key（见图f）：功效键。有　功能的显示，如位置显示，时间显示等等。（Fig f）gives access to up to 25 user-defined coordinates .

User key（见图f）：用户键。可以设定25个自定义坐标点。

Id key（Fig f) identifies the object the telescope is currently pointing to.

Id key（见图f）：身份键。识别当前望远镜所指向目标。

NGC,IC,M,PLANET,and OBJECT keys（见图 g）：可以进入Synscan近13，400个目标的数据库。

图. e

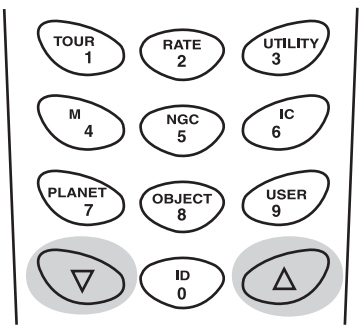


图. f

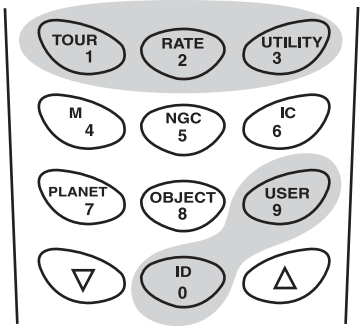
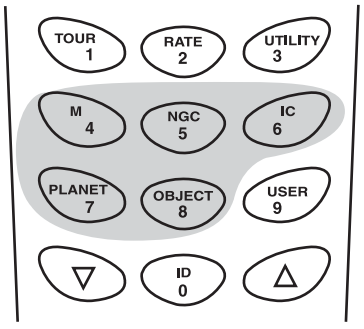


图. g



手控器的操作

本章将会教您如何一步一步操作Synscan手控器。

初始设置

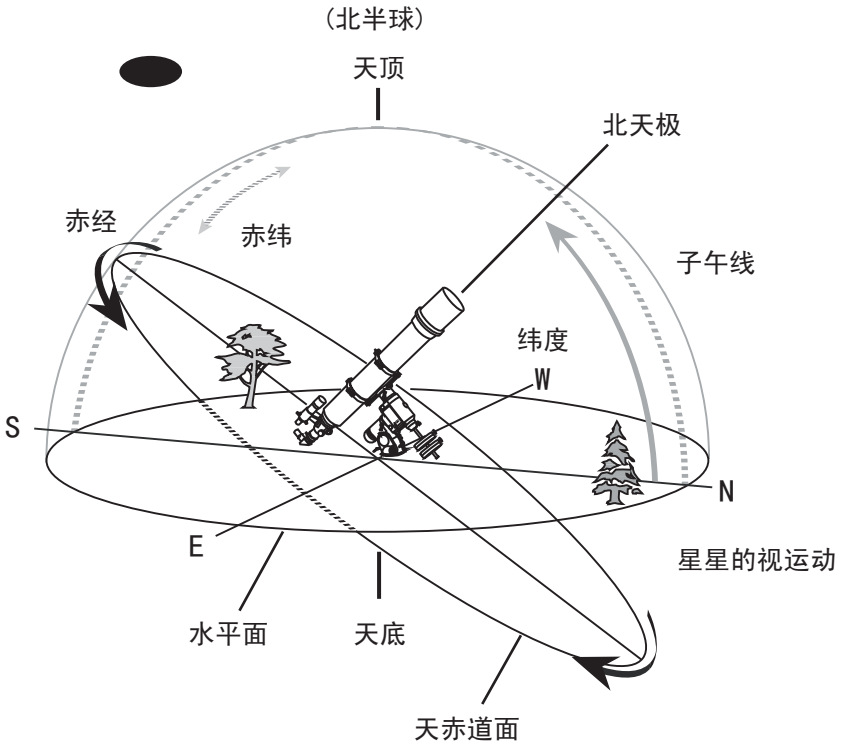
1) 利用极轴镜进行极轴对准

2) 如果您在北半球，调整望远镜大致对准北极(或北极星)位置，但要注意配重杆方向朝下，如图h所示。这样就完成了望远镜的初始位置的设置。

3) 将基座上的电源开　打到"ON"位置，以接通电源

4) 手控器屏幕上的初始显示为版本信息。请按"ENTER"键进入设置程序。

5) 手控器屏幕上将会闪现出一行温馨提示：请不要将望远镜直接对准太阳，如果您没有适当配备。假如您早已阅读过该信息，按"ESC"键跳过，可直接进入下一设置步骤。



注意：
如果手控器闲置30秒，则显示屏幕的红灯就会变得暗淡。触摸任何键都可恢复灯亮。

6) 通过数字键输入望远镜所在位置的经纬度。先输入经度坐标值，再输入纬度值。用滚动键来选择东或西，南或北。按住方向键中的左键或右键可将指示针移动到前面的数字或后面的数字。然后按"ENTER"键确认。输入格式举例如：123 04'W 49 09'N。

7) 输入您所在地时区，用滚动键和数字键(加号为东，减号为西)，按"ENTER"键确认。输入格式举例如：PST：－8

8) 按照下面的格式输入日期：月/日/年。再按"ENTER"键确认。

9) 输入您目前当地的24小时制的时间(如2:00PM=14:00)，按"ENTER"查看刚才所输时间的正确性，如果输入有误，按"ESC"键返回重输，如果无误，则按"ENTER"键进入下一环节时昼的设置。

10) 如果在第8步骤中输入的日期落在3月到11月这个区间，Synscan将会提示"白天存储?"，用滚动键选择，并按"ENTER"键确认。加入输入的日期不在这个区间，则Synscan不会提示，而是直接跳到下一环节。

11) 在完成"白天存储"设置后，Synscan显示屏则会提示：是否进行对准设置。按"1"或"ENTER"键进行对准程序。按"2"或"ESC"键退出对准程序。

注意：
如果在设置过程中进行了误操作，可按"ESC"键退回上一级菜单，再按"ENTER"键重新进行设置操作。

对星

为了使Synscan能够准确的对准天空中的目标，必须先进行对星，一般选择1－3颗熟悉的星星。由于地球的自转，天体目标似乎呈现一个弧形运动。通过预先输入的信息，望远镜能够复制天文运动及其模式。对星可以在观测的任何时间进行，可通过选择在主菜单中的设置模式进行操作。

有3种方式进行对星，不过这要取　于您对精确性的要求。如果您是第一　使用，我们建议您进行3星定位，因为它可以提供最精确的定位。但是在对星之前，我们必须得确认寻星镜是否与主镜筒得准星一致。我们将在下一页中介绍如何选择对星的目标。下面我们将一步步的介绍如何进行3星定位。

三星定位

1. 在定位屏幕上使用滚动按键， 选择三星定位。按ENTER进入。

2. 作为第一星定位，SYNSCAN提供你所在星域可观看的星星清单。使用滚动按键，从清单里选择一个合适的星星按ENTER进入。望远镜就会转向它。当望远镜停止回转时，通过方向键调整星星位置，直到星星在寻星镜中处于其十子线中心位置。

   现在通过目镜调节望远镜直到目标处于目镜视野的中心。

回转速度可以通过按RATE键调整。然后选择从0（最慢）到9（最快）的数字。

SYNSCAN一旦停止回转，就会保持静止。在听到嘟嘟声之前不要调整望远镜。在回转时只对ESC键作出反应。

3. 对于第二星准直，SYNSCAN提供可观测目标清单。用滚动按键从清单中选择一个星星，按ENTER键。重复中心对准程序，按ENTER进入。

4. 第三星准直时，SYNSCAN将再　提供可观测目标清单。从中选一个目标，按ENTER键。再　十　字线中心对准.

