

Introduction to the Astrometric Telescope Control System

For Celestron CI700 Telescope Mounts

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Please read this document first

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Introduction to the Astrometric Telescope Control System on the Celestron CI700 telescope mount

Introduction

This document provides an introduction to, and installation instructions for, the Astrometric Telescope Control System (ATCS) on the Celestron CI700 telescope mount. The version of ATCS covered in this document is the SkyWalker-Servo retrofit kit. The contents of this document are as follows:

- ◆ This introduction.
- ◆ Brief overview of ATCS: components and function.
- ◆ Installation of SkyWalker-Servo Celestron CI700 retrofit kit.

Much additional detail on the operation of ATCS is provided in the following two documents:

1. “SkyWalker-Servo Owner's Manual”.
2. “SkyGuide User's Manual”.

There are several important steps in installing the CI700 retrofit kit and important notes on using ATCS. These are highlighted in this document as follows:

Important: Please read important notes.

The user should be very careful to read, understand and follow these important notes. Otherwise, sub-par operation or even damage to your hardware can result.

Two important definitions are needed at this point:

- ◆ *SkyWalker mode*: when ATCS is being used without an attached PC it is being used in *SkyWalker mode*.
- ◆ *System mode*: when ATCS is being used with a Windows 95/98/ME PC running our SkyGuide telescope control system software it is being used in *System mode*.

The specifics of *SkyWalker mode* and *System mode* are provided in the next section.

If ATCS is to be used in *SkyWalker mode*, then read the “SkyWalker-Servo Owner’s Manual” next. There is no need to read the “SkyWalker-Servo Owner’s Manual” if ATCS is **not** used in *SkyWalker mode* since all typical SkyWalker-Servo installation details and setup are provided in this document.

If ATCS is to be used in <i>System mode</i> then be sure to read at least Chapter 1 (“Introduction”) and Chapter 2 (“Running SkyGuide for the first time”) in the “SkyGuide User’s Manual”.
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Brief overview of ATCS: components and function

ATCS allows for controlling all operations of a telescope “system”. The current version of ATCS has evolved from over a decade of development and use of telescope control systems. We believe that it is the most capable telescope control system available to amateurs today. We have taken great effort to include useful features and user-friendly interface to these features. Additionally, dedicated and patient “beta” testers have used ATCS throughout its development. We are indebted to these folks!

The major components of ATCS are briefly described in this section. More (and up to date) detail can be found at our web site www.astrometric.com.

SkyWalker and SkyGuide:

The hub of Astrometric Instruments’ Telescope Control System (ATCS) is the SkyWalker Telescope Motor and Accessory Controller. Together with its handpaddle, SkyWalker is a standalone telescope controller or, when used with a PC running our SkyGuide Telescope Control System software, a complete and full-featured telescope control system.

ATCS provides two levels of functionality: *SkyWalker mode* and *System mode*.

- ◆ In *SkyWalker mode*, the control system operates without the need for an attached PC. SkyWalker operates autonomously as a versatile telescope and accessory controller. High speed slew, four user selectable pan and slow motion rates, and five tracking rates for equatorial mounts are supported. Numerous telescope control functions (electric focus control, autoguider correction, reticle illumination etc.) are also available.

SkyWalker mode requires a SkyWalker and high performance motors adapted to a telescope. Astrometric Instruments provides retrofit kit packages that provide the motors, gearing and all the mechanical components necessary to use SkyWalker on the Celestron CI700 mounting (see below).

SkyWalker mode does not provide GoTo capability, nor interface to Planetarium software, nor a plethora of other features provided by SkyGuide (requiring a PC running Windows 95/98/ME).

- ◆ In *System mode*, the control system operates attached to a PC running our SkyGuide Telescope Control System Software (for Windows95/98/ME). Functionality increases dramatically with features such as automatic GoTo (coordinate, Planet or over 16000 deep sky objects), optical encoder support allowing for manual movement, joystick control and control from one of the many commercial or shareware planetarium programs available today running on the same or remote PC.

