Price $10.00

Celestron® Compustar™ Computer Controlled Telescopes

Instruction Manual

Celestron International
2835 Columbia Street
Torrance, CA 90503

Manual #94067
6-88

Celestron International
2835 Columbia St.
Torrance, CA 90503
(213) 328-9560

Call Toll Free: 800-421-1526
(In Continental U.S.A., Mon.-Fri.
8:00 AM - 4:00 PM P.S.T.)

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Solar Viewing Warning

CAUTION! PLEASE READ!

NEVER ATTEMPT TO VIEW THE SUN THROUGH ANY TELESCOPE WITHOUT PROPER FILTERING.

VIEWING THE SUN WITHOUT A PROPER FILTER MAY RESULT IN EYE DAMAGE, AS WELL AS DAMAGE TO THE TELESCOPE. NEVER ALLOW CHILDREN TO USE THE TELESCOPE DURING DAYLIGHT HOURS UNLESS THEY ARE SUPERVISED BY AN ADULT WHO IS FAMILAR WITH THESE INSTRUCTIONS.

1. NEVER look at the sun without a proper solar filter. Solar observing by children should always be conducted under adult supervision.

2. NEVER observe the sun through your telescope without having equipped it with a properly manufactured filtering device to optically reduce light energy. Observing without a filter may result in instant, permanent damage to your eye, even during a solar eclipse.

3. The smallest finderscopes collect sufficient light to cause eye damage. Keep the lens cover(s) on finderscopes.

4. Pointing a non-filtered telescope at the sun can result in serious damage to the instrument. Optical coatings can be ruined, and optical glass components may shatter.

5. Celestron offers safe, precision solar filters. The only safe solar filters fit *completely* over the *front* of the telescope and provide full diameter coverage of the lens to reduce the sun's intensity.

6. Celestron does not recommend eyepiece solar filters or Herschel Wedge (prism) solar filters. Do not use any filter which attaches to an eyepiece for observing the sun.

7. If the image you see through your telescope is uncomfortably bright, even with a solar filter, STOP USING THE FILTER IMMEDIATELY. The filter may have been damaged even if it appears to be in good condition. Have the filter checked for proper functioning.

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I. INTRODUCTION

The Celestron Compustar Computer-Controlled Telescope is a revolutionary new innovation in astronomical observing technology, designed to be used by amateur astronomers, educators, and professional astronomers.

Incorporating Celestron's acclaimed Schmidt-Cassegrain optical systems, the Compustar telescopes make it incredibly easy to set up and observe celestial objects without the time-consuming hunting, scanning, and searching so common to ordinary telescopes.

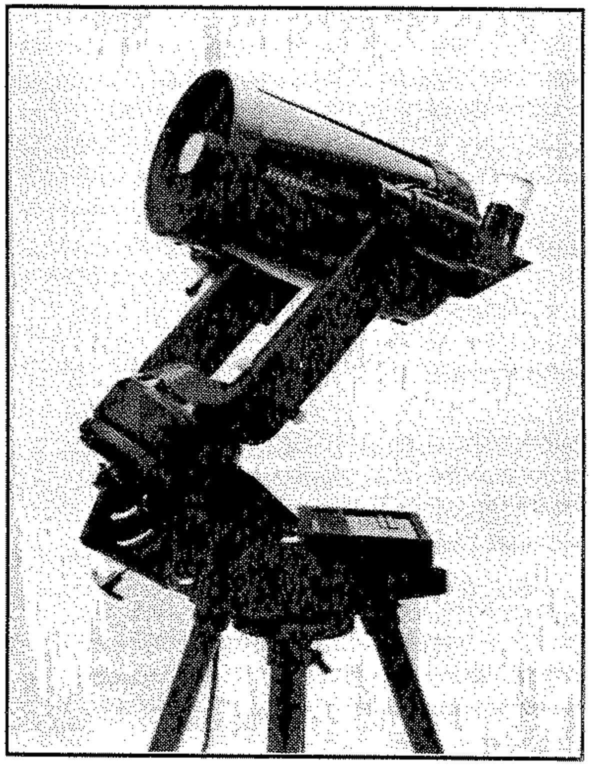
The Computer is controlled by an Intel 8052 Microprocessor which is an 8-Bit chip running at a blazing 12 Mhz.

The Compustar computer *finds objects for you*, and rapidly moves the telescope from object to object, based on what you decide you want to observe. Initial set-up and alignment is quick and easy; the Compustar computer guides you through a simple (initialization and polar alignment) procedure in just a few minutes.

The Compustar has three built-in catalogs containing a total of more than 8000 astronomical objects. They include:

• The famous Messier Catalog of deep-sky objects, M1 thru M110.
• The Computerized New General Catalog of deep-sky objects, CNGC 1 thru CNGC 7840.
• Reference Catalog of notable stars. REF 1 thru REF 218.

The Compustar computer displays the coordinates, type, magnitude, size and visual quality of each object as you observe, so you'll learn more about the objects you are seeing.



Observing time is valuable, whether you are an amateur or a professional. This is particularly true if you must travel to escape city lights or your skies are not often clear. The Compustar will help you get the most out of your telescope in the time you have to use it.

It's fast and easy to program the Compustar to take you on a sky tour of your favorite objects. Just tell Compustar, for example, that you want to look at all the globular clusters more than 30 degrees above the horizon, and that you want the telescope to stop for 30 seconds at each object, and off you go. The Compustar immediately moves to the first object, and when your time is up, beeps to warn you to get out of the way before it moves on.

Finding a particular object is even easier. Just press "M31" and the Compustar moves quickly to the Andromeda Galaxy (Messier Catalog Number 31).

Locating difficult or unfamiliar objects is easy since the Compustar points to objects quickly and accurately. The built-in catalogs include a subjective rating of object visibility, so you quickly learn what to expect if the Compustar tells you, for example, that the planetary nebula you can't see is rated 'POOR'.

The Compustar uses red backlit displays to reduce the inconvenience and adverse effects of flashlights and other lights (such as impairment of dark adapted vision).

Advanced users may take advantage of the built-in RS-232 interface, allowing the Compustar to be operated remotely by other computers.

The Celestron Compustar telescopes bring a long-awaited innovation in astronomical technology that will change amateur astronomy forever.

Compustar 8, 11, 14

The Compustar is available with 8", 11", or 14" diameter optical systems. Each is mounted on a similar fork mount, and the operation of each model is essentially the same. The size of the optical tube and mounting components increases on the larger sizes, and the set-up of each mount and tripod is a little different from each other. For example, on the Compustar 11 and 14, the fork arms are removed from the drive base and optical tube for storage; on the Compustar 8 the optical tube is stored attached to the fork arms and the drive base.

Many of the descriptions and photographs show only a particular Compustar model, so your telescope may appear slightly different from that shown or described.

Optical System

Schmidt-Cassegrain Optics

The Compustar uses Celestron's certified diffraction limited 1/10th wave Schmidt-Cassegrain catadioptric optical systems to obtain very bright images and, for a compact portable telescope, a long focal length and large flat field. The system has three elements: the Schmidt corrector; a concave primary mirror; and a convex secondary mirror. The corrector plate lens looks like a flat window at the front of the telescope. The curved concave primary mirror is at the back. Fastened to the center of the Schmidt corrector plate is a secondary convex mirror which faces the primary mirror. Light enters the telescope and is bent slightly (corrected) by the corrector plate. It is then reflected by the primary mirror to the secondary mirror, and finally passes to the eyepiece. A large dust cap protects mirrors and lens when not in use.

High Performance Coatings

High transmission special coatings of Magnesium fluoride (MgF_2) have been applied to both sides of the corrector lens. These anti-reflection coatings increase light transmission and enhance visual and photographic contrast. They are as durable as those on high quality camera lenses and, properly cared for, will last a lifetime.

The primary and secondary mirrors have Celestron's Starbright® enhanced mirror coatings, which increase light transmission by approximately 12% per surface. This significantly increases image brightness and contrast for both visual and photographic use.

Finderscope

Each Compustar telescope includes a wide-angle finderscope to aid in positioning of the telescope, especially during initial polar alignment. In most telescopes, the finderscope is the principal means of locating objects; the Compustar's computer system essentially eliminates use of the finder in this way.

Visual Back

The visual back at the rear of the Compustar 8 & 11 telescopes holds 1-1/4" eyepieces or other accessories. When the large knurled ring on the visual back is loosened, the silver thumb screw can be set at any angle for convenient and comfortable use. A plastic cap covers the open hole in the visual back when you are not using it to protect the telescope from contaminants and other hazards.

Star Diagonal

The Compustar 8 & 14 are supplied with a 2" star diagonal to make your viewing angle more comfortable. It accepts all 2" dia. oculars. The Compustar 11 is supplied with an 1.25" star diagonal. The Compustar 14 has a 2" visual back to hold 2" eyepieces or other accessories.

Mechanical

Equatorial Fork Mount

The fork mount included with each Compustar telescope allows the optical assembly to be aimed freely. The mount includes the Compustar drive base, fork arms, dual stepping motor electric drives for both right ascension (east / west) and declination (north / south). Mechanical locks allow for repositioning the optical tube assembly for manual use during the daytime or if required due to a power failure during operation of the computer control.

When mounted on the optional Equatorial Wedge or an optional permanent pier, the fork mount becomes an *Equatorial Mount*, or a mount which can be aligned with the motions of the earth.

Before starting to use your telescope to look at objects in the sky, the polar axis (also called the Right Ascension Axis) of the equatorial mount on your telescope should be aligned parallel to the Earth's axis.

By positioning the equatorial mount correctly, it is possible for the telescope to compensate for the Earth's rotation Only the polar axis needs to be rotated. With the Compustar motors powered up, the mount will automatically follow the apparent movement of the sky. (Of course, the mount is actually adjusting for the rotation of the earth.)

Tripods (Optional)

The sturdy Celestron field tripods are essential unless the telescope is permanently mounted. Each leg of the 8" model is individually adjustable, so it's ideal for use in almost any terrain; unique cam action and thumb screw locks for safety and stability. The 11"/14" model's super-rigid locked-triangle leg design is not adjustable.

Equatorial Wedges (Optional)

Attaches between the Tripod and telescope drive base. This accessory is essential unless the telescope is mounted on a pre-aligned permanent pier. It provides *altitude* and *azimuth* mechanical adjustments used during the computerized polar alignment procedure. Different models fit 8", 11", & 14" Compustar telescopes.

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Unpacking & Assembling the Telescope

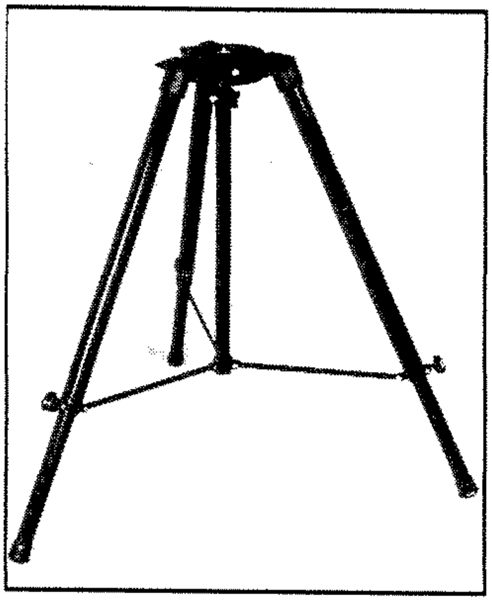
Before taking your telescope outside for the first time, assemble the telescope to the wedge and tripod indoors to familiarize yourself with the process; it will then be a lot easier to do it in the dark!

Compustar 8

1. Open The Boxes

Take all the parts out and line them up.

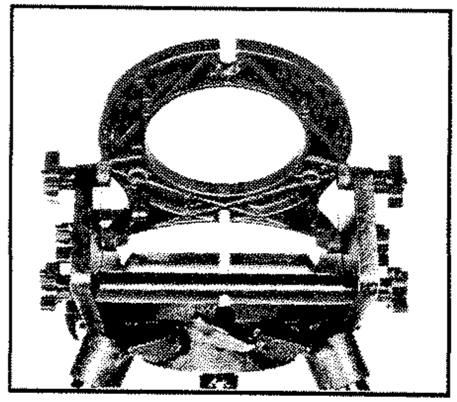
2. Set Up the Tripod



Unfold the tripod legs, spreading them as far as possible from the center column. The sliding collar (attached to the leg braces) on the center column should be moved to the bottom of the center column.

Loosen the leg extension locking knob at the end of each leg, and extend each leg to the height you prefer. If the telescope is to be used while standing up, the tripod legs should be fully extended. However, you will find that the telescope is a bit sturdier with the tripod set to a low height. Adjust one or more legs so that the top of the tripod is reasonably level.

3. Install Knobs & Adjusters On Wedge (Standard Wedge first use only)



If not already installed, replace the four hex-head bolts on the side of the Wedge with the black knob-head bolts provided loosely tightening them. Be sure to put the washers between the knobs and the side of the wedge.

Attach the wedge-tilt 'latitude adjuster' bar between the wedge sides, at the bottom of the slots in the wedge sides. Secure it with two of the bolts removed above.

Adjust the angle of the wedge tilt plate to approximate the latitude of your observing site, using the latitude scale on the wedge. Tighten the four side knobs.

Thread the long 'altitude adjuster' screw (with the black T-handle) through the center of the adjuster bar until the end of the screw fits into the triangular shaped depression at the bottom of the wedge tilt plate.

4. Attach the Wedge to the Tripod

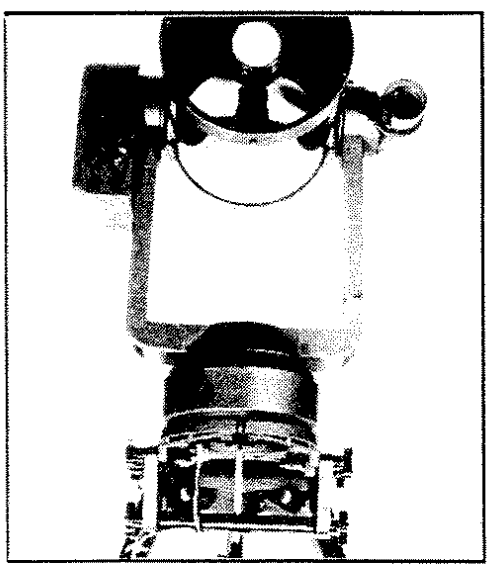
Use three bolts to attach the wedge to the tripod, placing the bolts through the three elongated holes in the wedge bottom. Snug up the knobs with the wedge positioned approximately in the center of the range of motion allowed by the elongated holes.

The adjustment of the wedge-to-tripod angle is one of the two basic polar alignment adjustments. It must be adjusted precisely later on under direction by the computer control. Roughly orient the wedge and tripod combination to the pole by picking it up and re-positioning the tripod leg nearest the low side of the wedge tilt-plate toward the north (south in the southern hemisphere).

The second of the two basic polar alignments is azimuth; the side-to-side rotation of the wedge on the tripod.

It is always necessary to loosen the three wedge-to-tripod securing bolts *slightly*, before adjusting the azimuth. Tighten all the knobs when the desired alignment is reached.

5. Attach the Telescope to the Wedge



Locate the three remaining knob-head bolts.

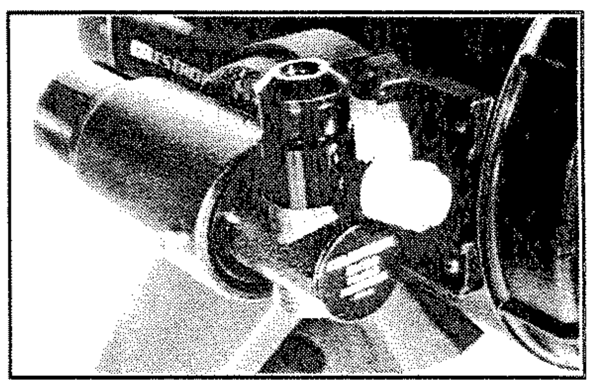
Examine the bottom of the telescope drive base, while leaving it inside the carrying case. Note the three large threaded holes on the bottom of the drive base, used for the securing bolts.

Thread one of the knob-head bolts three or four turns into the hole centered on the rounded side of the drive base.

Pick up the telescope with both hands, using the fork arms as handles. Slip the knob-head bolt into the slot in the top of the wedge tilt plate. The bottom of the telescope drive base should be flat against the tilt plate, between the sides of the wedge. Tighten the knob.

Screw in the other two knob bolts to complete the attachment of the telescope to the wedge. Tighten everything securely.

6. Attach the Finderscope (first use only)



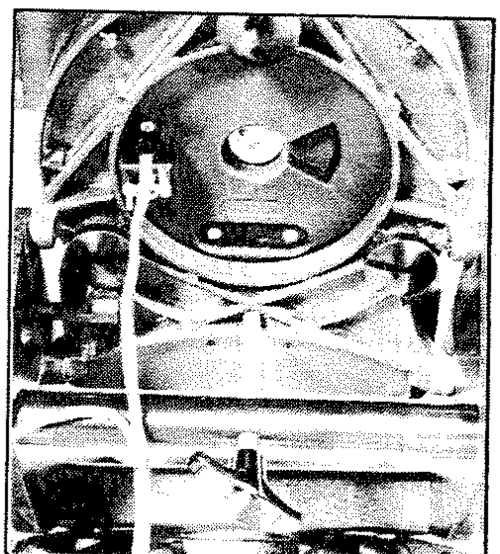
The finderscope should be mounted in its bracket when you first assemble your telescope.

On the Compustar 8, unscrew the entire lens assembly and the knurled slip-ring from the finderscope body. Insert the body through the mounting bracket. Push the rubber O-ring over the body of the finderscope. Position the body so that the ring is nested in the recess of the bracket. Replace the knurled slip-ring and lens assembly. Adjust the three alignment screws as described later under "Observing with a Telescope".

On the Compustar 11 and 14, the finder must be removed after each session to fit in the case properly.

7. Computer Control Connections

Declination



Right Ascension

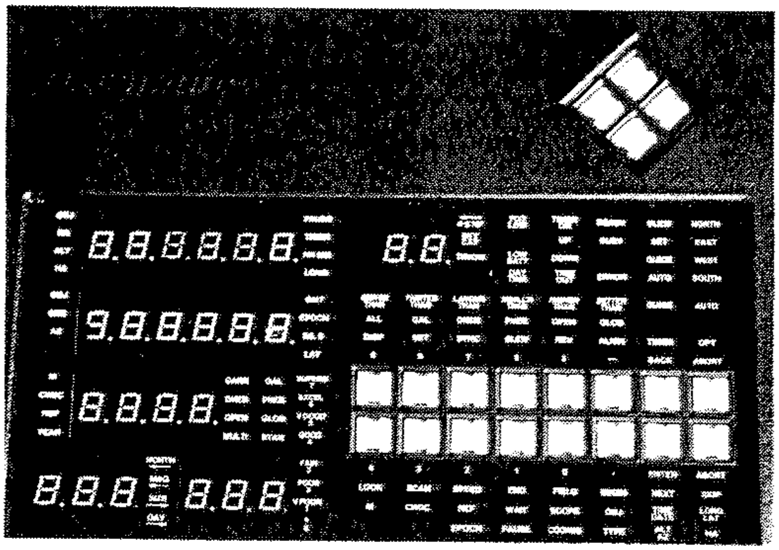
The Compustar computer system includes the Power Module and the Computer. The Power Module connects to the Computer through the cable with the large 25-pin connectors. The Power Module connects to the telescope motors through the two cables with 6-pin connectors. The "Male" 6-pin connector plugs into the telescope drive base. The "Female" 6-pin connector plugs into a short extension cord, then to the declination drive on the fork arm.

Compustar 11&14

The 11 and 14" models are essentially similar to the 8" model, except that the optical tube assembly and fork arms are removed from the drive base for storage.

In assembling these models, first attach the drive base to the wedge, then attach the fork arms, then attach the tube assembly.

Getting Acquainted With Your Compustar Computer



The Compustar Computer Control is an incredible device which makes finding celestial objects fast and easy. You can find a particular object by simply entering the object's catalog number, and in seconds you are viewing it. You can move the telescope to specific celestial coordinates by just punching them in. You can even observe an extended series of objects by telling the computer the range of objects you are interested in, and off you go on a celestial tour.

The Compustar Computer Control moves your telescope's built-in stepping motor drives to first locate and then precisely track each object you observe, counteracting the rotation of the earth.

Computer

The plastic-housed Computer unit has two functions; it lets you tell the Compustar what you want it to do, and it gives you information about the position of the telescope, about objects in the sky, and status of the system.

Be sure you do not set the unit directly on the ground where it might get wet or damaged.

Computer Display

The Compustar display includes two kinds of indicators. Numeric *characters* show telescope and object coordinates, time, date, and object size and brightness information. Separate backlit *legends* illuminate various words or numbers to indicate object information and computer requests for certain input or options you choose.

The legends nearest the two horizontal rows of eight pushbutton keys are used to show the function of a key, while the remainder of the legends provide information not associated with a particular key.

Computer Control Keys

The computer control pushbutton keys are of two distinct types:

Command (Soft) Keys
The *Command Keys* are the two horizontal rows of 8 keys. Each command key has four associated legends. The legends for the upper row of command keys are above the keys – the legends for the lower row of command keys are below the keys. The current function of each command key is always illuminated on the associated indicator. ***If none of the legends for a given key are illuminated, then the key has no function and will be ignored if pressed.***

This type of keypad, where the meaning of each key is variable, is called a *Soft Keypad*. Each key with its four associated legends is a *soft key*, which means that the key function is variable ,depending on system status. Executing a command is easy since, ***at each step, only valid soft key functions are illuminated*** – there is never any question of what you can do next.