5. 如果已经选好星星,并定位,SYNSCAN的手控器就会显示 “定位成功”,否则会出现 “定位失败”的警告,需重新定位.

两星定位

两星定位只需两个定位星,,没有锥体误差矫正(见附录A),可能没有三星定位准确.下面逐步介绍两星定位的操作.

1. 在定位屏上使用滚动按键选择2星定位,按ENTER键进入.

2. SYNSCAN将提供第一颗星定位时你所在星空可观测目标的清单.使用滚动按键选择一个你最熟悉的星星,按ENTER键进入.望远镜将回转向这颗星.当停止回转时,用方向键调整位置直至星星处于寻星镜十字线的中心位置.通过目镜观测,调整望远镜直至目标处于目镜视野的中心.按ENTER键进入.

3. 第二星定位时,SYNSCAN提供目标清单.用滚动按键选择一个星星,按ENTER进入.重复中心对准操作,然后按ENTER键确认.

4. 如果已经选好星星,并定位,SYNSCAN的手控器就会显示 “定位成功”,否则会出现 “定位失败”的警告,需重新定位.

三星定位

只需要一颗定位星,但是没有正确的两极定位和锥体误差矫正(见附录A),可能没有其他的定位方法准确. 于 HEQ5/EQ6如何准确两极定位详见其说明书,下面逐步介绍一星定位的操作.

1. 确定望远镜已经两极定位.
2. 在定位屏上使用滚动按键选择1星定位,按ENETR进入.
3. SYNSCAN将提供你所在星空可观测目标的清单.使用滚动按键选择一个你最熟悉的星星,按ENTER键进入..当望远镜停止回转时,用方向键调整位置直至星星处于寻星镜十字线的中心位置通过目镜观测,调整望远镜直至目标处于目镜视野的中心.按ENTER键进入.
4. 一旦结束,SYNSCAN将显示 “定位成功”.

下面是如何选择定位星的几点建议:

一星: 选择一个靠近CELSTRIAL 赤道的星星(偏差绝对植较小)

二星: 选择子午线同一边的两个星,RA轴至少隔开3个时角,DEC轴至少隔开3 . 如果你怀疑两极对准偏离1 , 最好选择DEC轴大于3 小于60 的两个星星.

三星: 对于前2个定位星, 操作同两星定位. 对第三个定位星, 选择一个同前2颗定位星在子午线相反方向的星星. 前2颗定位星和第3颗定位星在在DEC轴上的绝对值为30 到70 . 如果先选择的星DEC轴小(< 30), 第三颗星的DEC轴至少要50 . 下面的公式可以用参考当定先选择的和第三颗星DEC轴时:140 > ABS(DEC1)+ABS(DEC2) > 60

增加指向准确性(PAE)

三星定位对任何观测目的的定位已经足够. 对于星空特定部分的高精密的定位, SYNSCAN提供了增加指向准确性(PAE)的功能. PAE用于可以覆盖整个星空的85个区域. SYNSCAN准确的绘制出定位星所在区域. 将来提高定位准确性还是必要的. 下面逐步介绍PAE的操作:

1. 从星图或行星软件中选一个参考目标.此参考物为明亮的已知的星星,并和你感兴趣的星星在星空的同一区域.
2. 在SYNSCAN的手控器数据库里找到参考目标.如果拖架使用的是行星软件,CLICK ON目标,回转向目标.
3. 调整望远镜使目标处于目镜或CCD的中央.
4. 按压ESC键2秒.手控器会显示 “回到中心”参照目标的名字会闪现3 . 如果进入指令由行星软件发出而不是目标名称,手控器会显示 “最后进入目标”.
5. 确认目标仍在视野中心按ENTER键进入.如果你不希望记录结果,可以按ESC键终止操作.按ENTER 键进入后，SYNSCAN将记录指向错误数并重新计算星空类型。现在星空特定区域的

即使没电了，星定位和PAE的结果也还会储存在手控器里。你只需要操作星定位在以下两种情况下:
1. 在 掉电源前，望远镜移向原始停放位置。
2. 望远镜，包括拖架没有被移动。
请确定键入手控器的时刻同内置设置的时刻来源相同。比如，在观测时根据手表键入时刻，你下 键入的时刻也应是根据手表键入。

目标目录

SYNSCAN的目标数据库

SYNSCAN拥有超过13，400个目标的庞大数据库，该数据库包括以下目录：

太阳系-太阳系的其他8个行星，包括月亮
命名星-212颗已知星星
NGC-修改的新目录里包括7840颗明亮深空里的目标
IC-索引目录里5386颗标准星星和深空目标
MESSIER-110颗MESSIER目标
考德威尔- 109颗考德威尔目标
双星- 55颗著名双星
变星- 20颗著名的变化星

选择目标

一旦望远镜定位，你可以进入数据库观看13400颗不同的目标。以下是3种选择观测方法：

短切键 旅行- 带你进入你所在星空旅行。为了你观测愉快，它会自动选择最亮最美的深空目标。使用滚动键观测深空目标。按ENTER键选择目标，它会显示所选目标的坐标，再 按ENTER键，望远镜就会回转向目标。

M，NGC，IC- 这些短切键是进入天空目录的通道。每个目录都有很多木笔哦啊可供选择。键入数字就可通过数字键选择目标。按ENTER键就可显示其坐标，主要信息像大小，数量，星座通过按滚动键都可获知。再 按ENTER键就可使望远镜回转向目标。

行星- 短切键可以直接带你到达数据库的行星菜单。使用滚动键在太阳系行星清单里寻找目标，按ENTER键观看坐标，再按ENTER键，望远镜转向目标。

使用者- 带你进入你设定的数据库。你可以键入一个新地点或以前存入的目标（见使用使用者社顶数据库）

目标键 目标键带你进入目标数据库，可进入星空的13400个目标。（见目标数据库和菜单）

菜单 主菜单中用滚动键选择目标目录并按ENTER键进入。同目标键相似，将提供13400个天体目标。（见目标数据库和菜单）。

图. i

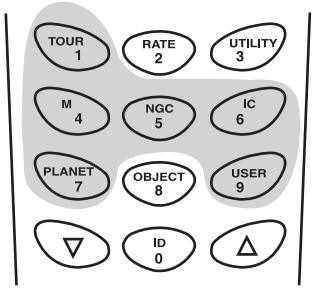


图. j

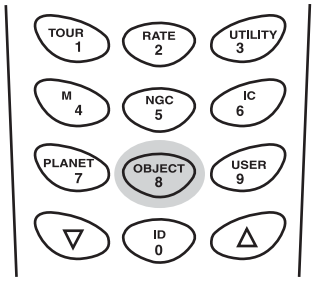
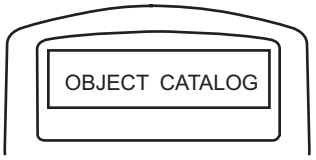


