ASTRO-PHYSICS
GTO KEYPAD

Version v5.010

Please read the manual even if you are familiar with previous keypad versions

Flash RAM Updates

Keypad Java updates can be accomplished through the Internet.
Check our web site www.astro-physics.com/software-updates/

June 20, 2022

ASTRO-PHYSICS

KEYPAD MANUAL FOR GTOCP4 & GTOCP5
Version 5.010
June 20, 2022

ABOUT THIS MANUAL

The keypad is a multi-function, portable, hand-held computer which gives you total freedom to set up in the field or at star parties without being tethered to the extra bulk of power-hungry computers. Since our keypad can be used during cold winter nights, it is especially handy and useful. It is very powerful, yet easy-to-use whether you are a visual observer or dedicated imager!

Version 5 of the firmware was introduced in November 2020 for Mach2GTO mounts with the GTOCP5 control box. In June 2022, it became more widely available as an upgrade for keypads used with the GTOCP4. Refer to "Requirements" on page 6 for more information.

The keypad features that are available in version 5 will depend on the firmware of your control box. These are some differences:

● The GTOCP5 and Mach2GTO have a different startup routine due to the construction of the mount.

● The pointing, tracking and drift modeling features are available to all GTOCP5 control boxes (available to Mach2 only) and only those GTOCP4 control boxes that have the Keypad Modeling Feature License enabled.

This manual provides instructions to guide you when using version 5 of the keypad firmware. Over time, we will update the manual in order to improve presentation of the information or to describe new features. We highly recommend that you check the Software Updates section of our web site for a link to the latest information and for future updated versions of this and other manuals.   https://www.astro-physics.com/software-updates/

For clarity and smoother reading, we will refer to the control boxes as CP4 and CP5 rather than GTOCP4 and GTOCP5, respectively. When referring to both control boxes, we will abbreviate CP4/5.

A final note and an apology to our friends in the southern hemisphere. Many of the instructions in this manual are written entirely from the point of view of those of us in the northern hemisphere. Since descriptive terms like left and right are meaningless without a defined point of reference, we tend to use east and west to avoid ambiguity. The east and west sides of a German equatorial mount are, of course, reversed in the southern hemisphere. At one point, our thought was to always use phrases like the following: ... on the east side (west side in the southern hemisphere) ... This quickly became cumbersome and made the text more difficult to read. For simplicity, we decided to leave many of the explanations in their northern hemisphere framework. To our southern hemisphere friends: We appreciate you no less and apologize for this unintended slight. Thank you for your understanding.

PLEASE RECORD THE FOLLOWING INFORMATION FOR FUTURE REFERENCE

Keypad Serial Number: _____

Purchase Date: _____

User Name _____   *Password* _____

REQUIREMENTS

It is important to understand that your control box and keypad both have firmware that enables them to function and to communicate. Each time you upgrade your keypad, you will also need to ensure that your control box has the appropriate version so that all of the necessary commands are available.

The upgrade instructions on our website will specify the minimum required control box firmware version. The Keypad Loader Utility will also query the control box to be sure that the correct version is present. before you begin the load.

New control box and keypad firmware versions can be downloaded from this link:
 https://www.astro-physics.com/software-updates/

What Mount Control Box is Required?

- GTOCP5: All GTOCP5 control boxes (shipped only with the Mach2GTO) have full capabilty to use all functions of the keypad version 5 firmware, including modeling. As new versions of the keypad firmware are introduced, it may be necessary to upgrade the GTOCP5, as well. This information will be provided in future download instructions.

- GTOCP4: These control boxes can be upgraded to use keypad version 5. firmware. However, in order utilitize the modeling features, the Keypad Modeling Feature License must be activated in the GTOCP4. Refer to the section below for more details . It is important to understand that there are some differences in the way that the GTOCP5 and GTOCP4 will function with the keypad. These differences are discussed throughout this manual.

- GTOCP1, GTOCP2 and GTOCP3: Regrettably, these earlier control boxes can not used with keypads that are loaded with v5.xxx firmware. They do not have the computing power and required commands and the CPx firmware cannot be upgraded. Version 4.19.3 or 4.19.5. is recommended for keypads used with these older control boxes.

Keypad Modeling Feature License

- The modeling features available in the V5 keypad version can only be used if this feature has been activated in the GTOCP4 control box. This is not part of a typical control box update and must be done with a separate internet download.

- All GTOCP4 control boxes with serial numbers CP4-1423 and later were programmed with this feature prior to shipment. The license is available for purchase for all earlier control boxes and can be installed by the user. For more information, refer to: https://www.astro-physics.com/software-updates

Can I Upgrade My Present Keypad?

- Keypads with serial number 1565GTO or earlier that have the original 256K circuit board cannot be used with the v5.xxx firmware, as they lack the memory capacity. If you have a keypad with a lower serial number that has been repaired, it may have the required memory. The serial number of these keypads are preceeded by the letter "R".

- Two of the buttons in the lower row of the newer keypads have different lettering on them. The FOCUS button has been changed to the RECAL button. The button labeled RA DEC REV will actually function as an ENTER button. The RA DEC REV function will now be accessed through the +- button. The MENU button has been relabeled to include ESC.

If you load v5.xxx onto an older keypad, you can continue to use your original buttons and simply memorize the new function. Alternatively, you may send your keypad to Astro-Physics to be upgraded with the new button pad. Contact Astro-Physics for additional information.

Older Button Labels

Newer Button Labels

GTO KEYPAD
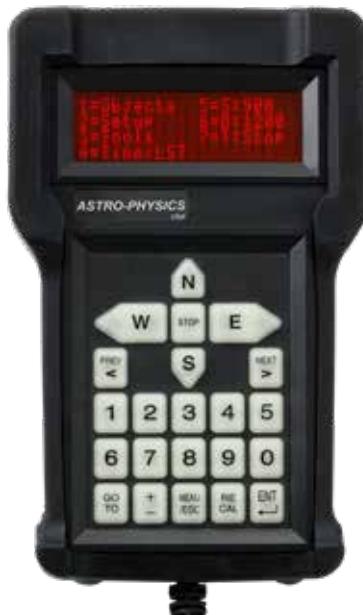
The GTO keypad is the communication center for the operation of your GTO mount. We have designed this unit to be as intuitive and easy to use as possible while filling it with terrific features to make your observing session productive and pleasurable. With a few keystrokes, you can slew to objects by their common name or catalog number, set up search parameters to find all the open clusters within a particular catalog that are visible on a given night, set the countdown timer for the exposure, enter RA and Dec coordinates to find the newest super nova, and much more.

Note: Please understand that the keypad is NOT the brain of the mount. The real control is in the CP4/5 Control Box. The keypad simply provides data for the CP4/5 to do its job. Likewise, a computer with software can function as an input device. The mount can be operated using only the keypad, using only a computer, or using both.

The heart of the keypad is the 4-line display window that will guide you through all operations. The alphanumeric keypad itself is translucent and backlit with red LEDs for easy visibility at night. The buttons are also made with a phosphorescent material that will glow in the dark for a brief time. Shine an LED on them to extend their luminescence.

Button functions are clearly defined on the button itself or as an instruction on the display window. You do not have to remember shift key patterns or complex keystroke sequences. The directional buttons are shaped like arrows to help you find them in the dark without looking at your keypad. The stop button is readily accessible if you need to cancel any slewing request immediately.

The menu system is very easy to navigate. Each window will display several choices, which correspond to a number button. Simply press the number button to initiate the command, e.g. 1=M, 2=NGC. When you press 1 the Messier entry window will display and you can enter the number of the object that you wish to see. Press GOTO, which will cause the mount to slew. The <PREV and NEXT> buttons will allow you to scroll quickly through the lists of common names or to find more data about the object you are viewing. To adjust most settings, you will press the number indicated on the window several times to scroll (toggle) through your choices and stop at the one you want.

Layout and Buttons of the Keypad

Vacuum Fluorescent Display

The keypad features a four-line, 20-character alphanumeric display. The brightness of the display is adjustable with dim and bright settings by using the <PREV and NEXT> buttons as described below and in "Brightness of the Display Window" on page 18

N-S-E-W Directional Buttons

These four buttons are arranged so that the E and W buttons control the movement in right ascension and the N and S buttons control the declination. Depending on which side of the mount the telescope is on and if you are using a star diagonal, when you press the N button, the star should move in an upward direction toward the top of your eyepiece field. If the movement does not match the direction shown in the eyepiece, you may wish to use our RA/Dec reverse feature as described in "RA/Dec Reverse" on page 48

In addition, you can press two buttons simultaneously for diagonal movement, e.g. the N and W buttons will cause a Northwest movement. Note: north and south buttons can be misleading concepts in movement of the Dec axis. The reality is that N moves the Dec axis counterclockwise and S moves the Dec axis clockwise as viewed from above.

STOP Button

Press the STOP button to cancel a slewing command and stop the movement of the telescope immediately. The mount will know where it is, so you can proceed to your next command.

<PREV and NEXT> Buttons

These buttons are used for the following functions depending on the commands you are entering: move from one menu level to another, backspace to make corrections to number entry, or scroll through lists of objects. The < and > symbols

appear on many window displays. They signify that you can press the <PREV and NEXT> buttons for more choices or additional information.

When you are in the Main Menu, these buttons toggle the display window brightness. Pressing the <PREV button will dim the window and pressing the NEXT> button will brighten it. There are two brightness levels: dim and bright.

The NEXT> button can also be used in conjunction with the RECAL button to recalibrate on a position.

Note: Even when the keypad is set to the bright setting, it will be difficult to see during daylight hours. You will need to shield it with your hands. This is an unfortunate drawback of the vacuum-fluorescent window. We originally chose this display because of its excellent performance in cold weather down to -40º F (-40º C, yes, the number is the same). Alternative displays scroll very slowly at temperatures below freezing and would not work well at all in extreme temperatures. Since many of our customers (and ourselves) observe during the cold Midwestern winter months, we opted for performance. !

Number Buttons

The buttons labeled 1–9 and 0 are used to enter numerical data and to make menu choices.

GOTO Button

Press the GOTO button after you have selected the object that you want to view. The mount will slew to the object. This button may also used for other functions.

± Button

This button has different functions:

- Use it to quick-access a menu that includes: Button Rate (for N-S-E-W directional buttons), Slew to Home and Recal, Park Controls and RA/Dec Controls (for Meridian Delay and Scope Flip).

- Use it when editing location, time and date.

- Use it to toggle between **+** and **-** when entering Dec coordinates.

MENU / ESC Button

Press this button to move to a previous menu level or to cancel a prompt.

RECAL and NEXT> Buttons Pressed Simultaneously

This button combination is most commonly used following a GoTo slew. The N-S-E-W buttons are toggled to precisely center the object. Once the object has been centered, the RECAL button and NEXT> buttons can be pressed simultaneously to update the coordinates. The keypad will beep to confirm recalibration. We require two buttons so that you do not recalibrate by accident.

ENT Button ⏎

This button serves the common function of saving entered data. It will also display Tracking Status of the active modeling routine if it is pressed while in the Main Menu.

Retractable Hanger

On the back of the controller, look for a slot with a thumb rest area. Push up to extend the hanger. A lanyard can be attached here to allow you to hang your keypad on one of the lanyard posts or base knobs of the mount when it is not in use.

Keypad Protector

The keypad protector is a heavy-duty molded rubber casing with a full 1/4" thickness on all impact surfaces. If you accidentally drop your keypad, the rubber casing will absorb much of the blow. Your display, keypad, electronics and the case itself will be protected from damage. In addition, the rubber prevents the keypad from sliding when placed on a table or other flat surface and the keypad will feel secure in your hands as your observe. The KEYPRO also offers protection during transport and storage.

Refer to the Keypad Maintenance Instructions linked from the Support page of our website for the KEYPRO's removal and installation. This must be done with care to prevent tearing the material.

Keypad Care and Warranty

Warranty

Keypad: Three (3) years parts and labor.
Battery: 90 days.

The keypad manufacturer warrants that the product is free of defects in materials and/or workmanship from the date of shipment for a period of three years. This warranty does not apply to any products which have been subject to misuse, accident, alteration or if the unit has been serviced by anyone other than an authorized representative. During the warranty period, the manufacturer will, at its discretion, (1) repair the product to full working order or (2) replace the product with a comparable product. Replacement products will be new or serviceably used, comparable in function and performance to the original product. The product will be warranted for the remainder of the original warranty or ninety (90) days from the date of shipment of the product, whichever is longer. **DO NOT open a keypad that is within its warranty period or you will void the warranty!**

Keypad Battery for 512K Memory Boards

This includes keypads with serial number 1565GTO or later (and some earlier keypads that have been repaired or upgraded with a new 512K memory board). These keypads also have a 3V Lithium battery with an estimated life of 5 years at room temperature. This battery has been wired into a special pigtail wire assembly. The replacement battery can be either purchased from Astro-Physics (part # E0334 or E0338), or you can purchase the battery locally and transfer the pigtail harness yourself by following the instructions on our website: The battery is easy to install into the keypad, so there is no need to return it to Astro-Physics for service unless the battery fails within the 3-year warranty period, which is highly unlilkely. Opening the unit to replace the battery within the first three years could void the warranty.

Cleaning Red Keypad Display

The red display window is made with a Mylar material. It is recommended to use a commercial glass cleaner to wipe down the display. Spray the cleaner on a cloth and rub the display lightly. Do not use solvents of any kind. ***Note:*** *It is a good idea to leave the clear protective plastic cover that ships with the keypad in place. It will extend the display window's lifespan. However, it can be removed if you prefer.*

Temperature Ratings

The real time clock, battery-backed RAM, Extended Temperature Vacuum Fluorescent display, and backlit panel are all rated to -40 degrees F (-40 degrees C).

Environmental Recommendation

Your keypad is rugged and dew resistant, but it is not waterproof. Please take care to hang it vertically by the provided lanyard or to place it face down when operating in damp conditions. Storing it indoors when not in use for extended times is also a good precaution.

GETTING STARTED – DO THIS AT HOME, IF POSSIBLE

Set Up your Mount and Cable Connections

Refer to the instructions in the control box and mount assembly manuals to set up your mount. The following cables must be connected: RA and Dec cables, keypad cable and power cable. You do not need the mounting plate or telescope tube assembly for these setup procedures.

Gather Basic Information

You must enter your local time and location parameters to ensure that the mount functions properly. The mount needs to know the local time (and whether you are on daylight savings) and the latitude and longitude of your observing site. You can enter up to nine observing sites to be stored in memory.

To determine your latitude and longitude, do an internet Google search or use a GPS unit. The closer you can get the better, however, it is usually not necessary to be exact to the seconds (last two number entry fields) since the purpose of these entries is to calculate which objects are above your local horizon. Please make sure that your location information is in **Degrees: Minutes: Seconds** format (i.e.: 42:22:00 Lat. 89:01:07 Long.), rather than decimal format (i.e. 42.3667° Lat. 89.0186° Long.). Also note if you are west or east of the Greenwich (prime) meridian, and north or south of the equator. Information on converting the format is on page 30 of the Setup section.

The time zone is also measured from the prime meridian (aka Greenwich meridian).. The keypad no longer determines if you are east or west based on your entered longitude as it did in prior versions (4.x and earlier). Doing this posed a problem for some European users whose longitude was west, but whose time zone was east. To avoid possible confusion, we now use the less ambiguous E (east) and W (west), so entering a positive or negative number is not needed. For your reference, these are the US time zones.

US Eastern standard time	05
US Central standard time	06
US Mountain standard time	07
US Pacific standard time	08
US Hawaii standard time	10

Most of this information will be entered only once and will be remembered by the keypad. We recommend that you make these entries at home before you go to your observing session to ensure that you have the information that you need. If you have a GPS (Global Positioning System) device, you may want to enter the coordinates once you reach your site and have the proper numbers. Latitude and Longitude MUST be in degrees, minutes and seconds format. Decimal values must be converted. We also recommend keeping a cheat sheet with each location's relevant data.

Enter Your Location, Time and Date

Refer to the section entitled page 13. Once you have entered this data, you can explore the keypad menus and functions with the information in this manual.

Polar Alignment

The manuals for each mount discuss the importance of polar alignment and various methods to achieve it with a polar alignment scope or various software solutions. One of our favorite methods utilizes the keypad and can be accomplished during daylight hours. It is quick and easy and only requires a small carpenters (aka torpedo) level.

GTOCP5 and Mach2GTO Daytime Alignment Routine

Being able to polar align your mount during the daytime is a great way to prepare for solar observing or events. It is also a way to get a jump on your evening observing, especially if you are hosting a public event where people are clamoring to view while you are trying to polar align!

1. Roughly aim the mount using a compass (or phone app) toward the pole in azimuth.

2. Approximately level the mount with the bubble level (or phone app).

3. Set up your scope and equipment on the mount, balance, and tighten clutches.

4. Power up the mount and unpark. This will initialize the Mach-2GTO. It does not matter where the scope is pointing.

5. Command the mount to go to Park 5 (see Park position at right).

6. Use a carpenter's level and turn the altitude knob until the scope is level.

7. Tell the mount to GOTO a visible object: the sun (with solar filter protection), the moon, bright planets or stars. For this step, it is better if the object is NOT directly overhead.

8. Use the azimuth adjuster until the object is centered in the field.

9. You are roughly polar aligned and ready to start observing!

You can repeat this process (#5 to #8) to gain accuracy. This may be sufficient for visual observing. For more precise alignment, follow it with your favorite routine after dark.

PARK 5

Northern Hemisphere

The scope is level the mount, facing The counterweight and pointing due west.

on the east side of the northern horizon. shaft is also level

Both Hemispheres: RA is horizontal,
North: Dec = (90-Latitude) South: Dec = (-90-Latitude)

The southern hemisphere is mirror reversed. The scope is still level on the east side of the mount, but is facing the southern horizon. The counterweight shaft is also level and pointing due west.

Southern Hemisphere

GTOCP4 Daytime Routine with Other Mounts

1. Roughly aim the mount using a compass (or phone app) toward the pole in azimuth.

2. Approximately level the mount with the bubble level (or phone app).

3. Set up your scope and equipment on the mount and balance the system

4. Carefully level both the telescope and coounterweight shaft into either the Park 1 or Park 5 position, and tighten clutches. For this step, it is the counterweight shaft that requires the most precision in leveling. (See Park 5 diagram above)

5. Power up the mount and unpark from the position selected in #4 above.

6. Park the mount to Park 2.

7. Carefully level the telescope using the declination clutches. DO NOT use the direction buttons for this step, and do not adjust the RA with the clutches! Only adjust by rotating the Dec. Retighten the Dec clutches when finished.

8. Command the mount to go to Park 5 (see Park position on previous page).

9. Use a carpenter's level and turn the altitude knob until the scope is level. Do NOT use the clutches or direction buttons to level the telescope. Just use the altitude knob.

10. Tell the mount to GoTo a visible object: the sun (with solar filter protection), the moon, bright planets or stars.

11. Use the azimuth adjuster until the object is centered in the field.

12. You are polar aligned and ready to start observing!

You can repeat this process (#8 to #11) to gain accuracy. This may be sufficient for visual observing. For more precise alignment, follow it with your favorite routine after dark.

Pro Tip: If possible, try to account for your magnetic declination when using a compass to find north. Here is a handy calculator to determine your magnetic declination:
https://www.ngdc.noaa.gov/geomag/calculators/magcalc.shtml?useFullSite=true
In a nutshell, locations in a north-south line from Minneapolis MN through Lafayette LA will be the only places in the lower 48 of the USA where a compass points to true north. In Bangor ME, your compass will point west of true north by almost 16 degrees! In Seattle WA, you have almost the same error, only it is to the east. Most hiking compasses have a declination ring for you old-schoolers. Many of us have smart phone compass apps that can be set to provide true north or south.

PARK 1

Northern Hemisphere

The scope is level on the west side of the mount, facing the northern horizon. The counterweight shaft is also level and pointing due east. This position is also called the Reference Park Position.

Both Hemispheres: RA is horizontal,
North: Dec = (90-Latitude)   South: Dec = (-90-Latitude)

The southern hemisphere is mirror reversed. The scope is still level on the west side of the mount, but is facing the southern horizon. The counterweight shaft is also still level and pointing due east.

Southern Hemisphere

PARK 2

Northern Hemisphere

The scope is level on top of the mount facing the eastern horizon. The counterweight shaft is pointing down.

Both Hemispheres: RA axis is vertical, Dec = 0

The southern hemisphere is mirror reversed. The scope still points to the eastern horizon, but east is to the left when facing the southern pole.

Southern Hemisphere

KEYPAD START UP SEQUENCE FOR NEW SETUPS OR SETUP IN NEW LOCATION

Set your keypad to AutoConnect: NO if your mount is used under the following circumstances:

- Your initial setup and when traveling to different locations. This is the default setting when you receive your new keypad from Astro-Physics.

- You are not using an external computer to control your mount.

Background Information: In order for your mount to operate properly, it must have basic information: location, date, time, time zone and daylight savings. This information must come from an external computer source, in this case, the keypad. You will have to enter (or confirm) this information each time you start up when you are set to AutoConnect:NO.

AutoConnect NO can be activated or de-activated by pressing 2=Setup > 4=Kpd,Mt,Park Opt. Press button 7 to toggle between YES, NO and EXT.   Information about starting your session with Auto-Connect: YES is provided on page 16 and Auto:Connect: EXT on page 17

The sequence for the GTOCP4 and GTOCP4 begin the same, but the final steps are different due to the inherent differences in the construction of the Mach2GTO mount.

Assemble Your Mount

Refer to the instruction manual for your mount to set up at your observing site. Be sure that you connect your RA and Dec cables, keypad cable and power cable, preferably in that order.
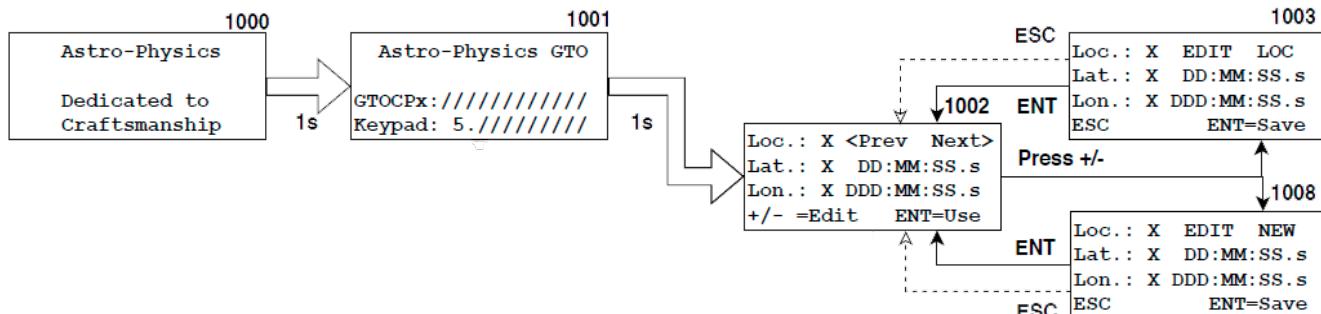
Refer to your mount manual for polar alignment recommendations or use the Daytime Polay Alignment routine described in the previous section. The more accurately you polar align, the more accurate will be the centering of objects in a high-power field-of-view.

Startup Sequence

When you turn on the power, the first display of the keypad will briefly read "Astro-Physics Dedicated to Craftsmanship" and then the window changes to display the firmware version number of your CP4/5, keypad program version and keypad database version number for a few seconds. The location selection/setup window will follow automatically.

Note: If the Main Menu window appears, that means that the Auto-Connect feature is set to YES. If you wish to set the Auto-Connect feature to NO, select 2=Setup > 4=Kpd,Mnt,Park Opt. Press 7 to toggle Auto-Connect to NO. This setting will be remembered for your next session or power cycle.

Location Setting - GTOCP4 & GTOCP5

Select Existing Location
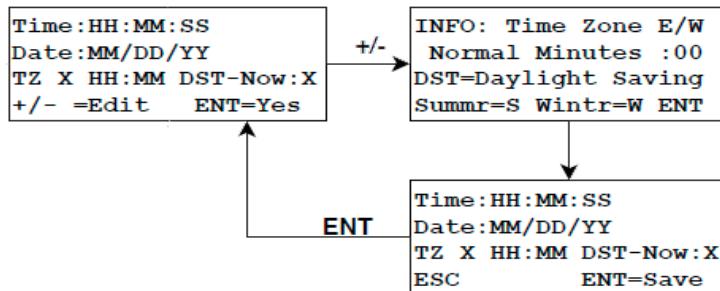
The <PREV or NEXT>   buttons allow you to scroll between the location numbers in order to select a location that you entered previously or advance to the next blank entry window.

- Select +- button to modify the data for the chosen location number. You will be given the choice to save it or not.

- Select ENT button to use the selected location in your session.

Set Up New Location

- Scroll <PREV OR NEXT> until you find a location with no values or edit an existing location.

- The Lat and Lon values will be zeros for new location windows.

- Be sure to enter N or S with latitude and E or W with longitude.

- Your longitude and latitude must be entered using the degrees: minutes: seconds format. For help converting decimal values to this format, refer to page 30.

- Select ENT button to save.

- Once saved, select ENT button to use in your session. The Date & Time screen will appear.

Date and Time Setting - GTOCP4 & GTOCP5

```
Time:HH:MM:SS                    INFO: Time Zone E/W
Date:MM/DD/YY          +/-        Normal Minutes :00
TZ X HH:MM DST-Now:X             DST=Daylight Saving
+/- =Edit    ENT=Yes             Summr=S Wintr=W ENT
```

```
                                 Time:HH:MM:SS
                       ENT       Date:MM/DD/YY
                                 TZ X HH:MM DST-Now:X
                                 ESC           ENT=Save
```

Carefully review all of the information that is on this screen. If correct, press ENT. Otherwise, push the ± button to enter new data or correct the existing data. An information screen will display regarding time zones and Daylight Saving abbreviations. Press ENT to proceed.