Motion Control Keys

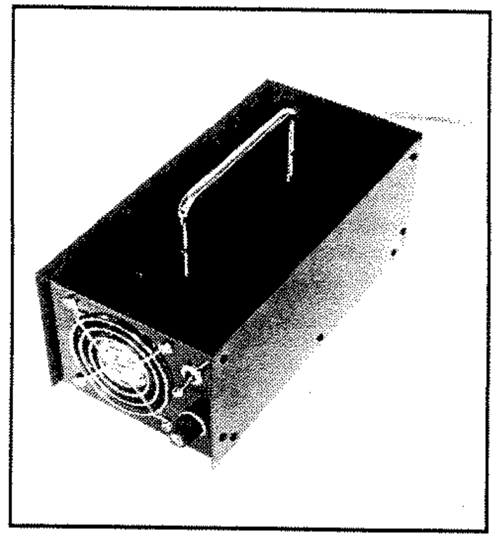
The *Motion Control Keys* are the 4 keys in a diamond configuration in the upper right corner of the Computer. When depressed, they cause the telescope to move. The motion will slowly (over about 5 seconds) increase to the top speed of the selected speed range (SLEW, SET, or GUIDE).

The three speed ranges allow these keys to be useful for either rapid slewing of the telescope across the sky, fine positioning or setting of the telescope position, or very precise micro-adjusting or guiding of the telescope during long exposure photography.

The speed range of the motion keys is changed easily by pressing the SPEED key, then the command key for the desired speed.

Do not confuse the SLEW and SET *speed ranges* with the SLEW and SET *command keys*; the speed range is exclusively related to the motion keys while the command keys are related to finding objects and setting various optional conditions on the computer.

Power Module



The Power Module contains electronic components that generate a significant amount of heat. This includes the power driver transistors for the stepper motors and the voltage regulator for the Computer.

A small fan is used to remove heat from the enclosure. Point the fan end roughly northward so it does not introduce turbulence into the air in the optical path of the telescope. Be sure that the Power Module is open to free air so it doesn't overheat.

The Power Module has two connectors and one split cable with two connectors:

1. 2-pin connector for power input.
2. 25-pin connector for connecting the Power Module to the Computer .
3. 6-pin cable with Male connector for RA stepper drive.
4. 6-pin cable with Female connector for Dec stepper drive.

The 2-pin connector is used to supply 12 VDC power to the Power Module. This is the only external power required by the Compustar.

Observing with the Telescope

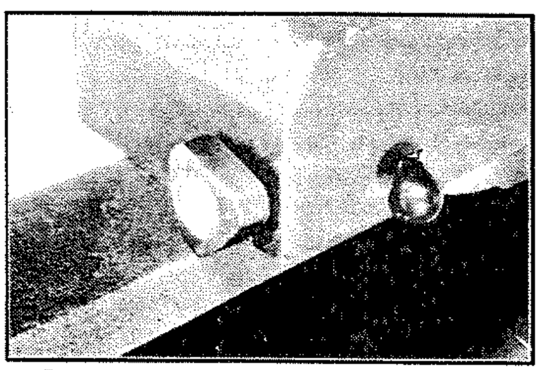
You've set up your telescope for the first time, and are probably pretty eager to look at something! If you would like to use the computer now, skip to the next section. When ready to take the scope outdoors, return to this section. While there is a lot more to learn about your new telescope, why not take a look?

Your First Look

You are probably eager to test the optics of your new telescope. Choose something that's fairly large and bright, and that can be viewed *without pointing the telescope through window glass or heat waves*. We want your first impression to be a good one!

During the daytime, the top of a telephone pole a few blocks away is a good choice. At night, aim for the moon if it's visible, or a street light some distance off if it's not. (Don't try to find a smaller or fainter object until you have focused the telescope initially.)

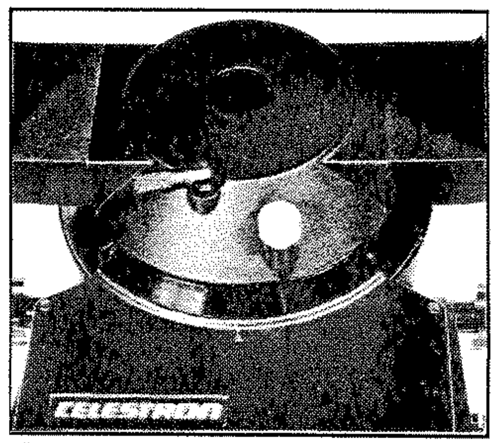
You can't see anything through your telescope without an *eyepiece* (also called an *ocular*). Attach your *diagonal prism* to the back of the optical tube, and put your low power eyepiece into the diagonal prism.



Declination gear release knob (teardrop) and securing knob (triangular).

Do not move the telescope tube manually while either of the clamps are locked; this may cause damage to the telescope's gearing!

At the lower side of the motor housing on one fork arm (on the 8") you will find the teardrop-shaped declination gear release knob and it's companion triangular securing knob. You can release the tube to rotate freely by loosening the triangular knob slightly, and pulling on the spring-loaded teardrop knob. Tighten the triangular knob while the release knob is pulled to keep the scope moving freely. Leave the triangular knob loosened during normal operation.



Right Ascension Lock and Right Ascension Slow Motion Knob.

At the base of the 8" & 11" telescopes, between the fork arms, is a clamp called the *Right Ascension (RA) Lock*. Unlock it and swivel the tube into position. You may want to loosen both the Declination Lock and the Right Ascension Lock together.

When you've found your object, sight in on it by aiming along side the optical tube. Once in the general vicinity, sight in on it using the finderscope, center it in the finder, and lock both clamps. If the finderscope is properly aligned, you should be able to find your subject in the main eyepiece.

The knob beside the RA lock is the *Right Ascension Slow Motion Knob*. It works only when the RA lock is *loosened*. (Note: the RA slow motion knob normally feels somewhat loosely coupled to the internal gear.)

When you first look into the main eyepiece, your subject will probably not be in focus. Your telescope has a very wide focus range, and you may need to turn the focus knob quite a distance to find the proper focus. The knob moves the internal primary mirror inside the tube. Focus on closer objets by turning the knob clockwise, and on distant objects by turning the knob counter-clockwise.

Aligning the Finderscope

Although you won't use your finderscope as often with the Compustar as you would with an ordinary telescope, you'll want to keep it in alignment with the main optics. You obviously want to be sure that an object in the middle of the finderscope's crosshairs is also in the center of the field of view of the telescope.

To set the alignment, first find a prominent subject that is at least a mile or so away (a bright star is ideal; the top of a distant telephone pole is good, too). Don't use anything too close, the foot or so separating the center of the finder from the center of the main telescope will then cause an alignment error.

Center your target object precisely in the center of the field of the *main telescope*, using your highest power or a crosshair eyepiece. Then look through the eyepiece of the *finderscope*, and adjust the finder's alignment screws until the target object is right in the center of the crosshairs. Be sure all the finder alignment screws are secure and the alignment is still good.

Magnification & the Eyepiece

The telescope has one task: to form an optical image. That task is performed by the main optical elements of the telescope; the primary and secondary mirrors and the corrector plate. The eyepiece magnifies the image formed by the main optics, enabling you to see it with your eye.

Magnification (or power) in a telescope depends on the focal lengths of both the main optics and the eyepiece.

To calculate the magnification of your combination of telescope and eyepiece, divide the focal length of the telescope by the focal length of the eyepiece. For example, using the 2000mm focal length of the Compustar 8 with a 50mm eyepiece, the magnification of the object is 40x, or 40 times larger than what you see with your unaided eye. (2000mm divided by 50mm = 40x) If you change to a 7mm eyepiece, the magnification will be about 286x. (2000mm/7mm=285.71)

High magnifications are not 'better' than low ones; much as high gear in an automobile is not 'better' than lower gears; just different. In fact, lower powers show larger areas of sky and brighter images than higher powers.

Brightness decreases rapidly as power is increased; Doubling the magnification drops brightness to one-fourth. Larger, faint diffuse nebulae usually look best at low to medium powers. Bright planets and double stars usually look best at medium to high powers.

As a general rule, lower power eyepieces are used more often than higher power ones. Always start out observing with your low power eyepiece; switch up to higher powers when conditions seem appropriate.

"Seeing"

Seeing is the term astronomers use to describe the atmospheric conditions which alter the quality of an image seen through a telescope. The atmosphere is between the object you are looking at and the telescope. Air itself is a lens. Since the atmosphere is in constant motion and at many different temperatures, the light from distant objects is bent and interrupted, in a manner similar to the heat waves seen over a highway on a hot summer day.

You can determine the seeing, that is, the atmosphere's condition, with the naked eye, by observing how much the stars appear to "twinkle". When the stars shine with a steady glow (rather than a twinkle) the seeing is steady. The less twinkle, the better the image you see in the telescope.

A slight haze on a still night often indicates periods when the atmosphere is stable. Even though a clear cold night might seem to be a good time to use your telescope, the upper atmosphere is usually quite turbulent causing star twinkle.

Planetary viewing is especially bad during periods of bad seeing. Deep sky objects (nebulae and galaxies) are not nearly as affected by seeing conditions. Here the most important factors are the transparency of the atmosphere and the darkness of your observing site. The darkness of the sky, far from city lights, is very important when viewing deep sky objects and can't be overemphasized. Some objects can't be seen at all in areas with even slight city light pollution. Even the light of the moon will keep you from observing deep sky objects.

"Local seeing" can be affected by thermal disturbances near your telescope. A warm nearby building, highway, or even a person standing "up wind" from your telescope can have a profound effect on your observing.

Try to keep your hands off the tube of the telescope as much as possible to avoid disturbing the air inside the tube. Your body's heat creates air movement. It is also good practice to avoid rapid movement in front of the telescope.

You can see "heat waves" by aiming at a bright star, de-focusing the telescope, and putting your hand in front of the telescope; you'll be surprised by the currents of warm air you can see all around your hand.

Adapting Your Eyes to the Dark

Once you are out observing celestial objects, you'll find that it takes a while for your eyes to adapt to darkness and reach their maximum sensitivity. It can take as much as 30 minutes or more of complete darkness until you'll see faint objects at their best.

You'll need to completely avoid any exposure to 'white light' while observing or adapting your eyes to the dark. Always use a red-lens, dim flashlight when you need light at all, or best of all avoid using any additional light while observing.

If you've been to an astronomy 'star party', you already know that turning on a light around observing amateur astronomers is the fastest way to lose friends! It only takes a few seconds to lose your 'night vision'.

Definite things to avoid: Street lights, automobile headlights, porch lights, matches or cigarette lighters, white-light flashlights, interior auto 'dome' lights. It's also a good idea to keep out of bright daylight (or wear sunglasses) as much as possible the day before an observing session; this will reduce sensitivity to faint light for quite a while.

Welcome To Your Universe

Basics of Celestial Mechanics

The Compustar will allow you to do extensive exploring in the universe. To do this, however, you need to understand some basic astronomy and you will need to align your telescope properly. The rest of this section will provide you with the information you need even if you are just a beginner. If you are more advanced, we suggest you glance quickly through the following pages and then go on to the following, more technical information in this manual.

Our Moving Earth

The earth is in constant motion. A giant ball, it rotates like a top around an axis that goes through the North and South Poles. This rotation causes day and night. The apparent movement of the sun (and at night the moon and stars) across the sky is the visual result of the Earth's rotation. The Earth also rotates around the sun. Less obvious on a daily basis, this motion causes our seasons. It also causes the changing scenes in the night sky throughout the year. Constellations seen in Winter are hidden by the daylight sun in the summer. Using a telescope, the rotation is magnified. Nothing you look at in the sky will stay in the telescope's field of view very long!

Where we are on the Earth's surface determines our relationship to the North and South Poles, and therefore to the movement of the sun, moon, and stars.

Visualize a line drawn through the Earth's Poles which intersect a giant sphere with the stars on it. The Polar line pierces the star sphere at a point called the North Celestial Pole. The star nearest this point is called the North Star or Polaris. Regardless of the season or time of night, Polaris appears at about the same place in the sky. As you face Polaris, everything else in the sky seems to rotate (counterclockwise or East to West) around Polaris.

Now visualize a giant circular plane that cuts the earth in half at the Equator. Extend it to intersect the star sphere. This intersection is called the Celestial Equator.

The coordinates used for specifying the location of everything in the sky are based on these two intersections. The two coordinates are called *Right Ascension* (RA) and *Declination* (DEC). Right Ascension is measured in Hours, Minutes and Seconds (based on a 24 hour clock) from an arbitrary point in the sky (called the "First Point of Aries", a sort of celestial Greenwich). The numbers increase as you go east along the Celestial Equator. Declination is measured in Degrees, Minutes, and Seconds, North or South of the Celestial Equator. North Declinations are usually listed as positive numbers, while South Declinations are listed as negative numbers. For example, the North Celestial Pole is at 90° North or +90°.

What's out there?

Once you have carried out the basic alignment of your system, you are ready to start your journey outward to the moon, the planets and beyond into deep space. Worlds and universes await you. Every observer should have several books and atlases of the celestial wonders; understanding what you are looking at is the key to enjoying your observations.

Many stars are in the Compustar CNGC catalog as CNGC, M, or REF objects. You can find these objects by simply entering the object catalog number after the SLEW command.

Here are some of the most popular things you'll see:

The Moon

You can see the Moon most easily during its partial phases and when it is at its highest point in the sky. The most detail is visible along the line dividing the dark from the illuminated side of the Moon called the *terminator*. Craters can be seen most dramatically near the terminator, because it is there that the longest shadows are cast by the high crater walls.

If the lunar image is too bright for comfortable viewing, a colored eyepiece filter or neutral density "moon filter" helps reduce the glare. Complete information on filters can be found in "Expanding Your Compustar System."

Because the moon moves in its own monthly cycle, separate from the stars, nebulae, and galaxies, its celestial coordinate position in the sky is constantly changing. You'll locate the moon visually, using the finderscope and the computer Motion Control Keys to center it in the field of view.

The Planets

The word planet means "Wanderer". Planets move in relation to the stars behind them. Often planets like Jupiter, Mars, and Saturn move so quickly it is easy to note the movement in a few days or weeks. Like the moon, the planets do not have constant celestial coordinates, so the Compustar computer cannot itself move directly to a planet without your help. Use a monthly star chart from *Astronomy* or *Sky & Telescope* to locate them, along with your finderscope and the Motion Control Keys on the Computer .

Planets are best seen when fairly high in the sky, using moderate to high power (70x to 300x). Higher powers magnify the planets but often show less detail. The planets are particularly affected by poor 'seeing' conditions, so take plenty of time observing them to be sure you catch them at their best. You'll get the best view of Mars, Jupiter, and Saturn when each is passing closest to the earth.

Venus

Venus is a cloudy planet, and appears in ever-changing phases, often resembling a crescent moon. The clouds keep you from seeing any surface detail. Venus, when visible, appears before sunset in the West or before sunrise in the East. At its highest point in the sky, this planet is the brightest object in the sky after the Sun and the Moon. Because Venus is always near the horizon, seeing will usually be poor and viewing of any detail other than the changing phases is difficult.

Jupiter

When Jupiter is visible in the night sky it is a very dramatic sight. Its cloud belts are visible at low power. The four biggest "Galilean" moons of Jupiter are very bright and prominent (even visible with binoculars). Their position in relation to the planet is a nightly dance of change. *Astronomy* and *Sky & Telescope* each month usually include charts which plot the positions of the four Galilean moons. Sometimes a giant red spot can be seen. A blue filter helps increase the contrast of the cloud belts and the red spot, as well as reducing glare.

Saturn

The rings of Saturn are a wonder to behold. The view of Saturn through your telescope will leave you saying "it looks like a picture". Saturn's magnificent ring system is instantly obvious through your Compustar telescope. On nights of good seeing you will even be able to see the shadow of the rings on the planet's surface. See if you can see

Cassini's division, which is a dark space dividing the rings into two separate areas.

Mars

Mars is identifiable by its red color. On a good night, when Mars is close to the Earth, some surface detail and the frozen polar ice cap is visible. Details are only possible when the planet is near opposition, which occurs about every two years. Red and orange filters reduce glare and help increase the contrast of the surface details. A blue filter is useful for emphasizing the atmospheric features of Mars.

Mercury

Mercury is always very close to the Sun. It is visible only at certain times just after sunset or just before sunrise. Mercury is a small planet, showing no detail other than changing phases much as Venus shows. The biggest thrill in observing Mercury is that you have found it at all!

Uranus

Uranus can be seen as a faint, pale blue-green disk without identifiable surface or cloud detail. It is the most distant planet that can be easily seen as a disk. It is so faint that it must be found by using the coordinates found in the monthly magazines.

Neptune and Pluto

These planets are difficult to locate and identify, since they appear almost identical to stars. It is a challenge to find and track these fainter objects. Astrophotographers may enjoy the challenge of 'discovering' Pluto in a time-exposure photograph.

The Stars

There are billions and billions of stars to see. Since they are so far away, no telescope can magnify them. They look like pinpoints of light at the highest magnification.

Star distance is measured in "Light Years". A light year is the distance light travels in a year (about 6 trillion miles). Light travels 186,000 miles in one second! This means light could go around the earth eight times in one second! The light from the Sun takes about eight minutes to get to the Earth. The nearest star (other than the Sun) is Alpha Centauri which is most visible in the Southern Hemisphere. It is a little over four light years away. Most stars you can see without a telescope are hundreds to thousands of light years away!

Many stars are actually two or more stars very close together. Some *double stars* or *binary stars* actually orbit around each other, others simply appear to be close together, while one star is closer to us than the other and unrelated to the other. Polaris (REF111) is an example of a double star which can be easily 'split' under moderate magnification. Some double stars are so close they cannot be resolved (seen as individual stars). High power is often necessary to split 'close' double stars (400x to 500x).

Popular double stars include the "Double Double", Epsilon Lyrae (two double stars, REF184 & REF185). These four stars are easily resolvable except in very poor seeing, when they look like only two stars.

Star Clusters

Star clusters are groups of stars relatively close together. They fall into two general categories: open star clusters (sometimes called Galactic Clusters) and globular star clusters.

Open star clusters are loosely arranged groups of stars. It is sometimes difficult to distinguish them from background stars. Since open clusters are relatively large groupings, use low power (25x to 50x).

Globular star clusters are tightly packed spherical groups of many stars. Use low to moderate power (50x to 160x) to see them.

Among the best star clusters are the large globular cluster in Hercules (M13) or the Pleiades open cluster (M45) sometimes called the Seven Sisters.

Nebulae

Nebulae are glowing clouds of gas and debris. They glow from the light of nearby stars. They fall into two distinct categories: Planetary Nebulae, which are small and bright, and Diffuse (or Emission) Nebulae, which are large and indefinitely defined.

Planetary nebulae are best seen using moderate to high magnification (100x to 225x). Diffuse nebulae are best seen at low to moderate magnification (50x to 175x).

Popular nebulae include the Ring Nebula M57 (an exploded star), or the Dumbbell Nebula (M27). One of the most dramatic nebulae is the Great Orion Nebula (M42) seen in the "sword" of the constellation Orion.

Galaxies

Galaxies are vast, remote "island universes" composed of millions of stars. They exist in a variety of sizes and shapes. Most galaxies are faint. The closest one, the Andromeda galaxy (M31), is over two million light years away! Don't let that discourage you; this giant can sometimes be seen with the unaided eye (on good nights) and is visually as big as the Moon!

Astronomers have mapped millions of galaxies! If you look at a map of galaxies (omitting the Milky Way's stars) it looks like a star map!

Galaxies are best seen using low power and an eyepiece with a wide field of view (25x to 75x). For smaller galaxies, use moderate magnification (100x to 225x).

Popular galaxies include the Whirlpool Galaxy (M51), and two unusual nearby galaxies are M81 and the exploding galaxy M82.

The Sun

Observing the sun, the center of our solar system, is a fascinating and informative project. But please remember that you are turning your system towards a powerful source of heat and light and never forget to take the recommended precautions to protect your eyes and your equipment. When observing the sun, always take the following precautions:

1. Use only an approved, optical glass solar filter which covers the entire front of the telescope.
2. Place the filter snugly over the front cell of your telescope.
3. Don't leave your telescope unattended while pointed at the sun.
4. Always cap the finderscope so the heat doesn't damage the finder.

With the Celestron solar filters, you will be able to see the Sun's boiling granulating surface and the magnetic storms called sunspots. Additional filters, such as neutral density filters, may be used in conjunction with Celestron filters to reduce the brightness of the solar image.

CAUTION: WE DO NOT RECOMMEND THE USE OF HERSCHEL PRISMS, SUN DIAGONALS, OR EYEPIECE SOLAR FILTERS BECAUSE THEY HAVE BEEN KNOWN TO SEPARATE OR FRACTURE FROM HEAT. THEY ALSO DO NOT PROTECT THE TELESCOPE FROM THE SUN'S RAYS.

READ THE SAFETY NOTICE AT THE BEGINNING OF THIS MANUAL.

III. USING THE COMPUSTAR

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Supplying Power to the Telescope

DC power requirements, battery considerations, connections.

One source of 12 volt DC power is a car battery. The power cable supplied with the Compustar has a 2-pin power connector on one end and two battery clips (black & red) on the other. Connect the black clip to the negative (-) battery terminal and the red clip to the positive (+) terminal.

The Compustar draws a lot of current, up to 12 Amps, so it is a good idea to get a heavy-duty battery and keep it in good shape. Field tests indicate a fully charged, properly maintained heavy-duty battery (100 amp-hour @ 10 amp rate) can power the Compustar all night.

We recommend use of a "deep-cycle" storage battery (such as the Sears Marine and Recreational Vehicle batteries), that will allow repeated heavy discharges and recharging without damage to the battery.