图. k



其他特征

实用功能

实用功能是有用的工具，提供简单的，一步到位的程序：

显示地点- 显示望远镜所在 地点的坐标
显示时间- 显示当地时间和当地恒星时间
停放望远镜：使望远镜回复原始状态
咨询版本- 此子菜单显示五金件，固件和手控器数据库版本。如果手控吴起和拖架相连，此菜单也会显示马达板的固件版本。使用滚动键查看版本数目。
PEC培训- 见错误周期纠正版
LCD/LED调整- 子菜单可做以下调整：LCD后光亮度，LCD字体黑度和LED后光亮度。使用滚动键选择所需的调整。按右或左方向键来增强或降低。

设置功能

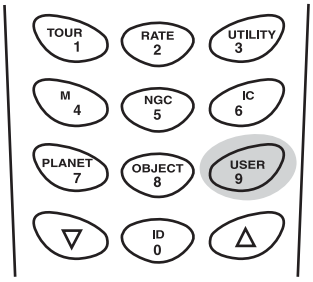
设置功能可用于改变一切可变系统或地点，时间，日期和定位配制。按SETUP键或使用滚动键滚动到菜单里的SETUP。以下列出了你可获得的不同功能和目的：
日期-可改变内设的日期
时间-可改变现有时间
观测点-可改变目前的地点
白天节电模式- 可改变节电模式
定位- 可操作星点定位
设置齿隙误差- 这个功能允许你为每个轴输入一个值以补充它的齿隙误差。为了指向的准确性，设置的持续误差值要和轴承间真正的齿隙误差数相同或更大。齿隙误差的设置默认值是10′00〞（10弧分，0弧秒）。使用数字键输入设定值，按右方向键移动指针到下一个数字。首先设定RA值，按ENTER键继续DEC的设定。

设定追踪
- 恒星速率：以恒星速率追踪（R.A.追踪）
- 月亮速率：以月亮的速率追踪（R.A.追踪）
- 太阳速率：以太阳的速率追踪（R.A.追踪）
- PEC+恒星速率：恒星速率和误差周期纠正
- 停止追踪：立即停止追踪

自动导航速度- 使用自动导航时，速度为1 ，0.75 ，0.5 ，0.25 ，或0.125 的恒星速率。

使用用户自定义数据库

图.1



使用者可储存25个目标在用户自定义数据库里。

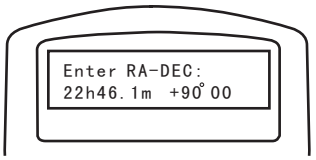
储存一个目标到数据库

1. 在主菜单里，使用滚动键翻看清单目标，按ENETR键进入。
2. 在目标目录滚动清单中选择用户自定义

按快速键用户(数字9)也可进入用户自定义菜单

4. 目标目录里第一个可供选择的是恢复目标，就是你以前存入的目标，使用滚动键翻到“input coordinal”再按ENTER键进入
5. SYNSCAN采用两种格式R.A/DEC和ALT//AZ轴存储用户自定义目标，按1是R.A/DEC格式，2是ALT-AZ格式。
6. SYNSCAN将默认R.A/DEC或ALT/AZ坐标来显示望远镜的位置，对于R.A/DEC格式，读出的坐标类似于“22H46.1M+90 00 ”即在R.A轴22小时46.1分钟DEC轴“+90 00 ”.用数字键

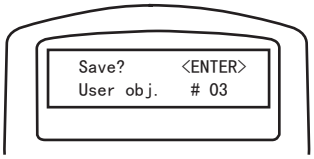
图. m



如果键入的RA/DEC坐标不存在,即使按了ENTER键控制器有不会作出反应.检查输入的错误再 输入正确的坐标.

7. 为了存贮一个目标或以ALT/AZ格式表示位置,首先使望远镜指向期望的地点 获得ALT/AZ值,然后按ENTER键存贮.
8. 存储好坐标后,SYNSCAN将显示用户目标代码，如图N所示,使用滚动键根据你期望的坐标值更改数字，再按ENTER键进入
9. SYNSCAN将显示“Viecoobject”和你输入的用户目标代码。按ENTER键自动寻找目标或ESC键返回到坐标菜单录入。

图. n



显示的用户目标数字可能不是空白的。如果你不能确定那些数字是空白的，你可以先通过调看存储的用户目标加以检查。

调看用户自定义目标

1. 详见1-4的“储存目标到数据库”。选择调看目标按ENTER进入
2. 使用滚动键浏览用户目标数字，直到你要的目标出现。按ENTER显示其坐标。再按ENTER键转向目标。

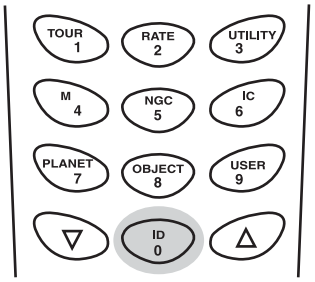
1. 如果所选的目标是空白的，控制器不会做出任何反映。用滚动键选择其他目标再 尝试 。如果调出的目标低于地平线，控制器会显示“低于地平线！！请试其他目标”并自动返回调出目标菜单。

鉴别未知目标

SYNSCAN有鉴别未知目标的功能，很简单，如下：

1. 按ID键或滚动键在主菜单中鉴别，按ENTER键进入
2. 控制器将显示一个清单，告之同离M，IC，NGC和命名星菜单中哪颗星星最近，同望远镜目前所指地点有多远的距离。
3. 按ESC键退出。

图. o



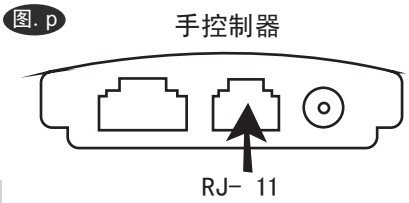
连接计算机

SYNSCAN另外一个功能是通过一些连接线就可和计算机相连。很多商业的行星软件都可用于SYNSCAN，SYNSCAN3.00版本和以后的同CELESTRON 5I/8I 和NEXSTAR GPS相同的协议。

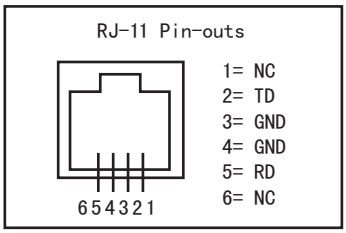
1. 确定望远镜已经对准

2. 把RS-232连接线连接到控制器的RJ-11的连接头和你计算机的COM接口。

图. p



除了提供的RS-232连线，不要用其他RS-232连线连接控制器和计算机，可能会损坏你的计算机和手控制器。如果你按照附录B提供的信息制作自己的连接线，请确定只有插针2，3和5连到计算机的COM接口上。



3. 在行星软件里的驱动设定菜单里选择“Celestron Nexstar 5i”或“Celestron 8/9/11 GPS”，根据提供的说明来建立和望远镜的连接，一旦连接成功，你的望远镜就会在你的计算机控制下工作。