1. Modify the following information.

   - Time is in hours, minutes and seconds. **You MUST enter the time in 24 hour format!**

   - Date is in month, day and year. Use a leading zero if there is only one digit...example: 07 instead of 7.

   - Enter Time Zone as W or E to indicate on whether your local time is behind, or ahead of UTC (GMT). Enter the time zone in the first two number fields using a leading zero, if appropriate. The minutes fields are for 1/2 and 1/4 hour time zones as found in parts of Australia, the Pacific and Asia. Time zone information is used to calculate the zenith and LST of the object that you are viewing.

     Like longitude, time zones are measured from the Prime Meridian. Time zones are entered into the keypad as positive numbers. The keypad knows the difference because you have entered E or W. .

   - Set Daylight Saving/Standard Time using the W or S buttons on your keypad..

     - W= Standard Time, set to W in Winter or if you observe standard time year around.

     - S= Daylight Saving Time, set to S in summer.
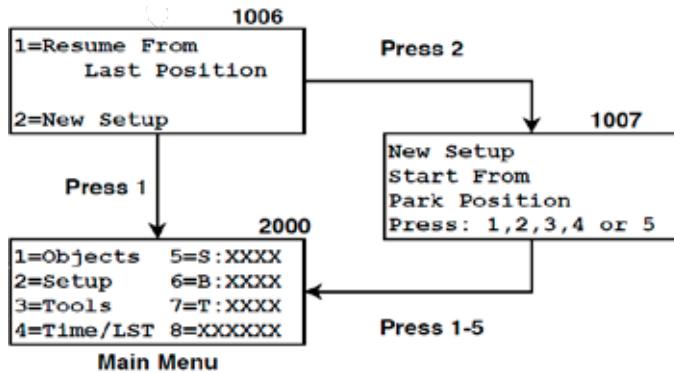
2. Press ENT=Save. You will hear a beep to indicate the information is saved. Review the data on the screen once more to double check your entry. Pay particular attention to the time zone since this is often overlooked.

3. Press ENT=Yes to confirm

   a) GTOCP5 - The display will advance to the Main Menu.

   b) GTOCP4 - Refer to page 13

For a more detailed discussion of date and time, refer to "Set Date and Time" on page 30, which discusses time zones and daylight savings in greater detail and makes a case for setting your keypad to UTC.

New Setup or Resume from Last Position - GTOCP4 Only

The GTOCP4 requires additional information regarding its position in order to properly initialize. Since all of the mounts that utlitze the GTOCP4 have clutches, special care must be taken to let the mount know where it is pointing. If the clutches are released and the mount moved, the stored positional information will not be accurate. This is true even if the mount has absolute encoders due to the mechanical construction of these mounts. In contrast, the Mach2GTO was constructed so that the absolute encoders are coupled to the output shaft. Consequently, when the clutches are released, the positional information remains accurate.

When initializing the mount with the GTOCP4, you must indicate whether the stored information from the last session is to be used or new positional information must be established. Follow this procedure:

1. Select desired option:

    a) **Resume from Last Position.** Choose this option if you previously parked the telescope after an observing session and have not moved the scope via the clutches. The stored position information will be remembered.

    b) **New Setup.** For this start position you will need to have a bubble level (or at least a good eye). Manually (with your hands) move your mount to your chosen park position by setting both axes to be properly oriented for your position-al choice. These factory pre-defined park positions serve as "reference positions." When the mount is in position, select the park position that you have approximated. This option is particularly useful when using the Polar Aligning in the Daytime procedure. "Appendix F: Pre-Defined Park Positions" on page 76 for illustration of the various park positions.

2. The Main Menu will display on the keypad so that you can proceed with your session.

Helpful HInts

- New Setup is only used when you are setting up the mount for the first time or if you have readjusted the scope position via the clutches and wish to restart from a reference park positon.

- Resume From Last Position is used when you parked the mount at the end of the previous session and wish to begin a new night of observing. Selecting it will initialize the mount and you'll be ready to go to your first object.

- When resuming from one of the reference park positions, be sure that the mount is actually in the position that you are going to select. Otherwise, the misinformation will cause the mount to be lost and it could slew into the pier.

- If you are in a permanent setup, you should set the keypad to "Auto-Connect:YES so that when you power up the mount, it will automatically be initialized and ready to go to your first object. This is the most automated of the setups using the keypad.

Mach2GTO as well as 1100 and 1600 mounts with Absolute Encoders:

If you have started the mount and are not sure if it is pointing correctly, you can send the mount HOME . This is useful if you inadvertently do a false recal or sync on an incorrect object that was commanded from any source. I

In order for this procedure to function properly, the correct time/date/location data must be sent to the mount during initialization. If you realize that the initialization data was not correct, start the session again and follow the procedures above.

Refer to page 47 for additional information about Slew Home and Sync.

KEYPAD START UP SEQUENCE FOR MOUNTS USED AT THE SAME LOCATION WITHOUT A COMPUTER

Auto-Connect: YES is a simplified startup sequence appropriate for mounts that meet the following requirements: Review the section pertaining to your mount.

GTOCP5 with Mach2GTO

- Polar-aligned Mach2s in a permanent location or portable mounts that are used in the same general location, e.g. in your backyard or nearby star party.
- You are not using an external computer to control your mount.

Please remember that you must follow the procedures as described in "Auto-Connect: No" on page 13 during your first session at this location before setting Auto-Connect to YES.

This feature can be activated or de-activated by pressing 2=Setup > 4=Kpd,Mt,Park Opt. Press button 7 to toggle between YES, NO and EXT.

When the keypad is in the Auto-connect:YES mode, all you need to do is connect power, and the system will remember the location, date, time, time zone and daylight savings.   The Main Menu will appear on the window so that you can go directly to the Objects Menu and enter the desired objects to be viewed.

GTOCP4 with All Other AP Mounts

- Mounts that remain at a fixed location and are polar aligned.
- Telescope position was not disturbed since it was last used.
- You are not using an external computer to control your mount.

Please remember that you must follow the procedures as described in page 13 during your first session at this location before setting Auto-Connect to YES.

This feature can be activated or de-activated by pressing 2=Setup > 4=Kpd,Mt,Park Opt. Press button 7 to toggle between YES, NO and EXT.

When the keypad is in the Auto-connect:YES mode, all you need to do is connect power, and the system will remember the location, date, time, time zone and daylight savings.   The Main Menu will appear on the window so that you can go directly to the Objects Menu and enter the desired objects to be viewed.

Mach2GTO as well as 1100 and 1600 mounts with Absolute Encoders:

If you have started the mount and are not sure if it is pointing correctly, you can send the mount HOME . This is useful if you inadvertently do a false recal or sync on an incorrect object that was commanded from any source. I

In order for this procedure to function properly, the correct time/date/location data must be sent to the mount during initialization. If you realize that the initialization data was not correct, set AutoConnect to NO and start the session again following the procedures in page 13.

Refer to page 47 for additional information about Slew Home and Sync.

Important Points

Meridian Delay for All Mounts. The Meridian Delay is remembered or not from your last session depending if you removed (turned off) power.

- If you removed power, during the last session, the meridian delay is NOT remembered. When you apply power again, the meridian delay resets to zero. This forces you to set up the meridian delay for each session to prevent unintended consequences.

- If you parked the mount, but did not remove power, the meridian delay setting will still be active when you unpark. Be very careful to remember your settings.

KEYPAD START UP SEQUENCE FOR COMPUTER CONTROLLED MOUNTS

Auto-Connect: EXT is a simplified startup sequence appropriate for mounts that are connected to a computer with telescope control software, which has initialization capability. The mount must be polar-aligned.

Please remember that you must follow the procedures as described in page 13 during your first session at this location before setting Auto-Connect to EXT.

This feature can be activated or de-activated by pressing 2=Setup > 4=Kpd,Mt,Park Opt. Press button 7 to toggle between YES, NO and EXT.   Once Auto-Connect is set to EXT, power cycle the mount (power off, wait 10–15 seconds, then power on) in order to activate this feature.

1. **Prepare your computer and software.** Ensure that your computer is connected to the mount. The CP4/5 has multiple connection options from which to choose. These choices are detailed in the appropriate manual for your control box. Check your computer's Device Manager to see which COM port number to choose for the software connection.

2. **Power up your mount and the external startup window will appear on the keypad.** This window will check the mount every few seconds to see if the computer has sent it the location and time data it needs to complete the startup (initialization) process. It will patiently wait for the software connection.

3. **Connect to your mount in the computer software.** Once you make the software connection to the mount, initialization via the computer will take place and the display on the keypad will change to the Main Menu.

Mach2GTO as well as 1100 and 1600 mounts with Absolute Encoders:

If you have started the mount and are not sure if it is pointing correctly, you can send the mount HOME . This is useful if you inadvertently do a false recal or sync on an incorrect object that was commanded from any source. I

In order for this procedure to function properly, the correct time/date/location data must be sent to the mount during initialization. If you realize that the initialization data was not correct, set AutoConnect to NO and start the session again following the procedures in page 13.

Refer to page 47 for additional information about Slew Home and Sync.

Important Points

The Computer Controls the Time.

If you have used the External Startup Sequence, do not attempt to change the time on your keypad. Use the computer program to control the time.

Meridian Delay

The Meridian Delay is remembered or not from your last session depending if you removed (turned off) power.

- If you removed power, during the last session, the meridian delay is NOT remembered. When you apply power again, the meridian delay resets to zero. This forces you to set up the meridian delay for each session to prevent unintended consequences.

- If you parked the mount, but did not remove power, the meridian delay setting will still be active when you unpark. Be very careful to remember your settings.

MAIN MENU FUNCTIONS

```
1=Objects    5=S:1200
2=Setup      6=B:64
3=Tools      7=T:Side
4=Time/LST   8=ModOFF
```

Brightness of the Display Window

Use the <PREV and NEXT> buttons to adjust the brightness of the display to a bright or dim setting.

Note: Even when the keypad is set to the bright setting, it will be difficult to see during daylight hours. You will need to shield it with your hands or drape a dark cloth over your head. This is an unfortunate drawback of the vacuum-fluorescent display. We chose the VFD display because of its excellent performance in cold weather down to -40º F (-40º C, yes, the number is the same). Alternative displays scroll very slowly at temperatures below freezing and would not work well at all in extreme temperatures. Since many of our customers (and ourselves) observe during the cold Midwestern winter months, we opted for performance

1=Objects

This is your gateway to all object databases, tour functions and the RA/Dec coordinate entry window. Refer to the Objects Menu section beginning page 20 for a complete discussion of the options available.

2=Setup

Refer to the Setup Menu section on page 29 for a complete discussion of the available options.

3=Tools

Tools Menu offers a variety of handy routines to make your observing or imaging session easier and more pleasurable. Refer to page 39 for a complete discussion.

4=Time/LST

This display window will show your local time, date, LST (local sidereal time, also known as the zenith hour) and UTC (Coordinated Universal Time, successor to Greenwich Mean Time). Press and hold MENU button a few seconds to exit window. In addition, the current selected location number will appear in the lower right corner. For example, LOC=1 indicates that location 1 is currently selected.

Notice that the display will appear to skip a second once in a while. This happens because the display does not update exactly in sync with the clock. As a result, it gets slightly behind and has to skip a second to catch up. This is not a problem.

This is a display window only. You must go into the Location and Time menu to change the data, time and location.

5=Slew Rate for GoTo Slew Commands

Press 5 on your keypad to change the slew rate that will be used when issuing a GoTo command.   Note that the selection changes (toggles) each time you press the button. We recommend that you use slower rates in cold weather.

GTOCP5: 600x, 1000x or 1800x. When using 12V, the maximum rate will be 1200x (but display as 1800x)
GTOCP4 : 600x, 900x or 1200x.

6=Button Rate

Press 6 on your keypad to change the rate that will be used when you press the N-S-E-W buttons. Available rates include: 0.25x, 0.5x, 1x, 12x, 64x, 200x, 600x, or 1200x.   Press the 6 button to toggle between these rates. The displayed rate will be active. This rate can also be changed on a display window accessed by the ± button. The keypad buttons are useful for centering an object, cruising over the lunar surface or moving to another part of the sky.

7=Tracking Rate

Press 7 on your keypad to change the tracking rate: Side (Sidereal), King, Cstm (Custom) and Stop. There is no Solar or Lunar rate setting since these will be set automatically when the user slews to the Sun or Moon. The lunar rate in the mount is the average rate. The moon has some variability in its rate that can diverge from the average and varies a bit in declination. As a result, it has a drift component in addition to the atmospheric refraction. The Horizons program provided with our Astro-Physics Command Center (APCC) can give you very tight lunar tracking, if required.

T:Side Brings up the default sidereal tracking rate.

T:King Brings up the variable King rate that compensates the RA tracking for atmospheric refraction.

T:Cstm Brings up the custom rate calculated from pointing model data, previously measured by the user with the keypad and stored in the CP4/5 control box. Both RA and Dec axes will be driven at the calculated rates. If no data is present, then the custom rate will equal the Sidereal rate.

T:Stop Turns RA tracking off.

8=Model Status

GTOCP5: All users have access to the modeling features, so the status of the present model will display here. Refer to the selections below.

GTOCP4 with the Keypad Modeling Feature License enabled: Only Control Boxes with the Keypad Modeling Feature license enabled can review model status. Refer to the selections below.

GTOCP4 that does not have the Keypad Modeling Feature License enabled. If your control box displays the error message: "Model Disabled" when you toggle the 8 button, your control box does not have the requisite license for this feature. Refer to "Keypad Modeling Feature License" on page 6 for more information regarding this license

Selections

Press 8 to toggle through and set the 3 modeling options.

ModOFF Turns off the Pointing, Ortho and Drift models. It does not affect the custom tracking rate.

PntON   Turns on the Pointing model and the Ortho model and uses whatever data was measured and stored by the user. It does not affect the Custom Tracking Rate.

DrftOn   Replaces the Custom Tracking Rate with the Drift Rate that was measured by the user with the alternate Drift Model routine. It does not turn on the Pointing or Ortho models.

OBJECTS MENU – HAVE SOME FUN!

Objects Menu

- **<=Object will display current object.** Press <PREV button. The object data for the last object that was selected for a slew will display.

```
<=Object      RA/DEC=>
1=M    4=Sol   7=R/D
2=NGC  5=Strs  8=Tour
3=IC   6=More  9=AlAz
```

- **RA/DEC=> will display actual current RA/Dec and Alt/Az coordinates.** When you are in Objects menu, press NEXT>. The RA/Dec coordinates of the exact position of your mount will display. These may be slightly different from the object data coordinates discussed above since the calculations that compensate for atmospheric refraction and precession will change the coordinates slightly. Also, if you move the mount with the N-S-E-W directional buttons or with a software program such as *TheSky™*, this display window will be updated.

- The remaining selections will guide you as you tour the universe. Many of the selections are described below.

Tips for Using the Buttons and Menus

- **Correcting data entries.** When entering catalog numbers into the keypad, you can use <PREV button to delete the last digit entered. Enter the correct digit. Use NEXT> button to advance forward.

- **Scrolling object lists.** Some of the object selection windows will display < and/or >, usually in the corners. These symbols indicate that you can scroll a list of objects using the <PREV or NEXT> buttons. If you hold these buttons, the object names will scroll quickly in some windows (e.g. stars, common objects).

- **Object Below Horizon.** If the object that you wish to view is not visible, the window will display: Object Below Horizon Altitude -xx. Note that this object might be visible at another time of the night or it may be in the opposite hemisphere. The message does not differentiate.

- **N–S–E–W directional buttons.** The N-S-E-W directional buttons can be used to center your object when you are in the Main Menu, Objects Menu, modeling routines and when the object data windows are displayed. They are not active when you are in object selection windows, e.g. when entering a Messier number or the photographic timer and some setup windows. Remember that you can change your button rate easily by pressing the +- button and pressing <PREV or NEXT> to scroll through the rates.

- **Review object data of catalog items prior to slew.** Enter the number of the object that you are considering, then press NEXT>. The magnitude, object type (galaxy, globular cluster, etc.) and constellation will display. You can press GOTO in this window to initiate a slew, if you wish, or press MENU to exit to make an alternate selection.

- **Display coordinates of catalog object after a slew.** Press <PREV button. The catalog RA and Dec coordinates will display. Press <PREV button again to toggle back to object data. Note that the coordinates of the solar system objects display on the selection window before you slew.

- **Recalibration.** You can recalibrate on current object at any time to fine-tune your calibration. Simply center the object in your eyepiece with the N-S-E-W directional buttons and press the RECAL and NEXT> buttons simultaneously. Listen for the beep to confirm recalibration.

- **Cancel slewing at any time.** Press STOP to cancel a slewing operation. Your telescope will stop immediately. The mount will know where it is, so proceed to the next object using the N-S-E-W buttons or catalog requests described below.
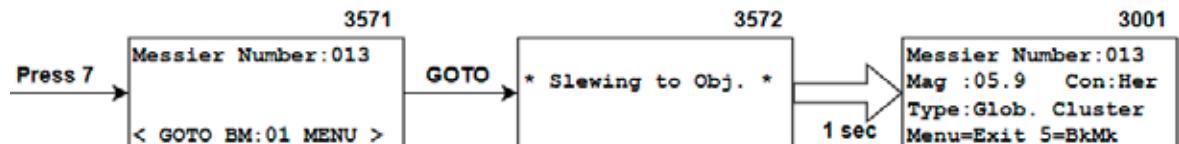
Object Bookmark Tool/Utility

Creating Bookmarks - Adding an Object to the List

To add an object to the bookmark list, simply GOTO any object. When the mount has successfully slewed to the object, you can add it to the bookmark list by pressing the 5=BkMk option from the object detail window. The bookmark utility will auto-determine the first FREE bookmark space inside the bookmark list. You can also override this selection by pressing the <PREV' and NEXT> buttons to select the bookmark number you would like to place this object into within the bookmark list.   Most of the object windows will offer this option. You may add up to 50 bookmarks.

```
              3001    Press 5                    3002
   ┌─────────────────────┐      ↓      ┌─────────────────────┐
   │ Messier Number:013  │             │ Messier Number:013  │     ╭──────────────╮
   │ Mag :05.9   Con:HER │             │ 1=Accept BkMk Nbr   │     │Cycle through the│
   │ Type:Glob. Cluster  │             │ First Free BkMk#:01 │     │ available BkMk │
   │ Menu=Exit 5=BkMk    │             │ <     Menu/Exit   > │     ╰──────────────╯
   └─────────────────────┘             └─────────────────────┘      Press < or >
                    ESC
                         Press 1↓           3003
                    ┌─────────────────────┐
                    │ -- Obj Bookmarked --│
                    │ Obj Bookmarked As:XX│
                    │                     │
                    │ Press Menu to Exit  │
                    └─────────────────────┘
```

Viewing Your Bookmarked Objects

```
              3571                      3572                          3001
   ┌─────────────────────┐    ┌─────────────────────┐    ┌─────────────────────┐
   │ Messier Number:013  │GOTO│ * Slewing to Obj. * │    │ Messier Number:013  │
   │                     │    │                     │    │ Mag :05.9   Con:Her │
   │                     │    │                     │    │ Type:Glob. Cluster  │
   │ < GOTO BM:01 MENU > │    │                     │1sec│ Menu=Exit 5=BkMk    │
   └─────────────────────┘    └─────────────────────┘    └─────────────────────┘
   Press 7
```

1. Path: Objects Menu > 6=More > 7=Objects Bookmark.

2. The first (or last viewed) object of the bookmark list will display with the catalog name and number, if you have already set one up.

3. Choices:

    a) Pressing GOTO will initiate slewing to that object.

    b) Press NEXT> to view the next object in the bookmark list. You may also press < PREV to see the previous object in the bookmark list.

    c) Press MENU to return to More Objects Menu to make an alternate choice.

4. When you have finished viewing your bookmarked objects, press MENU to return to the More Objects Menu.

Delete Bookmarks

1. To Remove/Delete an object from the bookmark list, simply select the tools menu option from the Main Menu.

2. Select 4=BookMark Edit.

```
┌─────────────────────┐
│ <  BookMark Edit  > │
│ 1=Clear ALL BookMks │
│ 2=DEL BookMk Nbr:02 │
└─────────────────────┘
```

3. Select desired option:

    a) 1=Clear all BookMks. This will remove the entire 50 object list.

    b) 2=DEL BookMk Nbr:xx where 'xx' equals the last added bookmark used value. Press the '<' or '>' buttons to scroll through the 50 object book mark values which will permit you to delete the object bookmark you specifically wish to delete.   When you delete an object's bookmark by pressing 2, the screen will display a single line confirming that the bookmark has been deleted.

4. Press MENU to continue.

5. The numerical position of your remaining bookmarks will remain the same. They will not shift to fill the empty position. When you create your next new bookmark, you will be offered the first available position as shown in screen 3002 on the previous page, which may be the one that was just deleted.

Object Catalogs and Tours

Solar System Objects (Sol)

WARNING - Observing during the daytime can be dangerous. Refer to the section entitled "Slewing During the Day" on page 53 for precautions.

```
Solar Menu      7=Satn
1=Sun   4=Ven  8=Uran
2=Moon  5=Mars 9=Nept
3=Merc  6=Jupt 0=Plu
```

All the planets, Pluto, the Moon and the Sun.

1. From Objects menu, select 4=Sol (Solar System).

2. Press the number that corresponds to your choice. The RA/Dec coordinates of the object will display.

3. Press GOTO to initiate slewing or Menu=Exit. If you select GOTO, the mount will slew to the object, assuming it is above the horizon. If you select the sun or the moon, the tracking rate will automatically change to the solar or lunar rate. Note that the displayed rate in the Main Menu will not indicate these tracking rates.

M, NGC, IC

These are the most common catalogs used in astronomy and include the brightest and most famous objects including galaxies, diffuse (bright) nebulae, planetary nebulae, globular clusters and open clusters. Many faint objects visible only in larger instruments are included also. A few objects are listed in more than one catalog, so there is some overlap. M (Messier) = 110 objects, NGC (New General Catalog) = 7,840 objects, IC (Index Catalog) = 5,386 objects.

1. Go to Objects menu.

```
Messier Number:013
Press GOTO for Obj
Press > for Obj-Data
Press Menu to EXIT
```

2. Choose M, NGC or IC – press the number that corresponds to your choice (e.g. 1=M).

3. Enter the catalog number with your keypad. Look carefully to be sure that the numbers register as you press them.

4. Choices: Press GOTO to initiate slewing, NEXT to review object data or MENU to exit.

    a) After you press NEXT> for object data, you can press <PREV for RA/Dec coordinates. You may also GOTO from that window.

5. Once you reach the target object, press <PREV to view the RA/Dec coordinates. Press <PREV again to return to the object data.

6. Press MENU to return to Objects menu. or 5=BkMk to bookmark for later use.

Common Object Names

This is one of our favorite features. Many of us can't remember the catalog number of an object; however we remember the common name. Use this procedure to view 100 of all-time favorites.

```
Common Names:
1=Crescent neb    <
2=Double cluster
3=Dumbbell neb    >
```

1. From Objects menu, select 8=Tour.

2. Select 3=Common Obj. Names. Use <PREV and NEXT> to scroll through list of names that are arranged alphabetically. You may use the <PREV button to scroll backwards through the objects that are at the end of the list.

3. Select object. The window will display the magnitude, type of object and the constellation where it is found.

4. Choices: Press GOTO to initiate slewing, <PREV to review RA/Dec coordinates or MENU to exit.

5. Once you reach the target object, press <PREV to view the RA/Dec coordinates. Press <PREV again to return to the object data.

6. Press MENU to return to Objects menu or 5=BkMk to bookmark for future reference. The catalog number of the object will be remembered, not the common name.
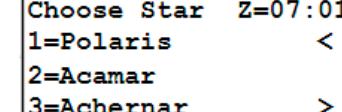
Tour Objects within Constellations

If you are observing within a constellation and want to know what other Messier, NGC or IC objects are nearby, this tour will provide you with lots of observing ideas. .

1. From Objects menu, select 8=Tour.

2. Select 2=Objects/Constell. The display will identify the constellation to which your telescope is pointing and offer choices of M, NGC or IC objects within that constellation.

```
< -  Const: And + >
1=M031     3=NGC7640
2=M032     4=NGC7662
6=Prev  Obj   Next=0
```

   a) Press 6=Prev Obj or Next=0 to scroll through the list of objects available within the current constellation.

   b) Use <PREV and NEXT> buttons to scroll through constellation lists. Choose a constellation that is visible.

3. Choose an object. Window will display the magnitude and type of object for your review.

4. Choices: Press GOTO to initiate the slew, <PREV to review RA/Dec coordinates or MENU to exit.

5. Once you reach the target object, press <PREV to toggle between RA/Dec coordinates and object data.

6. Press 5=BkMk to bookmark or MENU to exit.
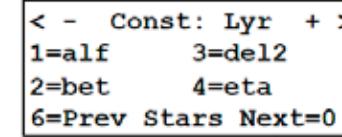
Common Star Names - Non-scientific

Many of these names are of Arabic origin. Refer to "Appendix B: Common Stars – By Constellation" on page 59 for the list of stars that we have included. The appendix also shows the Flamsteed-Bayer names and the approximate magnitude of each star. For full names of the constellations and their abbreviations can be found on "Appendix D: Constellation Abbreviations" on page 68

1. From Objects menu, choose 5=Strs (Stars).

2. Note that the Zenith hour displays in the upper right corner for your reference.

```
Choose Star   Z=07:01
1=Polaris          <
2=Acamar
3=Achernar         >
```

3. Select a star. Scroll the stars list by pressing the <PREV or NEXT> buttons. Hold button down for a more rapid scroll rate. Press the number that corresponds to your choice. Magnitude, constellation and type will display.