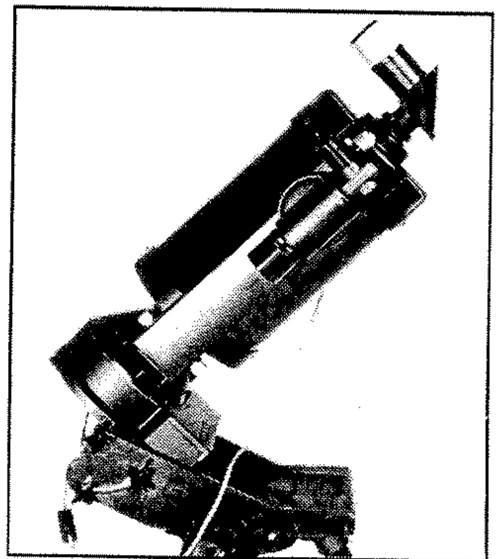
Do not use your car battery, as it will drain very quickly.

AC power supply considerations

A 12 volt DC power supply that plugs into standard grounded (3-prong) household AC outlets is available as an optional accessory. Any power supply used must be capable of providing at least 12 amps continuously to the Compustar.

Before You Turn on the Power

Your telescope should already be assembled, and all cables connected between the Computer and the Telescope, as outlined in the previous section "Unpacking & Assembling the Telescope". Connect the battery or AC power adapter to the Power Module cable.



Compustar 8 in "store" position.

The Compustar is automatically returned to its "store" position (folded down between the fork arms) when correctly turned off. Be sure it is in this position before starting out (release the motion locks and move it manually to this position if necessary). Also be sure that the eyepiece & diagonal prism are aligned so that they cannot strike either fork arm when the telescope slews automatically.

Polar Aligning the Telescope

Polar alignment is simply the process of aligning the telescope with the Earth's rotation, and synchronizing the Compustar's computer with two bright stars. You'll also need to tell the Compustar where you are, and what time it is. This process only takes a few minutes, and only needs to be done once for an entire evening of observing. The Compustar's computer makes this job much easier than with less sophisticated telescopes.

Southern Hemisphere Locations

Operation is similar to that described below, except all instructions referring to North become South. Enter southern latitude as a negative number by entering "-" before the latitude. Use Sigma Octantis instead of Polaris for polar alignment.

1. Approximately align the tripod & wedge

Locate Polaris (The North Star) in the sky. If you are not certain which star is Polaris, refer to a basic star atlas or a planisphere (star dial). Polaris is easily located by following the two 'pointer stars' in the Big Dipper. Polaris is not nearly as bright as the stars in the Big Dipper, and may be difficult to see under bright city lights.

Orient the tripod so that the two fork arms aim up toward Polaris. If necessary, adjust the angle of the wedge so that the fork arms are aiming directly at Polaris.

2. Start up the computer

Turn on the power switch on the Power Module. All the indicators will light up briefly, and when the Compustar computer is ready it will "beep".

Press the *BEGIN* Command Key.

3. Enter the time & date, Greenwich Mean Time

The Compustar flashes *GMT* to request entry of Greenwich Mean Time. Enter the time on the Command Keys in Hours, Minutes, and Seconds. The Compustar is a stickler for accuracy, so it asks for the time down to 1/10 of a second, but it's OK just to enter it within a minute or so (enter an extra zero for the tenths-of-second digit). When you've entered the time, press *Enter*.

The Compustar flashes *YEAR*, so enter it, then press *Enter*. Do the same for month and day. (Watch out for the correct GMT day . . . see below.)

GMT and Local Time

GMT, also known as Universal Time, is based on a 24 hour day. It can be determined in the United States by adding the amount below to your local (24 hour format) time:

	Standard Time	Daylight Time
Eastern	5 hrs	4 hrs
Central	6 hrs	5 hrs
Mountain	7 hrs	6 hrs
Pacific	8 hrs	7 hrs
Yukon	9 hrs	8 hrs
Hawaiian	10 hrs	9 hrs

Example: 6:30 PM Eastern Standard time is 18:30 EST in 24 hour format. Add 5 hours from the chart, it is 23:30 GMT.

Today or Tomorrow?

When you add the number of hours shown on the conversion chart to your local time, you will often find the resulting sum is greater than 24:00 GMT. This occurs when it is past midnight in Greenwich, England; therefore you must add one day to your local date to calculate the correct GMT date and time.

Example: 8:30 PM Pacific Daylight Time on July 1 is 20:30 in 24 hour format time. Add 7 hours to 20 for 27 hours. Since you are over 24 hours, subtract 24 and add one day to the date to end up with 3:30 July 2 GMT.

How accurate must the time be?

Enter the time as accurately as possible; preferably within one minute. This will make the initial alignment easier. If the original time that you enter is inaccurate, the telescope will point to where the reference star *would be* at the entered time, not necessarily where the star is in real time. A two minute input error will cause the telescope to point about one field-of-view away (at low power) from the desired target.

An inaccurate time simply makes the original line-up a little more difficult. Once you have completed the alignment procedure, the telescope and computer will be time synchronized with the sky accurately.

4. Enter the location, longitude & latitude

The Compustar flashes *LONG* to request the longitude. Enter it in degrees and minutes, then press *Enter*. Do the same in response to the flashing *LAT* for latitude.

Look out! When you press *Enter* after entering the latitude, the Compustar goes into action.

Latitude & Longitude

Determine the latitude and longitude coordinates of your observing site from a local road map or atlas. The initial alignment process will be easier if you enter these positions as accurately as possible.

Do not worry if you do not know the *exact* location. Once you have completed the polar alignment adjustment, the Compustar will correct for small errors. You should, however, know the latitude and longitude within about one degree.

Eastern Hemisphere: Compustar has no way to permit the direct entry of Eastern longitudes. Therefore, Eastern longitude must be subtracted from 360°, and the remainder entered.

Example: Longitude 10° 10 min East is entered as 349° 50 min. Be careful to subtract properly; 60 minutes = 1°.

Southern Hemisphere; Enter southern latitude as a negative number by entering "-" before the latitude.

Quick reference chart

Enter the exact latitude and longitude of your favorite observing sites in the quick reference chart inside the back cover of this manual. Having the exact coordinates will save you time in initial polar alignment.

5. Follow the ALIGN sequence

The Compustar's high-speed precision stepping motors accelerate the telescope to *slewing* speed, and aim the tube straight up the fork arms to where the computer expects to find Polaris. If you set up the telescope accurately, and entered the requested information accurately, you should be pretty close.

Adjust the Altitude & Azimuth manually.

When the telescope stops moving, Compustar flashes both *Align* and *ALT/AZ* to request you to mechanically align the telescope using the manual *altitude* (wedge tilt) and *azimuth* (wedge-to-tripod) adjustments described in the section on Unpacking & Assembling.

Adjust both the altitude and azimuth until Polaris is centered in the field of view of first the finderscope, and then the main telescope. If you have an eyepiece with crosshairs, use it in the main telescope for accurately indicating when you are precisely aligned.

When Polaris is centered in the eyepiece, and all the tripod and wedge bolts are tightened, press *ENTER*. The telescope slews to a bright reference star.

Adjust the telescope electronically.
Locate the bright star which is nearby, but probably not exactly centered in the finderscope. Using *only* the Compustar motion control keys, *not the mechanical adjustments*, center the reference star first in the finderscope and, then, in the main telescope.

When you are finished, press *Enter*.

For accuracy, repeat the above.
Unless the previous two steps required very little adjustment, repeat the two previous alignment steps by pressing the *Align* key. You may repeat them several times until no further adjustment is required, for maximum accuracy in polar alignment and the best centering of objects in your eyepiece throughout your observing session.

Finding Objects with the Compustar Computer

The Compustar makes finding objects easier than with any other telescope. You have your choice of finding a particular object by catalog number or celestial coordinates; scanning a series of objects that meet your specified criteria based on Compustar's huge internal catalogs; joyriding the joystick; or browsing through the internal catalogs, displaying object information on the Compustar display panel until you see something you want to observe, and then telling Compustar to slew to that object.

Finding a particular object with SLEW

BY KNOWN CATALOG NUMBER

You can find any object whose catalog number or celestial coordinates you know by using the SLEW command. Catalog number includes CNGC, M, or REF. In nearly every case, the RNGC number or M number found in the standard astronomical literature will work perfectly. Note that items in the Messier catalog are also in the NGC catalog; you can enter either number. The Compustar always displays the CNGC number even if items are in the Messier catalog.

For example, to find the Andromeda Galaxy (M31 in the Messier catalog) just press:

- SLEW
- M31 (Press "M", then "3", then "1".)
- ENTER

Compustar slews to object.

BY KNOWN CELESTIAL COORDINATES

To find an object not in the internal catalog, but whose celestial coordinates you know, such as a planet, comet, or asteroid, use a similar sequence. For example if you wish to look at coordinates 12 hours 14.0 minutes Right Ascension, 24 .5 degrees North Declination, enter:

- SLEW
- COORDS
- 1 2 1 4 .0

(enter 1/10 minutes digit 0)

- ENTER
- 2 4 3 0

(note 1/2 degree converted into 30 minutes)

- ENTER

Compustar slews to coordinates.

Enter south declinations as negative numbers, by pressing the (-) key before the declination. Declination is entered as four digits, the first two are degrees and the second two are minutes of arc. *Many catalogs list declination as degrees and decimal degrees;* you must convert these to degrees and minutes by multiplying the decimal portion by 6 to determine the correct number of minutes. For example 44.3 degrees equals 44 degrees, 18 minutes. (6 x 3 = 18).

Note: Compustar will not slew to a position below the horizon, or below the HIGHER THAN limit you may have specified with the SET command. In this case it will beep and illuminate the TOO LOW indicator. For more information see section IV, Compustar Reference, Detailed Commands SET and SLEW.

Viewing sequences of objects with SCAN

The Compustar's most entertaining and useful feature is its ability to sequentially scan the sky, stopping at each object in its catalogs that meets the criteria you choose. For example, you can choose to observe all the planetary nebulae brighter than magnitude 12 and higher than 25 degrees above the horizon, for 30 seconds each (see example key sequence below). You can select any conceivable combination of object types, positions, and characteristics.

You do not have to enter all these criteria; initially all are set to show the largest number of objects (ALL); you only need to change the criteria you wish.

The basic criteria you have to choose from include:

OBJECT TYPES. Diffuse Nebulae, Planetary Nebulae, Open Star Clusters, Globular Star Clusters, and Galaxies.

BRIGHTER THAN. Magnitude limit from 19.9 (very faint) to -5.4 (very bright).

FAINTER THAN. Magnitude limit (as in Brighter Than).

LARGER THAN. Diameter of object in catalog in arc-minutes from 1 to 359.

SMALLER THAN. Diameter limit as in Larger Than.

HIGHER THAN. Altitude above the horizon in degrees from 0 to 89.

BETTER THAN. Subjective visual quality. 7=Excellent, 1=Very Poor.

PAUSE. Delay between objects in hours, minutes, seconds. ***Pause of 0 is taken to mean an infinite pause (NEXT key required to move to the next object).***

BASIC SCAN KEY SEQUENCE

- Press SET
- Choose the Object Type mix by pressing the corresponding soft keys, if any changes are needed.
- Press SET.
- Choose the Scan Limits by pressing the desired soft key, limits, and ENTER for each limit.
- (Optional) Press SET, then PAUSE and pause time in seconds, then press ENTER.
- Press SCAN and then BEGIN or NEXT.

A Quick Look At The Best of Everything.

A quick and easy way to use SCAN is to look at all objects using only the BETTER THAN and HIGHER THAN criteria and, if you like, a PAUSE time. This way you can quickly get an overview of the best objects to later go back to for extended observing. Using the BETTER THAN criteria is simpler and more meaningful than BRIGHTER THAN for general observing, as it is based on actual observation of each object and works well with different types of objects.

Example 1:

- SCAN (All object types illuminate & blink. No changes are required.)
- SKIP (All Scan Limits illuminate)
- BETTER THAN
- 5 (5=Very Good)
- ENTER
- HIGHER THAN
- 20 (20° above the horizon. Objects low on horizon are greatly dimmed.)
- ENTER
- PAUSE
- 00:00:45.0 (Pause at each object for 45 seconds.)
- ENTER
- BEGIN

OPTIONS DURING A SCAN SEQUENCE

During the pause on each object, the NEXT, BACK, WAIT, SYNC and ABORT soft keys are illuminated. These are used to cause the following actions:

NEXT - Go to the next object in the sequence immediately. Press this key if you are finished viewing this object and don't want to wait for the pause timer to run out. You also use this key if you have the pause time set to zero (infinite wait) or have previously pressed the WAIT key.
BACK - Go back to the previous object immediately. This is handy if you weren't paying attention and your preset time ran out before you are finished observing an object.
WAIT - Stops the pause timer. Observe for as long as you like; the sequence will not continue until you press the NEXT key.
SYNC - Synchronizes the computer coordinates to the position of the object being viewed. This command is used to 'tweak' the computer if you have centered the object with the motion control keys; in other words the telescope is a little off to one side. ***DON'T press SYNC unless the object is centered and you are sure it is the object displayed!***
ABORT - Terminates the current scan sequence (but doesn't throw away your settings). If you've decided, for example, than you don't want to stop at the faintest objects, you can use the SET command to make any changes you desire (precisely the same way as when you started with SCAN) and NEXT to start where you left off.

Example 2:

Here's how you would enter the example sequence at the beginning of the section:

- SCAN

All object types flash indicating all are selected. Soft keys illuminate for each of the object types. Press the soft keys for all the flashing object types you *don't* want to see, until only the PNEB indicator is flashing. Each keystroke toggles the object type between selected and unselected. Again, object types flashing are those that are selected.

- SET

The SET key switches from object type to scan limits. The soft keys for each type of scan limit illuminate. In our example, we only care about BRIGHTER THAN, HIGHER THAN, and PAUSE.

- BRITER THAN
- 12
- ENTER
- HIGHER THAN
- 25
- ENTER
- PAUSE
- 30
- ENTER
- BEGIN (or NEXT)

Compustar now slews the telescope to the first object in the programmed sequence, and pauses for 30 seconds.

Browsing the Compustar catalogs with LOOK

The LOOK command lets you do everything the SCAN command does, with one important difference; the telescope does not move until you tell it to. This means you can browse through the internal catalogs by object type or other criteria, quickly skipping through objects you don't want to take the time to observe. When you get to an object you'd like to see, just press SLEW and Compustar moves immediately to that object.

This is a great way for more experienced observers to glean out those celestial gems that, for some reason or another, they never knew were around. Just skip over familiar objects and press SLEW when you find something interesting.

Refer to the previous section on SCAN for the proper sequence of keys. LOOK works just like SCAN, but you probably won't want to use the PAUSE feature; just press NEXT to go from object to object.

Finding Objects with the Motion Keys

When you simply want to point the telescope directly at an object you can see, such as a planet or the moon, just press the appropriate Motion Key. You can change the Speed Range of the Motion Keys with the SPEED command. The three speed ranges are SLEW (fast), SET (medium) and GUIDE (slow).

You can also reverse the direction of either the RA or DEC affected by the Motion Keys with the REV command. This can be handy if the image becomes reversed by adding or removing a diagonal prism. Just press REV followed by either UP, DOWN, LEFT, or RIGHT to reverse a pair of keys.

Computer Command Overview

These commands are described in detail in "Compustar Reference, Detailed Commands".

ABORT
Terminates whatever command is in progress, if any. Also initializes the optional joystick.

ALIGN
Used to fine tune the alignment of the polar axis of your telescope with the celestial pole and sync the coordinates of the computer with the sky. It is the second half of the BEGIN command, but can be repeated by itself for increased alignment accuracy.

BEGIN
Used to begin each observing session. First, the Compustar asks for basic information (time, date, longitude, & latitude). Then it goes through the align sequence designed to help you quickly align the polar axis of your telescope with the celestial pole.

DISP
Displays selected information about the telescope, an object, or internal Compustar values.

END
Used after an observing session; returns the telescope to the "parked" position.

FIELD
Identifies the deep-sky object nearest the center of the field of view. If there are no CNGC objects within 30 arc-minutes of the center of the field, then no object information is displayed.

LOOK
Identical to the SCAN command except the telescope does not move. Information about each object is displayed for your consideration. You can command the Compustar to slew to any of the objects with the SLEW command.

NEXT
Resumes execution of the most recent SCAN or LOOK command, moving to the next catalog object in the specified sequence.

OPTION
Used to permit expansion of the capabilities of the Compustar at a later date. For example, if a new accessory for the Compustar is developed, a new OPTION command may be needed to support it.

REV
Used to reverse the counting direction of the Compustar's built-in timer. It is also used to reverse the direction of motion caused by the motion control buttons or joystick.

SCAN
Tells the Compustar to look through its internal CNGC catalog of deep-sky objects for those that satisfy criteria that you specify — and to slew to them sequentially.

SET
Used to set a value used by the Compustar. It can be used to set the internal timer, time/date, longitude/latitude, epoch of celestial coordinates, or any of the parameters used by the SCAN and LOOK commands.

SLEW
Causes the telescope to move rapidly to a specified object or coordinates.

SPEED
Selects the speed range (SLEW, SET, GUIDE) for the motion control buttons or joystick.

SYNC
Synchronizes the coordinates of the computer with the coordinates of the object most recently pointed to by a SLEW or SCAN command.

TIMER
Toggles the Compustar's built-in timer on or off. The timer may be used for timing of photographic exposures.

Computer Displayed Information

The Compustar continuously displays various kinds of information related to the position of the telescope and/or objects, and characteristics of objects you are observing or which are in the internal catalogs. Usually, the relevant information you need will automatically be shown. Less frequently required information can be requested by using the DISPLAY command and other specific keys. Further information can be found in "Compustar Reference, Detailed Commands, DISPLAY".

Celestial Coordinates

The coordinates of objects and the telescope are your key to knowing exactly where you are observing. A general discussion of them is found in "Getting To Know Your Compustar Telescope, Welcome To Your Universe".

Telescope Coordinates

The current Right Ascension and Declination coordinates where the telescope is pointed will be displayed on the upper left side of the display most of the time. These coordinates will change as you SCAN or SLEW to new objects, or as you move the telescope with the Motion Keys or optional joystick.

Object Coordinates

At times, such as when you use the LOOK command to browse through the Compustar's internal catalogs, the coordinates displayed will be those of an object in the catalog, rather than where the telescope is pointed. This is shown by the illumination of the adjacent OBJ legend.

Restoring Coordinate Display

If you have changed the display by use of the DISPLAY command, and information other than the coordinates are now displayed, you can restore the normal telescope or object coordinates by entering:

- DISP
- SCOPE or OBJ
- COORDS

Altitude & Azimuth

Altitude and Azimuth are alternate ways of stating the position of an object or the aiming of the telescope. The references are *terrestrial*, not *celestial*. Altitude is the angle above the horizon. Azimuth is the angle along the horizon, measured westward, from the south point of the horizon.

To display the Altitude & Azimuth of the displayed object or the telescope, enter:

- DISP
- OBJ or SCOPE
- ALT AZ

The appropriate indicators ALT, AZ, and if object display, OBJ will be illuminated.

Hour Angle

Hour Angle is a position east or west of the meridian (an imaginary line connecting the north and south points on the horizon with the point directly overhead). It is a sometimes used alternate to the more common Right Ascension.

To display the Hour Angle and Declination, either of the displayed object or of the telescope, enter:

- DISP
- OBJ or SCOPE
- HA

The appropriate indicators HA, DEC, and, if object display, OBJ will be illuminated.

Time & Date

To display the currently used GMT time and date, press:
- DISP
- TIME/DATE

Object Catalog

When object information is displayed, either when you have moved to and are observing an object or when you are browsing through the internal catalog, the Object Catalog indicators tell you what standard astronomical catalogs have referenced that particular object.

Messier Catalog
The famous catalog of 104 bright deep-sky objects compiled by the French astronomer Charles Messier.

CNGC Catalog
The Computerized New General Catalog compiled by Mike Simmons, designer of the Compustar computer control. These numbers generally correspond to the standard Revised New General Catalog, commonly listed in publications as NGC or RNGC.

Tirion Sky Atlas 2000
The popular sky atlas plotting and showing the positions of many celestial objects, available from Sky Publishing Corp.

Sky Catalog 2000
The companion reference volume associated with the Tirion Sky Atlas 2000.

Object Information

Magnitude
Brightness of object displayed, range -5.4 to 19.9.
Size
Diameter of object from .1 arc-minute to 5.9 degrees.

Object Type

Description of object displayed, catagorized as follows:

DARK	Dark Nebula in front of Diffuse Nebula
DNEB	Diffuse Nebula
DNEB OPEN	Diffuse Nebula & Open Cluster
PNEB	Planetary Nebula
OPEN	Open Star Cluster
GLOB	Globular Star Cluster
GAL	Galaxy
STAR	Star
MULTI STAR	Double or Triple Star
MULTI GAL	Multiple Galaxy
DNEB GAL	Diffuse Nebula in another Galaxy
OPEN GAL	Open Cluster in another Galaxy
GLOB GAL	Globular Cluster in another Galaxy

Object Quality

Visual estimate of object appearance, based on observation of most objects with a Compustar C14 and good skies, with computed estimates for objects not observed.

7 - SUPERB	Superb
6 - EXCEL	Excellent
5 - V GOOD	Very Good
4 - GOOD	Good
3 - FAIR	Fair
2 - POOR	Poor
1 - V POOR	Very Poor

Field Display

Pressing the FIELD key causes the Compustar to display information about the CNGC object nearest the center of the field of view, if there are any within 30 arc-minutes (1/2 degree). This is useful if you are scanning manually with the motion control keys or optional joystick, and wish to identify an unknown object you see. (The FIELD command does not display objects in the CNGC catalog with unknown size or brightness.)

Status Display

Timer

The TIMER ON indicator illuminates when the timer is counting, with the UP or DOWN indicator showing the direction of counting. The TIME OUT indicator illuminates if the timer has counted down to zero, beeped to indicate time out, after which the timer counts up until stopped.

Ready

The READY indicator shows that the Compustar Computer is ready for you to communicate through the RS-232 external computer interface.