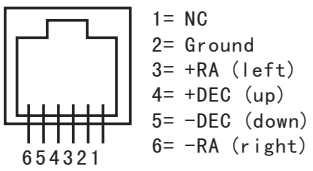
于 RS-232连接器的相 资料. 参见附录B

4. 当结束时，根据指示 闭同望远镜的连接。

自动导航

SynScan的托架设计有一个用 Auto Guider表示.6针式接口可以匹配ST-4,用于市场上绝大多数的AUTOGUIDER.如图 Fig.q把AUTOGUIDER线连到SYNSCAN上就可以校准AUTOGUIDER.可以添加继电器加以保护.注意四个INPUTS 是ACTIVE-LOW.指导速度可以使用设置菜单里自动 功能设置进行调整。

图. q



周期误差纠正

由于轻微的离心率和未调整,几乎所有的蜗轮都有周期误差.PEC则可减少蜗轮的误差.通过记录指导相对马达轴角度的一整圈,SYNSCAN可以补偿由周期误差引起的RA恒星追踪的偏离.以下逐步介绍PEC的操作:

PEC功能供用于长时间曝光拍照的爱好者. 需要仔细的指导. 规则的恒星追踪使用SYNSCAN已经足够而无须PEC调整.

所需配件:可以和望远镜结合产生至少300倍率的双十字照明目镜. 真正的观测视野不应超出10弧分. 于视 场的更多信息详见HEQ5 / EQ6说明书之“选择合适的目镜”部分。

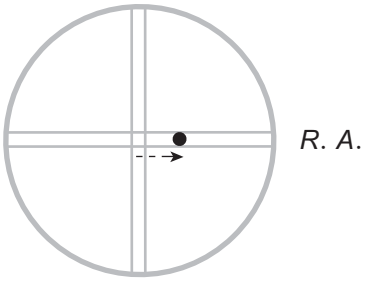
PEC训练

1. 完成精确的极轴校准(见HEQ5/EQ6操作指南)
2. 流览或用手动操作使望远镜指向一颗星的DEC坐标，这颗星就是导向星。
3. 从设定菜单里选择恒星跟踪（见设定功能）一旦开始跟踪，按ESC就可返回设定菜单。
4. 旋转十字目镜直到一条线同RA的运动轨迹平行（详见锥形误差校正发展2到4）
5. 使用方向键使指向星处于目镜中心。
   在控制器里选择效用功能PEC 按ENTER进入

在键区里UTILITY快捷键就可以进入该功能

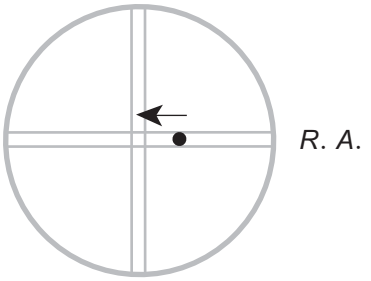
7. PEC TRAINING 选用RA导向速度
8. 一旦选定导向速度，控制器会显示当前的时间，说明已经开始记录
9. 使用左或右方向键移动望远镜，使指向星始终处于目镜视场中心。无论何时都可重复作。

图. r



导向星从中心漂移

图. s



调节望远镜将导向星移回中心位置

10. 为了校正周期误差EQ6 SYNSCAN控制器8分钟（HEQ5 10分30秒）记录追踪过程。按ESC键即可立即停止进一步记录，并退出。当PEC测试在半途被打断后，导星过程仍被记录；此时，PEC就不精确，除非执行了一个完整的PEC测试周期。
11. 当测试时间结束后，控制器会发出“嘟嘟”的响声并显示“记录完成”，按任意键退出PEC功能。如果在PEC+恒星速度模式下，突然断电，控制器将不再保持和RA蜗杆齿轮的同步进行。当电源打开后，PEC测试将不得不重新执行，为避免这种情况，在开 电信号可在“Utilities Fanction”模式下选择“Pack Scope”将望远镜带回初始状态。

播放PEC记录

在设定菜单或按设定快捷键即可激活PEC跟踪。在设定菜单里选择跟踪设定，然后PEC 恒星。SYNSCAN将播放周期误差的纠正。

SYNSCAN将继续在PEC+恒星的模式下追踪直至选择另外一个模式，控制器将和RA蜗轮不同步，当电力恢复后又将重新运行TRAINING。为避免这种状况，在 闭电源前选择PARK SCOPE使望远镜回到原始状态。

更新设置

3．0或3.0以上的版本都可以由用户自行升级
用户可以从SKY WATCHER网站下载SynScan的最新版本,升级自己的控制器.

系统配置

3.0或3.0以上版本的SynScan控制器
WINDOWS95或以上
PC具有可用的RS-232C端口连接手控制器
DC输出为7.5-15V/100mA.电源插头内孔直径2.1MM尖端正极.

为升级准备PC

1. 在你的电脑上就所有SYNSCA相 文件创建一个文件 并命名为SYNSCAN
2. 录SKY WATCHER的 术支 持网页:http://www.SkywatcherTelescope.net/support.html
3. 下载并储存SYNSCAN FIRMWARE LOADER到你电脑里的SYNSCAN文件里.你可以在桌面创建一个快捷方式.你只需要下载一 软 件.储存到电脑里,以后的升级只需软件的数据文件.
下载并储存软件数据文件并命名SYNSCANV .SSF(表明版本数)

升级SYNSCAN控制器

1. 将PC连接线的RJ-11端插入控制器中部的插座.把连接线的另一端DB9接口插入你的PC的 RS-232端口.
2. 同时按下“0”和“8”键,如图所示把电源线插入控制器，然后松开。
3. 控制器将发出嘟嘟声,表明成功启动.如图SYNSCAN在LCD上将显示 “SYNSCAN 升级版本 ”.
在PC上运行SYNSCANFIRMWARELOADER软件.一旦运行,你会看见如图的窗口. “Hc版本”提供软件版本

图.t

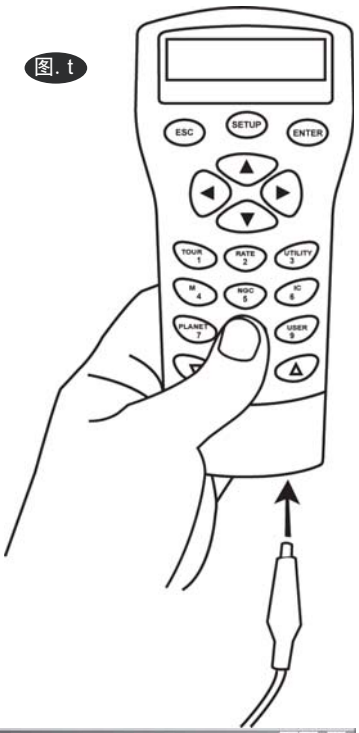


图.u

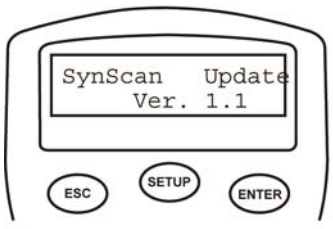


图.v

5. 在SYNSCAN文件里点击 “Browse”选择升级版本。然后点击 “Upgrade”将下载新软件到你的控制器. 在初始化后界面你会看到最新升级状况 .