4. Choices: Press GOTO to initiate slewing, <PREV to review RA/Dec coordinates or MENU to exit.

5. Once you reach the target object, press <PREV to toggle between RA/Dec coordinates and object data.

6. Press 5=BkMk to bookmark or MENU to exit.

Greek Star Names - Organized by Constellation

This menu showcases the brightest stars in each constellation.

1. From Objects menu, select 8=Tour.

2. Select 1=Stars/Constell. The display will identify the constellation to which your telescope is pointing and offer choices of stars with Greek names within that constellation. Refer to "Appendix B: Common Stars - By Constellation" on page 59.

```
< -  Const: Lyr  + >
1=alf      3=del2
2=bet      4=eta
6=Prev Stars Next=0
```

   a) Press 6=Prev Stars or Next=0 to scroll through the list of stars available within the current constellation.

   b) Use <PREV and NEXT> buttons to scroll through constellation lists. Choose a constellation that is visible.

3. Select a star. Window will display the magnitude of the star.

4. Choices: Press GOTO to initiate the slew, <PREV for RA/Dec coordinates or MENU to exit to the Stars/Constellation menu to make your next selection.

5. Once you reach the target object, press <PREV to toggle between RA/Dec coordinates and object data.

6. Press 5=BkMk to bookmark or MENU to exit.

Abell Galaxy Clusters

We have included 2,712 of the approximately 4,000 Abell Galaxy Clusters (ACO).

1. From Objects menu, choose 6=More. This will bring you to the More Objects menu.

2. Choose 1=Abell Galaxies.

```
Abell Number: 0895
Press GOTO for Obj
Press > for Obj-Data
Press Menu for EXIT
```

3. Enter Abell Number. Note that not all Abell Galaxies are in the database.

4. Choices:

   a) Press GOTO to initiate slewing

   b) NEXT> for object data, then press <PREV for RA/Dec coordinatess. Toggle <PREV to toggle back to object data. You may GOTO from either window.

   c) MENU to exit.

5. When you reach the target object, press <PREV to toggle between RA/Dec coordinates and object data.

6. Press 5=BkMk to bookmark or MENU to exit.

Aitken Double Star Catalog (ADS)

We have included 215 of the most popular double stars in this catalog. Please refer to "Appendix F: Aitken's Double Star (ADS) List" on page 70 for the ADS numbers that we have included and the corresponding Greek star name.

1. From Objects menu, choose 6=More. This will bring you to the More Objects menu.

```
< -  Const: Lyr  + >
1=11635    3=11745
2=11639    4=12197
6=Prev  ADS   Next=0
```

2. Choose 2=ADS Double Stars. The window will display the name of the constellation to which your telescope is pointed and a list of ADS objects within that constellation.

   a) Press 6=Prev ADS or Next=0 to scroll through the list of double stars available within the current constellation.

   b) Use <PREV and NEXT> buttons to scroll through constellation lists. Choose a constellation that is visible.

3. Select a star. The window will display the approximate separation of the stars, constellation and object type (Dbl. Star). Remember that apparent separation may vary from year to year. Consult an ephemeris for the most accurate data.

4. Choices: Press GOTO to initiate slewing, <PREV to view RA/Dec coordinates (press again to toggle back to object data) or MENU to exit.

5. When you reach the target object, press <PREV to toggle between RA/Dec coordinates and object data.

6. Press 5=BkMk to bookmark or MENU to return to ADS selection window to make additional choices.

Palomar Globular Clusters (PAL)

We have included all 15 of the PAL (Palomer) Globular Clusters.

1. From Objects Menu, choose 6=More. This will bring you to the More Objects Menu.

2. Select 3=PAL.

```
Pal Number: 10
Press GOTO for Obj
Press > for Obj-Data
Press Menu for EXIT
```

3. Enter a PAL Number from 1-15.

4. Choices:

   a) Press GOTO to initiate slewing.

   b) NEXT> for object data, then press <PREV for RA/Dec coordinatess. Toggle <PREV to toggle back to object data. You may GOTO from either window or MENU to exit.

c) MENU to exit.

5. When you reach the target object, press <PREV to toggle between RA / Dec. data and object data.

6. Press 5=BkMk to bookmark or MENU to exit.

Uppsalla Galaxy Catalog (UGC)

We have included 2,904 of the 12,921 galaxies in the Uppsalla Galaxies catalog.   This catalog features galaxies visible from the northern hemisphere .

1. From Objects Menu, choose 6=More. This will bring you to the More Objects Menu.

2. Choose 4=UGC.

```
UGC Number: 2457
Press GOTO for Obj
Press > for Obj-Data
Press Menu for EXIT
```

3. Enter UGC Number. Note that not all UGC Galaxies are in the database.

4. Choices:

    a) Press GOTO to initiate slewing.

    b) NEXT> for object data, then press <PREV for RA/Dec coordinatess. Toggle <PREV to toggle back to object data. You may GOTO from either window or MENU to exit.

    c) MENU to exit.

5. When you reach the target object, press <PREV to toggle between RA / Dec. coordinates and object data.

6. Press 5=BkMk to bookmark or MENU to exit.

Lynds' Catalog of Bright Nebula (LBN)

We have included all 1,125 of the HII emission nebulae in Beverly Lynds' Bright Nebula catalog.   Note that the magnitude field will display Lynds' relative brightness scale ranging in whole integer values from 1 (brightest) to 6 (dimmest).

1. From Objects Menu, choose 6=More. This will bring you to the More Objects Menu.

2. Press 5=LBN.

```
LBN Number: 0890
Press GOTO for Obj
Press > for Obj-Data
Press Menu for EXIT
```

3. Enter LBN Number. It is not necessary to enter the leading zero.

4. Choices:

    a) Press GOTO to initiate slewing.

    b) NEXT> for object data, then press <PREV for RA/Dec coordinatess. Toggle <PREV to toggle back to object data. You may GOTO from either window or MENU to exit.

    c) MENU to exit.

5. When you reach the target object, press <PREV to toggle between RA / Dec. coordinates and object data.

6. Press 5=BkMk to bookmark or MENU to exit.

Lynds' Catalog of Dark Nebula (LDN)

We have included all 1,791 of the dark nebulae in Beverly Lynds' Dark Nebula catalog.   Note that the magnitudes field will display Lynds' relative opacity scale ranging in whole integer values from 1 (lightest / most transparent) to 6 (darkest / most opaque).

1. From Objects Menu, choose 6=More. This will bring you to the More Objects Menu.

2. Choose 6=LDN.

3. Enter LDN Number.

4. Choices:

   a) Press GOTO to initiate slewing.

   b) NEXT> for object data, then press <PREV for RA/Dec coordinatess. Toggle <PREV to toggle back to object data. You may GOTO from either window or MENU to exit.

   c) MENU to exit.

5. When you reach the target object, press <PREV to toggle between RA/Dec. coordinates and object data.

6. Press 5=BkMk to bookmark or MENU to exit.
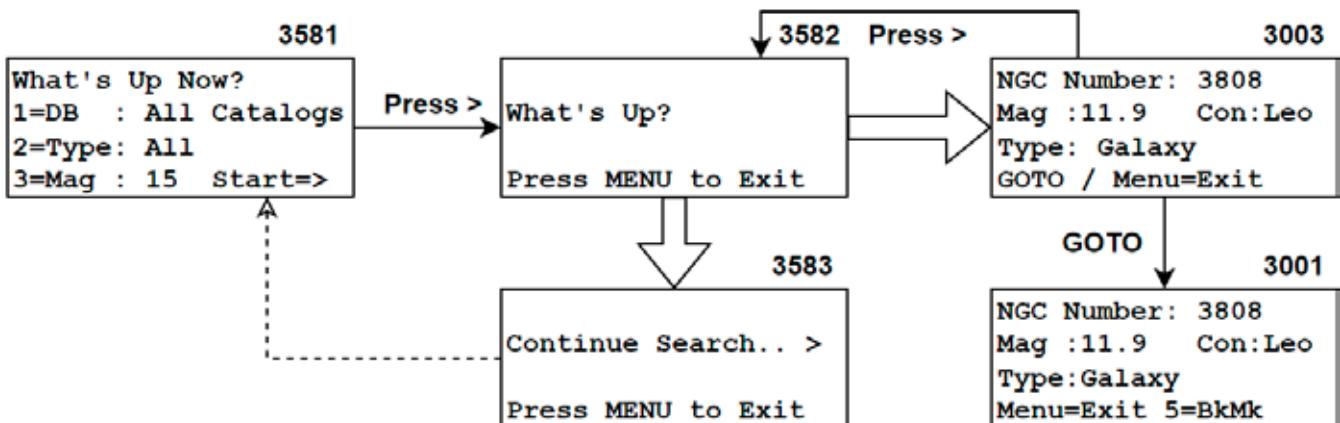
```
LDN Number: 70
Press GOTO for Obj
Press > for Obj-Data
Press Menu for EXIT
```

What's Up Now?

The What's Up Now feature is great fun when you are out under the stars with no real plan other than exploring at whim. It's also very handy when entertaining others at a star party or at home. You might discover new objects that you would not have thought to view. Follow the instructions below to narrow your search according to the capabilities of your telescope or preferences.

3581
```
What's Up Now?
1=DB  : All Catalogs
2=Type: All
3=Mag : 15  Start=>
```

Press >

3582 Press >
```
What's Up?

Press MENU to Exit
```

3003
```
NGC Number: 3808
Mag :11.9    Con:Leo
Type: Galaxy
GOTO / Menu=Exit
```

3583
```
Continue Search.. >

Press MENU to Exit
```

GOTO

3001
```
NGC Number: 3808
Mag :11.9    Con:Leo
Type:Galaxy
Menu=Exit 5=BkMk
```

1. From Objects Menu, choose 6=More. This will bring you to the More Objects Menu.

1. Choose 8=What's Up Now

2. Use the keypad to make selections to narrow the range of your search, if you wish.

   a) DB (database or catalog) – The default is All Catalogs. Press 1 to toggle between these choices: All Catalogs, Messier, NGC, IC, Abell Gx (Abell Galaxy), ADS Dbl Str (ADS Double Star), PAL Glob. (PAL globular clusters), LBN Diff Neb (LBN Diffuse Nebula) and UGC Gx (UGC Galaxies).

   b) Type of object - The default is All. Press 2 to toggle between these options: All, Galaxy, Opn Cluster (Open Cluster), Glob Cluster (Globular Cluster), Planetary (Planetary Nebula), Nebula, Dbl. Star (Double Star). Note that if you select a specific database, the corresponding type will automatically be selected and you will be prevented from selecting an incorrect object type.

   c) Magnitude - The default is 18. Press 3 to toggle between 01 to 20 to designate the maximum magnitude that you wish to include in your search. Select this number based on the capability of your telescope to avoid selecting objects that are too dim to view.

3. Press the NEXT> button to initiate the search. The screen will display What's Up? as the keypad searches the database for suitable objects that are above the horizon. The selection will be random and not based on where your telescope is pointing. As a result, you may slew to the other side even though you know there are suitable objects nearby. Just go with the flow and enjoy the surprises that are offered. You might discover something new.

   a) When an object is found in the database, the object data screen will display indicating the catalog number, magnitude, constellation and type of object. Your choices:

      i) Press GOTO to slew to the object if it interests you.

ii) Press NEXT> to search for another object.

iii) Press the PREV< button to display the RA and Dec coordinates.

iv) Press MENU to Exit to the What's Up Now Menu. Your previous settings will display.

b) If the keypad search does not find a match, the screen will display Continue Search.. >.   Note that this screen may display after only a few searches even when you know there are other objects that meet your criteria. Your choices::

i) Press NEXT> to request another search of the database.

ii) Press MENU to exit back to the What's Up Now menu screen.

4. Once you have gone to an object and enjoyed the view, press NEXT> again to initiate the next search.

5. You have the option to discontinue this routine throughout the process. When you have finished, press MENU once or twice to exit back to the More Objects menu.

Custom RA and Dec Coordinates

This menu option allows you to slew to any position in the sky as long as you know the RA and Dec coordinates. This feature is particularly handy if you wish to locate comets, super novas, asteroids or any object that is not included in our catalogs.

1. From Objects menu, select 7=R/D. The Custom RA/Dec entry window will appear.

```
Custom RA/DEC Entry
RA :   HH:MM:SS.ss
DEC: #DD:MM:SS.s
GOTO / Menu to Exit
```

2. Enter RA and Dec coordinates. Press NEXT> to bypass any numbers that you do not wish to change. Press <PREV if you want to back up to correct an error. To change the + or - press the ± button. See note below regarding precessed coordinates.

3. Press GOTO to initiate slew or MENU to Exit.

4. When the slew is complete, the window will display zero magnitude and state that constellation and type of object is not available. This is to be expected because you are not accessing a catalog. Press <PREV to display the RA/Dec coordinates again.

5. Press MENU to return to the Objects menu.

Important Note: When you enter custom RA and Dec coordinates they should preferably be entered as precessed coordinates (JNow or Topocentric coordinates). The keypad automatically precesses objects in its database, and any prior RECALS will have been done on precessed coordinates. However, the keypad cannot know the epoch of the coordinates that you are entering, so it only applies the small refraction transformations.   Therefore, for accurate pointing, you will want to maintain consistency and enter precessed coordinates.

Custom ALT / AZ Coordinates

This menu option allows you to slew to any position in the sky as long as you know the altitude and azimuth angles. This feature is particularly handy if you wish to take your dark frame for CCD imaging or observe terrestrial objects with the tracking turned off.

1. From Objects menu, select 9=AlAz. The Custom Alt/Az Entry will appear.

```
Custom ALt/Az Entry
Alt:  DD:MM:SS
Az : DDD:MM:SS
GOTO / Menu to Exit
```

2. Enter Altitude and Azimuth coordinates.

3. Choices:

4. Press GOTO to initiate a slew.or MENU to exit. The Object menu will appear.

Sun Warning

It is important to remember that slewing to objects near the sun can be quite dangerous to your eyesight. If the sun is above the horizon, the keypad will go through an additional check routine to be sure that the object or position that you select is outside a safe viewing zone. If the object is the sun itself or within 15 degrees of the sun, the warning will display.

```
WARNING: Looking at
or near the SUN can
DAMAGE your eyes.
GOTO / Menu to Exit
```

Please be sure that you have installed a good quality SAFE solar filter that covers the optics in front of the telescope or use a Herschel Wedge. Never use eyepiece filters since they may break due to the intense heat of the sun. Do not use solar filters that are cracked (glass), torn (Mylar or AstroSolar) or have many pinholes (any solar filter). Astro-Physics offers high-quality solar filters fabricated with Baader Planetarium AstroSolar material or you can purchase the AstroSolar material in sheets and make the filter yourself.

SETUP MENU

```
1=Locations & Time
2=Future Features
3=Set Limits, Power
4=Kpd,Mnt,Park Opt.
```
GTOCP5

```
1=Locations & Time
2=Future Features
3=Set Limits
4=Kpd,Mnt,Park Opt.
```
GTOCP4
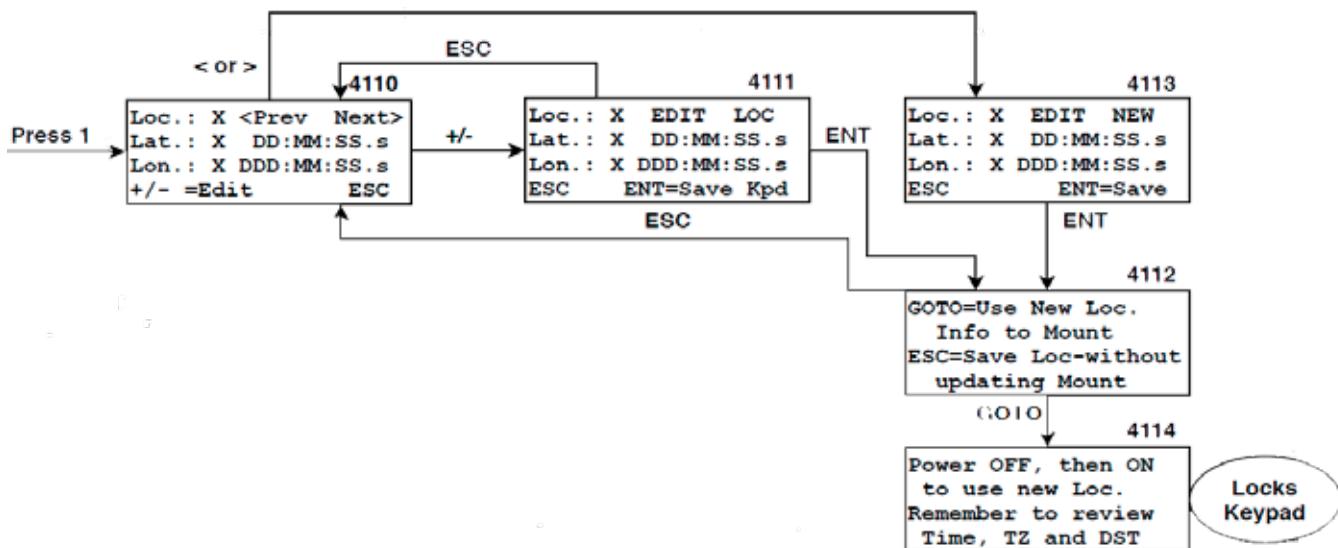
Locations & Time

Press 1 in the Setup Menu to bring up location and time data that can be edited or updated as required. Up to 9 locations can be saved. Time data can be edited or updated from data stored in the mount from an external precise time source such as a computer. Refer to the information below.

```
1=Site Location Data
2=Date&Time 5=QwkDST
3=Get Loc. frm Mount
4=Get Time frm Mnt
```

Site Location Data

Location data must be entered in degrees, minutes and seconds. If your data is in decimal format, refer to the formula on page 30 or, if you have the internet handy, Google it for the conversion. Enter your location as follows:

1. Path: Main Menu > Setup Menu > Locations & Time > 1=Site Location Data.

2. Current location data will display.

3. Either edit this information by pressing the +/- button or use <PREV or NEXT> buttons to scroll to other locations or find an empty location entry field.

4. To edit a location or enter a new location, enter E or W longitude and N or S latitude by pressing the direction buttons. If you make a mistake while entering the data, use the <PREV and NEXT> buttons to move back and fix it. Watch your entry carefully to be sure that all intended numbers are entered in the correct sequence. Note that leading zeros are required. i.e. W 089:08:03.0.

5. Press ENT to save the new location or ESC.

   a) Choose ESC. The values will NOT be saved.

   b) Choose ENT=Save Keypad.   The keypad will beep and screen 4112 will appear.

6. Screen 4112 offers two choices .

   a) Choose GOTO. The keypad will beep and a new window will provide instructions to power off. When you turn the power back on, your session will restart with the Auto-Connect:No routine in order to properly initialize your mount. Remember to review and adjust your time, time zone and daylight savings as required for your new location.

b) Choose ESC. the keypad will beep. This selection will save the data for future sessions. It will not be active now. This is handy when you prepare for an upcoming star party.

Convert Your Location Data That is in Decimal Format to Hours, Minutes and Seconds

Many websites and GPS units return your location in a decimal number of Lat and Long.
i.e. 42.3589 Latitude   89.0409 Longitude.

The Keypad's input is in Degrees, Minutes, Seconds.
i.e. 42° 21' 32" Latitude 89° 02' 27" Longitude.

If you were to type the decimal data into your Keypad it would give you an error message. This happens because the decimal number is not equivalent to the Degrees, Minutes, Seconds format. The 5.x Keypad has error checking that will not allow more than 60 minutes or 60 seconds to be entered. It is possible to have inaccurate location data in your mount if none of the minute or second values you entered were over 60.

Please double check your location data to make sure you entered it in the correct format.
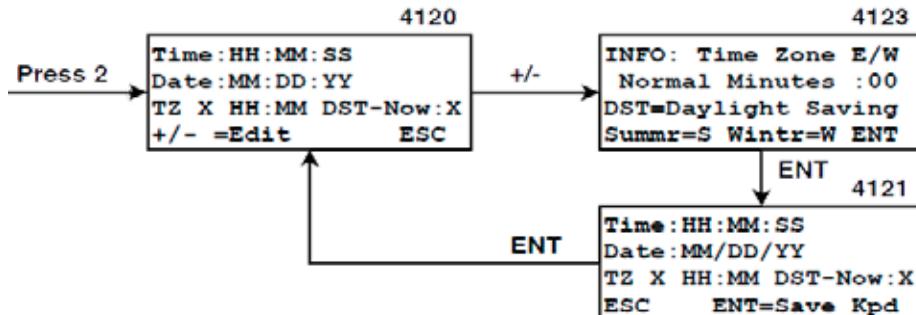
If you have access to the internet, download the Default IP Address Calculator and Latitude/Longitude Coordinate Converter from our website: https://astro-physics.info/tech_support/mounts/servo/latlong-ip-calculator.html

It is also relatively easy to calculate the conversion. Using the example above:

1. Separate whole degrees from decimal portion: 42° + 0.3589° Lat. and 89° + 0.0409° Long.

2. Multiply the decimal portion times 60.   This will give you the minutes:

3. 0.3589 x 60 = 21.534 Minutes Latitude – DO NOT round – use 21'.

4. 0.0409 x 60 = 2.454 Minutes Longitude – DO NOT round – use 02'.

5. Repeat the multiplication with the decimal portion of the minutes calculated in step 2. This will give the seconds:

6. 0.534 x 60 = 32.04 Seconds Latitude – round to 32".

7. 0.454 x 60 = 27.24 Seconds Longitude – round to 27".

8. Combine: Latitude: 42° + 21' + 32" and Longitude: 89° + 02' + 27".

Set Date and Time

1. Path: Main Menu > 2=Setup Menu > 1=Locations & Time > 2=Date &Time. If you only need to make adjustments for Daylight Saving, there is a quick and easy automatic process outlined in the Qwik Daylight Saving Time section on page 31.

2. Date and time information from the mount will display. Consider setting your time to UTC (GMT). Refer to page 32.

    Press the +/- button to modify the information. An information screen will display regarding time zones and Daylight Saving abbreviations. Make sure you note the definitions and abbreviations. Press ENT to proceed.

3. **You MUST enter time in 24 hour format.** If you make a mistake while entering the data, use the <PREV and NEXT> keys to move back and fix it. Watch your entry carefully to be sure that all intended numbers are entered.

    Please note: Incorrect time settings are a common operator error, particularly when setting up in the evening.   You

MUST enter the time in 24 hour format!   Use the correct local time AND be sure you have the correct time zone and daylight savings setting. Time zone is always standard time and does not change with daylight savings. Daylight savings adjusts the time zone's value by one hour to create the net UTC offset, but it doesn't change the actual time zone..

4. Set Time Zone (TZ). Use your actual time zone setting as described above. Do NOT try to fool the keypad by adjusting for Daylight Saving time. Enter E or W to indicate on which side of the Prime Meridian you are located. Enter the time zone in the first two number fields using a leading zero, if appropriate. The minutes fields are for 1/2 and 1/4 hour time zones as found in parts of Australia, the Pacific and Asia. Unless you live in one of those areas, the minutes value should be 00. Time zone information is used to calculate UTC from local time. ***UTC is vitally important*** because it is used to calculate the meridian as well as altitude and azimuth.
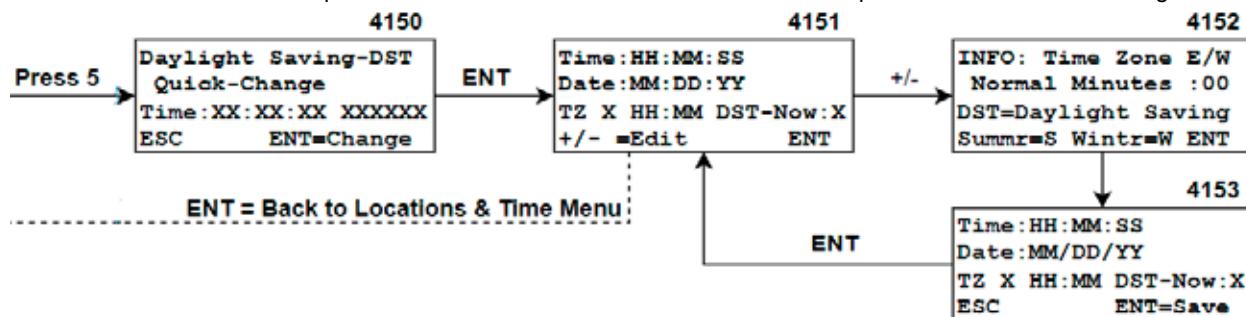
    Like longitude, time zones are measured from the Prime Meridian. Time zones are entered into the keypad as positive numbers, even though time zone 01 for central Europe is certainly different from time zone 01 for Iceland (2 hours different). The keypad knows the difference because you have entered E or W. Daylight Saving settings allow you to keep the keypad's clock correct with respect to both your current local time and UTC without having to use a fake time zone setting.

5. Set Daylight Saving/Standard Time using the W or S buttons on your keypad..

    ○   W= Standard Time, set to W in Winter or if you observe standard time year around.

    ○   S= Daylight Saving Time, set to S in summer.

6. Daylight Saving settings allow you to keep the keypad's clock correct with respect to both your current local time and UTC without having to use a fake time zone setting.   A good check is to look at the 4=Time/LST window from the main menu.

    ○   During standard time (winter in the N. hemisphere) the difference between UTC and your local time should equal your time zone.

    ○   During daylight saving time (summer) the difference will be your time zone MINUS 1 hour for western longitudes, and your time zone PLUS 1 hour for eastern time zones.

7. Save new data by pressing the ENT button (keypad will beep to confirm) or revert to the original data with the ESC button (screen 4121).

8. The time has now been updated in the keypad and sent to the mount. Proceed with your session. There is need to cycle power.