Slew, Set, Guide

These indicators show the current Speed Range for the Motion Control Keys.

North, East, West, South

These indicators illuminate during telescope movement to indicate the direction of motion relative to the normal sidereal tracking rate.

Astrophotography with your Compustar

Photographing astronomical objects is challenging and exciting. Your Compustar system and the optional accessories available from Celestron will enable you to take magnificent photographs of objects in space. However, even with the best equipment, you will need to practice and experiment. The sections that follow on focusing, tracking and precision alignment will get you started right.

Many techniques have been developed by amateur astronomers for obtaining successful astrophotographs. This is a rewarding and challenging pursuit; don't be disappointed if your first efforts do not produce magazine-quality results. Your dealer can recommend books on astrophotography methods and techniques.

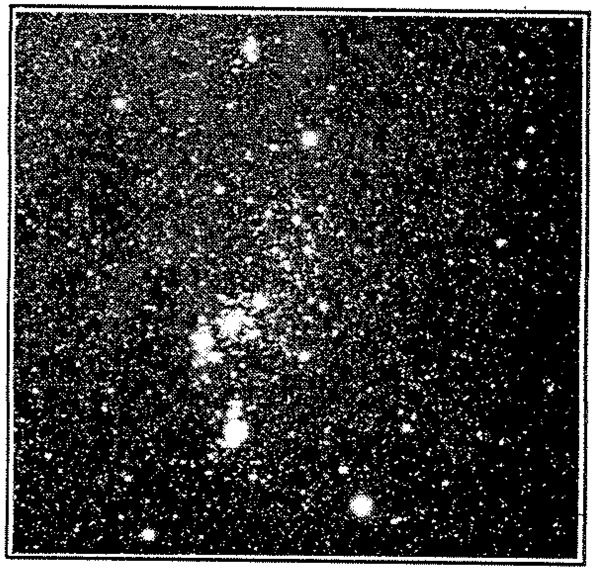
Focusing

Focusing can be difficult when using your camera with the Compustar. If the object is too dim for easy focusing, try focusing on a bright star nearby, then subsequently on the faintest star you can accurately focus on. If your camera has interchangeable focusing screens, it is helpful to purchase a very fine matte screen, resulting in a significant brightness increase over a standard screen. Most larger photo dealers stock interchangeable focusing screens.

Guiding

Even if you have polar aligned your telescope perfectly, the motor drive on your Compustar will not track the object to be photographed perfectly. Minute variations in the drive gears, in combination with the magnification of the telescope, will result in slight variations in tracking. While invisible to the observer, these errors will show in long-exposure photographs.

Guiding is the process of monitoring the exact tracking of the telescope during a time exposure photograph. By use of the *off-axis guider* or a *guide scope* the photographer can watch the position of a guide star with an illuminated reticle (crosshair) eyepiece. With the Compustar, you make minute *guiding corrections* using the motion control keys or the optional joystick, keeping the guide star on the crosshairs during the entire exposure.



Piggyback Photography

A *piggyback mount* lets you attach your camera to the side of the telescope, photographing through the camera's lens rather than the telescope optics. Spectacular photographs of the constellations, as well as large nebulae, galaxies, and the star clouds of the Milky Way, can be made easily with piggyback photography. Guiding is not always required, as the telescope motor drive is sufficiently accurate at the magnifications used. You can use a telephoto lens on your camera, and use the main telescope for guiding. This is a good way to practice your guiding skills in preparation for through-the-telescope deep-sky photography.

Lunar and Planetary

Prime focus photography of the moon and planets is accomplished by attaching your camera to the telescope with a *T-adapter* and *T-ring*. Depending upon the phase of the moon, exposure times on ASA 64 color film will range from 1/8 second to 1/25 second for the full moon. Your exposure meter should give you accurate results in most cases.

Although prime focus photography is satisfactory for small-scale renderings of the moon and planets, extremely long focal lengths are necessary to photograph finer details of the planets. You can increase the image size by inserting an eyepiece between the telescope and the camera. This technique is known as *eyepiece projection*. The eyepiece acts as an enlarging lens, projecting a magnified image onto the film. The most useful oculars for eyepiece projection are the longer focal lengths, from 32mm to 12mm. The shorter the focal length of the eyepiece, the larger the image on film. The *Tele-Extender* is used in place of a T-adapter for eyepiece projection photography.

Solar Photography

Excellent photographs of the Sun can be taken with the Compustar and Celestron Solar Filters.

Attach your camera with the T-adapter. With an off-axis solar filter and readily available color films, exposure times will range from 1/8 second for ASA 64 films to 1/15 second for ASA 200 films. If you use the full aperture solar filter, the exposure times will be 1/60 and 1/125 respectively. No guiding is necessary.

If possible, lock the mirror of your camera in the up position to eliminate vibrations. Use an air release cable to trip the shutter. Your Celestron should be set up to track the solar disk if the exposure time exceeds 1/60 second.

The *Tele-Extender* may be used with a 26mm to 32mm ocular for extreme close-ups of sunspot groups. With ASA 200 film, use an exposure of about 1/2 second with the full aperature filter.

See Solar Viewing Warning on page 3.

Deep Sky Photography

With some experience photographing the moon and the planets, you'll be ready to try deep sky photography of nebulae, galaxies, and star clusters.

The off-axis guider is the easiest way to guide deep-sky photos. Brighter objects such as the Hercules Globular Cluster (M13) or the Orion Nebula (M42) require an exposure of 10 to 20 minutes with high speed color film. Fainter objects will require longer exposures. Brightness of the night sky where you are located is a critical factor limiting the maximum useable exposure time.

Remember, you must guide continuously while the shutter of your camera is open.

Films & Exposure

Many modern films give excellent results for astrophotography. These suggestions will get you off to the right start, but are not intended to be a complete listing. Don't be afraid to experiment with whatever film you happen to have in your camera.

For long exposures of deep-sky objects, you need high speed, sensitive film. Among the best high-speed color print films are Konica 3200, and Kodacolor VRG 1000. For color slides, try 3M 1000 or Ektachrome 400. For black and white negatives, try Kodak Tri-X or specially hypersensitized Kodak Pan 2415 available from astronomy mail-order firms.

For the brighter objects such as the Moon and the Planets, however, you need fine-grain, slower speed films that will allow enlargement to show detail. For color prints, try Kodacolor VRG 100. For color slides, Kodachrome 64 is recommended. For black and white negatives, Kodak Pan 2415 gives excellent results.

Exposure Guide

The exposure times listed here are intended as simple starting points. Astrophotographers always 'bracket' exposures, with shots at faster and slower exposures to insure the best results.

Whole Disc Lunar Photography

Using the T-adapter.

	ASA 64	ASA 400
Crescent	1/4	1/15
Quarter	1/30	1/125
Full	1/60	1/250

Or, use the exposure meter built-in to your camera.

Lunar Close-Up Photography

Using the Tele-extender and eyepiece listed:

	ASA 64	ASA 400
25mm	2 sec	1/2 sec.
12mm	4 sec	2 sec.

Planetary Photography

Using the Tele-Extender and a 12mm eyepiece.

	ASA 64	ASA 400
Mars	2 sec	1 sec
Jupiter	4 sec	2 sec
Saturn	7 sec	3 sec

Solar Photography

Using a Celestron Solar Filter. Use the exposure meter built-in to your camera.

Helpful Hints

Using the Timer

The built-in timer can be used for timing photographs or the length of an observing session. It can either count elapsed time starting at zero (or any other number), or it can count down from a preset time.

Turning the timer on or off

The TIMER soft key toggles the timer on or off, without affecting any count or time which is already set or shown.

Setting the timer

To preset a number on the timer, use the SET command followed by the TIMER option, then enter the numbers desired for the timer. For complete details see the TIMER section in the Compustar Reference section.

Changing the count direction.

The REV command followed by the TIMER option is used to switch the timer from counting up to counting down, or back.

When your time is up

When the count reaches zero after a countdown time interval, the Compustar beeps at you, and displays the legend TIME OUT. It then counts up to show the time which has elapsed since the time reached zero. You can stop the counting up with the TIMER OFF command.

Cleaning Optics

The best way to maintain the optics of your telescope is to prevent them from getting dirty. Keep them covered at all times when not in use. A Celestron Skylight filter on the eyepiece end of the telescope keeps contaminants from entering the tube. Never touch the surface of any optical elements.

Do not clean your optics too often. Specks of dust or pieces of lint do not impair the performance of your telescope. Excessive cleaning can cause small surface scratches which may hurt performance more than a bit of dust would. Professional telescopes, used nightly, generally need to be cleaned only every six months to a year.

Should you choose to clean your optics yourself, you need only a few cleaning supplies.

The Celestron factory offers professional optical cleaning services; contact the factory directly for information.

When to Clean

Clean optical surfaces if you notice any fingerprints or noticeable 'fog' build-up on the outside surface of the telescope corrector plate or the outside of eyepiece or other accessory lens surfaces. Never disassemble the telescope or eyepieces to clean inside. Clean optics only with the use of professional optical cleaning materials.

Cleaning Tips

- Wash your hands before cleaning optics, to remove the oils which will contaminate your cleaning materials.
- Clean optics only in a clean, well lighted, well ventilated area.
- Blow dust and particles off the optical surface with optical 'dust-off' aerosol type compressed air before cleaning; this removes abrasive particles which may scratch.
- Never apply cleaning fluid directly to optics; it may penetrate around the edges and intrude inside the housing. Apply it to cleaning tissue only.
- Do not ingest cleaning fluids or get them in your eyes. Wash your hands after use.

Cleaning Oculars and small surfaces

- Blow off any dust or grit.
- Moisten a small wad of fresh lens tissue with a drop or two of lens cleaning fluid.
- Gently blot the surface of the lens, without rubbing or applying pressure.
- If necessary, use a cotton swab or the corner of a folded piece of lens tissue to clean hard-to-reach areas such as the edges of the lens.
- Dry the surface with a fresh piece of dry lens tissue.

Corrector surfaces

- Do not remove the corrector from the telescope.
- Remove dust and particles with a can of compressed air.
- A cotton swab moistened with lens fluid can be used to remove stubborn particles. If sticky materials (such as tree sap) will not come off, use a small amount of acetone on a swab.
- Dilute one part lens fluid with one part distilled water.

• Clean a small area by blotting gently with lens tissue. Change tissue often to avoid scratching the corrector with particles picked up by the tissue.

• Dry with fresh sheets of lens tissue gently wiped over the surface to remove liquid or streaks from the liquid.

• If the inside surface of the corrector requires cleaning due to a build-up of film or fog (usually only after many years), carefully remove the corrector as outlined in "Cleaning the Mirror Surfaces" and clean the inside in the same way as the outside.

Mirror surfaces

Mirror surfaces are internal to your telescope, and seldom need cleaning. The mirror surfaces would have to be *very* dirty before the telescope's performance is affected. If your mirror(s) are quite dirty, you may wish to have them cleaned or clean them yourself.

Mirror cleaning is more delicate than cleaning the external surfaces of your telescope; *professional cleaning provided by your dealer is recommended.* You may, however, clean them yourself if you use care.

• To get at the mirrors, aim the telescope straight up, and remove the retaining ring in front of the corrector by removing the screws from the retaining ring. These screws are those which are *normally hidden from view if the lens cap is in place.*

• With a pencil, mark the positions of the cork shims that can be seen between the edge of the corrector and the metal cell it rests in. Make a small alignment pencil mark on the edge of the corrector and on the cell, so that when you replace the corrector it will be rotated in the precise alignment it was in originally.

• Remove the corrector by gripping the secondary mounting fixture in the center of the corrector. Never remove the front corrector cell from the tube!

• The secondary mirror will now be exposed on the back side of the corrector, and the primary mirror at the bottom of the tube. Do not try to remove the primary mirror from the tube.

• Remove dust and particles from the mirror surface by using the compressed air. This is usually all that is needed.

• If it is necessary to use cleaning fluid, dilute one part cleaning fluid with one part distilled water.

• Moisten a tissue with the diluted cleaning agent and allow the wet tissue to adhere to the surface and then drag it gently along the surface. The mirror coating is protected with a layer of hard Silicon monoxide overcoating but excess rubbing may cause scratches.

• Dry the surface with a wad of fresh dry lens tissue.

• If the mirror cannot be cleaned effectively this way, you may require a professional cleaning.

• Replace the corrector, being sure that the cork shims are in exactly the same positions as they were originally. Also be sure that the corrector is rotated to be in exactly the same alignment as it was originally, by lining it up with your pencil marks.

• The telescope may require re-collimation after the corrector has been removed & replaced.

Celestron offers factory cleaning and collimation services for your telescope at its Torrance, California factory, using highly accurate tooling for adjusting and cleaning your instrument. Contact the factory for current prices.

Mechanical Adjustments

Collimation

Telescopes often perform poorly because their owners are not acquainted with the technique of collimation. Collimation is the process of aligning the optical elements, and is critical to the proper performance of the instrument. Your Celestron has been perfectly collimated at the factory, and may never require adjustment. But, if it is jarred severely or subjected to repeated vibration, it might need to be collimated.

Collimation is a relatively simple procedure. The use of a *test star* will allow you to align the optics every bit as accurately as the factory laser collimator. The only adjustment that is necessary (or possible) with your Celestron is the tilt adjustment of the secondary mirror.

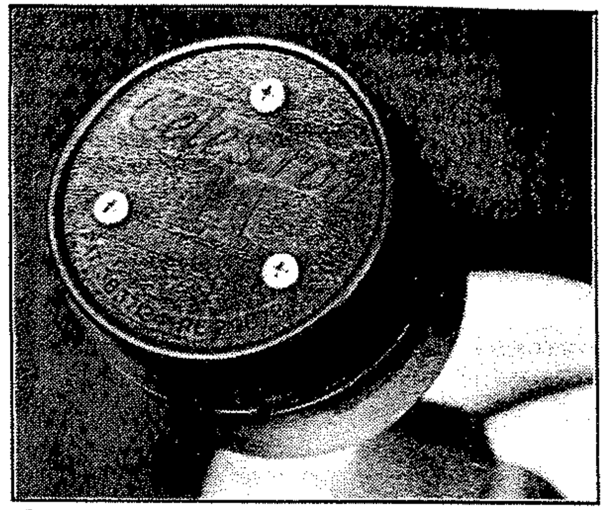
• To check collimation, aim the telescope at a star high overhead. The telescope should be allowed to cool to the same temperature as the outside air for at least 45 minutes before checking or adjusting the collimation.

• Using a medium to high power eyepiece, center the star in the field of view. Rotate the focusing knob and watch the image of the star grow in size as it goes out of focus.

• Observe the dark circle in the center of the out-of-focus star image. This is the shadow of the secondary mirror. When the star image is *precisely centered in the field of view* of the eyepiece, the shadow should be in the center of the round out-of-focus star image.

• If it is not, use the Compustar Motion Keys to move the out-of-focus star image to the edge of the field of view in the same direction as the shadow is out of center.

• If there is an orange cover over the front of the secondary mirror housing, remove it by prying it off with a small screwdriver.



Secondary mirror collimation adjusting screws.

Important: The tilt adjustments of the secondary mirror are very sensitive. 1/10 of a turn of one screw will change the collimation completely. Do not force the screws. If a screw is very tight, loosen a different screw slightly. Always keep tension on all the screws, or the secondary mirror may rotate on its center support.

• Tighten the secondary collimation screw(s) on the secondary housing *slightly*, in the direction that the shadow is off-center. Keep re-centering the star image with the Motion Keys.

• Repeat the small adjustments and re-centering of the star image until the shadow is in the center of the out-of-focus star when it is in the center of the field of view. Switch to your highest power eyepiece and repeat this procedure until it is as accurate as you can get.

• Final collimation may be done on a night of good seeing with the star image in focus at high power. The center will then appear as a bright spot called the Airy Disk. If seeing is very good, you will be able to see a single diffraction ring around the Airy Disk. A perfectly concentric diffraction disk indicates a perfectly collimated telescope.

Right Ascension lock

The pressure plate under the Right Ascension lock on the Compustar 8 & 11 may need periodic adjustment. To tighten the lock:

• Remove the lock lever. Tighten the exposed screw using a screw driver so that you can't rotate the fork manually but can rotate it slightly using the slow motion knob.

• Replace the lock lever in the lock position. Point it to the left. When you unlock the lock, the fork should swing with a very slight friction.

In Case of Difficulty

Computer Troubleshooting

The Compustar was designed to be rugged and reliable. Most troubles encountered during use are "user short-circuits" like forgetting to plug in one of the cables. In any complex device, however, an occasional unit will develop a problem with a component — usually a moving part or connector.

The following troubleshooting guide of symptoms and possible causes will help you solve the "user short-circuits" and identify a problem in the Compustar unit if one develops.

Nothing Happens. Fan in Power Module is not running.

Power is not getting to the Power Module.

1. Power Supply or battery is defective or not charged.

2. The power cable that connects the Power Module to a 12VDC power source is not properly connected at one end or the other. This is the cable that connects the Power Module (2-pin connector) to a 12 VDC power source.

3. Battery terminals are corroded.

4. The 20 Amp fuse mounted on the enclosure of the Power Module is blown. The most probable causes of blowing the fuse are:

A. Reverse polarity connection of the power cable to the 12 VDC power source. System is not damaged; fuse blows. Unplug the power cable and replace the fuse.

B. Connection of the power cable to an improper power source. If the power source is not 12 VDC, the fuse may blow. If the power cable is connected to an AC source (household wall outlets) then the fuse will blow, but the Compustar may be destroyed. Contact the factory.

5. Switch on Power Module not turned "on".

Nothing Happens. Fan in Power Module is running.

Power is not getting from Power Module to Computer .

1. The control cable that connects the Power Module to the Computer is not properly connected at one end or the other. Through this cable power is supplied to the Computer by the Power Module and motor control signals are supplied to the Power Module by the Computer. Without proper connection of this cable, the Compustar will not operate correctly.

2. A momentary power surge or power outage has confused the system. (Usually occurs when using a generator for power.) Turn the system off, wait a few seconds, and turn the system on again. The most probable cause of a power outage is an unreliable connection between the power cable and the power source. This can be due to

improper attachment of the power cable to the power source, forces applied to the cable while connected, or a poor connector on: the Power Module, the Power Module end of the power cable, the power source end of the power cable, the power source.

Display works, telescope does not move properly.

Motors are not being driven properly by Power Module

1. The RA and/or DEC motor control cable that connects the Power Module to the RA/DEC stepper motor connector is not properly connected at one end or the other. Through this cable the Power Module drives the RA/DEC stepper motors. Check the connections at both ends.

2. The RA and DEC motor control cables are interchanged. If the RA motor control cable is plugged into the connector for the DEC motor (and vice-versa), then the telescope will move, but it will not go where it is supposed to go. Check for reverse connection of RA and DEC motor control cables.

3. The RA friction clamp must be *locked tight*, or the telescope will not be driven properly by the RA stepper motor. Tighten the RA friction clamp.

4. No Compustar should have an operable DEC slo-motion, since it can result in damage to the dec drive gearing. The DEC drive must be engaged (C8) or the drive clutch clamp tightened (C11, C14) in order to operate correctly.

5. If the DEC motor/worm assembly is not set to engage the DEC worm gear, then the telescope will not move in declination, but a loud noise will not be made by the DEC motor. Carefully engage the DEC motor/worm assembly with the DEC worm gear.

Power failure during operation

If the power fails during operation, the telescope must be returned to the storage position manually before starting the computer again with the BEGIN command. Loosen the manual RA and DEC clamps before moving the tube by hand.

Accidentally pressing BEGIN

Do not press the BEGIN key except when specified in the instructions. Accidentally pressing the BEGIN key will require re-entering the information required for start-up.

IV. COMPUSTAR REFERENCE

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Detailed Command Reference

When sequences of keystrokes are shown, a colon (:) is used to separate the keystrokes. When a number is to be input by the user, the "#" is used. Comments and actions that you take as part of the command sequence are enclosed in parentheses.

ABORT

Used to exit any other command at any point. It also looks to see if the accessory joystick is connected. If it is, the joystick is used to control telescope motion rather than the motion control buttons on the Computer. In this case the position of the joystick when the ABORT key is pressed is taken as the RA & DEC zero position.

ALIGN

Used to align the polar axis of your telescope with the celestial pole with increased precision. The ALIGN command is identical to the last part of the BEGIN command. Each time you execute the ALIGN sequence the polar axis is aligned with slightly increased accuracy.

After the BEGIN command is executed, the polar axis should be aligned with sufficient accuracy for low power visual observing.

If you will be using your telescope for long-exposure astrophotography, then repeated execution of the ALIGN command will be necessary. Repeat the ALIGN command until no improvement in initial alignment accuracy is noticed.

The basic execution sequence:
ALIGN : (Adjust Mount To Center Pole Star) : ENTER : (Center Reference Star with Motion Control Keys) : ENTER

Aligning the polar axis with the celestial pole.
The Compustar helps you align the polar axis of your telescope with the celestial pole as follows:

- The Compustar slews to Polaris (the "north star") and flashes the ALIGN and ALT/AZ indicators. Sigma Octanis is used instead of Polaris in the southern hemisphere (you enter a negative latitude).
- You ALIGN the polar axis of your telescope with the celestial pole by adjusting the ALTITUDE and AZIMUTH controls on the wedge until Polaris (or Sigma Octanis in the southern hemisphere) is centered in the field of view. Then press the ENTER key.
- The Compustar moves to a reference position near the meridian, pauses for a moment, then moves to a bright (REF Catalog) star near the meridian.
- You center the star in the field using the motion control keys or the joystick. Then press the ENTER key.
- To repeat the process for increased accuracy, press ALIGN.

BEGIN

The BEGIN command is used to begin each observing session. First, the Compustar asks for the basic information (time, date, longitude, and latitude). Then it goes through a simple sequence designed to help you quickly align the polar axis of your telescope with the celestial pole.