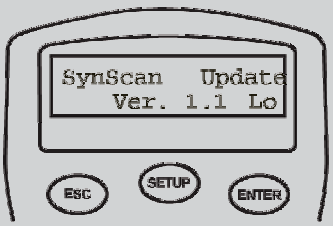
图. w

6. 当下载完成时, 将显示 “下载完成”. SYNSCAN现在就升级到最新版本了. 一般耗时30秒, 如果 你使用USB-RS232 CONVERTER可能耗时更长.

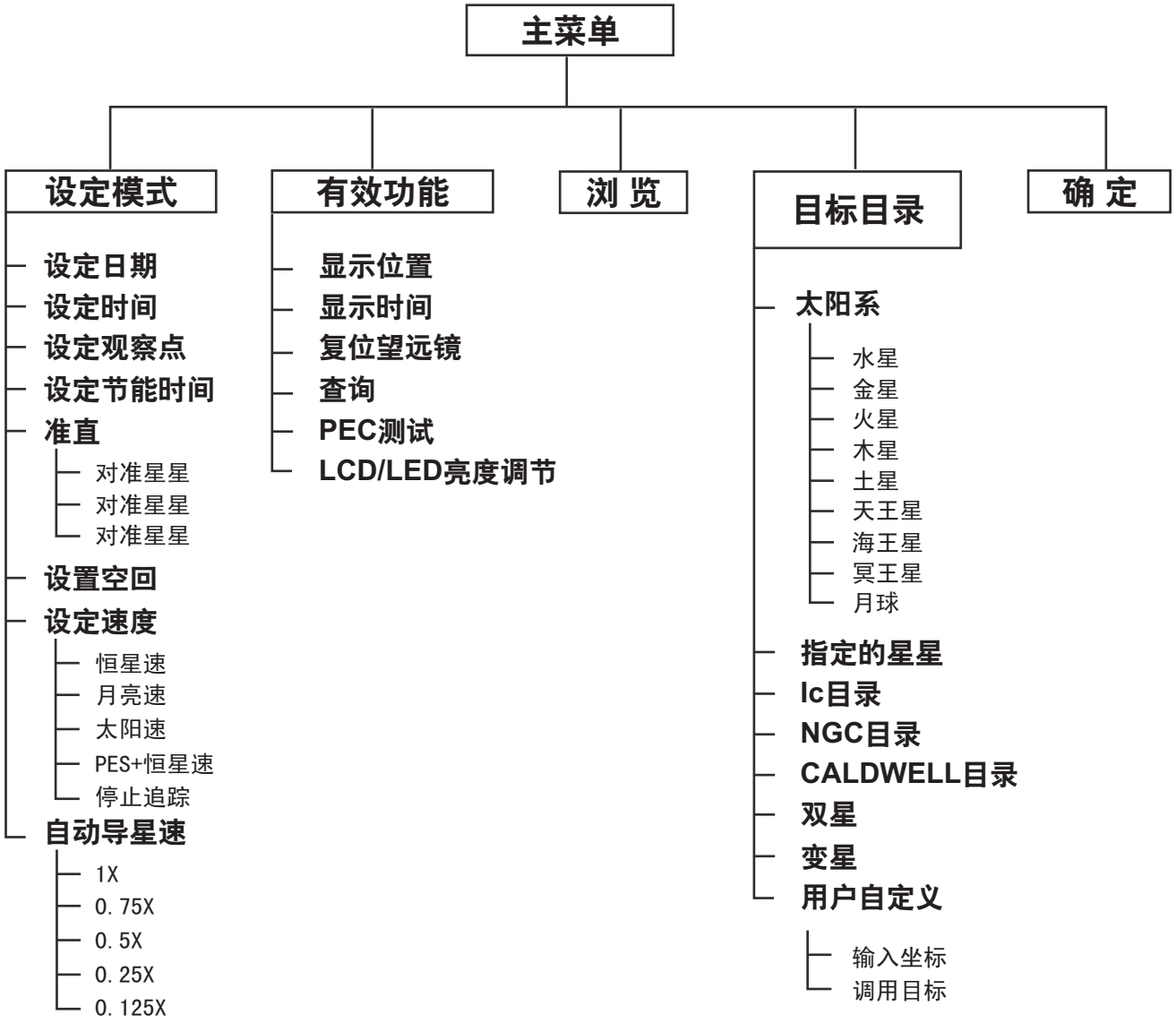
如果显示“不能连接到控制器” 的信息,请检查以下连接口和PC连接线.确定一切状况都好. 掉可能占据RS-232应用软件,并再 尝试 .

如果显示 “软件升级失败”,拔掉电源插头,让控制器稍作休息,然后再 插上插头,重复操作.

SYNSCAN控制器和PC的默认数据连接率为115KBPS.在一些PC上的RS-232C接口可能达不到这么高的传输率.如果重新尝试后升级仍然失败,插入电源后按 “Setup”键, 降低连接率.这样连接率可降到9.6KBPS.LCD屏幕在右下角将显示“LO”， 表示处于低传输率. 除了耗时更长，其实升级步骤相同(大概240秒).



SynScan主菜单


主菜单
设定模式
设定日期
设定时间
设定观察点
设定节能时间
准直
对准星星
对准星星
对准星星
设置空回
设定速度
恒星速
月亮速
太阳速
PES+恒星速
停止追踪
自动导星速
1X
0. 75X
0. 5X
0. 25X
0. 125X
有效功能
显示位置
显示时间
复位望远镜
查询
PEC测试
LCD/LED亮度调节
浏 览
目标目录
太阳系
水星
金星
火星
木星
土星
天王星
海王星
冥王星
月球
指定的星星
Ic目录
NGC目录
CALDWELL目录
双星
变星
用户自定义
输入坐标
调用目标
确 定

SynScan主菜单

规格参数

供电电源：	11到15V DC 2AMP(尖端正极)
马达类型和精度：	步进马达，步进角为1. 8 ／ 步
	精度：0. 144弧秒（或9, 024, 000步/圈）
浏览速率：	Rate 0 = 0. 5X Rate 1 = 1X Rate 2 = 8X Rate 3 = 16X Rate 4 = 32X Rate 5 = 64X Rate 6 = 400X Rate 7 = 500X Rate 8 = 600X Rate 9 = 800X
齿轮速比：	705
跟踪速率：	Sidereal, Lunar, Solar
跟踪模式：	R. A. 单轴跟踪
校准方式：	One-Star Alignment, Two-Star Alignment, Three-Star Alignment
数据库：	25个用户自定义目标，完整的M，NGC，IC星库
	共计13436个目标
指向精度：	高达1弧分

附件A – 锥度误差校准

总体来说，SynScan的指向精度和跟踪精度在大多数应用中已足够了。不过，如果需要更高的精确性，举例来说，天文摄影，那么就可能需要精确的极轴校准和“锥度”误差校准。参见HEQ5/EQ6托架的指导册以了解使用极轴寻星镜来精确校准极轴。