Qwik Daylight Saving Time

 Version 5 of the keypad features an easy-peezy automated process for the time changes between Daylight Saving Time (DSvT) and Standard Time (ST). Just a few button presses and you are done.

1. Path: Main Menu > 2=Setup Menu > 1=Locations & Time > 5=QwkDST. The present time and DST setting will display.

These characters will flicker since they are continually updating. This is normal.

2. Press ENT=Change. The keypad will beep and the DST setting will automatically change to the opposite season and the hour will either "Fall back" or "Spring forward" as appropriate.

3. Review the settings and press ENT=Yes to confirm (the keypad will beep) and return to the Locations & Time menu. That's all there is to it.   If you need to make further changes, use the +- button to edit.

Setting Keypad to UTC (aka GMT)
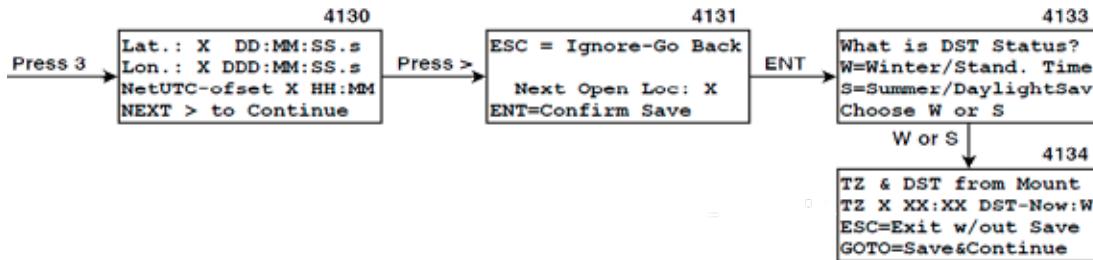
Running everything on UTC is a great way to do things if the laptop is completely dedicated to astronomy endeavors. Some professional astronomers set everything including their lives to UTC. **The main thing to remember is that EVERYTHING needs to be set to UTC.** Normal commercial software intended for amateurs will often want to default you to a time zone. Once you have everything set up though, it's awesome.

1. Go to the Date & Time entry window (Main menu > Setup > 1=Locations & Time > 2=Date & Time > +/-=Edit). An information screen will display regarding time zones and Daylight Saving abbreviations. Press ENT to proceed.

2. Set the time to the current UTC time and Time Zone = 00. The DST setting must also be set to W=Winter and it will stay W all year round. If you do not know the UTC time, simply search the internet: UTC time.

3. Press ENT to save. The keypad will beep when the values are saved and sent to the mount. You will return to the Setup Menu.

4. Press Menu/ESC to go back to the Main Menu

5. Press 4=Time/LST and verify that Local time = UTC

6. DONE!! Don't forget to set your astronomy computer to UTC.

Get Location From Mount

If you are using an external computer to control your telescope, the mount and the keypad could be using different location settings. This command will update the keypad with the last location that was sent to the mount from your computer. This feature is extremely handy for computers synced with GPS units.
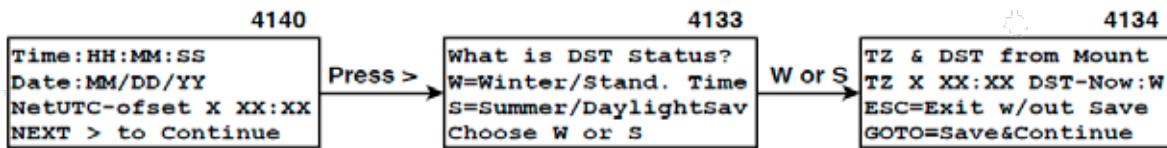
When this feature is selected, a display will appear with the information the keypad has obtained from the mount. If you are using a computer, compare this screen to your computer's settings to be sure they match. If they do not match closely you may need to initialize the mount again from the computer.

1. Go to the Date & Time entry window (Main menu > 2=Setup > 1=Locations & Time > 3=Get Loc. frm Mount). The keypad will query the mount and display the current location data in the CP4/CP5 memory.

2. Review the data and press NEXT> to continue.

3. The next open location slot will display. If you already have location data in 9 slots, the new data will overwrite the data in the 9th slot.

   a) Press ESC to cancel out of the routine

   b) Press ENT to confirm saving in the next open slot and proceed to the DST status screen.

4. Enter Your Daylight Saving (DST) status using either the W or S button.

5. Review the Time Zone (TZ) and Daylight Saving (DST) data from the mount to be sure that they are accurate for your present location.

   a) Press ESC to ignore and cancel out of the change and go back to the Setup Menu.

   b) Press GOTO to save the location to memory in the designated slot.

6. If you use 3=Get Loc. frm Mount, it is strongly advised that you then use 4=Get Time frm Mnt.

Get Time From Mount

If you are using an external computer to control your telescope, the mount and the keypad could be using different time settings. This command is extremely handy for computers synced with atomic clocks and will sync the keypad with the time that was sent to your mount by the computer. When this feature is selected, a display will appear with the information the keypad has obtained from the mount. Compare this screen to your computer's settings to be sure they match.

```
              4140                        4133                            4134
 ┌──────────────────────┐     ┌──────────────────────┐      ┌──────────────────────┐
 │Time:HH:MM:SS         │     │What is DST Status?   │      │TZ & DST from Mount   │
 │Date:MM/DD/YY         │Press>│W=Winter/Stand. Time  │W or S│TZ X XX:XX DST-Now:W  │
 │NetUTC-ofset X XX:XX  │     │S=Summer/DaylightSav  │      │ESC=Exit w/out Save   │
 │NEXT > to Continue    │     │Choose W or S         │      │GOTO=Save&Continue    │
 └──────────────────────┘     └──────────────────────┘      └──────────────────────┘
```
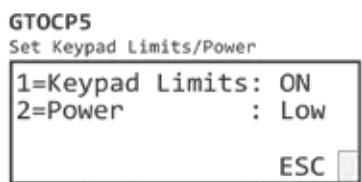
1. Go to the Date & Time entry window (Main menu > 2=Setup > 1=Locations & Time > 4=Get Time. frm Mnt). The keypad will query the mount and display the current time and date and NetUTC offset that is in the CP4/CP5 memory.

2. Press NEXT > to continue.

3. Enter Your Daylight Saving (DST) status using either the W or S button.

4. Review the Time Zone (TZ) and Daylight Saving (DST) data from the mount to be sure that they are accurate for your present location.

   a) Press ESC to exit without saving.

   b) Press GOTO to save and continue.

Future Features
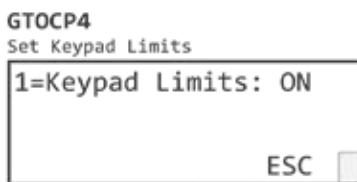
Reserved for future feature updates.

Set Keypad Limits (Both); Power (GTOCP5)

Press 3 in the Setup Menu to bring up the Keypad Limits (aka: safety mount tracking limits). Keypad Limits are present for both the GTOCP4 and GTOCP5. Power settings (CP5 only).

```
GTOCP5
Set Keypad Limits/Power

┌─────────────────────────┐
│1=Keypad Limits: ON      │
│2=Power        : Low     │
│                         │
│                 ESC  ▯  │
└─────────────────────────┘
```
AP Mach2GTO

```
GTOCP4
Set Keypad Limits

┌─────────────────────────┐
│1=Keypad Limits: ON      │
│                         │
│                         │
│                 ESC  ▯  │
└─────────────────────────┘
```
All Other AP GTO Mounts

Keypad Limits On/Off

Be sure that you upgrade your control box to version P02-06 or later before using this feature.

Limits can be toggled ON or OFF by pressing 1.

Limits OFF

Allows the mount to track past the meridian with the scope underneath the mount until either:

- The safety hard stop is reached in the Mach2. In this position, the CW-shaft will point be pointing up near the meridian.

- The permanent preset internal firmware limit is reached in the GTOCP4. When the preset limit is reached, the counterweight shaft will be pointing at the meridian. The position of the limit cannot be changed by the user; it is hard-coded in the firmware. NOTE: The factory default is set to OFF to avoid confusion of the mount stopping for no apparent reason.

This setting allows the scope to be sent manually under the mount on the east side to track through the meridian into the west with normal counterweight-down orientation. You must exercise caution when using the mount with limits off and monitor the scope to prevent collision.

Limits ON

The mount stops at the counterweight-horizontal position and stops tracking at the meridian. You have several options to track past the meridian:

- Meridian Delay can be used to advance the stop point to allow tracking past the meridian by 1 to 6 hours. Care must be taken to assure that the telescope will clear the pier or tripod when tracking past the meridian. Refer to the information regarding meridian delay on page 50.

- Flip the mount to the other side with the following procedure: Press +- button . 9=RA/DEC Controls -> 4=Flip Scope. Refer to additional information on page 50

- Entering an object a second time and pressing GoTo will also flip sides and continue tracking.

Important Notes

- The limit setting is remembered by the mount through a power cycle beginning with CP4/5 firmware version P02-06.

- APCC will turn this limit off when its own limits are engaged, so it doesn't interfere with any of the APCC limits.

- Other 3rd party programs do not change this limits status because they do not know about these limits or the commands.

- ***PLEASE always use the latest firmware in your GTOCP4/5 control box!*** Limit behavior has been vastly improved since v. P02-06. Updates to the firmware are quite simple and relatively fast using either a browser or the Java-based Astro-Physics USB/Serial Utilities. Use your provided username/password to download at: https://www.astro-physics.com/software-updates/

Power HI/MED/LOW - GTOCP5 only

Toggle through three power settings: HI, MED, and LOW.

The HI setting is the normal default setting which produces the full torque on the servo motors for tracking the most unbalanced loads and the heaviest telescope setups without possibility of stalling.

The two lower settings can be used for lighter loads that are well balanced. They are useful where the mount is operated with a battery and where low current consumption is needed. The Low setting reduces power approximately 40% from 1.35 amps to 0.9 amps at 12.5 volts battery usage. Slewing power and torque are not affected, only the current consumption during tracking is reduced which is 95% of the power normally drawn from a battery. Power settings are remembered in new sessions.

Park, Auto-Connect and Keypad Update Options

Press 4 in the Setup menu (Main Menu > Setup > Kpd, Mnt, Park Opt.) to bring up six mount park positions, the AutoConnect options and the keypad database update routine.

```
0,1,2,3,4,5=Mnt Park
7=Auto-Connect:NO
8=Keypad Update
```

Park Options

Basic Concepts

Simply turn power off: The scope can be left in any orientation and power can be turned off without first parking the mount. The motors, CP4/5 and keypad will all be de-energized. The position of the mount will be stored in the CP4/5 and remembered when the mount is powered up again. It will <u>begin to track immediately</u> so must be used with some care.

- ○ Recommended only for for AutoConnect:Yes since the mount will start tracking immediately when power is applied. This can be quite useful if you have a brief power outage during an imaging session since the mount will automatcially initialize and begin tracking as if nothing had happened. However, if your keypad is set to AutoConnect:No, the mount must be initialized right away to avoid a timing error which has the potential to track into a counterweight-up position before initializing and cause the first GoTo slew to take the scope into the pier!

- ○ Please do not power down the mount with the counterweights higher than the telescope ... it is not a recommended position from which to restart.

Defined park positions: Press 1 thru 5 to send the mount to one of the preset park positions which can be used to orient the telescope for a number of alignment options. Parking the mount turns off the motors but keeps the keypad and CP4/5 controller powered on until the power is turned off. Refer to "Appendix F: Pre-Defined Park Positions" on page 76 for photos illustrating each park position and additional information.

Park 0: Park 0 (Park in Place) is not a predefined park position. Rather, it used to put the mount into a custom parked state at your current position. Park 0 basically says: "Park here." The motors are de-energized, but the keypad and CP4/5 remain powered on until the power is turned off. The position will be remembered, but the mount will not begin tracking again until initialized in the next session. Park 0 does NOT save the position to be used again to park at a later time. You must redefine this custom position each time.

It is important to understand that parking is a state of being in which the motors are de-energized. The mount will remain in a parked state when it is powered up the next time. It will await initialization from the control program, whether it be the keypad or a computer program. This is a very safe state.

Park Your Mount to a Defined Park Position or Park 0

1. Path: Main Menu -> Setup -> 4=Kpd,Mnt,Park Opt.

2. Choose either 0, 1, 2, 3, 4 or 5 wtih the buttons. Depending on which number you choose, the scope will slew to one of the park positions shown on page 76 (Park 0 will park at the current location). The screen display will remind you to let the park slew finish before powering off. You will also have the option of selecting MENU to unpark and resume tracking in the event you change your mind.

3. Remove the power to avoid potential damage by lightening. Disconnect the power supply from the wall for optimal protection. f

Starting Your Next Session

The startup routine will vary depending on the control box that you are using. The Mach2GTO is unique in its construction wtih the absolute encoders coupled to the shaft so that it always knows its position.

GTOCP5 Only with Mach2GTO

- ● Positions 1 thru 5 are fixed encoder positions and do not change with time, date, location or ReCal data. Position 0 is not an encoder position and is the same in the CP5 as it is for the CP4 as described above.

- Starting your next session: The encoders are used to determine the mount position automatically when power is turned back on during the next session. No accuracy is lost and no homing is required when starting a new session. The mount will know where it is even if the clutches were loosened and moved.

GTOCP4

- Starting your next sesson if your mount has NOT been moved by hand using the clutches.

    ○ Auto-Connect: NO. The mount will begin tracking in R.A. when you select "1=Resume from Last Position. This initializes the mount.

    ○ Auto-Connect: YES. The mount will automatically be initialized with the last position and begin tracking when you apply power.

- Starting your next session if your mount HAS been moved using the clutches.

    ○ Auto-Connect: NO. Select 1=New Setup during the startup procedure, move your mount to the desired park position by hand and select the appropriate Park Position (1,2,3,4 or 5).

    ○ Auto-Connect: YES. Follow one of these:

        ◦ Before you begin the startup routine, move your mount back to the same position that you ended the prior session and proceed with the startup routine. This is a good reason to be consistent with the park position that you choose at the end of your sessions.

        ◦ If already initialized with Auto-Connect:YES, you will need to set your keypad to Auto-Connect: NO (through the Main Menu > 2=Setup > 4=Kpd,Mnt,Park Opt.) Then, park your mount and follow the startup procedure for Auto-Connect: NO. You may then change back to Auto-Connect:YES for the next session, if desired.

Auto-Connect: NO, YES or EXT

Press 7 in the Kpd, Mnt, Park Opt. window to toggle through: NO, YES, EXT.

AutoConnect NO: At power-up, the location and time/date are displayed on the keypad and can be edited or updated. Options are to accept the data, edit the data or bring up a new location for initializing this session. Tracking will begin as soon as the mount is initialized. AutoConnect NO should be the default setting for mounts that are frequently moved and do not have a permanent setup.

AutoConnect YES: At power-up, the mount will initialize with the saved location data and use the keypad clock time for initialization of the mount CP4/5 servo. The keypad will go directly to the Main menu without bringing up the time, date, location data. Tracking will begin as soon as the mount is powered up. This is the preferred method for mounts that are in a permanent location and are not being initialized from external software.

AutoConnect EXT: At power-up, the keypad will not initialize the mount with keypad time, date, location data and will wait until the mount is initialized by external data from a computer or other device. This way the mount can be sent more exact time data from a precision time source on your computer via APCC or the ASCOM driver. Initial pointing accuracy in R.A. is dependent on sub-second time accuracy since the RA axis position will be off by 15 arc seconds for every 1 second time error upon initialization. For the mount to know exactly where it is pointed in the sky it must have accurate time data at startup.

If super-accurate pointing is required at startup but exact time is not available, then the next best thing is to do a plate solve and ReCal on a known star or star field. APCC Pro has the capability to do plate solves and other pointing functions with available software.

The startup routines for each of these various options were discussed earlier in this manual.

Impact of Auto-Connect Settings:

- Auto-Connect set to NO: The mount will not start tracking until you complete the startup routine to initialize.

- Auto-Connect set to YES: The mount will begin tracking as soon as power is applied.

- Auto-Connect set to EXT: The mount should be parked and unparked only by the computer, not the keypad in order to utilize the most accurate time information from the computer. Do not park with one and then unpark with the other. This is very important to remember.

Keypad Database Update

Use this routine only when instructed for a keypad update.

Press 8 in the Kpd, Mnt, Park Opt. window to access the Keypad Upgrade Menu. Follow the procedure below only if you have prepared the Keypad Loader program and are ready to begin the loading process.

Press 1= Load Data Base. Use this to load a new database in the future or reload the database if you replaced your keypad battery.   You will not need to go into this menu during the normal use of your mount. If you enter the window by mistake, press the MENU/ESC button to exit.

Press 2=Reset keypad. Use this to reset the location, time, time zone, daylight savings and other user settings to the default zero values. This may be useful if you purchase a used mount and wish to set the parameters yourself. It may also be necessary in certain circumstances for keypad updates.

TOOLS MENU

The Menu that displays will depend on the settings within your CP4/5 that indicate whether the mount has absolute encoders and if the Keypad Modeling License has been activated. Only the functions that are available to the CP4/5 will display and may vary depending on the CP4/5 that is used. . These are the possible screen displays:

All GTOCP5 and GTOCP4 with Absolute Encoders and Modeling License

```
Tools Menu
2=Modeling
3=Photo Timer
4=Bookmark Edit
```

GTOCP4 with Absolute Encoders, no Modeling License

```
Tools Menu
3=Photo Timer
4=Bookmark Edit
```

GTOCP4 with Modeling License, no Absolute Encoders

```
1=PEM
2=Modeling
3=Photo Timer
4=Bookmark Edit
```

GTOCP4 with no Modeling License or Absolute Encoders

```
1=PEM
3=Photo Timer
4=Bookmark Edit
```

PEM (Permanent Error Memory) Curve - GTOCP4 only

Astro-imaging demands the highest tracking accuracy to obtain pinpoint star images throughout your exposure. This routine corrects any periodic error present in your system for optimum performance. You do not need PEM if you are a visual astronomer. It is only recommended for the most critical applications.

GTOCP4 of new mounts without absolute encoders. The CP4 for these mounts are preloaded with the corrected PEM curve measured during the final phase of our testing process during assembly. It is not necessary to generate a new PEM until you have used the mount for a while. The new curve can be generated using the keypad with the procedure below or with PEMPro Periodic Error Management software from Sirius Imaging.

GTOCP4 of 1100 and 1600 mount with absolute encoders. The absolute encoders correct periodic error continuously. This feature will not be visible to these mounts since PEM curves should not be generated.

GTOCP5 with Mach2GTO. All Mach2GTO mounts have absolute encoders which correct periodic error continuously. The PEM option will not display on the keypads used with these mounts since PEM curves should not be generated.

The servo drive electronics contain a very sophisticated permanant periodic error compensation circuit (other manufacturers call this PPEC). Because a majority of the periodic error is due to the R.A. drive worm and is quite predictable, it is possible to signifcantly reduce it by simply having the controller "memorize" the corrections you make with your button inputs and automatically play them back for each cycle of the worm.

Polar align your muont so that you have minimum R.A. and Dec. drift. Be sure that the night is steady enought with minimum atmospheric motion, and pick a star nea the zenith to minimize atmospheric refraction errors. You must use an eyepiece with a reticle. The recording process with take about 7 minutes to compete for the 1600,, 1200, 1100, 900 and Mach1 mounts and 8 mniutes for the 600E and 400 mounts. the keypad will deisplay the PEM recording screen for the full 8 minutes. However, the actaul recording will only occur for the appropriate length of tiem for your mounts. this timing information is stored in the CP4/5 control box.

Record Permanent Error Memory

1. Select response rate for N-S-E-W buttons at the Main Menu or by pressing the +_ button.. For medium power, use 1x, for higher powers use 0.5x or 0.25x.

```
      PEM Setup
PEM State: None
1=Rec 2=Play 3=None
Press MENU to Exit
```

2. Go to 1=PEM setup screen (Main Menu -> Tools)

3. Be sure that the PEM state is set to NONE.

4. Put star on reticle. Place a medium brightness star on the reticle at moderately high power so you can easity see the R.A. gear drift. It is sometimes easier if you defocus the star a bit. Practice moving the star with your N-S-E-W buttons to get the feel for guiding. To change the response rate for the N-S-E-W buttons, press "+-" button.

5. Choose 1=Rec. A warning screen will display. Press 1=Cont to continue. The record cycle will begin approximately 10 seconds later, signaled with an audible beep. The screen will show "Recording" throughout the entire cycle.

```
WARNING:
PEM will be
overridden
1=Cont / Menu=Exit
```

6. Keep star on reticle. During the 7 minute recording period, keep the star on the reticle using the N-S-E-W buttons. Every button input will be recorded. Avoid trying to guide out any atmospheric scintillation since this will add a random noise error into your initial guide rate. If an autoguiding camera is available, it can be used to guide, and the controller will faithfully remember each error correction that it makes. An autoguider is extremely accurate and will place into memory a very smooth corection of the gear error. A countdown timer is provided for your convenience. You cannot cancel the recording session once it has begun.

7. Screen will return to PEM setup screen and you will hear a beep when the recording cycle is complete.

8. The PEM state will change to Play upon completion of the cycle. You can watch the reticle again to see how accurately your corrections were made. If you are not satisfied with your results, record again using the same procedure.

Playback PEM Corrections

Activate the corrections when guiding astrophotos or CCD images if you are satisfied with the quality of your recording. When autoguiding, the signal from the autoguider will override the PEM correction as needed. the recording itself will remian unchanged until you record over it again.

1. Choose PLAY from the PEM Setup screen. The keypad will automatically play back the correct portion of the worm gear error at whatever tracking, slewing or directional button rate that you choose.

2. If you do not want PEM to be active, toggle to the NONE setting.

Modeling

These modeling features are useful for imagers who primariy control their scopes with the keypad and wish to do unguided imaging. It is not necessary for visual observers.

```
1=Point+Track Model
2=Drift Model
3=Ortho Model
              ESC
```

GTOCP5: Modeling has been enabled for all CP5 control boxes.

GTOCP4: In order utilitize the modeling features when using the GTOCP4, the Keypad Modeling Feature License must be activated in the CP4. All CP4 control boxes with serial numbers CP4-1423 and later were programmed with this feature prior to shipment. Refer to "Keypad Modeling Feature License" on page 6 for more information.
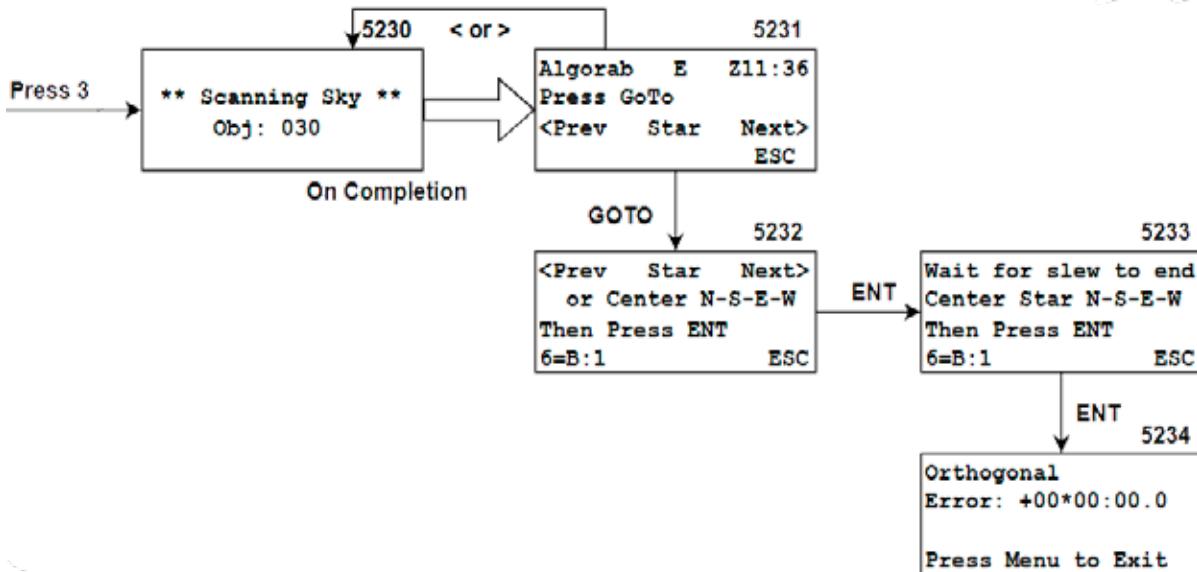
Under Tools Menu there are 3 choices for the CP4/5: Modeling, PhotoTimer, and Bookmark.

Select 2 = Modeling to bring up 3 modeling choices - Ortho, Point&Track and Drift models. Depending on the setup and software available, the user can employ the Drift and Ortho routines with just the keypad or the full Point + Track model for all-sky modeling.

Ortho Model

What you need: GTOCP4 with Keypad Modeling License Feature enabled or any GTOCP5.