Detailed BEGIN Sequence

EXAMPLE: Begin Computer Start-up:

Keys:	Display	Description
BEGIN	GMT	Requests entry of Greenwich Mean Time
0 4 1 5 3 0 0	04:15:30.0	Enter GMT as HH MM SS.S
ENTER	YEAR	Request entry of GMT Year
1 9 8 8	1988	Displays the year.
ENTER	MONTH	Requests entry of GMT Month
0 8	0 8	Displays the month.
ENTER	DAY	Requests entry of GMT Day
22	2 2	Displays the day
ENTER	LONG	Requests west longitude of observing site in degrees and minutes.
1 2 0 5 0	122.50	Displays the longitude.
ENTER	LAT	Requests latitude of observing site in degrees and minutes
3630	36.30	Displays the latitude.
ENTER		Telescope motors start, slew tube to aim at computed location for Polaris.
	ALIGN ALT/AZ	Requests you to align the telescope mechanically by adjusting the altitude (wedge tilt) and azimuth (wedge-to-tripod) until Polaris is centered in the field of view.
ENTER		Telescope motors slew to a reference star. Center the star in the field with the direction keys (or optional joystick)
ENTER		Compustar is ready for use.

DISPLAY

The DISPLAY command is used to display information of various types. You can display information from the internal catalogs, or display information about the telescope position or the status of the Compustar computer.

You can display information from the internal catalogs in one of these ways:

DISP : M : # (1 through 110) : ENTER
DISP : CNGC : # (1 through 8191) : ENTER
DISP : REF : # (1 through 240) : ENTER

The Compustar responds with a display of all information in the catalogs, even though the telescope does not move to viewing position for the object displayed.

For more information on the information displayed, see III - Using Your Compustar, Computer Displayed Information, and IV - Compustar Reference, Computer Displayed Information.

The coordinates (RA and DEC) displayed are taken from the internal catalog and precessed to current date, but no correction for atmospheric refraction is carried out. Atmospheric refraction computations are performed only when the telescope slews.

The epoch of the internal catalogs can be displayed by the following keystroke sequence:

DISP : CNGC : 0 : ENTER.

The epoch year will be displayed on the displays that normally display the object number, but no object catalog will be illuminated when the epoch year is displayed.

DISP : TIMER - (Display the current value of the Compustar's internal timer)
DISP : TIME/DATE - (Displays the current GMT TIME and DATE)
DISP : LONG/LAT - (Displays the longitude and latitude of your telescope)

When you display one of these items, you set its current value.

DISP : SCOPE : COORDS - (Displays RA and DEC of the telescope)
DISP : SCOPE : ALT/AZ - (Displays ALT and AZ of the telescope)
DISP : SCOPE : HA - (Displays HA and DEC of the telescope)
DISP : OBJECT : COORDS - (Displays RA and DEC of the telescope)
DISP : OBJECT : ALT/AZ - (Displays ALT and AZ of the telescope)

DISP : OBJECT : HA - (Displays HA and DEC of the telescope)
DISP : OBJECT : TYPES - (Displays the LOOK/SCAN object types)

When you display the coordinates or the hour angle of the telescope or an object, the display is continuously updated. Altitude and azimuth are computed only once, so they are valid for only a minute or two after you display them. The coordinates are precessed from the epoch of the internal catalogs, but are not corrected for atmospheric refraction.

You can display the limits set with BETTER THAN, HIGHER THAN, and the other similar commands by pressing DISP followed by one of these keys. See the SCAN command for a detailed description.

END

The END command is used at the end of each observing session. The telescope slews to its storage position (HA = 00h 00.0m DEC = -90 degrees) and the RA & DEC stepper motors are turned off.

If for any reason, such as a power failure during operation, the telescope does not return to the storage position after executing the END command, loosen the manual declination lock, disengage the declination drive gear, and move the telescope to this position by hand.

FIELD

The FIELD command identifies the CNGC object nearest the center of the field, if there are any within 30 arc-minutes. If there is one, information about that object is displayed as in the DISP OBJECT command. If more than one CGNC object is within 30 arc-minutes, the object nearest the center of the field is chosen. If no CNGC objects are within 30 arc-minutes, no object information is displayed.

If you move the telescope with the joystick or motion control keys, then new objects may become closer to the center of the field than the one for which information is currently displayed. In this case a short tone is emitted and information about the new object is displayed.

The FIELD command is useful for determining what an object in the field might be. This is particularly useful in comet hunting where quick identification of "faint-fuzzies" is important (potential comet discoveries).

The accuracy of the FIELD command is primarily dependent upon the accuracy with which the center of the field corresponds to the coordinates displayed. Keep the scope "SYNCed" to the sky to optimize accuracy.

Executing any other command cancels the FIELD command.

JOYSTICK COMMANDS

The two buttons on the optional joystick can be used to execute commands at appropriate times. Pressing the primary (orange) button causes a SYNC command to execute. The secondary (black) button cycles between SPEED ranges. If the OBSERVING LOG option is enabled (see Appendix O; OPTION 0 command), then pressing both buttons will cause an "*" to be appended to the current line of the observing log.

As a safety feature, whenever the telescope is slewing, pressing either of the buttons on the joystick will ABORT the slew to cause the telescope to stop within a second or so.

Within a SCAN or LOOK command, the primary button functions the same as the SYNC key. The secondary button functions the same as NEXT/WAIT key. If the OBSERVING LOG option is enabled (see Appendix O, OPTION 0 command), then pressing both buttons will cause an "*" character to be appended to the current line of the observing log.

LOOK

The LOOK command is identical to the SCAN command except that the telescope does not slew to the objects. All the information in the CNGC catalog is displayed for each object, just as in the SCAN command. If you want to view any of the displayed objects through the telescope, you can make it slew to the object by pressing the SLEW key.

NEXT

The NEXT command continues the most recently executed SCAN or LOOK command where it left off. The NEXT object that would have been selected by that command is selected followed by normal execution of the command.

OPTION

The OPTION commands are used to support functions or accessories that may be added to enhance the Compustar product from time to time. For details on option commands, see Appendix B.

REV (REVERSE)

The counting direction of the timer is specified buy the UP and DOWN indicators. If you want to reverse the direction, execute REV : TIMER.

REV : UP (Reverse the North/South motion control conventions)
REV : DOWN (Reverse the North/South motion control conventions)
REV : LEFT (Reverse the East/West motion control conventions)
REV : RIGHT (Reverse the East/West motion control conventions)

By executing one of these commands, you can reverse the direction that objects move in the field when you press a motion control key or move the joystick. The UP, DOWN, LEFT and RIGHT keys are the motion control keys grouped in a diamond configuration at the top right of the Computer Display/Control.

SCAN

The SCAN command is used to tell the Compustar to scan through its internal CNGC catalog for deep-sky objects that satisfy the criteria you choose – and to slew to them sequentially.

For example, if you want to observe all the planetary nebulae in the CNGC catalog that are brighter than magnitude 13.2 and higher than 25 degrees above the horizon for 30 seconds each, you can use the SCAN command. It will find all the appropriate objects, slew to each, and pause 30 seconds before moving to the next.

There are a number of limits, restrictions or criteria that apply to the SCAN command; summarized below:

OBJECT TYPES:

To qualify, a CNGC object must contain one of the OBJECT TYPES that you specify. The object types recognized by the SCAN command are:

DNEB	Diffuse Nebula
PNEB	Planetary Nebula
OPEN	Open Star Cluster
GLOB	Globular Star Cluster
GAL	Galaxy

SCAN LIMITS:

BRITER THAN To qualify, a CNGC object must be brighter than the BRITER THAN limit that you specify. The BRITER THAN limit can range from 19.9 (super-faint) to -5.4 (super-bright), or include ALL objects.

FAINTER THAN – To qualify, a CNGC object must be fainter than the FAINTER THAN limit that you specify. The FAINTER THAN limit can range from 19.9 (super-faint) to -5.4 (super-bright), or include ALL objects.

LARGER THAN – To qualify, a CNGC object must be larger than the LARGER THAN limit that you specify (in arc-minutes). The LARGER THAN limit can range from 1 arc-minute to 359 arc-minutes (5.9 degrees), or include ALL objects.

SMALLER THAN – To qualify, a CNGC object must be smaller than the SMALLER THAN limit that you specify (in arc-minutes). The SMALLER THAN limit can range from 1 arc-minute to 359 arc-minutes (5.9 degrees), or include ALL objects.

HIGHER THAN – To qualify, a CNGC object must be higher above the horizon than the HIGHER THAN limit that you specify. The HIGHER THAN limit can range from 0 degrees to 89 degrees, or include ALL objects.

BETTER THAN – To qualify, a CNGC object must be better than or equal to the BETTER THAN limit that you specify. The BETTER THAN limits recognized by the SCAN command are:

7 – Superb
6 – Excellent
5 – Very Good
4 – Good
3 – Fair
2 – Poor
1 – Very Poor
0 – Unknown

The BETTER THAN ratings in the CNGC catalog are subjective judgements made by the designer, obtained by visual observations with a Compustar C14 in very dark skies for most objects. For the remaining objects, a computed algorithm that takes into account the object type, size, & magnitude is used. During the rating process, it was found that every CNGC object can be seen with a Compustar C14. The faintest objects (mag 15-16) require a dark observing site, a clear night, and careful use of averted vision, but they ARE visible!

Remember, a Compustar 8 used in the city will have different results than a Compustar 14 in a very dark sky location.

PAUSE – The Compustar stops on each object for the PAUSE duration before searching for another object to slew to. PAUSE can range from 00h 00m 00.0s to 23h 59m 59.9s. ***A PAUSE value of zero (00h 00m 00.0s) is taken to mean an infinite pause; the computer will wait for a NEXT command before continuing.***

STARTING VALUES:

When you power-up your Compustar, each of these limits has a starting value:

OBJECT TYPES –	"ALL"
BRITER THAN –	"ALL"
FAINTER THAN –	"ALL"
LARGER THAN –	"ALL"
SMALLER THAN –	"ALL"
HIGHER THAN –	0 deg..

(All objects above the horizon.)

BETTER THAN –	0 (All objects)
PAUSE –	0 (Infinite pause; use NEXT key.)

These limits remain unchanged until you explicitly change them with a SET command or within a SCAN or LOOK command.

TYPES OF SCAN SEQUENCES

There are an infinite number of keystroke sequences possible within the SCAN command, but they all fall into the following general sequence:

SCAN : (Specify Object Types) : SKIP : (Specify Object Limits) : BEGIN or NEXT

1. You press the SCAN key.

2. The object types currently selected for the SCAN command will flash in the object type indicator group. Soft keys that correspond with each type of deep-sky object will be illuminated.

3. You can change the mix of object types by pressing the soft keys that correspond to the object types you want to change. A keystroke toggles the object type between selected and unselected. If the object types are already correct then no keystrokes are needed.

4. If you want to specify any of the SCAN limits (BRITER THAN, etc), press the SKIP key. If you don't, then go to step 8.

5. The SCAN limits (BRITER THAN, etc.) will be illuminated on the soft keypad.

6. If you want to change any of the SCAN limits then press the appropriate key. If not, go to step 8.

7. You enter the desired value for that SCAN limit, ending with an ENTER keystroke. You can change as many SCAN limits as you want by repeating steps 5 through 7.

8. BEGIN and NEXT are illuminated on the soft keypad. Either key will start the execution of the SCAN command, but with a slight difference. If you press the BEGIN key, the SCAN command will begin with the northern-most CNGC object at roughly the current RA of the telescope. If you press the NEXT key, the SCAN command will begin with the object that would have come next in the most recent execution of the SCAN or LOOK command.

9. The SCAN command searches for the next object that satisfies the object type and SCAN limits and slews to it. It then pauses on the object for the PAUSE duration. When the PAUSE time expires, Step 9 is repeated.

During the pause on each object, the NEXT, BACK, WAIT, SYNC, and ABORT soft keys are illuminated. You can cause a number of actions to occur by pressing the following soft keys:

NEXT – Go to the NEXT object immediately.
BACK – Go BACK to the previous object immediately.
WAIT – WAIT for a NEXT or BACK keystroke (stop PAUSE countdown).
SLEW – SLEW to the object displayed again (after wandering around).
SYNC – SYNC the scope coordinates to the coordinates of the object.
ABORT – ABORT the SCAN command & await further commands.

While in the SCAN command the buttons on the optional accessory joystick provide remote SYNC and NEXT/WAIT capabilities. Pressing the primary button causes a SYNC function to occur, just as if you had pressed the SYNC key on the soft keypad. Pressing the secondary button causes a WAIT or NEXT function to occur. A WAIT function will be performed if the Compustar is not already WAITing. A NEXT function will be performed if the Compustar is currently in a WAIT state.

If the PAUSE delay is set to zero (infinite pause), a NEXT function will result. If the observing log function is enabled and you press both buttons, an "*" will be printed on the current line of the observing log, usually to indicate that you could not see the object.

If you find that you want to change one or more of the SCAN limits governing the operation of the SCAN command, then the following sequence is useful:

1. Press ABORT to get out of the SCAN command.
2. Use the SET command to change the desired SCAN limits or types.
3. Press NEXT to continue the SCAN command where it left off.

SCANNING ORDER

The SCAN command scans through the CNGC catalog for objects that satisfy the SCAN limit & type restrictions in a very specific, dependable, convenient, repeatable way. Here's how it works.

The internal CNGC catalog is organized as 31 blocks of 256 objects as follows:

BLOCK 0 = CNGC 0000 through CNGC 0255 (STRIP 0)
BLOCK 1 = CNGC 0256 through CNGC 0511 (STRIP 1)
BLOCK 2 = CNGC 0512 through CNGC 0767 (STRIP 2)
...(etc)
BLOCK 30 = CNGC 7680 through CNGC 7840 (STRIP 30) CNGC 7840 = last CNGC object

The objects in each block fall into an approximately 12 degree wide strip of sky extending from the north celestial pole to the south celestial pole.

At the beginning of the SCAN command, the Compustar computes the strip of sky that the telescope is currently pointing to. Within this strip, the northern-most CNGC object that satisfies the SCAN limits & type restrictions is selected. The object information from the CNGC catalog is displayed and the Compustar slews to the object. When it is time to select the next object, the SCAN command selects the next northern-most CNGC object that satisfies the SCAN limits and type restrictions. The result is that the telescope always moves southward within a strip, and less than 12 degrees in RA. When the southern-most qualified object within the current strip of sky has been observed, the SCAN command repeats the same process in the next strip (to the east) except in a south to north direction.

SET

The SET command is used to set information of various types. The following execution sequences are grouped into general categories:

SET : TIMER : # (HHMM SS.S) : ENTER
SET : TIME/DATE : #(HH MM SS.S) : ENTER : #(YY MM DD) : ENTER
SET : LONG/LAT : #(DDD MM) : ENTER : #(DD MM) : ENTER
SET : EPOCH : #(YY) : ENTER

When you SET information about one of these items, you set the current value of that item. The TIME (GMT) starts running when the ENTER key is pressed. The same is true of the TIMER if it is currently counting. The EPOCH is the epoch year of all coordinates that you specify, as in the SLEW COORDS command, for example:

SET : SCOPE : COORD : # (RA = HH MM.M) : ENTER : #(DEC = DD MM) : ENTER

This command is used to set the telescope coordinates when it is centered on an object of known coordinates. The RA is set by the first ENTER keystroke and the DEC is set by the second ENTER keystroke. If the object is in any of the internal object catalogs (M, CGNC, REF), then it is much easier to DISP the object information and execute a SYNC command.

SET : OBJECT TYPES (Set object types for LOOK and SCAN)
SET : BRITER THAN (Set the BRITER THAN limit for LOOK and SCAN)
SET : FAINTER THAN (Set the FAINTER THAN limit for LOOK and SCAN)
SET : LARGER THAN (Set the LARGER THAN limit for LOOK and SCAN)
SET : SMALLER THAN (Set the SMALLER THAN limit for LOOK and SCAN)
SET : HIGHER THAN (Set the HIGHER THAN limit for LOOK and SCAN)
SET : BETTER THAN (Set the BETTER THAN limit for LOOK and SCAN)
SET : PAUSE (Set the PAUSE time for LOOK and SCAN command)

When you set one of these items, the specified limit used in the LOOK and SCAN commands is updated. See the SCAN command for a detailed description.

SLEW

The SLEW command is used to make the telescope SLEW (move rapidly) to an object in one of the internal catalogs (M, CNGC, REF), to coordinates that you select, or to the object whose information was most recently displayed.

The Compustar emits a tone for 1 second before it moves. This is to warn you that the telescope is about to slew so you can move clear of the telescope.

If the object is below (lower in altitude) the HIGHER THAN limit, then the Compustar will emit a high-pitched tone for 2 seconds, illuminate the TOO LOW indicator, and will not slew. When the Compustar is turned on, the HIGHER THAN limit is automatically set to 0 degrees so the telescope will slew to any object that is above the horizon. You can change the HIGHER THAN limit with the SET command. A HIGHER THAN limit of 15-30 degrees is normal for reasonably good observing sites. The HIGHER THAN limit is also used in the SCAN and LOOK commands.

Whenever the Compustar slews to an object, (or to coordinates that you specify), the Compustar compensates for precession and atmospheric refraction (which displaces the object slightly). Therefore, the coordinates displayed when the slew is complete will usually be somewhat different from the coordinates displayed by a DISP or LOOK command.

You can stop the telescope from slewing by pressing the ABORT soft key at any time during the slew. Pressing either button on the joystick also stops the telescope from slewing. As soon as the slew is complete, they return to their previous function.

Example SLEW execution sequences:

SLEW : M : #(1 through 110) : ENTER
SLEW : CNGC : #(1 THROUGH 8191) : ENTER
SLEW : REF : #(1 THROUGH 240) : ENTER
SLEW : COORDS : #(RA as HH MM.M) : ENTER : #(DEC as DD MM) : ENTER
SLEW : OBJ (OBJ = most recently displayed object)

SPEED

The SPEED command is used to select the speed at which the telescope responds to the motion control keys from one of four possibilities:

SPEED : SLEW (Up to slew speed, 12 deg./sec. max)
SPEED : SET (UP TO 64X sidereal, 15 arc-min./sec. max)

SPEED : GUIDE (Up to 2x sidereal, 15 arc-sec./sec. max)
SPEED : AUTO (Up to 2x sidereal, 15 arc-sec./sec. max)

The AUTO speed is provided to allow the Compustar to be used in the future with photoelectric automatic guiders. This function is not currently supported.

The maximum speeds in RA are about 60% of the DEC speeds. The max rates shown above are the highest speeds obtainable by full deviation of the joystick from its null (spring return center) position. Slower, more precise motions are made using smaller displacements of the joystick.

When the speed range is changed, the Compustar emits short BEEPs to help you keep track of which speed range you have selected:

1 BEEP – SLEW
2 BEEPs – SET
3 BEEPs – GUIDE
4 BEEPs – AUTO

SYNC

The SYNC command is used to synchronize the coordinates of the Computer with the position of the object most recently pointed to by a SLEW or SCAN command. When the Compustar moves to an object, it may not be exactly centered in the field of the view, due to polar alignment error, manufacturing tolerances, flexure, etc. By centering the object with the joystick or motion control buttons, and then executing the SYNC command, the coordinates of the telescope are set to the coordinates of the object (corrected for atmospheric refraction during the slew). This will reduce subsequent pointing errors, especially for objects in the same part of the sky.

One of the advantages of the optional joystick accessory is that you can center the object more quickly and conveniently than with the motion control buttons. Another advantage is that the SYNC command can be executed by pressing the primary button on the joystick. So, each time the Compustar slews to an object, you can center the object and SYNC the coordinates without moving away from the eyepiece.

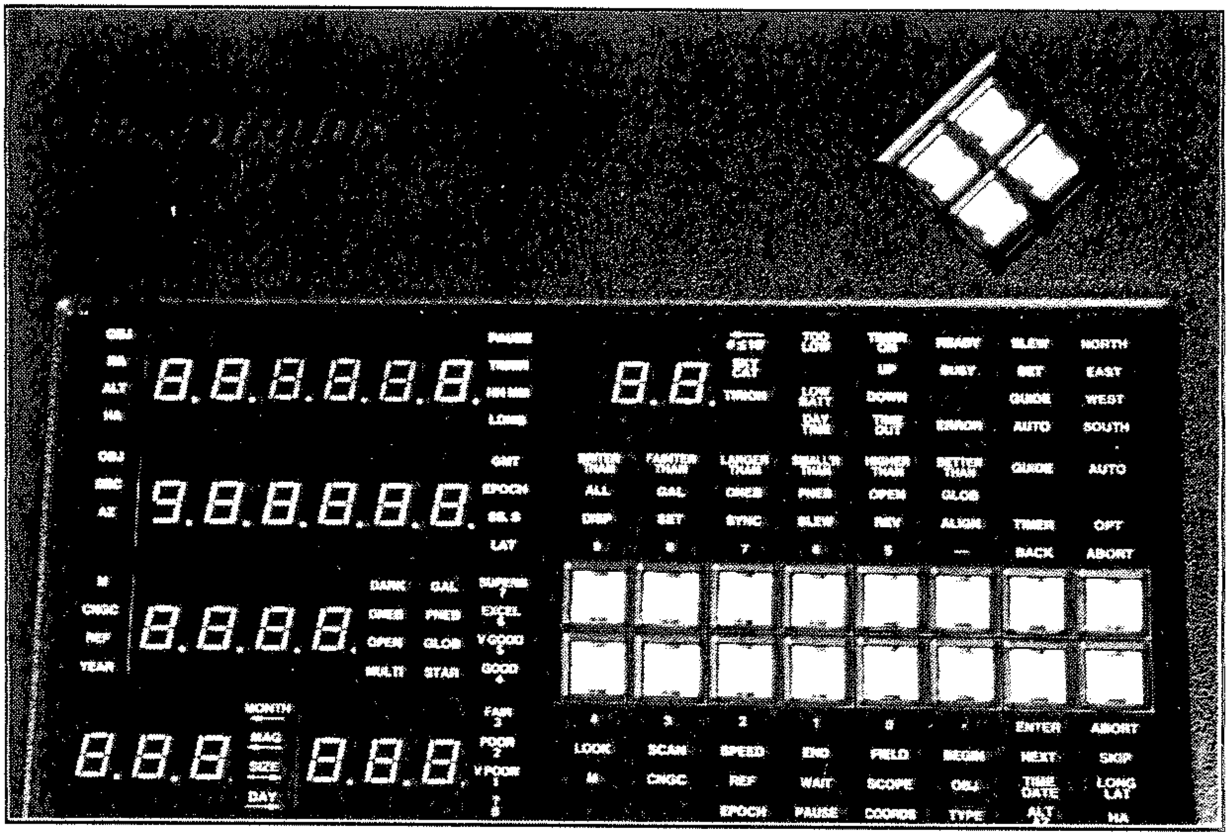
Since the coordinates are corrected for atmospheric refraction during the SLEW process (SLEW or SCAN commands), you should not execute the SYNC command after displaying (but not slewing to) an object (DISP or LOOK commands unless the object is at least 30 degrees above the horizon.