锥度误差在所有German EQ托架上都存在，是一个普遍的不足。这是由于光轴并未与托架的RA轴准直所造成的。这会影响SynScan的指向精度。三星准直会自动补偿锥度误差。如果你选择一星或双星准直方式，那你还必须进行手动托架校准以避免锥度误差。以下的校准步骤应在开始使用望远镜前就进行，并且之后定期进行以确保精度。

测试锥度误差

在夜晚时使用天空中相对的两颗明亮的星星做此测试。请确保望远镜已精确极轴准直，使用一颗东边的星星作为准直星星来进行单星校准。要在单星校准后，选择西边的一颗亮星，这颗亮星应是在SynScan目标数据库中的，然后使望远镜转到那颗星星。如果光轴精确对准RA轴，望远镜的目镜的视域正中应能出现这颗亮星。如果是这样，你的望远镜没有锥度误差，你无须进行校准。如果星星稍稍偏离中心，只要位于目镜视域内，并靠近中心，这都是合格的。许多因素都会影响SynScan的指向精确性，比如不正确的星星准直，RA或DEC的锁紧手轮松开或锥度误差。如果你的望远镜上的目镜中没有这颗星星，你首先要确定这是否是锥度误差引起的指向错误。如果无需转动DEC轴，就可将星星调到目镜中，那么很有可能你的望远镜存在锥度误差。

校准过程

1 插入照明的十字丝目镜。请确保望远镜已正确架好和平衡,寻星镜也已和镜筒精确校准.

步骤2到步骤4是辨认RA轴和DEC轴在十字丝目镜的移动方向.如果你对此已熟悉,可跳到第5步.

2 找到任何亮星,并对准到目镜视域中心.

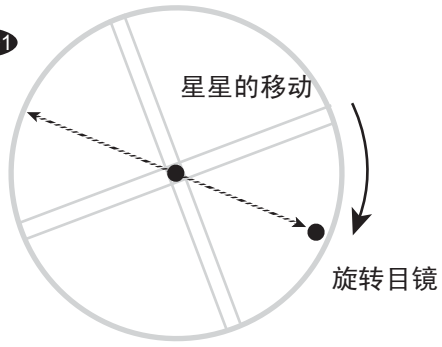
3 朝目镜内看.使用控制器上的RA方向键,沿RA轴移动望远镜,同时仔细观看星星和移动.

4 使望远镜沿RA轴前后移动, 不过亮星必须仍保留在目镜视域中.转动目镜直到星星的移动与任何一条线平行(见图A-1). 这样,这条线就会代表RA的移动,而与之垂直的另一条线则代表DEC移动.锁紧目镜紧定螺钉将目镜固定在位.

5 将望远镜指向正北方,根据你当地的纬度，使用纬度调整螺杆来纬度设定，或用极轴寻星镜对准北极星，只要你的极轴寻星镜已完美地与托架转动轴校准。

所需附件:照明十字丝目镜配有双重十字丝.根据你安装板的设计,也许需要进行修改.(步骤10就描述了在安装板上所需的机构.)

图.A-1



目镜视图

6. 松开RA锁紧手轮，沿着RA轴转动望远镜直到配重杆与地面平行（图A-2）.
7. 使用控制器上的DEC方向键，在DEC轴调整望远镜，因而北极星正好位于十字丝目镜的RA线上（图A-3）
8. 不要动RA轴，调整Azimuth准直手轮使北极星位于目镜的中心（图A-4）。也许需要用控制器调整DEC方向。

图. A-2

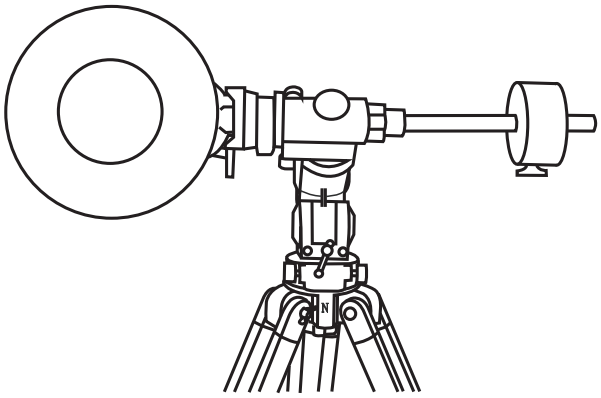
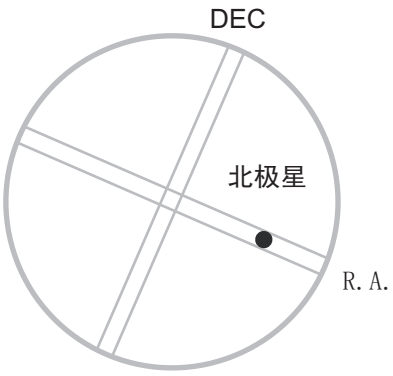
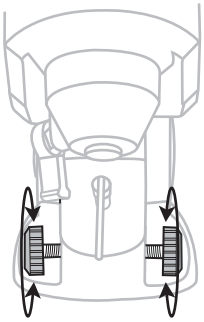


图. A-3



在R. A. 方向上北极星的位置

图. A-4



9. 松开RA锁紧手轮，小心沿RA轴将望远镜转动180度(图A-5). 请用RA度盘并尽可能的精确。
10. 再一 ，在DEC轴调整望远镜，因而北极星正好位于十字丝目镜的RA线上（图A-3）
11. 仔细看一下镜筒下方的安装板。在安装板的各一端，接近 紧箍锁紧螺钉的地方，应有一套螺钉（如果你的安装板没有这套螺钉，那你需要对安装板做修改。）

图. A-5

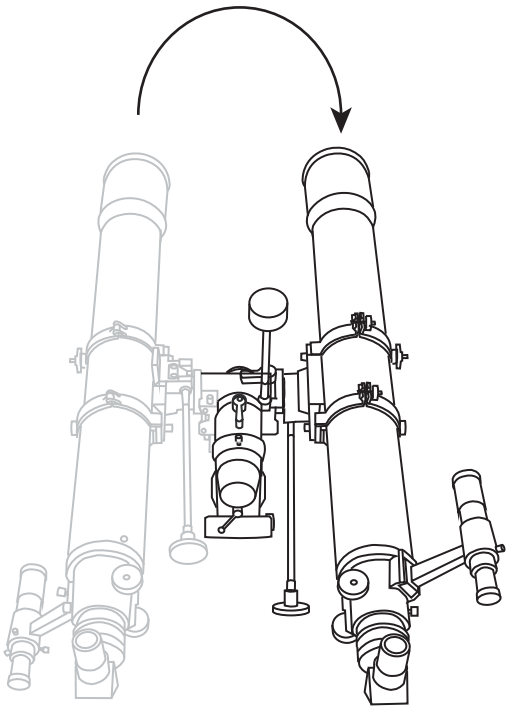
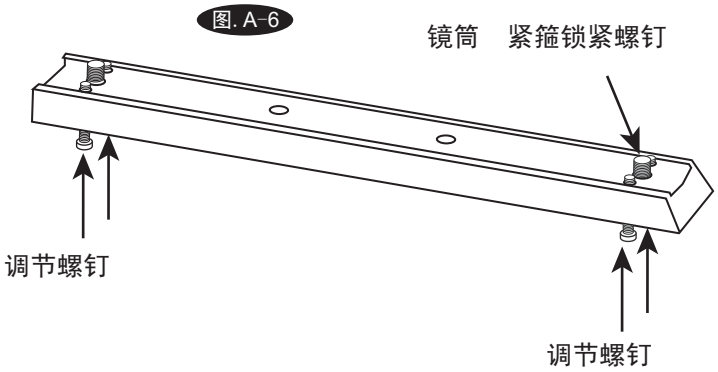