The Ortho routine uses the star database in the keypad to compensate for telescope non-orthogonality. It is an automatic routine that simply requires the user to start it going and to center the star at the keypad prompt. This is a quick-and-easy routine that only uses one star.

```
        5230    < or >              5231
Press 3    ┌──────────────────┐   ┌──────────────────┐
──────────▶│ ** Scanning Sky **│──▶│Algorab   E   Z11:36│
           │    Obj: 030       │   │Press GoTo          │
           └──────────────────┘    │<Prev   Star  Next>│
                                    │                ESC│
              On Completion         └──────────────────┘
                                        │ GOTO
                                        ▼
                                      5232                    5233
                             ┌──────────────────┐      ┌──────────────────┐
                             │<Prev   Star  Next>│ ENT  │Wait for slew to end│
                             │ or Center N-S-E-W │─────▶│Center Star N-S-E-W │
                             │Then Press ENT     │      │Then Press ENT      │
                             │6=B:1          ESC │      │6=B:1          ESC │
                             └──────────────────┘      └──────────────────┘
                                                              │ ENT
                                                              ▼  5234
                                                        ┌──────────────────┐
                                                        │Orthogonal         │
                                                        │Error: +00*00:00.0 │
                                                        │                   │
                                                        │Press Menu to Exit │
                                                        └──────────────────┘
```
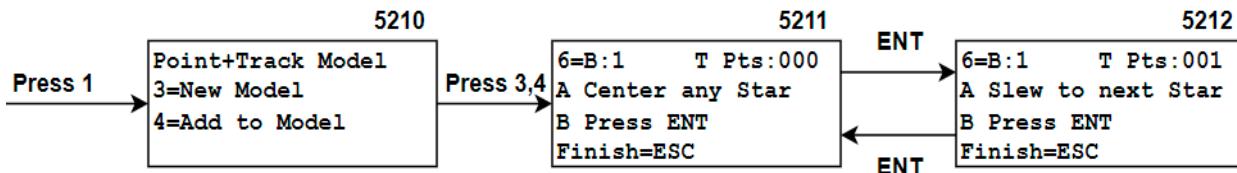
The Ortho model can be used by itself or in conjunction with the pointing model to form an all-sky model. The Ortho model should be created first or it will invalidate an existing pointing model. This happens because the effects of non-orthogonality on same-side pointing would be accounted for twice, once in the ortho model, and again in the pointing model. So, the ortho model **must be done first** to assure it is active when the pointing model is generated. Once the ortho model has been done the first time, it does not need to be re-done each time the pointing model is re-generated, unless the OTA / imaging train is changed.

1. Go to the Tools Menu window (Main Menu > 3=Tools)

2. Press 3=Ortho Model and the keypad will scan the database and display the name of a star within one hour of the meridian line. You can either press GoTo to send the scope to that star or use < or > buttons to select another star from the keypad database and press GoTo.

    a) If the screen displays W in the middle of the top line, the scope is pointing west and the star is in the west. If E is displayed, the scope is pointing east and will chose a star in the east.

    b) The zenith hour will will display in the upper right of the screen. Zenith hour is synonymous with LST (local sideral time).

3. Once the scope has reached the star's position, center it in your crosshair (eyepiece or digital image on your computer screen). Use button 6 to set the appropriate button rate. Press ENT to proceed. .

4. The mount will flip sides and do a safety slew to pick up the star on the opposite side.

5. Simply center the star again and press ENT.

6. The window will show the orthogonal error and the CP4/5 will apply the correction every time you slew.

7. The Ortho model is active all the time. It does not need to be user-activated.

Point + Track Model

What you need:
- GTOCP4 with Keypad Modeling License Feature enabled or any GTOCP5.
- Planetarium program.
- Telescope with camera.
- Plate solve program, recommended.

Point + Track model can be used for both precision pointing and for precise tracking of an object's path across the sky for unguided imaging. The model can store up to 8 data points along a series of 16 declination lines on both sides of the meridian. For CP4 units with S/N CP4-1005 and earlier, the non-volatile memory (NVM) is smaller. This results in only 8 available DEC lines. The unit can determine what NVM is installed, and will adjust the number of available DEC lines accordingly.

It is easiest to create the Point + Track Model with an external planetarium program where the user simply slews to any number of stars whose positions are precisely known. Then using a crosshair, the star is simply centered exactly and the data is entered into the control box memory. Once enough data points are stored, the model can be turned on for precise pointing, and the tracking rate can be set to Custom for precise tracking over time. It is not necessary to be precisely polar aligned for the pointing and tracking to be improved with modeling. However, the more precise the polar alignment, the more precise the model will be for long time exposures.

The upper right corner of window 5211 displays the number of data points that have been added for any particular Dec line. A new declination data line is created when a star is entered 10 degrees in declination from the original. Dec lines are created at 10 degree intervals from -90 to +90 degrees. Each Dec line is a corridor that includes any star that is within +/-5 degrees of the first one. Up to 8 stars can be measured and entered as data points on any one of 16 (or 8, in older units) declination lines in the model. The first declination line will have numbers from 1 to 8. The second Dec line will have numbers from 11 to 18, the third will have numbers from 21 to 28 and so on. As an example, a number 64 means that the 7th Dec line has 4 data points in it, and the user can add 4 more before that line is full.

Pointing Model

The easiest way to do the modeling is to follow one declination line on your planetarium program. For example, you could pick several stars near Declination +30 Deg that are within the +- 5 degree envelope. A star at +26 Dec and a star at +33 Dec would be sorted into the 30 degree corridor. A star at +36 degrees would be sorted into the +40 degree corridor and would therefore be registered as the first star in the second Dec line. All stars' motions and positions would be calculated properly according to their actual RA and Dec coordinates and proper offsets be applied, even if they are not exactly on the actual Dec center line.

The east and west models are independent. All mapped points are remembered through power cycles, available for correction in subsequent sessions, until you create a new model.

Recommendations

For good pointing over the entire sky, a minimum of 3 stars are needed for each Dec. line on both sides of the meridian. Start a model run by choosing a reference star near the zenith after centering and doing a Recal (Sync) on it.

Creating a custom tracking model

You can create a tracking model for any object by creating a path that the object will follow across the sky. You only need to model 8 points on the declination line that the object is on. The 8 stars chosen for the model will need to be on the same declination within +- 20 arc minutes of each other (the closer the better). The stars do not need to be on the exact declination of the object. They can be within +- 5 degrees of the object, but within +- 20 arc minutes of each other. The easiest way to create an exact path is to do a plate solve and center for each data point.

The alternative is to measure the exact drift for 8 points along the object's declination line (see Drift Model).

To create a model:

1. First, create an Ortho model as described on page 41. Even if you do not plan to account for meridian flips, the Ortho model will improve tracking rates derived from the pointing model. Without an ortho model, all points on a constant

DEC line must have exactly the same DEC coodinate to compute accurate tracking rates. If plate-solving is used, this may not be a problem. If objects are chosen from a catalog or planetarium program, it may not be feasible for all points on a DEC line to have exactly the same DEC coordinate. In this case, making an ortho model first is necessary.

2. Open your planetarium program. Identify a declination line in the area of the sky you wish to model.

3. On your keypad, select Point + Track Model (Main Menu > 3=Tools > 2=Modeling > 1=Point+Track Model).

4. Select 3=New Model if you have not created a model previously. Window 5211 will appear. The upper right will read "T Pts:000" since you do not have any points in your model when you start.

5. In your planetarium program, select a star along your target declination line and slew to it using the planetarium program.

6. Image and download for evaluation.

   a) Set your button rate by toggling button 6 and center your target star using the N-S-E-W buttons of the keypad. The lower rates of 1x to 12x can be used to quickly center a star on the crosshair, and the lowest rates of .25x and .5x can be used for very fine adjustment of the centering.

      Pro Tip: set your camera on continuous (slow video mode) with your program in order to continuously update 1 per second. This will allow you to see your adjustments quickly.

   b) Press RECAL or Sync on your planetarium program. This establishes the first reference star.

   c) Press ENT once the star is centered and RECAL or Sync is done.

7. Refer to your planetarium program and find another star near the declination line.

   a) Slew to this star with the planetarium program. Caution: Do not RECAL or Sync on these!. Press ENT.

   b) Center this new star with the keypad and press ENT.

8. Follow the instructions on the keypad to enter each subsequent star. The model can store up to 8 data points along a series of 16 (or 8, in older units) declination lines on both sides of the meridian. The T Pts:xxx display in the upper right corner of your window will help you keep track of the number of points you have acquired as mentioned above.

9. **If you wish to add points to your model, return to window 5210 and select 4=Add to Model and repeat.**

10. **Once you have enough points, press MENU/ESC to finish.**

11. **Return to the Main Menu and select 8=PntON to apply your model and set the tracking rate to 7=T:Cstm.**

Error Codes

- DEC Line Full: All 8 points of the constant-DEC line have already been mapped.

- No DEC Lines Avail: All constant-DEC lines are already populated.

- Mount Isn't Tracking: Mount is not in tracking mode and cannot map.

- Sequence Error: Already in mapping mode.

Drift Model
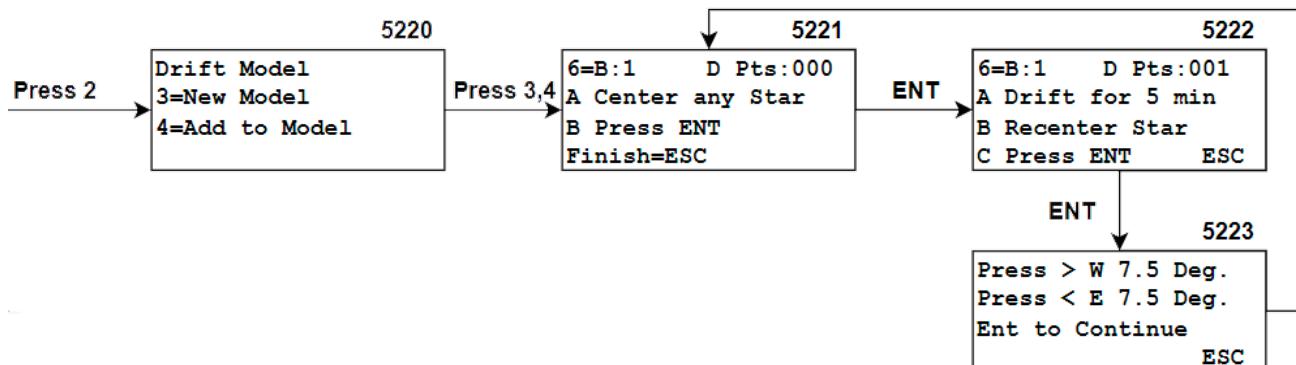
What you need:

- GTOCP4 with Keypad Modeling License Feature enabled or any GTOCP5.
- Telescope with camera.
- Computer with image aquisition software.

The Drift model is an alternate way to measure an object's path through the sky and then use it to compensate for drift for unguided imaging. It does not require any external planetarium software - it is a self-contained keypad routine. This model allows the user to build a tracking path for any object as it moves across the sky for a number of hours from East to West. The model measures the drift of stars along the constant declination of the object and applies the proper tracking rate in both RA and Dec axes to keep the object centered and not drifting for typical exposures of between 5 to 20 minutes.

The key is to measure the drift very accurately at several points along the path, starting with the object and moving west at several intervals. One simply does a GoTo slew to the object to be imaged, centers the object and takes a quick image to display some stars. You then pick any star, draw a small focus box around it (with crosshairs enabled) and begin a fast continuous download of the image. Magnify the image on the screen to perhaps 800x and center the star on the crosshair using the N-S-E-W buttons at the appropriate centering rate (.5x or .25x is recommended).

Up to 8 stars can be measured and entered as data points on any one of 16 (or 8, in older units) declination lines in the model. New object paths at different declinations can be measured as desired and simply added to the existing data. As long as the mount is not disturbed or moved, the data will be valid for future imaging sessions.

The upper right corner of window 5221 displays the number of data points that have been added for any particular Dec line. A new declination data line is created when a star is entered 10 degrees from the original. Dec lines are created at 10 degree intervals from -90 to +90 degrees. Each Dec line is a corridor that includes any star that is within 5 degrees of the first one. Up to 8 stars can be measured and entered as data points on any one of 16 declination lines (8 in older units) in the model. The first declination line will have numbers from 1 to 8. The second Dec line will have numbers from 11 to 18, the third will have numbers from 21 to 28 and so on. As an example, a number 64 means that the 7th Dec line has 4 data points in it, and the user can add 4 more before that line is full

The east and west models are independent. All mapped points are remembered through power cycles, available for correction in subsequent sessions, until you create a new model. It is not necessary to run the Ortho Model before the Drift Model; it will not be used.

1. Go to Drift Model window. (Main Menu > 3=Tools > 2=Modeling).

2. Select 3=New Model if you have not created a model previously. Window 5221 will appear. The upper right will read " D Pts:000" since you do not have any points in your model when you start.

3. Set your button rate (toggle button 6), center a star near the object you wish to image and press ENT. Window 5222 will display.

4. Allow some time to pass in order for drift to occur. The keypad window suggests 5 minutes; less time leads to lower accuracy.

5. Check your crosshair and recenter the star with your keypad buttons. If your camera can be put on video mode, this may facilitate quick centering.

6. Press ENT. This will register the drift measurement data at that point. Window 5223 will appear.

7. Press < or > to command the mount to move E or W in RA by 7.5 degrees (1/2 hour). Press the West button (> button)

to move 1/2 hour, or press it again to move 1 hour. The keypad will beep and the mount will move to the new position immediately. Each press of the button moves the mount by an additional 1/2 hour. It is recommended to move the mount by 1/2 hour if you are below about 45 degrees altitude, where the drift changes quickly. Above that altitude the drift is more regular and you can begin each point at 1 hour intervals. Generally it takes only 3 points above 45 degrees altitude and perhaps 3 - 4 points for locations between 0 and 45 degrees.

8. Press ENT. Screen 5221 will appear.

9. Find another star in the new field, center it and press ENT. You have just selected your second point. No need for RE-CAL or Sync.

10. Allow the mount to drift again and repeat the above procedure for as many points as you wish.   If you plan to image 1/2 to 1 hr, two points may be enough, one point near the object and the 2nd point 1 hr west of the object.

11. Once you have enough points, select Finish=ESC.

12. Return to the Main Menu and select 8=DrftON to apply your model.   At that point, the mount begins to apply the drift terms and adjusts the RA/Dec rates accordingly. If you want to see what they are, press ENT in the Main Menu and the display will show the RA and Dec drift rates in arc seconds per hour. Now re-enter the object and press GoTo to begin your imaging session.

13. If you wish to add points to your model at a later time, return to window 5220 and select 4=Add to Model. Points can be added at a later date and later session as long as the scope and mount have not been moved.

Pro Tip: Do your modeling before dark using an H-a filter to suppress the sky background and pick a bright star somewhere in the field along the declination of the object. You can generally be done in the hour during twilight before it gets dark enough for imaging. Stars of up to mag 5 can be imaged even before the sun has fully set if the sky is cloud and haze free.

If you don't move the mount and scope between imaging sessions, the model will be accurate for any length of time between sessions. The model will take into account drift due to polar misalignment, atmospheric refraction as well as minor drift due to instrument flexure (if repeatable). If you wish to add another object at a future time, you can use the Add Model routine instead of creating an entire new model. That new object can be anywhere in the sky at any declination.

If you model on a night of very high atmospheric pressure and then image on a night of low pressure, the measured refraction drift rate may be different. The model will not fully apply and you may be limited in exposure time before drift is detected in the image. Typically imaging times of 5 to 10 minutes will not be affected if the object is within +- 2 hours of the zenith.

This model is limited in scope, and if longer time exposures are needed or imaging with long focal lengths, we have a very extensive method using APCC-Pro with APPM that can take variable refraction into account as well as other factors.

Error Codes

- DEC Line Full: All 8 points of the constant-DEC line have already been mapped.

- No DEC Lines Avail: All constant-DEC lines are already populated.

- Mount Isn''t Tracking: Mount is not in tracking mode and cannot map.

- Sequence Error: Already in mapping mode.

- Drift Time Too Short: Didn't track long enough to get good data (currently at least 10 seconds is required).

- Excessive Drift: Amount of measured drift is way too large, i.e. did a large slew in the middle of the drift measurement.

Track Status

When you are in the main menu, press the ENT button to view the RA and Dec trim rates that are being applied to your track rate based on the model you created. You must have activated the model in order to see the numbers (Main Menu > 8=PntON or 8=DriftON).

```
Track Status
RA Trim  =   X
DEC Trim =   X
Arcsec per hr    ESC
```

Photographic Timer

Activate the countdown photographic timer to remind you when your exposure is completed. An audible beep will alert you that the time has expired.

1. Go to Photographic Timer window. (Main Menu > 3=Tools > 3=Photo Timer). The Photographic Timer window will appear.

```
Photographic Timer
Enter hh:mm:ss now
Timer: HH:MM:SS
Menu=EXIT        ENT
```

2. Enter hours, minutes and seconds. The timer will activate and begin recording in 10 seconds..

3. When the timer reaches 0, a series of audible beeps will sound. The display will begin to show negative numbers to let you know the time that has elapsed since the timer went off.

```
TIMER: HH:MM:SS


Press MENU to Exit
```

4. Press MENU to cancel timer at any time.

BookMark Edit

1. Go to the Bookmark Edit window (Main Menu > 3=Tools > 4=Bookmark Edit).

2. You have several options:

a) Press 1 to clear all bookmarks.

b) Press < or > to scroll through bookmarks until you find the one you want to delete. Note that only the bookmark number will display, so you have to know what object that bookmark represents in order to make your selection.

```
<   BookMark Edit   >
1=Clear ALL BookMks
2=DEL BookMk Nbr:02
```

c) Press 2 to clear the chosen bookmark.

d) Press MENU/ESC to exit.

e) Refer to "Object Bookmark Tool/Utility" on page 21 for a more complete discussion of the Bookmark feature.

+- BUTTON, HIDDEN TREASURES

CP4 no Encoders
```
Button Rate :<64  >

4=Kpd,Mnt,Park Opt.
9=RA/DEC Controls
```

CP4 w/ Encoders
```
Button Rate :<64  >
1=Find Home
4=Kpd,Mnt,Park Opt.
9=RA/DEC Controls
```

CP5
```
Button Rate :<64  >
1=Slew Home & Sync
4=Kpd,Mnt,Park Opt.
9=RA/DEC Controls
```

Button Rate

Press the +- button to adjust the rate when you are in the Main Menu, Objects Menu, object data menus and others. This ready availability is handy during your observing session for quick changes.

Refer to the three screens above. Note the differences based on the controller type and encoder status. Scroll through the rates with the <PREV or NEXT> buttons. Some menu locations will lock out the +- button.

Slew Home and Sync - Mach2GTO with CP5 Only

Use this command if you believe your mount is not pointing correctly. This can occur if you have inadvertently recalibrated or synced on an incorrect object.
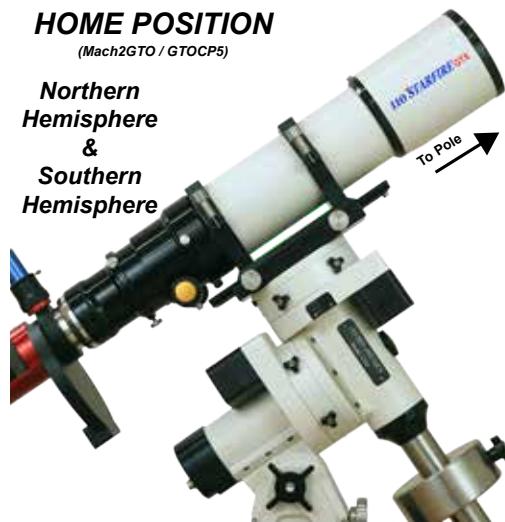
This feature works with a Mach2GTO even if the clutches have been released and the mount has been moved manually.

The home position was preset in the GTOCP5 at Astro-Physics approximating the park 3 position. The encoders know that position in all circumstances. It is NOT user configurable and cannot be changed.

- In order for this feature to function properly, the correct time/date/location data must be sent to the mount during initialization.

- This function is available when you press the +- button from within most menus. The screen display labeled CP5 above will appear.

- Press 1=Slew Home & Sync. The encoders will send your mount to the preset home position that has been programmed into your CP5. RA moves first, then Dec.

HOME POSITION
(Mach2GTO / GTOCP5)

Northern Hemisphere & Southern Hemisphere

To Pole

This is a very special position that is established by Astro-Physics when programming the Absolute Encoders. It is highly precise.

- The mount will automatically perform a full Sync on the HOME coordinates when it reaches the HOME position. You are finished. Proceed with your session.

Find Home - 1100 and 1600 Mounts with Absolute Encoders Only

Use this command if you believe your mount is not pointing correctly. This can occur if you have inadvertently recalibrated or synced on an incorrect object.

At the present, you cannot establish or modify encoder-based Home and Limits on the 1100GTO and 1600GTO using the keypad. The keypad can now *home* the mount, but there are limitations since these mounts are not *clutch aware.* (Clutch aware mounts like the Mach2GTO have mechanical features that allow the encoders to remain calibrated during and after movement via the clutches.) Homing requires that ALL of the following four conditions be met:

1. You MUST have already configured the Home position using either APCC or the APAE Utility.

2. The configured Home position MUST be at one of the 5 predefined AP park positions. The keypad cannot calibrate on custom Home positions.

3. The mount must be correctly initialized with time/date/location information. This is essential for determining the correct Right Ascension and Hour Angle values during the full Sync that is performed. .

4. The mount was NOT moved manually (by hand) with clutches released or by disengaging the motor/gearbox (for instance during balancing procedure). This doesn't just mean in the last few moments. You can NOT have used the clutches since the last time the Home position was established. Otherwise, you must reestablish encoder-based Home and Limits with APCC or the APAE Utility before you can use the keypad to *home* the mount.

Follow this procedure to home an 1100GTO or 1600GTO with Absolute Encoders:

This function is available when you press the +- button from within most menus. The center screen displayed at the top of page 47 labeled: *CP4 w// Encoders* will appear.

1. Press 1=Find Home. The mount will immediately slew to the pre-established home position: RA first - then Dec. It will NOT be automatically synced or recalibrated since the 1100 and 1600 do not have encoder systems that are clutch aware.

2. Verify that the mount has slewed to the correct position. If you haven't lost encoder calibration by using the clutches, the position should be perfect after the slew. If not, finish the movement by loosening the clutches and moving the mount. You want the mounjt as close as possible to your home position.

3. Select 2=Setup > 4=Kpd,Mnt,Park Opt. > 7=Auto-Connect:NO. Toggle to NO if set to YES or EXT.

4. Power the mount off. Wait a few seconds.

5. Power back on and resume from whichever park position you used as *Home*

6. Remember to restore your Auto-Connect setting if you changed it.

Shortcut to Kpd, Mnt, Park Opt Settings

Press +- button and refer to either CP5 or CP4 screen shown above. Select 4=Kpd,Mnt,Park Opt. to reveal the following options that are discussed fully in "Park, Auto-Connect and Keypad Update Options" on page 36: The +- Button provides quick access to these functions.

```
0,1,2,3,4,5=Mnt Park
7=Auto-Connect:NO
8=Keypad Update
```

- Park Options - Pre-set park positions

- Auto-Connect - YES, NO or EXT

- Keypad Update - Update firmware and/or database

RA/Dec Controls

Press +- button and refer to either CP5 or CP4 screen shown above. Select 9=RA/Dec Controls for these options:

Meridian Delay
Refer to "Meridian Delay Setting" on page 50 for detailed information.

```
1=Rev RA : Normal
2=Rev DEC: Normal
Meridian Del  < ss >
4=Flip Scope    ESC
```

Flip Scope
Refer to "Flip Scope" on page 50 to learn about this handy feature.

RA/Dec Reverse

If your object moves down when you push the "N" button or left when you push the "E" button, use this function to reverse the direction of the buttons.

1. Press the +- button when you are operating in many keypad windows.

2. Select 9=RA/Dec Controls.

3. Select 1 and/or 2 to correct the apparent motion. If you want to reverse direction of the "N" and "S" button, press 1 and the display will toggle from Normal to Reversed.   You can make the same adjustment with the "E" and "W" buttons by toggling number 2. When properly set up, the direction buttons will cause the object to move according to your orientation at the eyepiece.

TWEAK YOUR POINTING ACCURACY

If you slew to an object and it is not in the center of your eyepiece, you have several options.

Recalibrate

Recalibrate is used to correct the calibration of the mount if an object that you just slewed to does not appear in the center of the field. Recalibrate can be used even when the object is past the meridian and the telescope is below the mount.

Simply press the RECAL and NEXT> buttons simultaneously to recalibrate on your object. The keypad will beep to confirm that the command has been issued.

When using the GTOCP4/5, you can send the mount to an object via a GoTo slew using an external planetarium program, then center and recalibrate using the keypad.

NOTE: You can only use the recalibration option if the keypad has the target object in its memory, i.e. you just gave a slew command via the keypad or external program and the keypad already knows it should be at that object. You CANNOT use this option if you manually move the telescope to another position, since the keypad would have no way of knowing what that object is.

Orthogonality Model

This feature is available for all GTOCP5 control boxes and only those GTOCP4 control boxes that have Keypad Modeling Feature License enabled. Refer to "Keypad Modeling Feature License" on page 6 for more information.

If orthogonality issues are affecting your pointing accuracy, use the extremely quick and easy "Ortho Model" on page 41 . For a discussion of factors that cause orthogonality issues, see "Orthogonality" on page 52

Alternatively, you can use a smart strategy to compensate. Organize your observing around one or several regions of sky. The regions can be on opposite sides of the meridian, but slews within the region should not require you to cross the meridian. When you finish a region, slew to a bright star in the next region and recalibrate (RECAL + NEXT>). As long as you are not swapping sides by crossing the meridian, you should be able to slew to objects within a reasonable radius of your calibration star with satisfactory accuracy. The useful radius will simply depend on the degree to which your system is not orthogonal, but you should be able to observe in a radius of 20 to 30 degrees before recalibrating.