Be sure not to execute the SYNC command unless you are sure that the object that is centered in the field IS the object whose data is displayed! If you are not certain, then don't execute the SYNC command! If you make this mistake, then move the telescope with the joystick or motion control buttons to an object you know, display the object with the DISPLAY command, and then execute the SYNC command.

Each time SYNC is executed, two quick BEEPs are emitted to let you know that the SYNC command has been executed.

TIMER

The TIMER command toggles the timer ON and OFF. If the timer is ON, the TIMER command will turn it off, and visa versa. The timer is ON (counting) when the TIMER ON indicator is illuminated.



Computer Display Groups

Information is displayed on two types of red LEDs:

1. 7-Segment LEDs – used primarily to form numeric digits
2. Indicator LEDs – used to backlight various messages

The 7-Segment LEDs are called "digits" and the indicator LEDs are called "legends". Information is displayed in "groups" composed of digits and/or legends.

RA Display Group

The legends at the left and right ends of the "RA DISPLAY GROUP" specify the meaning of the digits as follows:

Meaning of Legends & Digits

RA — Right Ascension of the telescope.
OBJ RA.— Right Ascension of a selected object.
ALT – Altitude of the telescope.
OBJ ALT — Altitude of a selected object.
HA — Hour Angle of the telescope.
OBJ HA – Hour Angle of a selected object.
PAUSE (HH MM) – Pause duration for SCAN & LOOK commands (hours & minutes).
TIMER (HH MM) – TIMER value (hours & minutes).
GMT (HH MM) – Greenwich Mean Time (hours & minutes) "
LONG — Longitude of your observing site

DEC Display Group

The legends at the left and right ends of the "DEC DISPLAY GROUP" specify the meaning of the digits as follows:

Meaning of Legends & Digits

DEC – Declination of the telescope.
OBJ DEC – Declination of a selected object.
AZ – Azimuth of the telescope.
OBJ AZ – Azimuth of a selected object.
PAUSE (SS.S) – Pause duration (seconds). "HH MM" is in RA Display Group.
TIMER (SS.S) – Timer value (seconds). "HH MM" is in RA Display Group.
GMT (SS.S) – Greenwich Mean Time (seconds). "HH MM" is in RA Display Group.
EPOCH – EPOCH year for user input coordinates.
LAT – Latitude of your observing site.

Object Catalog Display Group

The legends at the left end of the "OBJECT CATALOG DISPLAY GROUP" specify the meaning of the digits as follows:

Meaning of Legends & Digits

M – Messier catalog object (M 1 through M 110).
CNGC – CNGC catalog object (CNGC 1 through CNGC 7840).
REF – REF catalog object (REF 1 through REF 240).
YEAR – Year portion of the current date.

Object Information Display Group

The legends in the center of the "OBJECT INFO DISPLAY GROUP" specify the meaning of the adjacent digits as follows:

Meaning of Legends & Digits

<– MONTH – Digits on left are the month portion of the current date.
<– MAG – Digits on left are the magnitude of the specified object.
–> SIZE – Digits on right are the size of the specified object.
–> DAY – Digits on right are the day portion of the current date.

Object Type Display Group

The legends in the "OBJECT TYPE DISPLAY GROUP" specify the type of the specified object as follows:

Meaning of Legends

DARK------------ Dark Nebula in front of Diffuse Nebula
DNEB------------ Diffuse Nebula
DNEB OPEN---- Diffuse Nebula & Open Cluster
PNEB------------ Planetary Nebula
OPEN------------ Open Star Cluster
GLOB ------------ Globular Star Cluster
GAL-------------- Galaxy
STAR------------ Star
MULTI STAR--- Double or Triple Star
MULTI GAL----- Multiple Galaxy
DNEB GAL------ Diffuse Nebula in another Galaxy
OPEN GAL ------ Open Cluster in another Galaxy
GLOB GAL------- Globular Cluster in another Galaxy

Object Quality Display Group

The legends in the "OBJECT QUALITY DISPLAY GROUP" specify the estimated overall quality of the object for visual observing. The quality is determined by visual observations with a Compustar C14 at a good site. For those objects not yet observed, it is computed from the type, size, and magnitude information for the object. In the paper listing of the CNGC catalog, the objects rated by observation are rated in capital letters (A - G). On the Compustar, the object quality is specified as follows:

Meaning of Legends

SUPERB -------7---------- Superb
EXCEL ---------6---------- Excellent
V GOOD --------5---------- Very Good
GOOD ----------4---------- Good
FAIR -----------3---------- Fair
POOR -----------2---------- Poor
V POOR --------1---------- Very Poor
? -----------------0---------- Unknown

Object Field Display Group

The legends on the right of the "OBJECT FIELD DISPLAY GROUP" are used to specify the meaning of the digits and/or other information about the specified object as follows:

Meaning of Legends

<—#<=15' ---- Digits specify # of CNGC objects within 15 arc-min of object.
SKY CAT ---- The specified object is included in "SKY-CATALOG 2000".
TIRION ------ The specified object is included in "TIRION SKY ATLAS 2000"

Status Display Group

The legends in the "STATUS DISPLAY GROUP" specify a number of items of general interest concerning the status of the telescope and Compustar as follows:

Meaning of Legends

TOO LOW ----- Specified object is below the "HIGHER THAN" limit or the horizon.
TIMER ON --- TIMER is ON (counting)
UP ------------ TIMER is set to count UP
DOWN -------- TIMER is set to count DOWN
TIME OUT --- TIMER counted DOWN to zero, beeped, and started counting UP
READY ------- READY for a command
SLEW --------- Motion control buttons or joystick in SLEW SPEED MODE
SET ----------- Motion control buttons or joystick in SET SPEED MODE
GUIDE -------- Motion control buttons or joystick in GUIDE SPEED MODE
AUTO --------- Guiding from AUTO-GUIDER input (center DB-9S connector)
NORTH ------- NORTH telescope motion
EAST --------- EAST telescope motion (relative to sidereal)
WEST --------- WEST telescope motion (relative to sidereal)
SOUTH ------- SOUTH telescope motion

Keypad Display Group

The legends above and below the command keys (J) comprise the "KEYPAD DISPLAY GROUP". These legends specify the current function of the associated keys. The meaning of each indicator is given in the command section.

Computer Technical Description

The Computer contains two printed circuit (PC) cards; the CCM and the KDM. The CCM (Computer Control Module) card contains all the computer control electronics. The KDM (Keypad/Display Module) card contains the keypad & display components. There are four user-accessible connectors on the Computer Display/Control; three DB-9S connectors and a DB-25S. The three DB-9S connectors are located on the front edge of the Computer as follows:

Right Connector — Joystick Accessory
Center Connector — Auto-Guider Accessory (or 2nd joystick)
Left Connector — Accessory RS-232 interface (computer, printer, etc)

In a basic Compustar, nothing is connected to any of these DB-9S connectors. If you purchase a joystick, autoguider, or RS-232 interface accessory, then plug the accessory into the specified DB-9S connector.
The fourth connector, a DB-25S, is located on the rear edge of the Computer Display/Control, just above the four motion control keys (organized in a diamond configuration). A 25-conductor cable connects this DB-25S to the DB-25S on the Power Module. This cable was already described in detail in the Power Module summary.

Electrical Requirements

Power Required ----- 12 Volts DC at 12 Amps maximum (145 Watts)
Power Fuse----------- 20 Amps

Optical & Mechanical Specifications

See the Celestron brochure for full szpecifications.

V. APPENDICES

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Appendix B, Option Command 64

Appendix A, Accuracy & Alignment

It is impractical to build a telescope with perfect pointing accuracy. Even though the software and electronics of the Computer position the motors to a very high degree of precision, a number of other factors limit the accuracy with which objects are centered. The software is precise to a small fraction of an arc-second and after all the electronics and the motors the accuracy is still about an arc-second – very accurate indeed!

Since software in the Computer compensates for predictable errors like precession and atmospheric refraction, pointing accuracy is limited almost entirely by the mechanical aspects of the telescope – mechanical and polar alignments, flexure, and backlash.

Alignment of the mechanical axes is the responsibility of the user of the telescope – the person who sets it up and prepares it for use. Flexure is primarily a function of the design and fabrication of the telescope, but it is aggrevated by adding weight to the moving parts of the telescope.

If your Compustar is permanently mounted, then one thorough polar alignment should be all that is ever needed to achieve good pointing accuracy.

If you disassemble any of the moving parts of your telescope, you may find it necessary to realign the RA & Dec axes of the mounting to achieve good pointing accuracy again.

The three axes of a telescope are:

1. The OPTICAL axis
2. The DECLINATION axis
3. The RA (polar) axis

The proper relationship of the axes are:

1. The OPTICAL AXIS should be perpendicular to the DECLINATION AXIS.
2. The DECLINATION AXIS should be perpendicular to the RA AXIS.

The pointing error introduced by non-perpendicularity varies between zero and twice the error; a perpendicularity error of 10 arc-minutes between the RA and DEC axes will cause pointing errors of up to 20 arc-minutes.

The optical axis of most telescopes is made accurately perpendicular to the declination axis since it is difficult to measure an error in the field. Be sure not to disassemble your telescope in a way that decouples the tube from the declination axes (shafts) unless they can be accurately replaced.

The following technique for aligning the RA & DEC axes assumes the optical axis is perpendicular to the DEC axis. This technique is performed under the night sky. It is also the procedure used to find the exact +90 degree declination position (necessary when declination synchronization is lost).

1. Point the telescope as close to the +90 degree declination position as possible. Use the motion control buttons or joystick and the SET speed range once you get close. Also position the telescope at HA = 00h as shown in Fig A1.

2. Using the altitude and azimuth controls on the wedge/tripod, center Polaris (the North Star) in the field of view. A low power eyepiece with a reticle is best for this proceedure. The use of a right-angle diagonal is usually necessary.

3. Unclamp the telescope in RA so you can move it in RA by hand. Rotate the telescope around the RA axis (+/- 90 degrees) while watching Polaris. If Polaris stays centered in the field, then the RA & Declination axes are perpendicular — in this case go to step 6.

4. Move the scope North or South with the motion control keys (in the SET speed range) and recenter Polaris with the alt/az controls on the wedge. Again rotate the telescope around the RA axis and observe the motion of Polaris in the field. If the motion of Polaris is less than the previous check (and in the same direction) as the previous cycle, then you moved the scope the correct direction (N/S) with the motion control keys. If the motion of Polaris is greater than the previous check (and in the same direction), then you moved the scope in the incorrect direction (N/S). If Polaris moves in the opposite direction (clockwise/counterclockwise) in the field, then you went too far (N/S) in the correct direction. With this information, move the scope (N/S) in the appropriate direction and repeat this step (4) until the motion is as small as you can get it. If Polaris stays centered in the field, then the RA & Declination axes are perpendicular — in this case go to step 6.

5. Note the position of the center of the circle formed by the motion of Polaris. Without changing the position of the telescope in declination, move it in RA until HA = 00h. Slightly loosen the bolts that hold one of the fork arms to the drive base. While watching the position of Polaris in the field, gently move the fork arm up or down along the RA axis until Polaris moves to the center of the circular motion noted above. Retighten the bolts that hold the fork arm to the drive base. Go to step 3 and repeat steps 3 to 5 until the directions send you to step 6.

6. Make sure the fork arm is tightly secured to the drive base. Polaris should now stay relatively motionless when you manually move the scope +/- 90 degrees in RA. If it doesn't, then go back to step 3. Using the "SET : SCOPE COORDS" command, set RA = 00h 00.0m and DEC = +90 00'. The RA & DEC axes are now perpendicular and the declination coordinates are accurately set. Execute the "END" command. Then position the scope at HA = 00h 00.0m and tighten the RA clamp to ready the telescope for the observing session — starting with the "BEGIN" command.

It is unlikely that you will be able to reduce the motion of Polaris to zero. Since the telescope is pointing at an angle, there will be some differential flexure when you rotate it around the RA axis. The first time you align the RA & Dec axes you should take plenty of time. Reduce the motion of Polaris to the smallest value you can. Then, on future re-alignments, you will know just how close you can get — and how close you are on each adjustment cycle.

In a massive observatory instrument, the circular motion of Polaris may well be less than 1 arc-minute in diameter. In portable telescopes, the circle may be up to 5 arc-minutes in diameter. Obviously, the smaller the circle, the better the pointing accuracy of your Compustar.

Appendix B, OPTION 0 - Observing Log

The OPTION 0 command toggles an "OBSERVING LOG" feature ON & OFF. It is OFF when the Compustar is powered up or reset. When it is ON, then, each time the Compustar slews to an object, it will send a description of the object to the RS-232 serial interface.

A carriage return & line feed is sent before each description so a well organized observing log can be kept by connecting a simple printer to the Compustar serial interface. The information is sent in a fixed format so the information will be neatly printed in columns for quick reference. If the Compustar is interfaced to a computer, the fixed format makes the data much easier to process by specialized programs.

The format of each line of the log is:

1 - 9 CCCC XXXX
CCCC = Object Catalog
XXXX = Catalog #
12 - 21 TTTTTTTTTT
TTTTTTTTTT = Object Type
24 - 29 QQQQQQ
QQQQQQ = Object Quality Rating
32 - 35 MMMM
MMMM = Object Magnitude
38 - 41 SSSS
SSSS = Object Size (d = degrees)
44 - 50 HH MM.M
HH MM.M = Object RA (Right Ascension)
52 - 57 sDD MM
sDD MM = Object DEC (Declination)
60 - 65 YYMMDD
YY = Year :
MM = Month :
DD = Day
67 - 72 HHMMSS
Time: HH = Hour : MM = Minute : SS = Second
75 - 79 **** = Comments from user.

One or more "*" characters can be appended to the end of each line of the observing log. Each "*" is printed when BOTH joystick buttons are pressed and released. Some small printers support only 80 characters per line; on these, up to two or three "*" characters can be appended to a line before the printer automatically advances to the next line. Most printers support longer lines; the Compustar imposes no limit to the number of "*" characters added to the end of a line.

The "*" characters are observer notes. The normal convention is: Two "*" characters means that the observer could not see the object. One "*" means that the observer was not sure — that it may have been right on the boundary of visable / not visible. No "*" means that the observer definitely saw the object. This convention is only a suggestion — each observer may find other conventions more useful. All the Compustar does is print an "*" each time you press both joystick buttons when OPTION 0 is enabled.

The order chosen for the date and time digits was chosen for easy date and time processing with user-written personal computer programs. Since the numbers are ordered most significant digit thru least significant digit, a simple numeric comparisons of dates and times is sufficient to properly collate (order) observations. (YYMMDD HHMMSS)

CNGC	R.A.	Dec.	Size	Mag.	Type Comments	Name / Misc
7841	05 31 30	+21 59	360	8.4	PLAN NEB EMIS SN REM	M1 Crab Nebula 4kly
7842	21 30 55	-01 03	774	6.5	GLOB CLUS sp=F4	M2 40kly
7843	13 39 57	+28 38	972	6.4	GLOB CLUS sp=F7	M3 35kly
7844	16 20 34	-26 24	1578	5.9	GLOB CLUS sp=G0	M4 14kly
7845	15 16 02	+02 16	1044	5.8	GLOB CLUS sp=F6	M5 26kly
7846	17 36 46	-32 11	900	4.2	OPEN CLUS sp=B4	M6 1500ly
7847	17 50 38	-34 48	4800	3.3	OPEN CLUS sp=B5	M7 800ly
7848	18 00 04	-24 23	5400	5.2	OPEN CLUS + ENEB sp=O5	M8 Lagoon Nebula 5100ly
7849	17 16 14	-18 28	558	7.9	GLOB CLUS	M9
7850	16 54 29	-04 02	906	6.6	GLOB CLUS sp=G1	M10 20kly
7851	18 48 22	-06 20	840	5.8	OPEN CLUS sp=B8	M11 Very rich 5600ly
7852	16 44 36	-01 52	870	6.6	GLOB CLUS sp=F8	M12 24kly
7853	16 39 54	+36 33	996	5.9	GLOB CLUS sp=F6	M13 Hercules Globular
7854	17 34 59	-03 15	702	7.6	GLOB CLUS	M14
7855	21 27 36	+11 57	738	6.4	GLOB CLUS sp=F2	M15 X-Ray Source 34kly
7856	18 15 59	-13 48	2100	6.0	OPEN CLUS + ENEB sp=O7	M16 Eagle Nebula 5500ly
7857	18 17 52	-16 12	2760	6.0	DIFF ENEB + OPEN CLUS HII	M17 Omega/Swan/Horseshoe
7858	18 17 03	-17 09	540	6.9	OPEN CLUS	M18
7859	16 59 27	-26 11	810	7.2	GLOB CLUS OBLATE	M19 Oblate Shape Globular
7860	17 59 17	-23 02	1740	6.3	DIFF ENEB + OPEN CLUS HII	M20 Trifid Nebula 3500ly
7861	18 01 35	-22 30	780	5.9	OPEN CLUS	M21
7862	18 33 16	-23 58	1440	5.1	GLOB CLUS sp=F7	M22 10kly
7863	17 54 02	-19 01	1620	5.5	OPEN CLUS sp=B8	M23 1400ly
7864	18 17 00	-18 27	4800	4.7	OPEN CLUS	M24 Best with large field
7865	18 30 30	-19 16	2400	6.5	OPEN CLUS SPARSE	M25 IC 4725 Sparse Cluste
7866	18 42 38	-09 27	900	8.0	OPEN CLUS	M26
7867	19 57 25	+22 35	910	7.6	PLAN NEB	M27 Dumbbell Nebula 3500l
7868	18 21 28	-24 54	672	6.9	GLOB CLUS	M28
7869	20 22 05	+38 22	420	6.6	OPEN CLUS	M29
7870	21 37 29	-23 25	660	7.5	GLOB CLUS	M30

CNGC	R.A.	Dec.	Size	Mag.	Type Comments	Name / Misc
7871	00 40 02	+41 00	10680	3.5	GALAXY Sb I-II	M31 Andromeda Gal 178x63
7872	00 40 02	+40 36	456	8.2	GALAXY E2	M32 Comp of M31 7.6x5.8
7873	01 31 06	+30 24	3720	5.7	GALAXY Sc II-III	M33 Triangulum Gal 62x39
7874	02 38 47	+42 34	2100	5.2	OPEN CLUS	M34
7875	06 05 46	+24 21	1680	5.1	OPEN CLUS sp=B5	M35 2800ly
7876	05 32 51	+34 06	720	6.0	OPEN CLUS	M36
7877	05 49 04	+32 32	1440	5.6	OPEN CLUS sp=B8	M37 4200ly
7878	05 25 19	+35 48	1260	6.4	OPEN CLUS sp=B5	M38 4600ly
7879	21 30 24	+48 13	4800	7.5	OPEN CLUS	M39
7880	12 33 52	+26 16	930	10.3	GALAXY Sb + 3-SYS FAINT	M40 Edge-On with dust lane
7881	06 44 56	-20 42	2640	5.9	OPEN CLUS sp=B4	M41 2200ly
7882	05 32 52	-05 25	3960	3.9	DIFF ENEB + RNEB	M42 Orion Nebula 1300ly
7883	05 33 04	-05 18	900	5.8	DIFF ENEB + RNEB	M43 Orion Nebula Extension
7884	08 37 10	+20 10	9000	5.2	OPEN CLUS sp=A0	M44 Praesepe/Beehive 5901
7885	03 44 06	+23 58	7200	1.6	OPEN CLUS + RNEB sp=B6	M45 Pleiades 410ly
7886	07 39 33	-14 42	2400	9.2	OPEN CLUS sp=B8	M46 5400ly (+CNGC 2438 PN
7887	07 34 15	-14 22	2400	5.2	OPEN CLUS sp=B3	M47 1600ly
7888	08 11 10	-05 38	3240	5.9	OPEN CLUS	M48
7889	12 27 14	+08 17	480	10.2	GALAXY E4	M49
7890	07 00 30	-08 16	900	7.0	OPEN CLUS	M50
7891	13 27 51	+47 27	540	8.8	GALAXY Sc 2-SYS FACE-ON	M51 Whirlpool Galaxy + Com
7892	23 21 59	+61 19	21000	8.9	OPEN CLUS	M52
7893	13 10 29	+18 26	864	8.6	GLOB CLUS	M53
7894	18 52 00	-30 32	330	8.7	GLOB CLUS	M54
7895	19 36 55	-31 03	1266	7.0	GLOB CLUS sp=F5	M55 20kly
7896	19 14 38	+30 05	606	9.5	GLOB CLUS	M56
7897	18 51 40	+32 58	200	9.7	PLAN NEB RING-LIKE	M57 Ring Nebula 5000ly
7898	12 35 14	+12 06	378	11.5	GALAXY SBb	M58 (Near M59 (CNGC 4621))
7899	12 39 32	+11 55	270	11.0	GALAXY E3	M59 (Near M58 (CNGC 4579))
7900	12 41 08	+11 50	540	10.3	GALAXY E1	M60 Near M59 = CNGC 4621