图. A-6



12. 当通过目镜观测北极星运动时，用一个手指轻移望远镜。这样能　定哪个方向（左或右）可以使北极星更靠近目镜中心。
13. 接下来是根据你在第12步调节拖架盘上的调节螺钉。当望远镜移向你右手边时如果北极星向目镜中心移动，你就需要松开镜筒前面的调节螺钉，锁紧镜筒后面的螺钉，并VISE VERSA。看视场调节螺钉使北极星回到位于中心后部的一般位置见图10。

图. A-7

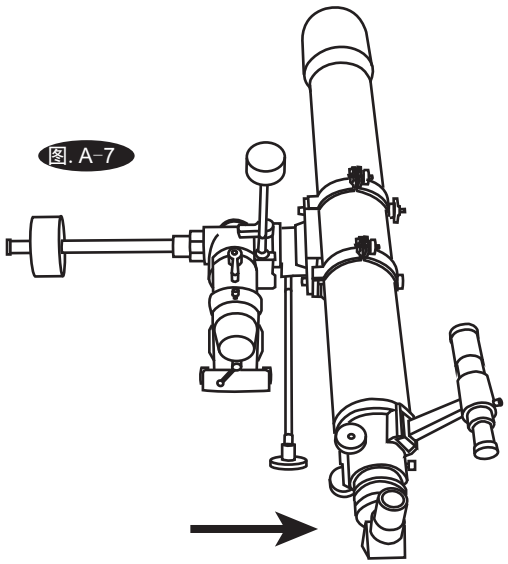


图. A-8

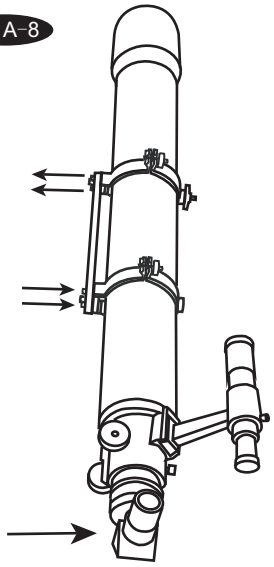


图. A-9

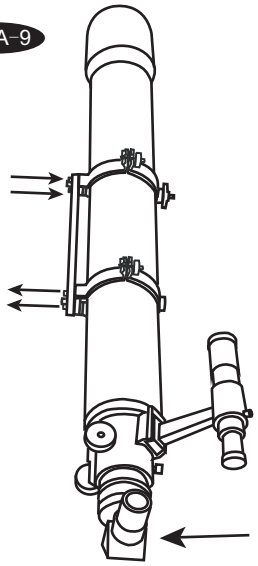
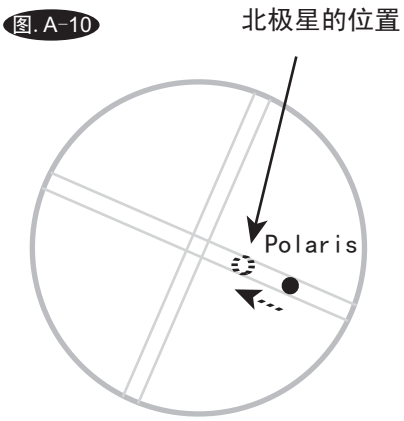


图. A-10



14. 重复步骤7和13直到北极星仍留在视场中心位置或大致存中心位置，然后托架绕RA轴旋转。

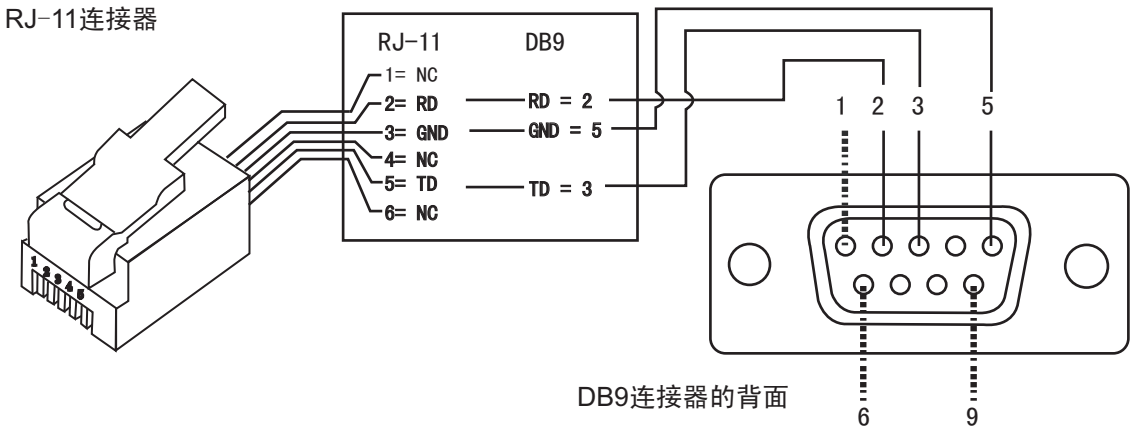
这种刻度方法使用于反射和折射式望远镜。不同设计的望远镜光路不影响镜筒和　紧箍在拖架盘上的调节。

附件B-RS-232 连接

SYNSCAN望远镜通过RS-232端口和RS-232连线可以接受来自于计算机的指令。一旦连接成功大多数的软件程序都可使用。还能和个人电脑在9600BITS/SEC，NO PARITY AND STOP BIT。ALL ANGELS ARE COMMUNICATED WITH 16 BIT ANGLE 并使用ASCII十六进制连接

描述	PC 指令ASCII码	控制器反应	备注
回声	KX	X#	有助于检查通讯是否正常
GOTO AZM-ALT	B12AB，4000	#	发送10个字符。B=指令，12AB=AZM，逗号，4000=ALT。如果指令同回转限制相抵触，将没有反应
GOTO RA-DEC	KX	#	望远镜必须定位准直。如果指令和回转限制相抵触，将没有反应。
GET AZM-ALT	Z	12AB，4000#	返回10个字符，12AB=AZM，逗号，4000#=ALT，#
GET RA-DEC	E	34AB，12CE#	必须定位准直
取消GOTO	M	#	
GOTO 在运行吗	L	0#或1#	0=不是，1=是“0”是ASCII，零个字符
定位结束了吗	J	0#或1#	0=不是，1=是
HC 版本	V	22	2个字节代表V2.2
停止/开始追踪	TX X=0（停止追踪） X=1（开始ALT-AZ） X=2（EQ-北） X=3（EQ-南）	#	ALT-AZ追踪需要定位
32 比特GOTO RA-DEC	R34AB0500，12CE0500	#	
32-BITGET RA-DEC	E	34AB0500，12CE0500#	最后的两个字符一般为0
32-BIT GOTO AZM-ALT	B34AB0500，12CE0500	#	
32BIT GET AZM-ALT	Z	34AB0500，12CE0500#	最后的两个字符一般为0