Pointing Models
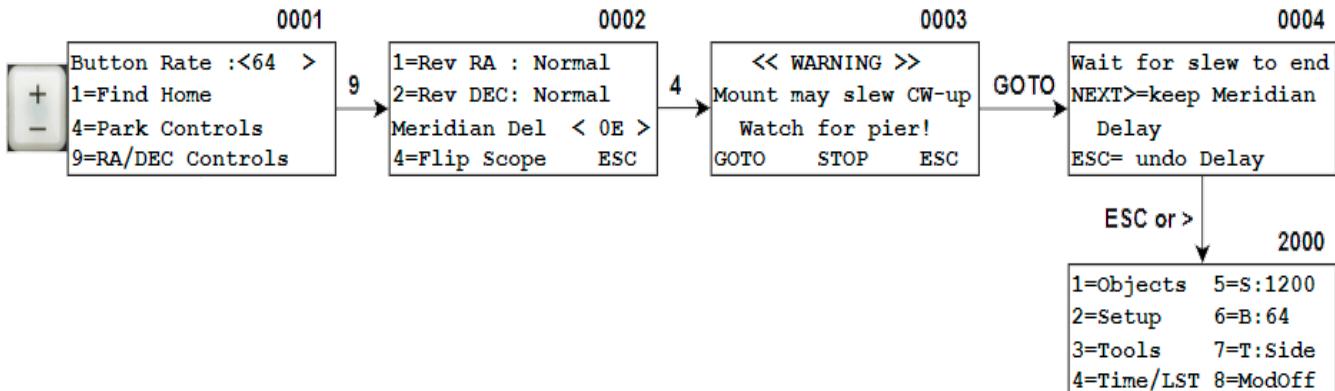
This feature is available for all GTOCP5 control boxes and only those GTOCP4 control boxes that have Keypad Modeling Feature License enabled. Refer to "Keypad Modeling Feature License" on page 6 for more information.

There are two pointing model options available in the keypad. The Pointing + Tracking Model can be used if you have a planetarium program available and the Drift Model can be used if you rely solely on the keypad. Check out the information in the corresponding sections beginning on page 40

MERIDIAN DELAY OPTIONS

Flip Scope
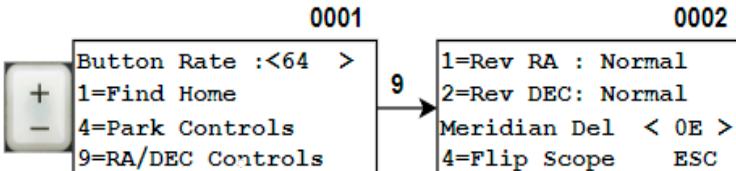
The Flip Scope routine is an alternative way to achieve meridian delay and is easier to accomplish than the Meridian Delay Setting described below.

Path to this function: +- Button > 9=RA/DEC Controls > 4=Flip Scope

1. Press 4= Flip Scope and a warning window will appear as shown in screen 0003 above.

2. Visually check the position of your telescope to determine if there is a chance it could strike the pier when it flips to the other side of the mount. Press ESC if you think there is a chance that the movement will not be successful.

3. Press GOTO to initiate the flip. Keep you finger near the STOP button just in case you need to halt the movement.

4. After the slew is complete, press NEXT> to keep the meridian delay or ESC to undo the delay. The mount will not slew. You must initiate another flip to go back to the other side.

Meridian Delay Setting

Path to this function: +- Button > 9=RA/DEC Controls > Meridian Del

This feature should be used with caution to prevent accidental telescope contact with the pier.

In normal use without any delay, the telescope will track through the meridian when you are following an object. However, when you enter the object again, or if you enter a nearby object that has drifted past the meridian and then slew, the telescope automatically switches sides so that the scope will be right side up instead of diving under the mount. Sometimes, for astro-imaging, you may wish to delay the meridian swap, especially if you are imaging mosaics and the area is beginning to drift across the meridian.

Remember, it is the GoTo slew that will flip the mount...not tracking!

To delay the swap, follow the path above from the +- button to the Meridian Del setting. Note that this is normally set to zero. Use the <PREV and NEXT> buttons to enter a 1 hour to 6 hour delay or advance of the meridian swap. A setting of 1W means that the scope will continue to slew to objects up to 1 hour past the meridian in the west. It effectively delays the meridian swap by 1 hour. A 6 hour delay means the scope will slew all the way to the horizon on the wrong side of the mount. Entering a 1E means that the scope can be placed on the other side of the mount by 1 hour earlier than normal.

Mnemonic devices: *E will flip the mount early and W will wait to flip! ...or...*
**   *E will move the meridian east and W will move the meridian west.***

As a general rule, objects on the pole side of your zenith are poor choices for using the meridian delay. When the telescope is pointed at an object on the pole side, the back of the instrument can hit the pier if you go past the meridian. Objects away from the pole (south if you are in the north and north if you are in the south) are less likely to be a problem. You can see this quite easily by loosening your clutches and swinging your telescope around your mount. Point your scope at various points in the sky along a north / south line and then see how far you can swing the RA past the meridian before striking the pier. In so doing, you can learn a range of safe declination values and meridian delay parameters for your location and particular setup.

Power off resets Meridian Delay to 0W. When you turn the power off, the meridian hour offset will return to the default setting of 0W. You will have to make a conscious decision to change it during each observing session. If you are permanently mounted and leave your power on after parking, be sure to remember that you have made this setting. We encourage you to return to 0W (or 0E) at the end of your observing session.

Note to programmers: The meridian delay is accomplished by sending a time to the mount that is from 1 to 6 hours different than the clock time. 6 hours plus delays the meridian to the east; 6 hours minus delays the meridian to the west. So, if you want to delay the meridian from your computer terminal, just send the revised time to the servo drive per the AP protocol. **Caution:** If you park the mount with this fake time and turn off the power, then unpark later, the mount will point at the wrong RA It will be off by the amount you faked. If you are going to send a fake time to the mount with your computer, then make sure you reset to the correct time before you park the mount and turn off the power.

ORTHOGONALITY

Version 5 of the keypad program includes the Ortho Model routine to correct for orthogonal error. This section provides an explanation of orthogonal error and outlines common causes.
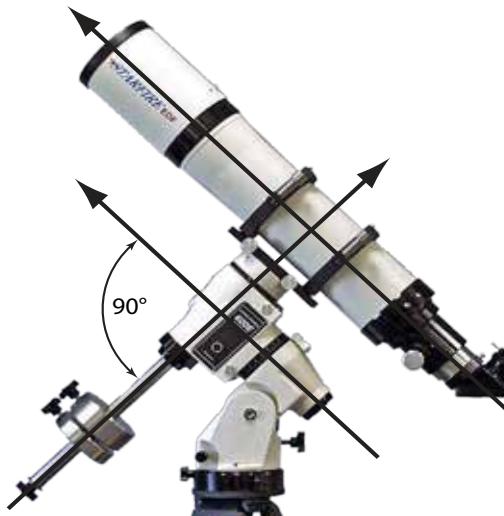
The ability to meature orthogonal error (often called "cone error") is available for all GTOCP5 control boxes and only those GTOCP4 control boxes that have the Keypad Modeling Feature License activated. Please refer to "Keypad Modeling Feature License" on page 5 for more information.

A telescope is said to be orthogonal when its optical axis is exactly 90 degrees from the declination axis as shown in the photo. In Alt-Az fork mounts, orthogonality is not an issue. Pointing is straightforward, the scope never has to flip sides and the mount does not need to be polar-aligned. However, in German equatorial mounts, a non-orthogonal telescope will cause errors in any routine that will reduce the pointing accuracy of the system by exactly twice the orthogonal error.

Telescope orthogonality requires that two conditions be met:

1. The RA and Dec axes of the mount are at precise right angles to each other. Astro-Physics mounts are very accurately machined and fulfil this condition.

2. The optical axis of the telescope must be parallel to the RA (polar) axis. Some of the factors which could affect this condition include:

   a) Improperly machined rings.

   b) Wedge in the mounting plate or brackets.

   c) Incorrect position and tilt of a diagonal mirror or diagonal assembly that is not machined square.

   d) Set screws in focusers, diagonals or adapters which tilt the optical axis.

   e) Die-cast tube assemblies that lack the precision squareness of a CNC machined part. The tube points in one direction while the optics can point several degrees off in another direction.

   f) Diagonal displacement or tilt in a Newtonian.

   g) Mirror shift in a catadioptric. The optics are not tied down to a reference plane, but can move around and point in different directions depending on focus position.

   h) Collimation adjustment. There is enough freedom in the tilt of a secondary mirror to allow the image to be moved completely out of the eyepiece field. Therefore, collimating the scope may disturb or change orthogonality.

Whatever the reason, the Ortho Model routine will calculate the orthogonal error and compensate for it as you slew from one object to another. Refer to "Ortho Model" on page 41

SLEWING DURING THE DAY

You must take extra precautions when observing during the daytime. If not done correctly, you may suffer permanent damage to your eyesight. Be sure to supervise all children and other observers who may not be aware of the dangers.

Observing in the daytime offers many rewards – finding the planets and stars, and observing sunspots and solar prominences of the sun itself.

Potential Dangers

- As the telescope is slewing from one part of the sky to another, it may pass across the face of the sun or near enough so that looking through the telescope would be dangerous unless you have a proper solar filter. DO NOT LOOK DIRECTLY INTO THE TELESCOPE OR VIEWFINDER WHILE THE TELESCOPE IS SLEWING.

- The position of the planet or star that you wish to see may be too close to the sun to observe safely. CHECK THE POSITION OF THE TELESCOPE BEFORE YOU LOOK INTO THE EYEPIECE OR VIEWFINDER. BE SURE THAT IT IS NOT POINTING AT OR ANYWHERE NEAR THE SUN. Remember that the finder has a wide field of view so you can see a large portion of the sky.

- PLEASE DO NOT OVERRIDE THE SUN SAFE ZONE DURING THE DAY. This feature is in the keypad for your safety.

- Observing the sun. Please be sure that you have installed a good quality SAFE solar filter that covers the optics in front of the telescope or use a Herschel Wedge. Never use eyepiece filters since they may break due to the intense heat of the sun. Do not use solar filters that are cracked (glass), torn (Mylar or AstroSolar) or have many pinholes (any solar filter). Astro-Physics offers high-quality solar filters fabricated with Baader Planetarium AstroSolar material or you can purchase the AstroSolar material in sheets and make the filter yourself.

```
WARNING: Looking at
or near the SUN can
DAMAGE your eyes.
GOTO / Menu to Exit
```

How to Observe Safely

1. Place dust cover or proper solar filters on the main objective of the telescope and the finder scope before you slew the telescope, use the N-S-E-W directional buttons or move it manually. Be sure to inspect your solar filter beforehand to be sure that it is not damaged in any way that will allow light through. Use a black marker to cover pinholes that may appear in the coating.

2. Slew or move the telescope.

3. Visually check the position of the telescope to be sure that it is not pointing at or anywhere near the sun.

4. If you are observing planets, the moon or stars – remove the dust cover or filter only when you are sure that it is safe.

5. To observe the sun – ALWAYS leave your solar filter in place over the front of the objective and finder.

6. Put the solar filters or dust covers back on the telescope before slewing to the next object.

UPDATING YOUR KEYPAD

Keypad updates will be available periodically through the Software Updates tab on our website. The keypad loader program is Java-based and can be used on Windows, Mac and Linux operating systems. Follow the directions available from the website to complete the load process.

There are two parts of the keypad firmware.

● Program Load. The firmware program for the function/features that send the commands to the control box.   These new versions will add new features and fix bugs.

● Database Load: The second part controls the object databases (names, RA/Dec coordinates, magnitudes, constellations, etc).   New databases may be issued in the future or you may need to reload your database if your keypad battery loses power. When the battery fails (average 5–6 years), then the database will need to be downloaded and reinstalled.

TROUBLESHOOTING

My keypad does not display the modeling features that I would like to use.

The modeling features are only available for the GTOCP4 control boxes in which the Keypad Modeling Feature License has been activated. All GTOCP4 control boxes with serial numbers CP4-1423 and later were programmed with this feature prior to shipment. The license is available for purchase for all earlier control boxes. For more information, refer to: https://www.astro-physics.com/software-updates.

The Keypad displayed the message "motor stall."

This error message indicates that the keypad and servo box are unable to communicate with each other and the LED on the control box will also turn yellow indicating that the overload protection feature has been activated. Here are some possible causes to check:

- Your telescope is not balanced properly. Refer to your mount manual for guidance.

- The motors are not connected to the servo box. Be sure all connectors are locked in place.

- A wire connection in one of the mount cables is broken.

- One of the motors is not functioning.

- The mesh of the worm gear and worm wheel is too tight. This will cause the motors to overload, which will cause the overload protection feature of the control box to activate and shut down the signal to the motors.

- All mounts except the Mach2GTO: One of the small gears in the motor box is jammed.

- Foreign material got into the motor gearbox.

Solution:

Check all possibilities above and correct, if possible. To initiate tracking again, press the N-S-E-W buttons or initiate a slew. If you still get an error message, press the button a second time, just to be sure that the buffer cleared. If you have not moved the telescope while diagnosing the problem, the position will still be in memory and you can continue as if nothing ever happened.

If the "motor stall" message appears again, you have not corrected the cause of the problem. If you are unable to resolve it, check the technical support section of our website before contacting Astro-Physics. Additional troubleshooting and adjustment information will be posted there in the future.

The keypad display says "low battery."

Your battery output has dropped below 11 volts. If you plug in your dew heater, CCD camera or other power-hungry device into the same battery that operates your mount, your battery voltage will drop momentarily. We recommend that you power your mount from a separate battery. You might consider a large marine battery. If 110V is available, we recommend that you use a power supply (filtered and regulated) with a minimum output of 5 amps at 12V DC. The Mach2GTO should use the power supply provided with the mount. DO NOT use a wall-transformer.

The keypad locks up on the "Astro-Physics" window and will not advance to the next window.

There are several conditions that may cause this to occur.

- Battery power has dropped. If you measure the output of your battery to be above 11.5V, but the keypad is locking up, please contact Astro-Physics. If your battery measures below 11.5V, replace your battery.

- The internal board may have come loose and pulled out of its socket. This can happen if the CP4/5 was dropped. Remove the top white cover by removing 4 screws (be careful to not pull out the antenna wire from the PC board). You will see the upper board that has the microprocessor on it. Push down on it to seat it fully in its connector. There may be 2 standoffs that the board snaps into (later versions are secured with screws). Make sure it sits fully on those standoffs. If the board is held by screws, it is very unlikely that the board has moved, but push the board down just in case.

  Plug the power into the CP4/5 and check to see if the LED lights. If it does, you should be able to communicate with the keypad. Replace the cover if everything checks out. If that does not fix the problem, contact Astro-Physics.

- Recent lightning strike or power surge damaged components in the control box. The control box will have to be returned to Astro-Physics. Please call ahead for a return authorization number.

- Other unknown chip failure in the control box. Contact Astro-Physics.

- Keypad locks up in cold weather but works fine when used in warmer temperatures. This is a rare problem caused by a defective real-time clock in the keypad. Contact Astro-Physics.

- Corroded circuit board in the Keypad.

The keypad display text blinks on and off, but there is no clicking sound.

- Battery power has dropped below the required threshold. If you measure the output of your battery to be above 11.5V, but the keypad is still blinking on and off, please contact Astro-Physics. If your battery measures below 11.5V, replace your battery.

The keypad is resetting – making a clicking sound as the window display disappears and reappears

- If Auto-Connect is set to "NO", the Location Selection menu will appear each time requesting you to startup again.

- If Auto-Connect is set to "YES" or "EXT", the display will reappear wherever you left off. The clicking noise will be annoying, but you will not lose functionality.

There are several potential causes and detailed solutions, which are outlined in the [Keypad Resetting Solutions](#) white paper on our website in the Support section for current products.

The telescope slewed in the wrong direction toward the pier.

As long as you provide the mount with proper information, your telescope will slew safely from one part of the sky to another. These are a few scenarios that can cause a problem:

- You did not start your first session at that location by following the appropriate procedure outlined in the manual.

- Your time or daylight savings is not set correctly (if it applies to your state or country). In the time & date menu, press the "W" button if daylight savings is not in effect (e.g. winter in the northern hemisphere). Follow the Daylight Savings change routine, if necessary. Refer to the appropriate section in the manual.

- Your time setting sent to the mount by the computer may be inaccurate.

- GTOCP4: You did not begin your session with the correct park postion selection.

I pressed the keypad button and it jumped ahead two steps.

This happens if you hold the button too long. Just give it a short press.

The power light goes out and the motors stop.

The voltage of your battery has probably gone below 10 volts.

The Time/LST Window doesn't exit right away when I hit the menu button.

Please push and hold the menu button until you are brought back to the Main Menu. A quick push may not be recognized right away in this menu since time is continually updating.

The Mount will not park correctly, nor will it point properly, it also indicates that an object is below the horizon when I can clearly see it is not.

GTOCP4: This can occur if you did not enter your location, date and time data and follow the Normal Startup Procedure with the keypad set to AUTOCONNECT:NO. Every time you start up at a new location or change your time, you must follow the New Setup startup procedure to send vital date, time and location data to your mount. Otherwise, it will be lost.

I am upgrading my keypad from the website and the loader appears to be working but no data is appearing on the window other than sending page x…

GTOCP4 only with versions prior to P01-01-14. In most cases this is caused by attempting to load the keypad through the bottom port on the control box. The keypad MUST be loaded through top COM port on the control box or the load will fail if you do not have a more recent version installed. If you have already attempted to load your keypad in this manner and are only left with a blinking cursor on the window, you can start the loading steps from the start and your eypad will load properly. Please follow all download instructions very carefully.

When I enter an object it slews to the wrong place, tells me that it is below the horizon by several degrees and has completely incorrect object data.

If all 3 of these symptoms are occurring it is likely that your keypad's database has been corrupted or lost. Many things can cause this to happen, removing the internal keypad battery improperly, having a dead or dying battery or power surges caused by lightning strikes are all common triggers for this. Follow the directions on the website to reload the database. If the database continues to fail after you have reloaded it, please call Astro-Physics for further instructions.

APPENDIX A: RELEASE NOTES

Version 5.00.10, 06-20-22
- Improved error messages for modeling.
- Improved wording on +- button window. Changed 4=Park Controls to 4=Kpd,Mnt,Park Opt.
- Bug fix: Correct display of Tools Menu to show options approproiate for each control box configuration.I
- Bug fix: Lock out possible number entry for +- fields in Custom RA/Dec entry screens.

Version 5.00.9,   09-18-21
Database must be loaded when upgrading to this version.
- Add display of database version.
- Increase the time that the version numbers display before advancing.
- Added keypad selections required for GTOCP4.
- Bug fix: Errors in star database.

Version 5.002 to 5.008   (not released, development only)
-

Version 5.001, 11-10-20
- Improved routine for Get Time from Mount and Get Location from Mount.

Version 5.00.135.2, 11-07-20
- Released for Mach2GTO mounts with GTOCP5.

APPENDIX B: COMMON STARS – BY CONSTELLATION

Constellation	Star Name	Flamsteed-Bayer Designation	Abbrev	Magnitude(SAO)
Andromeda				
	Alpheratz	21-Alpha Andromedae	Alf And	2.1
	Mirach	43-Beta Andromedae	Bet And	2.4
	Almach	57-Gamma1 Andromedae	Gam And	2.3
Aquarius				
	Sadalmelik	34-Alpha Aquarii	Alf Aqr	3.2
	Sadalsuud	22-Beta Aquarii	Bet Aqr	3.1
	Skat	76-Delta Aquarii	Del Aqr	3.5
	Albali	2-Epsilon Aquarii	Eps Aqr	3.8
Aquila				
	Altair	53-Alpha Aquilae	Alf Aql	0.9
	Alshain	60-Beta Aquilae	Bet Aql	3.9
	Tarazed	50-Gamma Aquilae	Gam Aql	2.8
Aries				
	Hamal	13-Alpha Arietis	Alf Ari	2.2
	Sheratan	6-Beta Arietis	Bet Ari	2.7
	Mesarthim	5-Gamma2 Arietis	Gam Ari	4.8
Auriga				
	Capella	Alpha Aurigae	Alf Aur	0.1
	Menkalinan	34-Beta Aurigae	Bet Aur	2.1
Boötes				
	Arcturus	16-Alpha Boötis	Alf Boo	0.2
	Nekkar	42-Beta Boötis	Bet Boo	3.6
	Seginus	27-Gamma Boötis	Gam Boo	3.0
	zar	36-Epsilon Boötis	Eps Boo	2.7
	Muphrid	8-Eta Boötis	Eta Boo	2.8
	Alkalurops	51-Mu1 Boötis	Mu Boo	4.5
Cancer				
	Acubens	65-Alpha Cancri	Alf Cnc	4.3
	Asellus Borealis	43-Gamma Cancri	Gam Cnc	4.7
	Asellus Australis	47-Delta Cancri	Del Cnc	4.2
Canis Major				
	Sirius	9-Alpha Canis Majoris	Alf CMa	-1.6
	Mirzam	2-Beta Canis Majoris	Bet CMa	2.0
	Wezen	25-Delta Canis Majoris	Del CMa	2.0
	Adhara	21-Epsilon Canis Majoris	Eps CMa	1.6
	Furud	1-Zeta Canis Majoris	Zet CMa	3.1
	Aludra	31-Eta Canis Majoris	Eta CMa	2.4
Canis Minor				
	Procyon	10-Alpha Canis Minoris	Alf CMi	0.5
	Gomeisa	3-Beta Canis Minoris	Bet CMi	3.1
Canis Venatici				
	Cor Caroli	12-Alpha Canum Venaticorum	Alf CVn	2.9
	Chara	8-Beta Canum Venaticorum	Bet CVn	4.3
Capricornus				
	Algedi	6-Alpha2 Capricorni	Alf Cap	3.8
	Dabih	9-Beta1 Capricorni	Bet Cap	3.3
	Nashira	40-Gamma Capricorni	Gam Cap	3.8
	Deneb Algedi	49-Delta Capricorni	Del Cap	3.0
Carina				
	Canopus	Alpha Carinae	Alf Car	-0.9
	Miaplacidus	Beta Carinae	Bet Car	1.8
	Avior	Epsilon Carinae	Eps Car	1.7
	Aspidiske	Iota Carinae	Iot Car	2.3
Cassiopeia				
	Schedar	18-Alpha Cassiopeiae	Alf Cas	2.5
	Caph	Beta Cassiopeia	Bet Cas	2.3
	Navi	27-Gamma Cassiopeiae	Gam Cas	2.8
	Ruchbah	37-Delta Cassiopeiae	Del Cas	2.7
Centaurus				
	Alpha Centauri	Alpha1 Centauri	Alf Cen	0.1
	Hadar	Beta Centauri	Bet Cen	0.9

Constellation	Star Name	Flamsteed-Bayer Designation	Abbrev	Magnitude(SAO)
	Menkent	5-Theta Centauri	Tet Cen	2.3
Cepheus				
	Alderamin	5-Alpha Cephei	Alf Cep	2.6
	Alfirk	8-Beta Cephei	Bet Cep	3.3
	Erral	35-Gamma Cephei	Gam Cep	3.4
	Kurhah	17-Xi Cephei	Xi Cep	4.6
Cetus				
	Menkar	92-Alpha Ceti	Alf Cet	2.8
	Diphda	16-Beta Ceti	Bet Cet	2.2
	Kaffaljidhma	86-Gamma Ceti	Gam Cet	3.6
	Baten Kaitos	55-Zeta Ceti	Zet Cet	3.9
	Mira	Omicron Ceti	Omi Cet	2.1
Columba				
	Phact	Alpha Columbae	Alf Col	2.8
	Wazn	Beta Columbae	Bet Col	3.2
Corona Borealis				
	Alphecca	5-Alpha Coronae Borealis	Alf CrB	2.3
	Nusakan	3-Beta Coronae Borealis	Bet CrB	3.7
Corvus				
	Alchiba	1-Alpha Corvi	Alf Crv	4.2
	Gienah	4-Gamma Corvi	Gam Crv	2.8
	Algorab	7-Delta Corvi	Del Crv	3.1
Crater				
	Alkes	7-Alpha Crateris	Alf Crt	4.2
Crux				
	Acrux	Alpha2 Crucis	Alf Cru	1.6
	Mimosa	Beta Crucis	Bet Cru	1.5
	Gacrux	Gamma Crucis	Gam Cru	1.6
Cygnus				
	Deneb	50-Alpha Cygni	Alf Cyg	1.3
	Albireo	6-Beta1 Cygni	Bet Cyg	3.2
	Sadr	37-Gamma Cygni	Gam Cyg	2.3
Draco				
	Thuban	11-Alpha Draconis	Alf Dra	3.6
	Rastaban	23-Beta Draconis	Bet Dra	3.0
	Eltanin	33-Gamma Draconis	Gam Dra	2.4
	Altais	57-Delta Draconis	Del Dra	3.2
	Edasich	12-Iota Draconis	Iot Dra	3.5
	Giausar	1-Lambda Draconis	Lam Dra	4.1
	Alrakis	21-Mu Draconis	Mu Dra	5.1
	Grumium	32-Xi Draconis	Xi Dra	3.9
Equuleus				
	Kitelpha	8-Alpha Equulei	Alf Equ	4.1
Eridanus				
	Achernar	Alpha Eridani	Alf Eri	0.6
	Cursa	67-Beta Eridani	Bet Eri	2.9
	Zaurak	34-Gamma Eridani	Gam Eri	3.2
	Azha	3-Eta Eridani	Eta Eri	4.0
	Acamar	Theta Eridani	Tet Eri	3.2
	Beid	38-Omicron Eridani	Omi Eri	4.1
	Keid	40-Omicron2 Eridani	Omi Eri	4.5
Gemini				
	Castor	66-Alpha Geminorum	Alf Gem	1.6
	Pollux	78-Beta Geminorum	Bet Gem	1.2
	Alhena	24-Gamma Geminorum	Gam Gem	1.9
	Wasat	55-Delta Geminorum	Del Gem	3.5
	Mebsuta	27-Epsilon Geminorum	Eps Gem	3.2
	Mekbuda	43-Zeta Geminorum	Zet Gem	3.9
	Propus	Eta Geminorum	Eta Gem	3.3
Grus				
	AlNair	Alpha Gruis	Alf Gru	2.2
Hercules				
	Rasalgethi	64-Alpha Herculis	Alf Her	3.5
	Kornephoros	27-Beta Herculis	Bet Her	2.8