CNGC	R.A.	Dec.	Size	Mag.	Type Comments	Name / Misc
7901	12 19 25	+04 45	396	10.9	GALAXY SBc 2-SYS	M61 Face-on Barred Spiral
7902	16 58 07	-30 03	840	8.1	GLOB CLUS OBLATE	M62 Non-symmetrical
7903	13 13 35	+42 18	960	9.7	GALAXY Sb	M63 Sunflower Galaxy
7904	12 54 16	+21 57	660	8.9	GALAXY Sb	M64 Black Eye Galaxy
7905	11 16 18	+13 22	570	9.6	GALAXY Sa 2-SYS	M65 Near M66 = CNGC 3627
7906	11 17 36	+13 16	540	8.9	GALAXY Sb 2-SYS	M66 Near M65 = CNGC 3623
7907	08 48 20	+12 00	1800	7.5	OPEN CLUS sp=F2	M67 Very old 2700ly
7908	12 36 46	-26 29	588	9.1	GLOB CLUS	M68
7909	18 28 04	-32 23	408	8.9	GLOB CLUS	M69
7910	18 39 58	-32 21	306	8.9	GLOB CLUS	M70
7911	19 51 29	+18 39	612	8.3	GLOB CLUS	M71
7912	20 50 44	-12 44	384	10.2	GLOB CLUS	M72
7913	20 56 14	-12 49	168	9.7	OPEN CLUS	M73
7914	01 33 57	+15 32	720	10.5	GALAXY Sc	M74
7915	20 03 14	-22 04	294	9.5	GLOB CLUS	M75
7916	01 38 50	+51 19	240	12.2	PLAN NEB (CNGC 0650/0651)	M76 Little Dumbbell Nebula
7917	02 40 07	-00 14	540	9.7	GALAXY Sb SEYFERT	M77 Seyfert Galaxy
7918	05 44 13	+00 02	660	11.3	DIFF RNEB	M78 1500ly
7919	05 22 10	-24 34	468	8.3	GLOB CLUS	M79
7920	16 14 07	-22 52	516	8.9	GLOB CLUS	M80
7921	09 51 33	+69 18	1200	7.8	GALAXY Sb	M81 (See M82 (CNGC 3034))
7922	09 51 43	+69 55	780	9.2	GALAXY IRR EDGE-ON EXP	M82 Exploding Galaxy
7923	13 34 18	-29 36	630	8.5	GALAXY Sc FACE-ON	M83
7924	12 22 32	+13 10	360	10.8	GALAXY S0-E1	M84 Near M86 = CNGC 4406
7925	12 22 56	+18 28	480	10.2	GALAXY S0 2-SYS	M85
7926	12 23 44	+13 13	720	10.9	GALAXY E3	M86 Near M84 = CNGC 4374
7927	12 28 20	+12 40	420	10.4	GALAXY E1 2-SYS	M87
7928	12 29 32	+14 42	402	10.6	GALAXY Sb/Sc MULTI-ARM	M88
7929	12 33 08	+12 50	216	11.1	GALAXY E0	M89
7930	12 34 20	+13 26		10.3	GALAXY Sb	M90

CNGC	R.A.	Dec.	Size	Mag.	Type Comments	Name / Misc
7931	12 32 56	+14 46	390	11.5	GALAXY SBb	M91
7932	17 15 38	+43 12	738	7.3	GLOB CLUS sp=F1	M92 X-Ray Source 26kly
7933	07 42 26	-23 45	1920	6.7	OPEN CLUS + DNEB	M93 Includes dark nebula
7934	12 48 31	+41 24	900	8.4	GALAXY Sb	M94
7935	10 41 17	+11 58	540	11.2	GALAXY SBb	M95 Near M96 = CNGC 3368
7936	10 44 05	+12 05	480	10.0	GALAXY Sa/Sb	M96 Near M95 = CNGC 3351
7937	11 11 51	+55 18	213	12.0	PLAN NEB	M97 Owl Nebula 12kly
7938	12 11 20	+15 11	612	11.0	GALAXY Sb 3-SYS	M98 Near edge-on
7939	12 16 20	+14 42	300	10.2	GALAXY Sc NEAR FACE-ON	M99 Sc Near face-on
7940	12 20 26	+16 06	408	10.6	GALAXY Sc FACE-ON	M100 Face-on Brite Nucleu
7941	14 01 31	+54 36	1680	8.7	GALAXY Sc FACE-ON	M101 Pinwheel Galaxy Sc
7942	15 05 07	+55 57	390	11.1	GALAXY S0	M102
7943	01 29 56	+60 27	4800	7.5	OPEN CLUS	M103
7944	12 37 18	-11 21	480	8.9	GALAXY Sbp	M104 Sombrero Galaxy
7945	10 45 11	+12 51	270	9.6	GALAXY E 2-SYS	M105
7946	12 16 28	+47 35	1320	9.3	GALAXY Sb	M106
7947	16 29 42	-12 56	768	10.1	GLOB CLUS	M107
7948	11 08 38	+55 57	528	10.7	GALAXY Sc NEAR EDGE-ON	M108 (See M97 (CNGC 3587))
7949	11 55 00	+53 39	498	10.7	GALAXY SBb	M109
7950	00 37 38	+41 25	1200	9.4	GALAXY E6 3-SYS (M31)	M110 (See M31 (CNGC 0224))
7951	00 05 44	+28 48		2.1	STAR B9p MANGANESE STAR	Alpheratz Alpha And
7952	00 06 31	+58 52		2.3	STAR F2 IV	Caph Beta Cas
7953	00 23 49	-42 35		2.4	STAR K0 IIIb	Ankaa Alpha Phe
7954	00 37 41	+56 15		2.2	STAR K0 III	Schedar Alpha Cas
7955	00 41 05	-18 16		2.0	STAR K1 III	Diphda Beta Cet
7956	00 53 40	+60 26		2.5	STAR B0 IV:pe	Gamma Cas A
7957	01 06 55	+35 21		2.0	STAR M0 III	Mirach Beta And
7958	01 35 53	-57 29		0.5	STAR B3 Vp	Achernar Alpha Eri
7959	02 00 50	+42 05		2.1	STAR K3 II	Almach Gamma And A
7960	02 04 24	+23 13		2.0	STAR K2 III	Hamal Alpha Ari

CNGC	R.A.	Dec.	Size	Mag.	Type	Comments	Name / Misc	
7961	01 54 00	+89 01	178	2.0	MULTI-STAR	F8 Ib	Polaris	Alpha UMi A
7962	02 16 46	-03 12		2.0	STAR	M5.5e - M9e	Mira	Omicron Cet
7963	02 59 37	+03 53		2.5	STAR	M2 III	Menkar	Alpha Cet
7964	03 04 38	+40 45		2.1	STAR	B8 V	Algol	Beta Per
7965	03 20 44	+49 41		1.8	STAR	F5 Ib	Mirfak	Alpha Per
7966	04 33 04	+16 24		0.9	STAR	K5 III	Aldeberan	Alpha Tau A
7967	05 12 09	-08 15		0.1	STAR	B8 Ia	Rigel	Beta Ori A
7968	05 12 58	+45 57		0.5	STAR	G8 III: +F	Capella	Alpha Aur
7969	05 22 23	+06 18		1.6	STAR	B2 III	Bellatrix	Gamma Ori
7970	05 23 05	+28 34		1.6	STAR	B7 III	Elnath	Beta Tau
7971	05 29 27	-00 01		2.2	STAR	O9.5 II		Delta Ori A
7972	05 30 28	-17 52		2.6	STAR	F0 Ib		Alpha Lep
7973	05 33 40	-01 14		1.7	STAR	B0 Ia	Alnilam	Epsilon Ori
7974	05 38 10	-01 58		1.8	STAR	O9.5 Ib	Alnitak	Zeta Ori AB
7975	05 45 22	-09 42		2.1	STAR	B0.5 Ia	'	Kappa Ori
7976	05 52 22	+07 24		0.4	STAR	M2 Iab	Betelguese	Alpha Ori
7977	05 55 47	+44 57		1.9	STAR	A2 V	Menkalinan	Beta Aur
7978	06 20 28	-17 55		2.0	STAR	B1 II-III		Beta CMa
7979	06 22 50	-52 40		-0.7	STAR	F0 Ib-II	Canopus	Alpha Car
7980	06 34 51	+16 27		1.9	STAR	A0 IV	Alhena	Gamma Gem
7981	06 42 51	-16 40		-1.5	STAR	A1 V	Sirius	Alpha CMa A
7982	06 56 37	-28 54		1.5	STAR	B2 II	Adhara	Epsilon CMa
7983	07 06 28	-26 19		1.9	STAR	F8 Ia		Delta CMa
7984	07 22 06	-29 11		2.5	STAR	B5 Ia		Eta CMa
7985	07 31 22	+32 00		2.0	STAR	A1 V		Alpha Gem A
7986	07 36 36	+05 21		0.4	STAR	F5 IV-V	Procyon	Alpha CMi A
7987	07 42 14	+28 09		1.2	STAR	K0 III	Pollux	Beta Gem
7988	08 01 50	-39 52		2.2	STAR	O5 Iaf		Zeta Pup
7989	08 07 58	-47 13		1.8	STAR	WC8		Gamma Vel A
7990	08 21 29	-59 20		1.9	STAR	K3:III + B2:V	Avior	Epsilon Car

CNGC	R.A.	Dec.	Size	Mag.	Type	Comments	Name / Misc
7991	08 43 22	-54 31		2.0	STAR	A2 V	Delta Vel AB
7992	09 06 11	-43 14		2.2	STAR	K4 Ib-IIa	Suhail Lambda Vel
7993	09 12 39	-69 30		1.7	STAR	A1 III	Miaplacidus Beta Car
7994	09 15 47	-59 03		2.3	STAR	A9 Ib	Iota Car
7995	09 20 34	-54 48		2.5	STAR	B2 IV-V	Kappa Vel
7996	09 25 07	-08 27		2.0	STAR	K4 III	Alphard Alpha Hya
7997	10 05 41	+12 13		1.4	STAR	B7 V	Regulus Alpha Leo A
7998	10 17 09	+20 06		2.0	STAR	K0 IIIp	Gamma Leo AB
7999	10 58 47	+56 40		2.4	STAR	A1 V	Merak Beta UMa
8000	11 00 38	+62 02		1.8	STAR	K0 III	Dubhe Alpha UMa AB
8001	11 11 24	+20 48		2.6	STAR	A4 V	Delta Leo
8002	11 46 26	+14 51		2.1	STAR	A3 V	Denebola Beta Leo
8003	11 51 07	+53 59		2.4	STAR	A0 V	Phecda Gamma UMa
8004	12 05 43	-50 26		3.0	STAR	B2 IVne	Delta Cen
8005	12 13 22	-17 44		2.6	STAR	B8 III	Gienah Gamma Crv
8006	12 23 42	-62 49		1.4	STAR	B0.5 IV	Acrux Alpha Cru
8007	12 28 25	-56 50		1.7	STAR	M4 III	Gacrux Gamma Cru
8008	12 38 49	-48 41		2.2	STAR	A0 IV	Gamma Cen AB
8009	12 44 55	-59 25		1.3	STAR	B0.5 III	Beta Crucis Beta Cru
8010	12 51 53	+56 14		1.8	STAR	A0pv Chromium-Europ	Alioth Epsilon UMa
8011	13 21 54	+55 11		2.3	STAR	A2 V	Mizar Zeta UMa A
8012	13 22 30	-10 54		0.9	STAR	B1 V	Spica Alpha Vir
8013	13 36 40	-53 13		2.3	STAR	B1 III	Epsilon Cen
8014	13 45 36	+49 34		1.9	STAR	B3 V	Alkaid Eta UMa
8015	13 52 24	-47 03		2.6	STAR	B2.5 IV	Zeta Cen
8016	14 00 15	-60 07		0.6	STAR	B1 III	Hadar Beta Cen AB
8017	14 03 42	-36 08		2.0	STAR	K0 IIIb	Menkent Theta Cen
8018	14 13 23	+19 25		-0.1	STAR	K2 IIIp	Arcturus Alpha Boo
8019	14 32 16	-41 56		2.4	STAR	B1.5 V:ne	Eta Cen
8020	14 36 05	-60 38		0.0	STAR	G2 V + K4 V	Rigil Kentaurus Alpha Cen A

CNGC	R.A.	Dec.	Size	Mag.	Type	Comments	Name / Misc	
8021	14 38 41	-47 11		2.3	STAR	B1 V		Alpha Lup
8022	14 42 47	+27 17		2.4	STAR	K1: III: +A		Epsilon Boo A
8023	14 50 52	+74 21		2.1	STAR	K4 III	Kachob	Beta UMi
8024	15 32 31	+26 53		2.2	STAR	A0 V	Alphecca	Alpha CrB
8025	15 57 25	-22 29		2.3	STAR	B0 V	Dschubba	Delta Sco
8026	16 26 21	-26 19		0.9	STAR	M1.5 Iab	Antares	Alpha Sco A
8027	16 34 26	-10 27		2.6	STAR	O9.5 V		Zeta Oph
8028	16 43 17	-68 57		1.9	STAR	K2 Ib	Atria	Alpha TrA
8029	16 46 49	-34 13		2.3	STAR	K2 IIIb		Epsilon Sco
8030	17 07 34	-15 40		2.4	STAR	A2.5 V	Sabik	Eta Oph AB
8031	17 30 15	-37 04		1.6	STAR	B1.5 IV	Shaula	Lambda Sco
8032	17 32 36	+12 36		2.1	STAR	A5 III	Rasalhague	Alpha Oph
8033	17 33 44	-42 58		1.9	STAR	F0 II		Theta Sco
8034	17 39 00	-39 00		2.4	STAR	B1.5 III		Kappa Sco
8035	17 55 24	+51 29		2.2	STAR	K5 III	Eltanin	Gamma Dra
8036	18 20 54	-34 25		1.8	STAR	B9.5 III	Kaus Australis	Epsilon Sgr
8037	18 35 11	+38 44		0.0	STAR	A0 V	Vega	Alpha Lyr
8038	18 52 08	-26 21		2.1	STAR	B2.5 V	Nunki	Sigma Sgr
8039	18 59 23	-29 57		2.6	STAR	A3 IV DBL @ <1"		Zeta Sgr AB
8040	19 48 21	+08 44		0.8	STAR	A7 IV-V	Altair	Alpha Aql
8041	20 20 25	+40 05		2.2	STAR	F8 Ib		Gamma Cyg
8042	20 39 40	+45 05		1.3	STAR	A2 Ia	Deneb	Alpha Cyg
8043	20 44 11	+33 46		2.5	STAR	K0 III		Epsilon Cyg
8044	21 17 29	+62 23		2.4	STAR	A7 IV-V	Alderamin	Alpha Cep
8045	21 41 43	+09 40		2.4	STAR	K2 Ib	Enif	Epsilon Peg
8046	22 05 00	-47 13		1.8	STAR	B7 IV	Al Ni'ir	Alpha Gru
8047	22 39 42	-47 09		2.2	STAR	M5 III		Beta Gru
8048	22 54 51	-29 54		1.2	STAR	A3 V	Fomalhaut	Alpha PsA
8049	23 01 20	+27 48		2.5	STAR	M2 II-III	Scheat	Beta Peg
8050	23 02 18	+14 55		2.5	STAR	B9.5 III	Markab	Alpha Peg

CNGC	R.A.	Dec.	Size	Mag.	Type	Comments	Name / Misc
8051	00 03 30	+58 09	15	6.4	MULTI-STAR	6.4:7.2 @308	REF101 1980=1.4 @287 107y
8052	00 37 18	+21 10	66	5.5	MULTI-STAR	5.5:8.7 @194	REF102 1964 Yellow:Blue
8053	00 39 48	+03 54	15	7.8	MULTI-STAR	7.8:9.4 @207	REF103 1980=1.5 @ 200
8054	00 47 12	+27 26	44	6.3	MULTI-STAR	6.3:6.3 @296	REF104 1959 p(Yellow:Blue
8055	00 51 54	+18 55	5	6.2	MULTI-STAR	6.2:6.9 @211	REF105 1980=0.5 @ 224 400
8056	00 52 18	+23 22	8	6.0	MULTI-STAR	6.0:6.4 @292	REF106 1980=0.6 @ 259
8057	01 03 00	+21 12	299	5.6	MULTI-STAR	5.6:5.8 @159	REF107 1964 Yellow:pBlue
8058	01 06 36	+46 59	5	4.6	MULTI-STAR	4.6:5.5 @133	REF108 1980=0.5 @ 140
8059	01 11 06	+07 19	230	5.6	MULTI-STAR	5.6:6.6 @063	REF109 1972 Yellow:pBlue
8060	01 37 54	-56 27	113	5.8	MULTI-STAR	5.8:5.8 @193	REF110 1980=11.1 @195
8061	01 48 48	+89 20	178	2.0	MULTI-STAR	2.0:8.9 @216	REF111 Polaris North Star
8062	01 50 48	+19 03	78	4.6	MULTI-STAR	4.6:4.7 @000	REF112 1969 1831=8.6
8063	01 53 18	+01 36	10	6.8	MULTI-STAR	6.8:6.8 @057	REF113 1980=1.2 @053
8064	01 55 06	+23 21	385	4.7	MULTI-STAR	4.7:7.7 @047	REF114 1973 Yellow:Blue
8065	01 59 24	+02 31	16	4.2	MULTI-STAR	4.2:5.2 @273	REF115 pBlue:pGreen
8066	02 00 48	+42 05	98	2.2	MULTI-STAR	2.2:5.1 @063	REF116 1967 Orange:Emeral
8067	02 09 30	+30 04	39	5.3	MULTI-STAR	5.3:6.9 @071	REF117 1959 Yellow:Blue
8068	02 10 48	+47 15	11	6.6	MULTI-STAR	6.6:7.1 @274	REF118 1980=1.1 @266
8069	02 24 54	+67 11	25	4.6	MULTI-STAR	4.6:6.9 @232	REF119 1980=2.4 @234
8070	02 34 06	+24 26	383	6.6	MULTI-STAR	6.6:7.4 @276	REF120 1973 Yellow:pBlue
8071	02 40 42	+03 02	28	3.6	MULTI-STAR	3.6:6.2 @297	REF121 1974 Yellow:Ashen
8072	03 11 30	+00 00	11	8.8	MULTI-STAR	8.8:8.8 @139	REF122 1980=1.0 @144
8073	03 14 30	+38 27	8	7.8	MULTI-STAR	7.8:8.3 @259	REF123 1980=0.9 @265
8074	03 30 54	+59 52	14	6.8	MULTI-STAR	6.8:7.6 @261	REF124 1980=1.3 @258
8075	03 31 30	+24 18	7	6.6	MULTI-STAR	6.6:6.7 @002	REF125 1980=0.6 @006
8076	03 47 18	+25 26	4	5.8	MULTI-STAR	5.8:6.2 @211	REF126 1980=0.6 @207
8077	03 51 48	-03 06	67	4.7	MULTI-STAR	4.7:6.2 @347	REF127 Fixed
8078	04 01 24	+80 34	7	5.5	MULTI-STAR	5.5:6.3 @120	REF128 1980=0.8 @109
8079	04 04 12	+37 57	16	7.4	MULTI-STAR	7.4:8.9 @353	REF129 1980=1.4 @003
8080	04 12 48	+31 34	7	8.0	MULTI-STAR	8.0:8.1 @275	REF130 1980=0.8 @270

CNGC	R.A.	Dec.	Size	Mag.	Type	Comments	Name / Misc
8081	04 17 18	+27 14	496	5.1	MULTI-STAR	5.1:8.5 @496	REF131 1973 Yel/Ora:Blue
8082	04 19 54	+14 56	14	7.3	MULTI-STAR	7.3:8.5 @352	REF132 Purple:Blue
8083	05 05 12	+08 26	7	5.8	MULTI-STAR	5.8:6.5 @349	REF133 1980=0.7 @021
8084	05 12 06	-08 15	92	0.2	MULTI-STAR	0.2:6.7 @206	REF134 Rigel
8085	05 32 24	+09 54	43	3.6	MULTI-STAR	3.6:5.5 @044	REF135 1959 Yellow:Purple
8086	05 32 48	-05 25	132	5.1	MULTI-STAR	5.4:6.8:6.8	REF136 Trapezium in M42
8087	06 26 24	-07 00	99	4.6	MULTI-STAR	4.6:5.1:5.4	REF137 Fixed White Stars
8088	06 41 48	+59 30	17	5.4	MULTI-STAR	5.4:6.0 @074	REF138 1980=1.7 @079
8089	06 43 00	-16 39	45	-1.5	MULTI-STAR	-1.5:8.5 @005	REF139 1980=10.3 @049
8090	07 09 42	+27 19	13	7.2	MULTI-STAR	7.2:7.2 @316	REF140 1980=1.3 @320 120y
8091	07 26 30	+50 05	8	8.8	MULTI-STAR	8.8:8.8 @195	REF141 1980=0.8 @189
8092	07 31 24	+32 00	30	1.9	MULTI-STAR	1.9:2.9 @073	REF142 1980=2.2 @095 420y
8093	08 09 18	+17 48	6	5.6	MULTI-STAR	5.6:6.0 @182	REF143 Yellow:Yellow:Blue
8094	09 17 54	+38 24	11	6.5	MULTI-STAR	6.5:6.7 @271	REF144 1980=1.1 @254
8095	10 13 36	+17 59	14	7.2	MULTI-STAR	7.2:7.5 @181	REF145 1980=1.4 @183
8096	10 17 12	+20 06	44	2.2	MULTI-STAR	2.2:3.5 @124	REF146 1980=4.3 @123
8097	11 15 36	+31 49	13	4.3	MULTI-STAR	4.3:4.8 @060	REF147 1980=2.9 @105
8098	11 29 30	+61 22	6	5.8	MULTI-STAR	5.8:7.1 @295	REF148 1980=0.4 @211
8099	12 13 36	+40 56	115	5.9	MULTI-STAR	5.9:9.0 @260	REF149 1925 Gold:Blue
8100	12 21 54	+25 52	16	6.8	MULTI-STAR	6.8:7.8 @325	REF150 1980=1.5 @326
8101	12 23 48	-62 49	47	1.6	MULTI-STAR	1.6:2.1 @114	REF151 1943 White:White
8102	12 32 36	+18 39	202	5.2	MULTI-STAR	5.2:6.8 @271	REF152 1963 Yellow:vBlue
8103	12 39 06	-01 11	30	3.5	MULTI-STAR	3.5:3.5 @287	REF153 1980=3.9 @297 Whit
8104	12 50 48	+21 31	8	5.1	MULTI-STAR	5.1:7.2 @194	REF154 1980=0.8 @175
8105	13 21 54	+55 11	144	2.3	MULTI-STAR	2.3:4.0 @151	REF155 1967
8106	13 46 48	+27 14	34	7.6	MULTI-STAR	7.6:8.0 @167	REF156 1980=3.4 @159
8107	14 12 48	+03 22	12	7.8	MULTI-STAR	7.8:7.9 @239	REF157 1980=1.1 @252
8108	14 18 30	+48 44	13	8.1	MULTI-STAR	8.1:8.3 @105	REF158 1980=1.2 @104 Whit
8109	14 36 12	-60 38	197	0.0	MULTI-STAR	0.0:1.2 @214	REF159 1980=21.8 @209
8110	14 38 48	+13 57	10	4.5	MULTI-STAR	4.5:4.6 @160	REF160 1980=1.1 @305 Whit