电路联接示意图



其它的RS232指令

通过RS232发送一跟踪速率到控制器

1. 用你想得到的追踪速率乘以4。举例来说，如果想得到追踪速率是120弧秒/秒（大约是恒星速率的8倍），那么TRACKRATE=480.
2. 将TRACKATE分成两个字节，比如 TRACKRATE=TRACKRATEHIGHBYTE*256+TRACKRATELOWBYTE. 举例来说，TRACKRATE=480，那么TRACKRATEHIGHBYTE=1, TRACKRATELOWBYTE=224, 要想传输追踪速率， 要送以下8个字节：

   A. 正AZM追踪：80,3,16,6 TrackRateHighByte,TrackRateLowByte,0,0

   B. 负AZM追踪：80,3,16,7 TrackRateHighByte,TrackRateLowByte,0,0

   C. 正ALT追踪：80,3,17,6 TrackRateHighByte,TrackRateLowByte,0,0

   D. 负ALT追踪：80,3,17,7 TrackRateHighByte,TrackRateLowByte,0,0

通过RS232发送一慢速GoTo命令到控制器

1. 将角度位置转为一24位字节的数字。举例来说：如果想要的位置是220?, 那么 Position_24BIT=(220/360)*224=10252743
2. 将Position_24BIT分隔成三个字节，象Position_24BIT =PosHighByte*65536 + PosMedByte*256 + PosLowByte)。举个例子，PosHighByte=156, PosMedByte=113, PosLowByte=199
3. 发送以下的8字节：

   A. AZM慢速GoTO：80，4，16，23，PosHighByte，PosMedByte，PosLowByte,0

   B. ALT慢速GoTO：80，4，17，23，PosHighByte，PosMedByte，PosLowByte,0
4. 数字35是从控制器中返回来的。

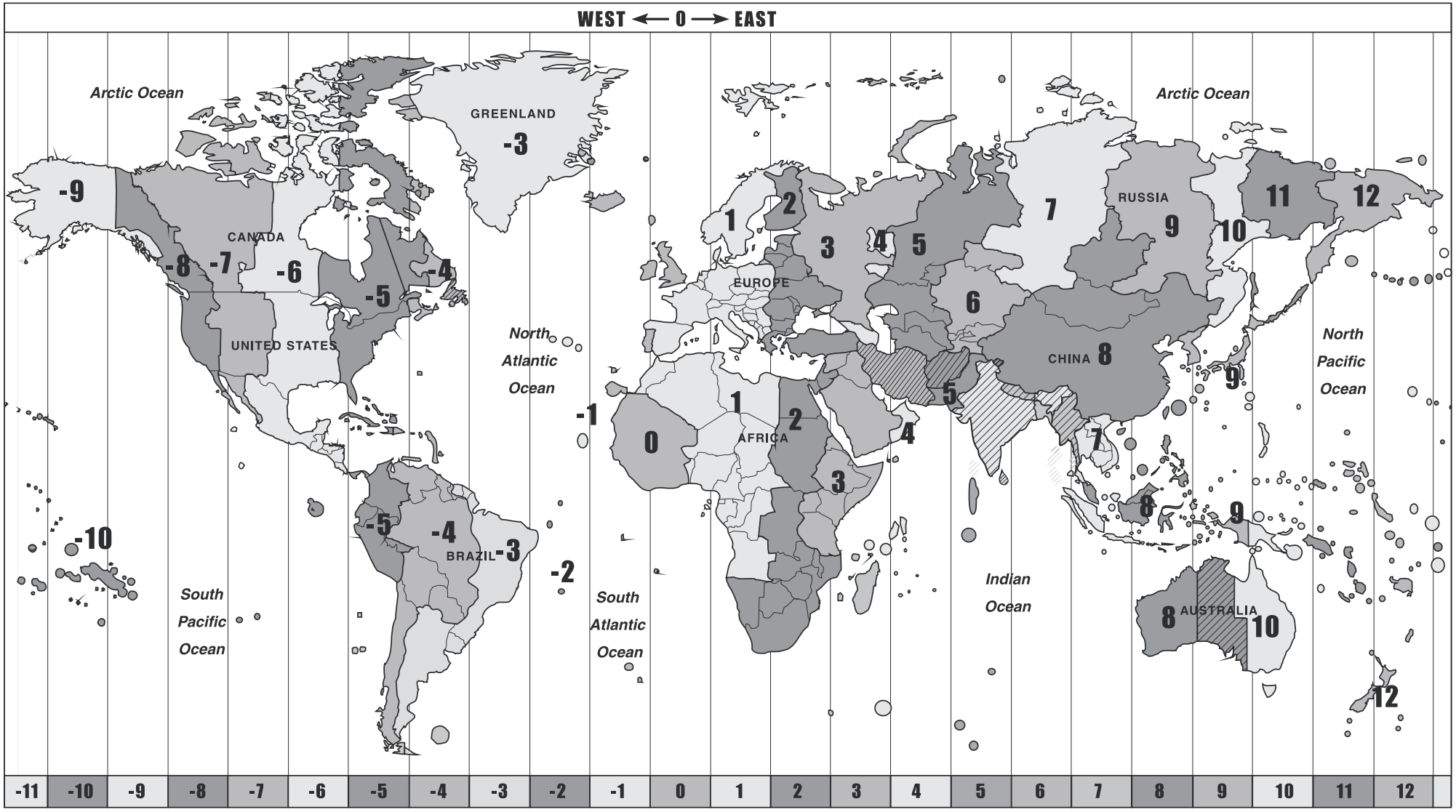
重新设置AZ或ALT的位置

1. 将角度位置转成一24字节数字，就如慢速GoTo一样。
2. 发送以下的8字节：

   A. AZM设定位置：80，4，16, 4, PosHighByte, PosMedByte，PosLowByte,0

   B. ALT设定位置： 80，4，17,4, PosHighByte, PosMedByte，PosLowByte,0
3. 数字35是从控制器中返回来的。

附件C 世界标准时区


WEST ← 0 → EAST
Arctic Ocean
GREENLAND
-3
-9
CANADA
-8
-7
-6
-5
-4
UNITED STATES
North
Atlantic
Ocean
-1
-10
South
Pacific
Ocean
-5
-4
BRAZIL
-3
-2
South
Atlantic
Ocean
1
2
3
4
5
EUROPE
6
7
RUSSIA
9
10
11
12
Arctic Ocean
0
1
2
3
AFRICA
4
5
6
7
CHINA
8
9
North
Pacific
Ocean
Indian
Ocean
8
9
8
AUSTRALIA
10
12
-11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12

SynScan™

不要用望远镜直接观看太阳，以免灼伤眼睛。观测太阳时在望远镜前端安装合适的太阳滤镜。观测太阳时用防尘盖盖住寻星镜或拿掉寻星镜以避免意外的暴光。不要使用目镜型号的太阳滤镜，不要用望远镜投射太阳光到其他表面。望远镜内部的热量将损坏其光学元件