Constellation	Star Name	Flamsteed-Bayer Designation	Abbrev	Magnitude(SAO)
Hydra				
	Alphard	30-Alpha Hydrae	Alf Hya	2.2
Leo				
	Regulus	32-Alpha Leonis	Alf Leo	1.3
	Denebola	94-Beta Leonis	Bet Leo	2.2
	Algieba	41-Gamma2 Leonis	Gam Leo	2.6
	Zosma	68-Delta Leonis	Del Leo	2.6
	Adhafera	36-Zeta Leonis	Zet Leo	3.6
	Alterf	4-Lambda Leonis	Lam Leo	4.5
	Chertan	70-Theta Leonis	Tet Leo	3.4
	Rasalas	24-Mu Leonis	Mu Leo	4.1
	Arneb	11-Alpha Leporis	Alf Lep	2.7
	Nihal	9-Beta Leporis	Bet Lep	3.0
Libra				
	Zubenelgenubi	9-Alpha2 Librae	Alf Lib	2.9
	Zubeneschamali	27-Beta Librae	Bet Lib	2.7
Lyra				
	Vega	3-Alpha Lyrae	Alf Lyr	0.1
	Sheliak	10-Beta Lyrae	Bet Lyr	3.9
	Sulafat	14-Gamma Lyrae	Gam Lyr	3.3
Ophiuchus				
	Rasalhague	55-Alpha Ophiuchi	Alf Oph	2.1
	Cebalrai	60-Beta Ophiuchi	Bet Oph	2.9
	Yed Prior	1-Delta Ophiuchi	Del Oph	3.0
	Yed Posterior	2-Epsilon Ophiuchi	Eps Oph	3.3
	Sabik	35-Eta Ophiuchi	Eta Oph	2.6
	Marfik	10-Lambda Ophiuchi	Lam Oph	3.9
Orion				
	Betelgeuse	58-Alpha Orionis	Alf Ori	0.6
	Rigel	19-Beta Orionis	Bet Ori	0.3
	Bellatrix	24-Gamma Orionis	Gam Ori	1.7
	Alnilam	46-Epsilon Orionis	Eps Ori	1.8
	Mintaka	34-Delta Orionis	Del Ori	2.5
	Alnitak	50-Zeta Orionis	Zet Ori	2.0
	Trapezium	41-Theta1 Orionis	Tet Ori	5.4
	Saiph	53-Kappa Orionis	Kap Ori	2.2
	Meissa	39-Lambda Orionis	Lam Ori	3.7
Pavo				
	Peacock	Alpha Pavonis	Alf Pav	2.1
Pegasus				
	Markab	54-Alpha Pegasi	Alf Peg	2.6
	Scheat	53-Beta Pegasi	Bet Peg	2.6
	Algenib	88-Gamma Pegasi	Gam Peg	2.9
	Enif	8-Epsilon Pegasi	Eps Peg	2.5
	Homam	42-Zeta Pegasi	Zet Peg	3.6
	Matar	44-Eta Pegasi	Eta Peg	3.1
	Biham	26-Theta Pegasi	Tet Peg	3.7
Perseus				
	Mirfak	33-Alpha Persei	Alf Per	1.9
	Algol	26-Beta Persei	Bet Per	2.9
	Atik	44-Zeta Persei	Zet Per	2.9
	Menkib	46-Xi Persei	Xi Per	4.0
Phoenix				
	Ankaa	Alpha Phoenicis	Alf Phe	2.4
Pisces				
	Alrescha	113-Alpha Piscium	Alf Psc	4.3
Piscis Austrinus				
	Fomalhaut	24-Alpha Piscis Austrini	Alf PsA	1.3
Sagittarius				
	Rukbat	Alpha Sagittarii	Alf Sgr	4.1
	Arkab	Beta1 Sagittarii	Bet Sgr	4.3
	Alnasi	10-Gamma2 Sagittarii	Gam Sgr	3.1
	Kaus Media	19-Delta Sagittarii	Del Sgr	2.8
	Kaus Australis	20-Epsilon Sagittarii	Eps Sgr	2.0
	Ascella	38-Zeta Sagittarii	Zet Sgr	2.7

Constellation	Star Name	Flamsteed-Bayer Designation	Abbrev	Magnitude(SAO)
	Kaus Borealis	22-Lambda Sagittarii	Lam Sgr	2.9
	Nunki	34-Sigma Sagittarii	Sig Sgr	2.1
Scorpius				
	Antares	21-Alpha Scorpii	Alf Sco	1.1
	Graffias	8-Beta Scorpii	Bet Sco	2.9
	Shaula	35-Lambda Scorpii	Lam Sco	1.7
	Lesath	34-Upsilon Scorpii	Ups Sco	2.8
Serpens				
	Unukalhai	24-Alpha Serpentis	Alf Ser	2.8
	Alya	63-Theta Serpentis	Tet Ser	4.5
Taurus				
	Aldebaran	87-Alpha Tauri	Alf Tau	1.1
	Elnath	112-Beta Tauri	Bet Tau	1.8
	Alcyone	25-Eta Tauri	Eta Tau	3.0
	Celaeno	16 Tauri	16 Tau	5.4
	Electra	17 Tauri	17 Tau	3.8
	Taygeta	19 Tauri	19 Tau	4.4
	Maia	20 Tauri	20 Tau	3.9
	Sterope	21 Tauri	21 Tau	5.9
	Merope	23 Tauri	23 Tau	4.3
	Atlas	27 Tauri	27 Tau	3.8
	Pleione	28 Tauri	28 Tau	5.2
Triangulum Australe				
	Atria	Alpha Trianguli Australis	Alf TrA	1.9
Ursa Major				
	Dubhe	50-Alpha Ursae Majoris	Alf UMa	2.0
	Merak	48-Beta Ursae Majoris	Bet UMa	2.4
	Phecda	64-Gamma Ursae Majoris	Gam UMa	2.5
	Alioth	77-Delta Ursae Majoris	Eps UMa	1.7
	Megrez	69-Delta Ursae Majoris	Del UMa	3.4
	Mizar	79-Zeta Ursae Majoris	Zet UMa	2.4
	Alkaid	85-Eta Ursae Majoris	Eta UMa	1.9
	Talitha	9-Iota Ursae Majoris	Iot UMa	3.0
	Tania Borealis	33-Lambda Ursae Majoris	Lam UMa	3.5
	Tania Australis	34-Mu Ursae Majoris	Mu UMa	3.2
	Alula Borealis	54-Nu Ursae Majoris	Nu UMa	3.7
	Alula Australis	53-Xi Ursae Majoris	Xi UMa	3.9
	Muscida	1-Omicron Ursae Majoris	Omi UMa	3.5
	Alcor	80 Ursae Majoris	80 UMa	4.0
Ursa Minor				
	Polaris	1-Alpha Ursae Minoris	Alf UMi	2.1
	Kochab	7-Beta Ursae Minoris	Bet UMi	2.2
	Pherkad	13-Gamma Ursae Minoris	Gam UMi	3.1
Vela				
	Regor	Gamma2 Velorum	Gam Vel	1.9
	Suhail	Lambda Velorum	Lam Vel	2.2
Virgo				
	Spica	67-Alpha Virginis	Alf Vir	1.2
	Zavijava	5-Beta Virginis	Bet Vir	3.8
	Porrima	29-Gamma Virginis	Gam Vir	2.9
	Vindemaitrix	47-Epsilon Virginis	Eps Vir	3.0
	Zaniah	15-Eta Virginis	Eta Vir	4.0
	Syrma	99-Iota Virginis	Iot Vir	4.2

APPENDIX C: ALPHABETICAL STAR LIST

These stars are listed in the same order as they appear on your display when you are either following the calibration routine or have chosen Stars from the Objects Menu. Note that Polaris appears twice.

Common Name	Flamsteed-Bayer Designation	Abbrev.	Magnitude (SAO)
Polaris	Alpha Ursae Minoris	Alf UMi	2.1
Acamar	Theta Eridani	Tet Eri	3.2
Achernar	Alpha Eridani	Alf Eri	0.6
Acrux	Alpha2 Crucis	Alf Cru	1.6
Acubens	65-Alpha Cancri	Alf Cnc	4.3
Adhafera	36-Zeta Leonis	Zet Leo	3.6
Adhara	21-Epsilon Canis Majoris	Eps CMa	1.6
Albali	2-Epsilon Aquarii	Eps Aqr	3.8
Albireo	6-Beta1 Cygni	Bet Cyg	3.2
Alchiba	1-Alpha Corvi	Alf Crv	4.2
Alcor	80 Ursae Majoris	80 UMa	4.0
Alcyone	25-Eta Tauri	Eta Tau	3.0
Aldebaran	87-Alpha Tauri	Alf Tau	1.1
Alderamin	5-Alpha Cephei	Alf Cep	2.6
Alfirk	8-Beta Cephei	Bet Cep	3.3
Algedi	6-Alpha2 Capricorni	Alf Cap	3.8
Algenib	88-Gamma Pegasi	Gam Peg	2.9
Algieba	41-Gamma2 Leonis	Gam Leo	2.6
Algol	26-Beta Persei	Bet Per	2.9
Algorab	7-Delta Corvi	Del Crv	3.1
Alhena	24-Gamma Geminorum	Gam Gem	1.9
Alioth	77-Epsilon Ursae Majoris	Eps UMa	1.7
Alkaid	85-Eta Ursae Majoris	Eta UMa	1.9
Alkalurops	51-Mu1 Boötis	Mu Boo	4.5
Alkes	7-Alpha Crateris	Alf Crt	4.2
Almach	57-Gamma1 Andromedae	Gam And	2.3
AlNair	Alpha Gruis	Alf Gru	2.2
Alnasl	10-Gamma2 Sagittarii	Gam Sgr	3.1
Alnilam	46-Epsilon Orionis	Eps Ori	1.8
Alnitak	50-Zeta Orionis	Zet Ori	2.0
Alpha Centauri	Alpha1 Centauri	Alf Cen	0.1
Alphard	30-Alpha Hydrae	Alf Hya	2.2
Alphecca	5-Alpha Coronae Borealis	Alf CrB	2.3
Alpheratz	21-Alpha Andromedae	Alf And	2.1
Alrakis	21-Mu Draconis	Mu Dra	5.1
Alrescha	113-Alpha Piscium	Alf Psc	4.3
Alshain	60-Beta Aquilae	Bet Aql	3.9
Altair	53-Alpha Aquilae	Alf Aql	0.9
Altais	57-Delta Draconis	Del Dra	3.2
Alterf	4-Lambda Leonis	Lam Leo	4.5
Aludra	31-Eta Canis Majoris	Eta CMa	2.4
Alula Australis	53-Xi Ursae Majoris	Xi UMa	3.9
Alula Borealis	54-Nu Ursae Majoris	Nu UMa	3.7

Common Name	Flamsteed-Bayer Designation	Abbrev.	Magnitude (SAO)
Alya	63-Theta Serpentis	Tet Ser	4.5
Ankaa	Alpha Phoenicis	Alf Phe	2.4
Antares	21-Alpha Scorpii	Alf Sco	1.1
Arcturus	16-Alpha Boötis	Alf Boo	0.2
Arkab	Beta1 Sagittarii	Bet Sgr	4.3
Arneb	11-Alpha Leporis	Alf Lep	2.7
Ascella	38-Zeta Sagittarii	Zet Sgr	2.7
Asellus Australis	47-Delta Cancri	Del Cnc	4.2
Asellus Borealis	43-Gamma Cancri	Gam Cnc	4.7
Aspidiske	Iota Carinae	Iot Car	2.3
Atik	44-Zeta Persei	Zet Per	2.9
Atlas	27 Tauri	27 Tau	3.8
Atria	Alpha Trianguli Australis	Alf TrA	1.9
Avior	Epsilon Carinae	Eps Car	1.7
Azha	3-Eta Eridani	Eta Eri	4.0
Baten Kaitos	55-Zeta Ceti	Zet Cet	3.9
Beid	38-Omicron Eridani	Omi Eri	4.1
Bellatrix	24-Gamma Orionis	Gam Ori	1.7
Betelgeuse	58-Alpha Orionis	Alf Ori	0.6
Biham	26-Theta Pegasi	Tet Peg	3.7
Canopus	Alpha Carinae	Alf Car	-0.9
Capella	Alpha Aurigae	Alf Aur	0.1
Caph	Beta Cassiopeiae	Bet Cas	2.3
Castor	66-Alpha Germinorum	Alf Gem	1.6
Cebalrai	60-Beta Ophiuchi	Bet Oph	2.9
Celaeno	16 Tauri	16 Tau	5.4
Chara	8-Beta Canum Venaticorum	Bet CVn	4.3
Chertan	70-Theta Leonis	Tet Leo	3.4
Cor Caroli	12-Alpha2 Canum Venaticorum	Alf CVn	2.9
Cursa	67-Beta Eridani	Bet Eri	2.9
Dabih	9-Beta1 Capricorni	Bet Cap	3.3
Deneb	50-Alpha Cygni	Alf Cyg	1.3
Deneb Algedi	49-Delta Capricorni	Del Cap	3.0
Denebola	94-Beta Leonis	Bet Leo	2.2
Diphda	16-Beta Ceti	Bet Cet	2.2
Double Double			6.0
Dubhe	50-Alpha Ursae Majoris	Alf UMa	2.0
Edasich	12-Iota Draconis	Iot Dra	3.5
Electra	17 Tauri	17 Tau	3.8
Elnath	112-Beta Tauri	Bet Tau	1.8
Eltanin	33-Gamma Draconis	Gam Dra	2.4
Enif	8-Epsilon Pegasi	Eps Peg	2.5
Errai	35-Gamma Cephei	Gam Cep	3.4
Fomalhaut	24-Alpha Piscis Austrini	Alf PsA	1.3
Furud	1-Zeta Canis Majoris	Zet CMa	3.1
Gacrux	Gamma Crucis	Gam Cru	1.6

Common Name	Flamsteed-Bayer Designation	Abbrev.	Magnitude (SAO)
Giausar	1-Lambda Draconis	Lam Dra	4.1
Gienah	4-Gamma Corvi	Gam Crv	2.8
Gomeisa	3-Beta Canis Minoris	Bet CMi	3.1
Graffias	8-Beta Scorpii	Bet Sco	2.9
Grumium	32-Xi Draconis	Xi Dra	3.9
Hadar	Beta Centauri	Bet Cen	0.9
Hamal	13-Alpha Arietis	Alf Ari	2.2
Hinds Crimson Star			6.0
Homam	42-Zeta Pegasi	Zet Peg	3.6
Izar	36-Epsilon Boötis	Eps Boo	2.7
Kaffaljidhma	86-Gamma Ceti	Gam Cet	3.6
Kaus Australis	20-Epsilon Sagittarii	Eps Sgr	2.0
Kaus Borealis	22-Lambda Sagittarii	Lam Sgr	2.9
Kaus Media	19-Delta Sagittarii	Del Sgr	2.8
Keid	40-Omicron2 Eridani	Omi Eri	4.5
Kitalpha	8-Alpha Equulei	Alf Equ	4.1
Kochab	7-Beta Ursae Minoris	Bet UMi	2.2
Kornephoros	27-Beta Herculis	Bet Her	2.8
Kurhah	17-Xi Cephei	Xi Cep	4.6
Lesath	34-Upsilon Scorpii	Ups Sco	2.8
Maia	20 Tauri	20 Tau	3.9
Marfik	10-Lambda Ophiuchi	Lam Oph	3.9
Markab	54-Alpha Pegasi	Alf Peg	2.6
Matar	44-Eta Pegasi	Eta Peg	3.1
Mebsuta	27-Epsilon Geminorum	Eps Gem	3.2
Megrez	69-Delta Ursae Majoris	Del UMa	3.4
Meissa	39-Lambda Orionis	Lam Ori	3.7
Mekbuda	43-Zeta Geminorum	Zet Gem	3.9
Menkalinan	34-Beta Aurigae	Bet Aur	2.1
Menkar	92-Alpha Ceti	Alf Cet	2.8
Menkent	5-Theta Centauri	Tet Cen	2.3
Menkib	46-Xi Persei	Xi Per	4.0
Merak	48-Beta Ursae Majoris	Bet UMa	2.4
Merope	23 Tauri	23 Tau	4.3
Mesarthim	5-Gamma1 Arietis	Gam Ari	4.8
Miaplacidus	Beta Carinae	Bet Car	1.8
Mimosa	Beta Crucis	Bet Cru	1.5
Mintaka	34-Delta Orionis	Del Ori	2.5
Mira	Omicron Ceti	Omi Cet	2.1
Mirach	43-Beta Andromedae	Bet And	2.4
Mirfak	33-Alpha Persei	Alf Per	1.9
Mirzam	2-Beta Canis Majoris	Bet CMa	2.0
Mizar	79-Zeta Ursae Majoris	Zet UMa	2.4
Muphrid	8-Eta Boötis	Eta Boo	2.8
Muscida	1-Omicron Ursae Majoris	Omi UMa	3.5
Nashira	40-Gamma Capricorni	Gam Cap	3.8

Common Name	Flamsteed-Bayer Designation	Abbrev.	Magnitude (SAO)
Navi	27-Gamma Cassiopeiae	Gam Cas	2.8
Nekkar	42-Beta Boötis	Bet Boo	3.6
Nihal	9-Beta Leporis	Bet Lep	3.0
Nunki	34-Sigma Sagittarii	Sig Sgr	2.1
Nusakan	3-Beta Coronae Borealis	Bet CrB	3.7
Peacock	Alpha Pavonis	Alf Pav	2.1
Phact	Alpha Columbae	Alf Col	2.8
Phecda	64-Gamma Ursae Majoris	Gam UMa	2.5
Pherkad	13-Gamma Ursae Minoris	Gam UMi	3.1
Pleione	28 Tauri	28 Tau	5.2
Polaris	1-Alpha Ursae Minoris	Alf UMi	2.1
Pollux	78-Beta Geminorum	Bet Gem	1.2
Porrima	29-Gamma Virginis	Gam Vir	2.9
Procyon	10-Alpha Canis Minoris	Alf CMi	0.5
Propus	Eta Geminorum	Eta Gem	3.3
Rasalas	24-Mu Leonis	Mu Leo	4.1
Rasalgethi	64-Alpha Herculis	Alf Her	3.5
Rasalhague	55-Alpha Ophiuchi	Alf Oph	2.1
Rastaban	23-Beta Draconis	Bet Dra	3.0
Regor	Gamma2 Velorum	Gam Vel	1.9
Regulus	32-Alpha Leonis	Alf Leo	1.3
Rigel	19-Beta Orionis	Bet Ori	0.3
Ruchbah	37-Delta Cassiopeiae	Del Cas	2.7
Rukbat	Alpha Sagittarii	Alf Sgr	4.1
Sabik	35-Eta Ophiuchi	Eta Oph	2.6
Sadalmelik	34-Alpha Aquarii	Alf Aqr	3.2
Sadalsuud	22-Beta Aquarii	Bet Aqr	3.1
Sadr	37-Gamma Cygni	Gam Cyg	2.3
Saiph	53-Kappa Orionis	Kap Ori	2.2
Scheat	53-Beta Pegasi	Bet Peg	2.6
Schedar	18-Alpha Cassiopeiae	Alf Cas	2.5
Seginus	27-Gamma Boötis	Gam Boo	3.0
Shaula	35-Lambda Scorpii	Lam Sco	1.7
Sheliak	10-Beta Lyrae	Bet Lyr	3.9
Sheratan	6-Beta Arietis	Bet Ari	2.7
Sirius	9-Alpha Canis Majoris	Alf CMa	-1.6
Skat	76-Delta Aquarii	Del Aqr	3.5
Spica	67-Alpha Virginis	Alf Vir	1.2
Sterope	21 Tauri	21 Tau	5.9
Suhail	Lambda Velorum	Lam Vel	2.2
Sulafat	14-Gamma Lyrae	Gam Lyr	3.3
Syrma	99-Iota Virginis	Iot Vir	4.2
Talitha	9-Iota Ursae Majoris	Iot UMa	3.1
Tania Australis	34-Mu Ursae Majoris	Mu UMa	3.2
Tania Borealis	33-Lambda Ursae Majoris	Lam UMa	3.5
Tarazed	50-Gamma Aquilae	Gam Aql	2.8

Common Name	Flamsteed-Bayer Designation	Abbrev.	Magnitude (SAO)
Taygeta	19 Tauri	19 Tau	4.4
Thuban	11-Alpha Draconis	Alf Dra	3.6
Trapezium	41-Theta1 Orionis	Tet Ori	5.4
Unukalhai	24-Alpha Serpentis	Alf Ser	2.8
UU	none	none	5.1
Vega	3-Alpha Lyrae	Alf Lyr	0.1
Vindemiatrix	47-Epsilon Virginis	Eps Vir	3.0
Wasat	55-Delta Geminorum	Del Gem	3.5
Wazn	Beta Columbae	Bet Col	3.2
Wezen	25-Delta Canis Majoris	Del CMa	2.0
Yed Posterior	2-Epsilon Ophiuchi	Eps Oph	3.3
Yed Prior	1-Delta Ophiuchi	Del Oph	3.0
Zaniah	15-Eta Virginis	Eta Vir	4.0
Zaurak	34-Gamma Eridani	Gam Eri	3.2
Zavijava	5-Beta Virginis	Bet Vir	3.8
Zosma	68-Delta Leonis	Del Leo	2.6
Zubenelgenubi	9-Alpha2 Librae	Alf Lib	2.9
Zubeneschamali	27-Beta Librae	Bet Lib	2.7
Sun			
Moon			
Venus			
Mars			
Jupiter			

APPENDIX D: CONSTELLATION ABBREVIATIONS

And	Andromeda		LMi	Leo Minor
Ant	Antlia		Lep	Lepus
Aps	Apus		Lib	Libra
Aqr	Aquarius		Lup	Lupus
Aql	Aquila		Lyn	Lynx
Ara	Ara		Lyr	Lyra
Ari	Aries		Men	Mensa
Aur	Auriga		Mic	Microscopium
Boo	Boötes		Mon	Monoceros
Cae	Caelum		Mus	Musca
Cam	Camelopardalis		Nor	Norma
Cnc	Cancer		Oct	Octans
CVn	Canes Venatici		Oph	Ophiuchus
CMa	Canis Major		Ori	Orion
CMi	Canis Minor		Pav	Pavo
Cap	Capricornus		Peg	Pegasus
Car	Carina		Per	Perseus
Cas	Cassiopeia		Phe	Phoenix
Cen	Centaurus		Pic	Pictor
Cep	Cepheus		Psc	Pisces
Cet	Cetus		PsA	Piscis Austrinus
Cha	Chamaeleon		Pup	Puppis
Cir	Circinus		Pyx	Pyxis
Col	Columba		Ret	Reticulum
Com	Coma Berenices		Sge	Sagitta
CrA	Corona Australis		Sgr	Sagittarius
CrB	Corona Borealis		Sco	Scorpius
Crv	Corvus		Sci	Sculptor
Crt	Crater		Sct	Scutum
Cru	Crux		Ser	Serpens
Cyg	Cygnus		Sex	Sextans
Del	Delphinus		Tau	Taurus
Dor	Dorado		Tel	Telescopium
Dra	Draco		Tri	Triangulum
Equ	Equuleus		TrA	Triangulum Australe
Eri	Eridanus		Tuc	Tucana
For	Fornax		UMa	Ursa Major
Gem	Gemini		UMi	Ursa Minor
Gru	Grus		Vel	Vela
Her	Hercules		Vir	Virgo
Hor	Horologium		Vol	Volans
Hya	Hydra		Vul	Vulpecula
Hyi	Hydrus			
Ind	Indus			
Lac	Lacerta			

APPENDIX E: COMMON OBJECT NAMES

These objects are listed in the order in which they appear on the window.

47Tuc

Andromeda Galaxy

Antennae

Barnard's Galaxy

Baxendell's Nebula

Bear Paw Galaxy

Beehive Cluster

Black-eye Galaxy

Blinking Planetary

Blue Snowball

Blue Planetary

Bode's Nebula

Box

Box Nebula

Bubble Nebula

Bug Nebula

Butterfly Cluster

Butterfly Nebula

California Nebula

Christmas Tree Cluster

Cocoon Nebula

Cone Nebula

Copeland's Septet

Crab Nebula

Crescent Nebula

Double Cluster

Dumbell Nebula

Eagle Nebula

Eight-burst Planetary

Eskimo Nebula

The Eyes

Filamentary Nebula

Flaming Star Nebula

Ghost of Jupiter

Great Cluster in Hercules

Great Nebula in Andromeda

Great Nebula in Orion

Helix Galaxy

Helix Nebula

Hind's Variable Nebula

Horsehead Nebula

Hourglass Nebula

Hubble's Variable Nebula

Jewel Box

Lacework Nebula

Lagoon Nebula

Little Dumbell

Little Gem

Maia Nebula

Merope Nebula

The Mice

Network-1 Nebula

Network-2 Nebula

North American Nebula

Omega Nebula

Owl Nebula

Papillon

Pelican Nebula

Pin-wheel Nebula

Polarissima Australis

Polarissima Borealis

Praesepe

Ring Nebula in Lyra

Rosette Nebula

Saturn Nebula

Sculptor Galaxy

Siamese Twins

Sombrero Galaxy

Southern Pleiades

Spindle Galaxy

Star Queen Nebula

Stephan's Quintet

Struve's Lost Nebula

Sunflower Galaxy

Tarantula Nebula

Toby Jug Nebula

Triangulum Galaxy

Trifid Nebula

Veil Nebula

Whirlpool Galaxy

Wild Duck Cluster

Witch Head Nebula

Eta Carina Nebula

Gamma Cas Nebula

Gamma Cygnus Nebula

Kappa Cru Cluster

Lambda-1 Cen Nebula

Lambda-2 Cen Nebula

Omega Cen

Rho Oph Nebula

APPENDIX F: AITKEN'S DOUBLE STAR (ADS) LIST

These commonly observed double stars were chosen from R. G. Aitken's <u>New General Catalogue of Double Stars</u>. Please note that the separations are approximate and may vary from year to year. If you are an avid double star observer, please consult an ephemeris for the most accurate data.