CNGC	R.A.	Dec.	Size	Mag.	Type	Comments	Name / Misc
8111	14 42 48	+27 17	28	2.5	MULTI-STAR	2.5:5.0 @339	REF161 1971 Orange:Green
8112	14 49 06	+19 18	70	4.7	MULTI-STAR	4.7:6.9 @326	REF162 Orange:Blue
8113	14 49 36	+45 08	11	8.4	MULTI-STAR	8.4:8.6 @348	REF163 1980=1.1 @346
8114	15 16 12	+27 01	15	7.3	MULTI-STAR	7.3:7.4 @255	REF164 1980=1.4 @250
8115	15 21 06	+30 28	10	5.6	MULTI-STAR	5.6:5.9 @027	REF165 1980=0.4 @321
8116	15 22 36	+37 31	22	7.0	MULTI-STAR	7.0:7.6 @012	REF166 1980=2.2 @016
8117	15 32 24	+10 42	39	4.1	MULTI-STAR	4.1:5.2 @179	REF167 1960 Yel-Whi:Ashen
8118	15 37 30	+36 48	63	5.1	MULTI-STAR	5.1:6.0 @305	REF168 1957
8119	16 01 36	-11 14	7	4.9	MULTI-STAR	4.9:4.9 @044	REF169 1980=1.2 @021
8120	16 12 48	+33 59	69	5.6	MULTI-STAR	5.6:6.6 @235	REF170 1980=6.7 @233
8121	16 26 18	-26 19	24	0.9	MULTI-STAR	0.9:5.5 @276	REF171 Antares Red:pGreen
8122	16 26 42	+18 31	17	7.7	MULTI-STAR	7.7:7.8 @129	REF172 1980=1.4 @136
8123	16 28 24	+02 06	15	4.2	MULTI-STAR	4.2:5.2 @022	REF173 1980=1.3 @ 013
8124	16 56 12	+65 07	14	7.1	MULTI-STAR	7.1:7.3 @069	REF174 1980=1.3 @069
8125	17 04 18	+54 32	19	5.7	MULTI-STAR	5.7:5.7 @025	REF175 1980=1.9 @042
8126	17 12 18	-26 32	48	5.1	MULTI-STAR	5.1:5.1 @151	REF176 Orange:Orange
8127	17 12 24	+14 27	47	3.2	MULTI-STAR	3.2:5.4 @107	REF177 1968 Yellow:Blue
8128	17 22 00	+37 11	40	4.6	MULTI-STAR	4.6:5.5 @316	REF178 1964
8129	17 59 24	+21 36	65	5.1	MULTI-STAR	5.1:5.2 @258	REF179 1953 Yellow:pRed
8130	18 00 24	-08 11	18	5.2	MULTI-STAR	5.2:5.9 @280	REF180 1980=1.9 @277
8131	18 02 48	+02 32	15	4.2	MULTI-STAR	4.2:6.0 @220	REF181 Yel-Ora:Ora
8132	18 23 00	+27 22	7	6.5	MULTI-STAR	6.5:7.5 @126	REF182 1980=0.7 @129
8133	18 33 36	+16 56	15	6.8	MULTI-STAR	6.8:7.0 @155	REF183 1980=1.6 @161
8134	18 42 42	+39 37	26	5.0	MULTI-STAR	5.0:6.1 @353	REF184 1980=2.7 @355 Whit
8135	18 42 42	+39 33	24	5.2	MULTI-STAR	5.2:5.5 @080	REF185 1980=2.3 @084 Whit
8136	18 55 12	+32 50	10	5.4	MULTI-STAR	5.4:7.5 @021	REF186 1980=1.1 @051
8137	19 03 00	-37 08	13	4.8	MULTI-STAR	4.8:5.1 @109	REF187 1980=1.5 @157
8138	19 24 30	+27 13	20	8.1	MULTI-STAR	8.1:8.4 @292	REF188 1980=1.8 @293
8139	19 28 42	+27 52	344	3.2	MULTI-STAR	3.2:5.4 @054	REF189 1967 Gold:Blue
8140	19 43 36	+33 30	24	8.3	MULTI-STAR	8.3:8.4 @349	REF190 1980=2.0 @357

CNGC	R.A.	Dec.	Size	Mag.	Type Comments	Name / Misc
8141	20 18 12	-14 56	2050	3.1	MULTI-STAR 3.1:6.2 @267	REF191 Yellow:Blue
8142	20 44 18	+15 57	98	4.3	MULTI-STAR 4.3:5.2 @268	REF192 1967 Gold:Blue-Gre
8143	20 45 30	+36 18	9	4.9	MULTI-STAR 4.9:6.1 @011	REF193 White:pBlue
8144	20 56 36	+04 06	10	6.0	MULTI-STAR 6.0:6.3 @285	REF194 1980=1.1 @286
8145	20 59 48	+06 59	28	7.3	MULTI-STAR 7.3:7.5 @217	REF195 1961
8146	21 04 42	+38 30	297	5.2	MULTI-STAR 5.2:6.0 @148	REF196 1980=29.0 @146
8147	22 26 12	+00 00	19	4.3	MULTI-STAR 4.3:4.5 @207	REF197 pYellow:pBlue
8148	22 26 18	+57 27	33	9.8	MULTI-STAR 9.8:11.5 @132	REF198 1980=2.6 @176 Reds
8149	22 31 36	+69 39	4	6.5	MULTI-STAR 6.5:7.0 @094	REF199 1980=0.5 @086
8150	23 31 30	+31 03	4	5.6	MULTI-STAR 5.6:5.7 @280	REF200 1980=0.4 @267
8151	01 24 39	-32 49		6.5	STAR VAR 6.5-8.1 N7.7	REF201 B-V=3.86 Deep Red
8152	03 37 26	+62 29		8.1	STAR VAR 8.1-8.6 N7.7	REF202 B-V=4.29 Deep Red
8153	04 57 32	-25 50		5.5	STAR VAR 5.5-10.5 C6	REF203 B-V=1.80 Red
8154	05 02 48	+01 07		6.5	STAR VAR 6.2-7.0 C6	REF204 B-V=3.45 Very Red
8155	05 52 26	+07 24		0.4	STAR VAR 0.4-1.3 M2	REF205 B-V=1.85 Betelgues
8156	06 37 34	-29 59		7.8	STAR K5	REF206 B-V=3.40 Very Red
8157	08 52 33	+17 26		6.5	STAR VAR 6.5-7.0 N7.7	REF207 B-V=3.36 Red
8158	12 42 46	+45 43		5.5	STAR VAR 5.5-6.0 N7.7	REF208 B-V=2.54 Red
8159	12 54 28	+66 16		6.8	STAR VAR 6.8-7.3 N7.7	REF209 B-V=3.26 Red
8160	13 04 19	-60 03		7.2	STAR M0	REF210 B-V=3.60 Very Red
8161	20 08 00	-89 07		5.5	STAR VAR 5.3-5.7 F0III	REF211 (Southern Pole Star
8162	17 38 58	-57 39		5.6	STAR VAR 5.6-7.5 N7.7	REF212 B-V=3.70 Red
8163	18 30 35	+36 58		8.3	STAR VAR 8.3-8.9 C6.5	REF213 B-V=3.67 Very Red
8164	19 01 43	-05 46		7.4	STAR VAR 7.4-8.0 N7.7	REF214 B-V=4.19 Very Red
8165	19 55 35	+44 08		7.9	STAR N7.7	REF215 B-V=3.43 Very Red
8166	20 11 33	+38 35		6.5	STAR VAR 6.5-9.3 N pe	REF216 B-V=3.31 Red
8167	21 41 57	+58 33		3.6	STAR VAR 3.6-5.1 M2	REF217 B-V=2.35 Garnet-Re
8168	23 43 48	+03 12		5.3	STAR VAR 5.3-5.8 C5	REF218 B-V=2.60 Red

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DECLINATION GEAR CLAMP

On the face of the declination drive cover is a hole through which is visible a hex head screw. Tightening this screw clockwise will clamp the worm gear drive to the declination axis thereby engaging the declination drive. The allen wrench used is the same one that fits the allen bolts on the side of your C-11/14 latitude wedge.

This clamp system enables you to unlock the drive during telescope assembly and transportation, or for balancing purposes. It is not intended to be used as a "clutch" by partial tightening. Remember to unlock the clamp before you disassemble or manually move the telescope. Failure to do so can cause damage to the drive mechanism.

TELESCOPE START-UP POSITION

The CCT User's Manual does not specifically state the start position of the CCT 11-14 telescope. The correct position is pointing at -90° declination (telescope pointing directly at drive base) and fork arms in a horizontal position.(Lay a carpenter's level across the fork arms so that it is parallel to the declination axis). Simply eyeballing these positions works reasonably well.

It has been found that using the align procedure 3 to 5 times will align the polar axis very accurately and is worth the extra ten minutes. When the telescope can drive from Polaris to the reference star with both stars in or very near the center of the field is when you can be confident that you have a good polar alignment.

The computer itself is very accurate. Its limitations are the basic mechanical flexures present in any telescope. For this reason the computer is considered a low power aquisition device. Using the lowest magnification, widest field eyepiece you have when slewing from one object to the next will guarantee the object you are scanning for will be in your field of view. The worst errors occur when you slew across the meridian. This is where any mirror "flop" will occur which affects pointing accuracy. The object will be in the field of view of a low power eyepiece but usually not near the center of the field. If this occurs you will find the SYNC button very useful. After the telescope is finished slewing all you need to do is center the object in the eyepiece using the electronic controls (the four buttons in the upper right hand corner) and once centered press the SYNC button.

POLAR ALIGNING USING THE COMPUTER CONTROL SYSTEM

The computer control is considered to be a LOW POWER, WIDE FIELD, AQUISTION DEVICE. This means that whenever you are scanning for a new object you should be using the lowest power, widest field eyepiece possible. I use and reccommend the 50mm WIDESTAR plossl available from CELESTRON Int. After a little more than a year of using the first C-11 computer controled telescope in the field I have found that the hardest thing to master on this system is the polar aligning routine. The following is a technique that I have been using and teaching to others with very good results.

The computer control has a polar alignment routine built in to assist in the polar alignment of your telescope. When you first turn on the computer the entire display will flash on and off for several seconds. When it stops flashing you are ready to start. (Note: A well aligned finderscope is extremely useful).

The starting position for the telescope is -90 degrees and fork arms in a horizontal position.

STEP 1) Press the SPEED then SLEW buttons.

STEP 2) Press the BEGIN button.

STEP 3) Enter G.M.T.(Greenwich Mean Time) using a HH:MM:SS format. Press the ENTER button.

STEP 4) Enter the YEAR, MONTH, DAY, then press the ENTER button.

STEP 5) Enter your WEST longitude. Press the ENTER button.

STEP 6) Enter your latitude. (Use the - key first if your latitude is negative.) Press the ENTER button.

STEP 7) The telescope will now start slewing to the position of polaris (sigma octanis for southern lats.). When it stops moving you should center polaris in the telescopes field of view using the altitude and azimuth controls on your pier or wedge.

STEP 8) Press the ENTER button. The telescope will now slew to one of the reference stars. (The reference stars are usually in the second magnitude range) Looking in your finder identify the brightest star and using the slow motion buttons (the four buttons in the upper right corner of the computer case) correct all the observed right ascension error and only half the declination error. Press the ENTER button.

STEP 9) Press the ALIGN button.

Repeat steps 7,8,9 until the telescope is slewing from polaris to the reference star and back again with both the stars centered in the telescopes field of view. When this happens you can stop at the end of step 8. You are now ready to start observing. Typically four repeats of the polar alignment sequence are needed to obtain good polar alignment. This is needed if the computer is to function properly.

REFERENCE STAR LIST NUMBERS 1 TO 100

REF. NUMBER	R.A.	DEC.	MAG.	NAME
1	00 07.7	29 01	2.1	ALPHERATZ/ ALPHA AND
2	00 08.5	59 05	2.3	CAPH/ BETA CAS
3	00 25.7	-42 22	2.4	ANKAA/ ALPHA PHE
4	00 39.8	56 28	2.2	SCHEDAR/ ALPHA CAS
5	00 43.0	-18 03	2.0	DIPHDA/ BETA CET
6	00 56.0	60 38	2.5	GAMMA CAS A
7	01 09.0	35 33	2.0	MIRACH/ BETA AND
8	01 37.3	-57 17	0.5	ACHERNAR/ ALPHA ERI
9	02 03.2	42 16	2.1	ALMACH/ GAMMA AND A
10	02 06.6	23 24	2.0	HAMAL/ ALPHA ARI
11	02 20.6	89 12	2.0	POLARIS/ ALPHA UMI A
12	02 18.6	-03 01	2.0	MIRA/ OMICRON CET A
13	03 01.6	04 02	2.5	MENKAR/ALPHA CET
14	03 07.1	40 54	2.1	ALGOL/ BETA PER
15	03 23.5	49 49	1.8	MIRFAK/ ALPHA PER
16	04 35.3	16 29	0.9	ALDEBERAN/ALPHA TAU A
17	05 14.0	-08 12	0.1	RIGEL/ BETA ORI A
18	05 15.8	46 00	0.5	CAPELLA/ ALPHA AUR
19	05 24.4	06 20	1.6	BELLATRIX/ GAMMA ORI
20	05 25.5	28 36	1.6	ELNATH/ BETA TAU
21	05 31.4	00 01	2.2	DELTA ORI A
22	05 32.2	-17 50	2.6	ALPHA LEP
23	05 35.6	-01 13	1.7	ALNILAM/ EPSILON ORI
24	05 40.1	-01 57	1.8	ALNITAK/ ZETA ORI AB
25	05 47.2	-09.41	2.1	KAPPA ORI
26	05 54.4	07 24	0.4	BETELGUESE/ ALPHA ORI
27	05 58.6	44 57	1.9	MENKALINAN/ BETA AUR
28	06 22.2	-17 56	2.0	BETA CMA
29	06 23.7	-52 41	-0.7	CANOPUS/ ALPHA CAR
30	06 37.0	16 25	1.9	ALHENA/ GAMMA GEM
31	06 44.6	-16 42	-1.5	SIRIUS/ ALPHA CMA A
32	06 58.1	-28 57	1.5	ADHARA/ EPSILON CMA A
33	07 09.0	-26 23	1.9	DELTA CMA
34	07 23.6	-29 15	2.5	ETA CMA
35	07 33.8	31 55	2.0	ALPHA GEM A
36	07 38.6	05 16	0.4	PROCYON/ ALPHA CMI A

REF. NUMBER	R.A.	DEC.	MAG.	NAME
37	07 44.6	28 03	1.2	POLLUX/ BETA GEM
38	08 03.2	-39 58	2.2	ZETA PUP
39	08 09.1	-47 20	1.8	GAMMA VEL A
40	08 22.2	-59 27	1.9	AVIOR/ EPSILON CAR
41	08 44.4	-54 39	2.0	DELTA VEL AB
42	09 07.6	-43 23	2.2	SUHAIL/ LAMBDA VEL
43	09 13.0	-69 40	1.7	MIAPLACIDUS/ BETA CAR
44	09 16.8	-59 13	2.3	IOTA CAR
45	09 21.7	-54 58	2.5	KAPPA VEL
46	09 27.0	-08 37	2.0	ALPHARD/ ALPHA HYA
47	10 07.7	12 02	1.4	REGULUS/ ALPHA LEO A
48	10 19.2	19 54	2.0	GAMMA LEO A
49	11 01.0	56 28	2.4	MERAK/ BETA UMA
50	11 03.0	61 50	1.8	DUBHE/ ALPHA UMA AB
51	11 13.4	20 35	2.6	DELTA LEO
52	11 48.4	14 38	2.1	DENEBOLA/ BETA LEO
53	11 53.0	53 46	2.4	PHECDA/ GAMMA UMA
54	12 07.7	-50 39	3.0	DELTA CEN
55	12 15.3	-17 57	2.6	GIENAH/ GAMMA CRV
56	12 25.9	-63 02	1.4	ACRUX/ ALPHA CRU
57	12 30.5	-57 03	1.7	GACRUX/ GAMMA CRU
58	12 40.9	-48 54	2.2	GAMMA CEN AB
59	12 47.2	-59 38	1.3	BETA CRUCIS/ BETA CRU
60	12 53.6	56 02	1.8	ALIOTH/ EPSILON UMA
61	13 23.4	54 59	2.3	MIZAR/ ZETA UMA A
62	13 24.5	-11 06	0.9	SPICA/ ALPHA VIR
63	13 39.1	-53 25	2.3	EPSILON CEN
64	13 47.0	49.23	1.9	ALKAID/ ETA UMA
65	13 54.8	-47 14	2.6	ZETA CEN
66	14 03.0	-60 18	0.6	HADAR/ BETA CEN AB
67	14 06.0	-36 19	2.0	MENKENT/ THETA CEN
68	14 15.2	19 14	-0.1	ARCTURUS/ ALPHA BOO
69	14 34.7	-42 06	2.4	ETA CEN
70	14 39.0	-60 48	0.0	RIGIL KENTAURUS
71	14 41.2	-47 20	2.3	ALPHA LUP
72	14 44.5	27 07	2.4	EPSILON BOO AB
73	14 50.7	74 12	2.1	KACHOB/ BETA UMI
74	15 34.1	26 45	2.2	ALPHECCA/ ALPHA CRB

REF. NUMBER	R.A.	DEC.	MAG.	NAME
75	15 59.7	-22 36	2.3	DSCHUBBA/ DELTA SCO
76	16 28.7	-26 24	0.9	ANTARES/ ALPHA SCO A
77	16 36.5	-10 32	2.6	ZETA OPH
78	16 47.3	-69 01	1.9	ATRIA/ ALPHA TRA
79	16 49.3	-34 17	2.3	EPSILON SCO
80	17 09.8	-15 43	2.4	SABIK/ ETA OPH AB
81	17 32.9	-37 06	1.6	SHAULA/ LAMBDA SCO
82	17 34.4	12 34	2.1	RASALHAGUE
83	17 36.5	-42 59	1.9	THETA SCO
84	17 41.7	-39 01	2.4	KAPPA SCO
85	17 56.2	51 29	2.2	ELTANIN/ GAMMA DRA
86	18 23.4	-34 24	1.8	KAUS AUSTRALIS
87	18 36.5	38 46	0.0	VEGA/ ALPHA LYRA
88	18 54.4	-26 18	2.1	NUNKI/ SIGMA SGR
89	19 01.8	-29 54	2.6	ZETA SGR AB
90	19 50.2	08 50	0.8	ALTAIR/ ALPHA AQL
91	20 21.7	40 12	2.2	GAMMA CYG
92	20 40.9	45 13	1.3	DENEB/ ALPHA CYG
93	20 45.7	33 54	2.5	EPSILON CYG
94	21 18.4	62 33	2.4	ALDERAMIN/ ALPHA CEP
95	21 43.6	09 51	2.4	ENIF/ EPSILON PEG A
96	22 07.4	-47 02	1.8	AL NI IR/ ALPHA GRU
97	22 42.0	-46 57	2.2	BETA GRU
98	22 57.0	-29 42	1.2	FOMALHAUT/ ALPHA PSA
99	23 03.2	28 00	2.5	SCHEAT/ BETA PEG
100	23 04.2	15 07	2.5	MARKAB/ ALPHA PEG

Quick Reference

Latitude & Longitude of Observing Sites

Location	Latitude	Longitude

Greenwich Mean Time Conversion

Add the number of hours listed to local time in 24 hour format:

Time Zone	Standard Time	Daylight Time
Eastern	5 hrs	4 hrs
Central	6 hrs	5 hrs
Mountain	7 hrs	6 hrs
Pacific	8 hrs	7 hrs
Yukon	9 hrs	8 hrs
Hawaiian	10 hrs	9 hrs

Example: 6:30 PM Eastern Standard time is 18:30 EST in 24 hour format. Add 5 hours from the chart, it is 23:30 GMT. Add 1 day if result is over 24 hrs.

See Page 27 for complete information on time zones.