ADS Number	Name	Separation	ADS Number	Name	Separation
00111	Kappa1 Sci	1.4	04002	Eta Ori	1.5
00191	35 Psc	11.6	04066	Beta Lep	2.5
00434	Lambda Cas	0.6	04134	Delta Ori	52.6
00513	Pi And	35.9	04177	19 Cam	1.3
00520	Beta 395 Cet	0.5	04179	Lambda Ori	4.4
00558	55 Psc	6.5	04186	Theta1 Ori	
00624	HN 122	36.1	04241	Sigma Ori	0.2
00671	Eta Cas	12.9	04263	Zeta Ori	2.3
00683	65 Psc	4.4	04334	Gamma Lep	96.3
00755	36 And	0.9	04566	Theta Aur	3.6
00782	Gamma Cas	2.1	04773	41 Aur	7.7
00899	Psi1 Psc	30.0	04841	Eta Gem	1.6
00996	Zeta Psc	23.0	04990	Mu Gem	121.7
01003	37 Cet	49.7	05012	Epsilon Mon	13.4
01081	42 Cet	1.6	05107	Beta Mon	7.3
01129	Psi Cas	25.0	05166	20 Gem	20.0
01394	Epsilon Scl	4.7	05253	Nu1 CMa	17.5
01457	1 Air	2.8	05400	12 Lyn	1.7
01477	Alpha UMi	18.4	05423	Alpha CMa	4.6
01507	Gamma Ari	7.8	05514	14 Lyn	0.4
01538	Sigma 186 Cet	1.1	05559	38 Gem	5.2
01563	Lambda Ari	37.4	05605	Mu CMa	3.0
01598	48 Cas	0.9	05654	Epsilon CMa	7.5
01615	Alpha Psc	1.8	05961	Lambda Gem	9.6
01630	Gamma And	9.8	05983	Delta Gem	5.8
01631	10 Ari	1.1	06101	Eta CMi	4.0
01683	59 And	16.6	06175	Alpha Gem	3.9
01697	6 Tri	3.9	06190	n Pup	9.6
01703	66 Cet	16.5	06255	k Pup	9.9
01778	Omicron Cet	0.1	06321	Kappa Gem	7.1
01860	Iota Cas	2.5	06420	9 Pup	0.2
01954	Omega For	10.8	06650	Zeta Cnc	6.0
02080	Gamma Cet	2.8	06724	Sigma 1193 UMa	43.1
02157	Eta Per	28.3	06815	Phi2 Cnc	5.1
02200	20 Per	14.1	06914	Beta 208 Pyx	1.6
02257	Epsilon Ari	1.4	06988	Iota Cnc	30.5
02312	Rho2 Eri	1.8	06993	Epsilon Hya	2.7
02362	Beta Per	81.0	07114	Iota UMa	2.0
02402	Alpha For	5.1	07203	Sigma2 UMa	3.9
02616	7 Tau	0.8	07292	38 Lyn	2.7
02799	Omicron Sigma 65 Tau	0.2	07307	Sigma 1338 Lyn	1.0
02843	Zeta Per	12.9	07351	Kappa Leo	2.1
02867	Omicron Sigma 67 Cam	12.9	07390	Omega Leo	0.6
02888	Epsilon Per	8.8	07402	23 UMa	22.7
03079	39 Eri	6.4	07545	Phi UMa	0.3
03093	Omicron2 Eri	83.4	07555	Gamma Sex	0.6
03137	Phi Tau	52.1	07654	Alpha Leo	176.9
03161	Chi Tau	19.4	07724	Gamma Leo	4.4
03321	Alpha Tau	121.7	07846	Beta 411 Hya	1.4
03572	Omega Aur	5.4	08119	Xi UMa	1.8
03797	Rho Ori	7.0	08123	Nu UMa	7.2
03800	Kappa Lep	2.6	08148	Iota Leo	1.7
03823	Beta Ori	9.5	08153	Gamma Crt	5.2

ADS Number	Name	Separation	ADS Number	Name	Separation
08175	57 UMa	5.4	11635	Epsilon Lyr	207.7
08196	88 Leo	8.4	11639	Zeta Lyr	43.7
08197	Omicron Sigma 235 UMa	0.6	11745	Beta Lyr	45.7
08406	2 Com	3.7	11853	Theta Ser	22.3
08539	Sigma 1639 Com	1.7	12197	Eta Lyr	28.1
08572	Delta Crv	24.2	12540	Beta Cyg	34.4
08573	Beta 28 Crv	2.2	12789	Sigma 2573 Dra	18.2
08600	24 Com	20.3	12880	Delta Cyg	2.5
08630	Gamma Vir	1.8	12962	Pi Aql 1.4	
08682	Sigma 1694 Cam	21.6	13007	Epsilon Dra	3.1
08695	35 Com	1.2	13148	Psi Cyg	3.2
08706	Alpha CVn	19.4	13371	Sigma 2640 Dra	5.6
08801	Theta Vir	7.1	2	Theta Sge	11.9
08891	Zeta UMa	14.4	13524	Kappa Cep	7.4
08974	25 CVn	1.8	13632	Alpha1 Cap	45.4
09000	84 Vir	2.9	13645	Alpha2 Cap	6.6
09025	Tau Boo	4.8	13765	Gamma Cyg	41.2
09085	au Vir	80.0	13887	Rho Cap	0.5
09173	Kappa Boo	13.4	14158	49 Cyg	2.7
09198	Iota Boo	38.5	14259	52 Cyg	6.0
09273	Phi Vir	4.8	14279	Gamma Del	9.6
09338	Pi Boo	5.6	14296	Lambda Cyg	0.9
09343	Zeta Boo	0.8	14360	4 Aqr	0.8
09372	Epsilon Boo	2.8	14499	Epsilon Equ	0.8
09396	Mu Lib	1.8	14636	61 Cyg	30.3
09406	39 Boo	2.9	14787	Tau Cyg	0.8
09413	Xi Boo	6.6	15032	Beta Cep	13.3
09425	Omicron Sigma 288 Boo	0.8	15270	Mu Cyg	1.2
09494	44,i Boo	2.2	15281	Kappa Peg	0.2
09532	Iota1 Lib	57.8	15536	Eta PsA	1.7
09584	5 Ser	11.2	15600	Xi Cep	8.2
09617	Eta CrB	0.8	15719	Sigma 2883 Cep	14.6
09626	Mu Boo	108.3	15753	41 Aqr	5.0
09701	Delta Ser	4.4	15764	Sigma 2893 Cep	28.9
09737	Zeta CrB	6.3	15828	Sigma 2894 Lac	15.6
09909	Xi Sco	0.4	15934	53 Aqr	3.1
09913	Beta Sco	13.6	15971	Zeta Aqr	2.1
09951	Nu Sco	41.1	15987	Delta Cep	41.0
09979	Alpha CrB	7.1	16095	8 Lac	22.4
10049	Rho Oph	3.1	16261	Xi Peg	11.5
10058	Eta Dra	5.2	16268	Tau1 Aqr	23.7
10074	Alpha Sco	2.6	16538	Pi Cep	1.1
10087	Lambda Oph	1.5	16633	Psi1 Aqr	49.6
10157	Zeta Her	0.8	16666	Omicron Cep	2.8
10279	20 Dra	1.3	16672	94 Aqr	12.7
10345	Mu Dra	1.9	16836	72 Peg	0.5
10418	Alpha Her	4.6	16957	78 Peg	1.0
10424	Delta Her	8.9	16979	107 Aqr	6.6
10526	Rho Her	4.1	17022	6 Cas	1.6
10628	Nu Dra	61.9	17140	Sigma Cas	3.0
10660	26 Dra	1.7	17175	85 Peg	0.7
10759	Psi1 Dra	30.3			
10786	Mu Her	33.8			
10875	90 Her	1.6			
11005	Tau Oph	1.7			
11046	70 Oph	4.5			
11061	40/41 Dra	19.3			
11483	Omicron Sigma 358 Her	1.3			

APPENDIX G: THE GREEK ALPHABET

We have included this list for your reference to help you translate Greek letter designations that may be used in your star atlas or other reference. The abbreviations are used in the keypad's Stars/Constell Tour as described previously under the heading "Greek Star Names, organized by constellation." They are also used in Appendices C & D and in many publications and planetarium programs.

Symbol		Translation	Abbreviation
A	α	Alpha	Alf
B	β	Beta	Bet
Γ	γ	Gamma	Gam
Δ	δ	Delta	Del
E	ε	Epsilon	Eps
Z	ζ	Zeta	Zet
H	η	Eta	Eta
Θ	θ	Theta	Tet
I	ι	Iota	Iot
K	κ	Kappa	Kap
Λ	λ	Lambda	Lam
M	μ	Mu	Mu
N	ν	Nu	Nu
Ξ	ξ	Xi	Xi
O	o	Omicron	Omi
Π	π	Pi	Pi
P	ρ	Rho	Rho
Σ	σ	Sigma	Sig
T	τ	Tau	Tau
Y	υ	Upsilon	Ups
Φ	φ	Phi	Phi
X	χ	Chi	Chi
Ψ	ψ	Psi	Psi
Ω	ω	Omega	Omg (or Ome)

APPENDIX H: SUGGESTED STARS FOR THE GTO QUICK STAR DRIFT METHOD

The following list of stars is intended to make the GTO Quick Star Drift Method much quicker and easier. Since hunting through a star atlas for suitable stars can take as long as performing the actual method itself, we put together this list of suggested stars to give you a big head start in most situations. The paired columns suggest pairs of stars that are found in the keypad's database for the northern and southern hemispheres. The stars in each row are very close in Right Ascension, but differ substantially in Declination. Use the pairings for the azimuth portion of this method. Since the rows are all relatively close in RA, you usually have the option of choosing a replacement star if one of the suggested stars is obstructed in some way. Stars on the list that are near the celestial equator are good choices for the altitude iterations.

Two additional partial columns of stars were added in the middle to increase your number of choices. Stars were added here if we felt that a gap needed filling in a particular RA row, or if one of the polar stars was very close to the pole, and therefore not suitable for a non-orthogonal system. There are, unfortunately, some parts of the sky where suitable stars are simply not to be found.

For the altitude portion of the adjustment, most people will find that the ideal star will be in the column for the other hemisphere's non-polar side. In other words, people in the north may find the best choice in the southern hemisphere's "NORTH" column, and those in the south will find good choices in the northern hemisphere's "SOUTH" column. These will tend to be stars that are not too far from the celestial equator, but are also somewhat overhead. If there is a star listed in the "Optional Additional Star" column, it may also be an excellent choice for the altitude adjustment. Choose a star that is slightly south of your zenith if you are in the northern hemisphere, and north of your zenith if you are down under. This is to protect your instrument from hitting the pier when you flip sides.

For the azimuth portion, make sure that BOTH stars are on the same side of the meridian. For example, in the southern hemisphere, if the LST is at 06:30, do not choose Canopus at RA 06:23 and Alhena at RA 06:37. Choose a pairing one or two rows above or below them in the list. Alternatively, you could wait a few minutes until the LST has gone past the higher RA, or you could activate the meridian delay feature to put both stars on the same side of the meridian. Also, keep in mind that you can be several hours east or west of the meridian with your azimuth pairs. The main advantage to being relatively close to the meridian is that you won't be as likely to lose stars in the atmospheric soup.

Remember also that any given RA value is equivalent to that same value plus or minus 12. What this means is that people in far northern or far southern latitudes can often substitute a circumpolar star 12 hours different in RA for one of the suggested stars. No matter what time of day or year, you should have available stars within one or two hours of the meridian. For example: assume you are at a latitude of +50 deg, and the LST is 02:30. You would choose the row with Eta Persei that has RA values near 02:50. Eta Persei, however, might be fine for someone at a latitude of 30 degrees, but at a latitude of 50, it is almost directly overhead. For the northern star in the azimuth routine, you could substitute Kochab which will have an equivalent RA of 14:50 and will be much lower in the north. Likewise, a person using this method from the southern tip of New Zealand when the LST is at 06:30 might decide that Canopus at RA 06:23 is much too straight overhead and choose Zeta Pavonis at R.A. 18:43 as the southern star instead in the azimuth routine.

Please note: The stars below that are listed by their Bayer designation must be accessed through the 1=Objects => 8=Tour => 1=Stars/Constell. menu system. The stars listed with common names are accessed through 1=Objects => 5=Strs.

SUGGESTED STARS FOR GTO QUICK STAR DRIFT METHOD

	Northern Hemisphere Azimuth Pairs		Optional Additional Stars		Southern Hemisphere Azimuth Pairs	
	North	South (Southern Hemisphere Altitude)	North	South	North (Northern Hemisphere Altitude)	South
Star:	Caph	Iot Cet		Bet 2 Tuc	Algenib	Bet Hyi
RA:	00:09:11	00:19:25		00:31:33	00:13:14	00:25:45
Dec:	+59*09:00	-08*49:00		-62*57:00	+15*11:01	-77*15:00
Star:	Tet Cas	Eta Cet			Eps Psc	Zet Phe
RA:	01:11:06	01:08:35			01:02:56	01:08:23
Dec:	+55*09:00	-10*10:00			+07*53:00	-55*14:00
Star:	Eps Cas	Baten Kaitos	Alrescha		Sheratan	Alf Hyi
RA:	01:54:23	01:51:28	02:02:03		01:54:38	01:58:46
Dec:	+63*40:00	-10*20:05	+02*45:49		+20*48:28	-61*34:00

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	Northern Hemisphere		Optional Stars		Southern Hemisphere	
	North	South			North	South
Star:	Eta Per	Tau 2 Eri	Azha	Acamar	Mu Cet	Nu Hyi
RA:	02:50:41	02:51:02	02:56:26	02:58:16	02:44:56	02:50:28
Dec:	+55*53:00	-21*00:00	-08*53:53	-40*18:18	+10*06:00	-75*04:00
Star:	Gam Cam	Tau 8 Eri	Lam Tau	Del Ret	Atik	Gam Hyi
RA:	03:50:21	03:53:42	04:00:40	03:58:44	03:54:08	03:47:14
Dec:	+71*19:00	-24*36:00	+12*29:00	-61*24:00	+31*53:02	-74*14:00
Star:	Alf Cam	Omg Eri			Aldebaran	Alf Dor
RA:	04:54:03	04:52:53			04:35:55	04:33:59
Dec:	+66*20:00	-05*27:00			+16*30:33	-55*02:00
Star:	Menkalinan	Eta Lep			Betelgeuse	Gam Pic
RA:	05:59:32	05:56:24			05:55:10	05:49:49
Dec:	+44*56:52	-14*10:00			+07*24:25	-56*10:00
Star:	Tet Gem	Adhara	Sirius		Alhena	Canopus
RA:	06:52:47	06:58:38	06:45:09		06:37:43	06:23:57
Dec:	+33*57:00	-28*58:19	-16*42:57		+16*23:57	-52*41:45
Star:	Pollux	Alf Mon		Chi Car	Procyon	Zet Vol
RA:	07:45:19	07:41:14		07:56:46	07:39:18	07:41:49
Dec:	+28*01:34	-09*33:00		-52*58:00	+05*13:29	-72*36:00
Star:	Rho Uma	Gam Pyx	Alphard		Acubens	Miaplacidus
RA:	09:02:32	08:50:31	09:27:35		08:58:29	09:13:12
Dec:	+67*37:00	-27*42:00	-08*39:31		+11*51:27	-69*43:03
Star:	Tania Australis	Mu Hya	Rho Leo	Tet Car	Algieba	Gam Cha
RA:	10:22:20	10:26:05	10:32:48	10:42:57	10:19:58	10:35:28
Dec:	+41*29:59	-16*50:00	+09*18:00	-64*23:00	+19*50:28	-78*36:00
Star:	Giausar	Zet Crt	Zavijava		Denebola	Lam Mus
RA:	11:31:24	11:44:45	11:50:42		11:49:04	11:45:36
Dec:	+69*19:53	-18*21:00	+01*45:52		+14*34:18	-66*43:00
Star:	Alioth	Psi Vir		Mimosa	Vindemiatrix	Del Mus
RA:	12:54:02	12:54:21		12:47:43	13:02:11	13:02:16
Dec:	+55*57:36	-09*32:00		-59*41:20	+10*57:32	-71*32:00
Star:	Mizar (brighter)	Spica			Zet Vir	Eps Cen
RA:	13:23:50	13:25:12			13:34:41	13:39:53
Dec:	+54*55:31	-11*09:41			-00*35:00	-53*27:00
Star:	Thuban	Pi Hya	Tau Vir		Muphrid	Hadar
RA:	14:04:23	14:06:22	14:01:38		13:54:41	14:03:49
Dec:	+64*22:34	-26*40:00	+01*32:00		+18*23:51	-60*22:23
Star:	Kochab	Zubenelgenubi	Mu Vir	Alf Aps	Izar	Alf Cen
RA:	14:50:42	14:50:53	14:43:03	14:47:51	14:44:59	14:39:36
Dec:	+74*09:20	-16*02:30	-05*39:00	-79*02:00	+27*04:26	-60*50:00
Star:	Tet Dra	Del Sco	Mu Ser		Gam Ser	Bet TrA
RA:	16:01:53	16:00:19	15:49:37		15:56:27	15:55:08
Dec:	+58*33:00	-22*37:00	-03*25:00		+15*39:00	-63*25:00
Star:	Eta Dra	Antares	Lam Oph	Eps Nor	Kornephoros	Gam Aps
RA:	16:23:59	16:29:24	16:30:54	16:27:11	16:30:13	16:33:27
Dec:	+61*30:00	-26*25:55	+01*59:00	-47*33:00	+21*29:22	-78*53:00
Star:	Del Umi	Xi Ser	Rastaban		Rasalhague	Del Ara
RA:	17:32:12	17:37:35	17:30:23		17:34:56	17:31:05
Dec:	+86*35:00	-15*23:00	+52*18:04		+12*33:36	-60*41:00

	Northern Hemisphere		Optional Stars		Southern Hemisphere	
	North	South			North	South
Star:	Chi Dra	Kaus Borealis	Eta Ser		Vega	Xi Pav
RA:	18:21:03	18:27:58	18:21:18		18:36:56	18:23:13
Dec:	+72*43:00	-25*25:18	-02*53:00		+38*47:01	-61*29:00
Star:	Rho Dra	Eta Aql			Gam Sge	Del Pav
RA:	20:02:48	19:52:28			19:58:45	20:08:43
Dec:	+67*52:00	+01*00:00			+19*29:00	-66*10:00
Star:	Alfirk	Sadalsuud	Pi 1 Cyg	Del Ind	Enif	Nu Oct
RA:	21:28:39	21:31:34	21:42:05	21:57:55	21:44:11	21:41:28
Dec:	+70*33:40	-05*34:15	+51*11:00	-54*59:00	+09*52:30	-77*23:00
Star:	Iot Cep	Skat		Eps Gru	Homam	Bet Oct
RA:	22:49:40	22:54:39		22:48:33	22:41:27	22:46:03
Dec:	+66*12:00	-15*49:14		-51*19:00	+10*49:53	-81*22:00

APPENDIX F: PRE-DEFINED PARK POSITIONS

The Mach2GTO does not require starting from pre-defined park positions, but it is often helpful to finish the evening in one.

Recommended: **Park 3** is a safe and balanced position. **Park 2** is a convenient position for loading and unloading your scope. **Park 5** is a safe, low profile position with minimum cable twisting.

PARK 1

Northern Hemisphere

The scope is level on the west side of the mount, facing the northern horizon. The counterweight shaft is also level and pointing due east. This position is also called the Reference Park Position.

Both Hemispheres: RA is horizontal,
North: Dec = (90-Latitude)   South: Dec = (-90-Latitude)

The southern hemisphere is mirror reversed. The scope is still level on the west side of the mount, but is facing the southern horizon. The counterweight shaft is also still level and pointing due east.

Southern Hemisphere

PARK 2

Northern Hemisphere

The scope is level on top of the mount facing the eastern horizon. The counterweight shaft is pointing down.

Both Hemispheres: RA axis is vertical, Dec = 0

The southern hemisphere is mirror reversed. The scope still points to the eastern horizon, but east is to the left when facing the southern pole.

Southern Hemisphere

PARK 3

Northern Hemisphere & Southern Hemisphere

The scope is pointing to the pole. The counterweight shaft is pointing down.

RA axis is vertical, Dec = 90

PARK 4

Northern Hemisphere

The scope is level on the east side of the southern horizon. shaft is also level west. This position is Park Position.

mount, facing the The counterweight and pointing due the New Reference

Both Hemispheres: RA is horizontal,
North: Dec = (-90+Latitude) South: Dec = (90+Latitude)

The southern hemisphere is mirror reversed. The scope is still level on the east side of the mount, but is facing the northern horizon. The counterweight shaft is also still level and pointing due west.

Southern Hemisphere

PARK 5

Northern Hemisphere

The scope is level on the east side of the mount, facing the northern horizon. The counterweight shaft is also level and pointing due west.

Both Hemispheres: RA is horizontal,
North: Dec = (90-Latitude) South: Dec = (-90-Latitude)

The southern hemisphere is mirror reversed. The scope is still level on the east side of the mount, but is facing the southern horizon. The counterweight shaft is also level and pointing due west.
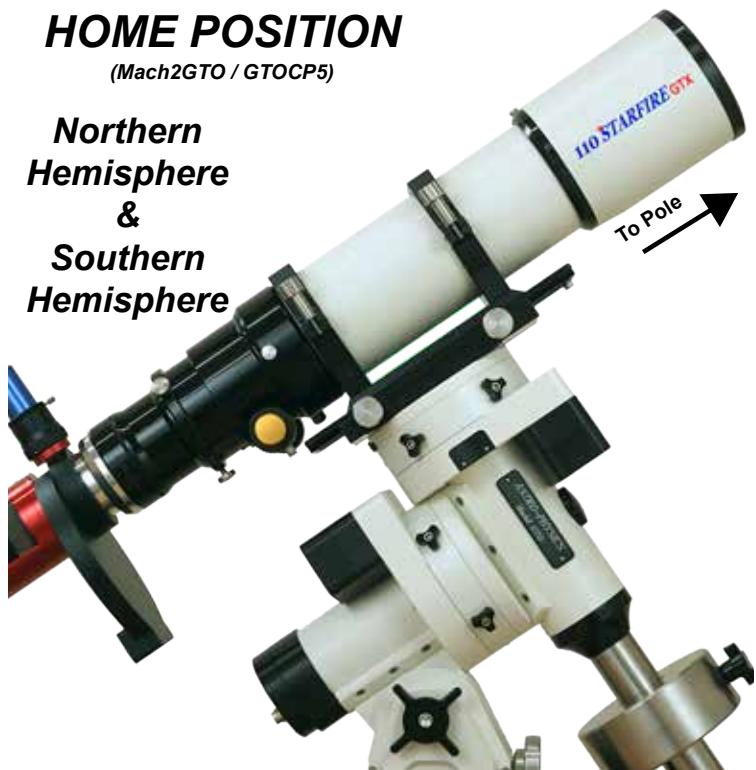
Southern Hemisphere

HOME POSITION
(Mach2GTO / GTOCP5)

Northern Hemisphere & Southern Hemisphere

To Pole

This is a very special position that is established by Astro-Physics when programming the Absolute Encoders. It is highly precise.

APPENDIX G: HOW DOES KEYPAD V5.X DIFFER FROM V4.19.3?

We offer this information so that users of the previous v4.19.3 can quickly identify differences between the two programs. This should help to aid the transition from one to the other.

- You must use your keypad with a GTOCP5 (minimum version P02-07) or GTOCP4 (not publicly released yet).

- There are feature differences depending if your mount has a GTOCP4 or GTOCP5. The keypad will detect whether you have the proper version and will display the features that are available to your mount.

- The button pad has two significant changes: New keypads have these updated buttons. Older keypads can be used successfully even if you have the original button pad. You simply have to remember that the buttons have different functions.

  - FOC button is now RECAL. However, to prevent unintended recalibration, you must also press NEXT> simultaneously.

  - RA/DEC REV button is now ENT. and is used to confirm your entries rather than using GOTO. The RA/DEC Reverse function can be accessed with the +- button.

- The Sync command is no longer available and the RECAL button is readily available as mentioned above.

- You don't have to power cycle the mount if you change your location unless you are changing from the northern to southern hemisphere or vice versa.

- There are no polar alignment routines within the program. However, the various park positions can help you complete the Daytime Polar Alignment Routine.

- The startup routines are simplified.

- The keypad will automatically adjust to solar or lunar rate when you slew to the sun or moon, respectively. Note that the Main Menu will not display these two rates as current status or provide an option to toggle them. They are only active when you have slewed to the sun or moon.

- Pointing accuracy for stars has improved with proper motion added.

- Time Zone and Daylight Savings are now part of Date/Time setup.

- Very simple process to change to and from Daylight Savings.

- What's Up Now and Search have been combined into a more useful function.

- The keypad loader has been updated to a Java-based version that is more user friendly and can be used across platforms with Windows, Mac and Linux operating systems.

- New features include:

  - Flip scope option.

  - Model options: Point & Track, Drift and Ortho

  - Bookmark favorite objects for quick access or to preplan an observing session.

  - Set power level low, medium or high. (GTOCP5 only).

- These 4.19.3 features are no longer available: focus adjustment, illuminated reticle brightness adjustment, Safe Zone Limits, Horizon Limits, RA and Dec backlash adjustment and SmartGuide.