System Mode requires a Pentium-120 (or better) PC, one communications port (RS232) and the Microsoft Windows95/98/ME operating system.

Celestron CI700 retrofit kit

To control a Celestron CI700 mounting, the SkyWalker-Servo retrofit kit is provided as a motor replacement kit. The retrofit kit is a two-axis drop-in replacement for the gear head stepper motors used on the Celestron CI700, and other, mounts. The SkyWalker-Servo retrofit kit used on the Celestron CI700 mounts slews at 6.5 degrees/second while maintaining extremely smooth and precise tracking. SkyWalker-Servo accomplishes this with only one high performance DC servomotor per axis while running on a single 12VDC power supply.

Figure 1 shows SkyWalker-Servo installed on a Celestron CI700 telescope mount.



Figure 1

Note: ATCS internal settings are configurable from within SkyGuide. As part of the SkyGuide software installation (detailed in Chapter 1 of the “SkyGuide User’s Manual”) default settings for a variety of mounts are selectable.

Upgrades:

Functional upgrades are being continuously made to ATCS. New features, user's suggestions/requests and bug fixes require this. These functional upgrades primarily involve SkyGuide however from time to time it may be necessary to upgrade the "firmware" (i.e. embedded software) in SkyWalker. As a customer of Astrometric Instruments, upgrades to SkyGuide and SkyWalker's internal firmware are available free of charge from our web site at www.astrometric.com.

Documentation upgrades are available as PDF files to be viewed with (the free) Adobe Acrobat Reader v3.0 or later. Registered users can request PDF documentation files by sending an email request to support@astrometric.com.

Replacement printed documentation will be provided, at cost, if requested by a registered user.

What do I do now?

After reading the next section on installing the CI700 retrofit kit please proceed as follows:

1. If use of ATCS in *SkyWalker mode* is planned then read the "SkyWalker-Servo Owner's Manual". It is anticipated that many installations will never use ATCS in *SkyWalker mode*. In this case reading the "SkyWalker-Servo Owner's Manual" is optional.
2. Before using ATCS in *System mode* it is recommended that the "SkyGuide User's Manual" is read. Since the "SkyGuide User's Manual" is rather voluminous, and since you probably want to start using ATCS as soon as possible, we have written the first two chapters to cover installation and use in an introductory way.

Please read at least the first two chapters of the "SkyGuide User's Manual" before using ATCS for more than the installation testing described at the end of this document.

Installation of the SkyWalker-Servo CI700 retroKit

This chapter describes how to install the SkyWalker-Servo system on the Celestron mount. It is very important to follow the installation procedure carefully to assure reliable operation. Improper installation of the Drive Units can lead to poor tracking accuracy, inability to slew and even damage to the Drive Unit and/or CI700 gearing. Particular care should be taken when adjusting the clearance between the worm and worm gear so that they properly mesh and do not pose undue load on the Drive Unit. The adjustment procedure that assures the necessary clearance is included in these installation instructions.

The CI700 retrofit kit consists of several components. Please identify these components before proceeding. They are labeled as follows:

- ◆ Astrometric Telescope Control System documentation
- ◆ SkyGuide installation floppy diskette
- ◆ Handpaddle (HP1)
- ◆ Handpaddle bracket (with attached magnets)
- ◆ Dec Servo Drive Unit
- ◆ RA Servo Drive Unit
- ◆ (2) Worm Drive Spur Gears
- ◆ Cables and Hardware (in bag likewise labeled)
- ◆ Power Cord
- ◆ Com Cable
- ◆ Tool Set

Important Installation Note

Allen key wrenches are included with the retroKit. They have a “ball drive” on their long ends. Do **not** use the ball drive end of the wrench to tighten screws since it can “strip-out” the inside of the screw’s socket.

CI700 Preparation

Step 1: Disconnect all cables to the Celestron CI 700 Drive Controller panel and drives (i.e. motors).

Step 2: Remove both Celestron RA and Dec drives (use medium sized Allen key wrench). Note (bottom of figure 2) that the screws to remove are inside the motor/gear assemblies and accessible through the slot in the bottom of the drive's mounting box.

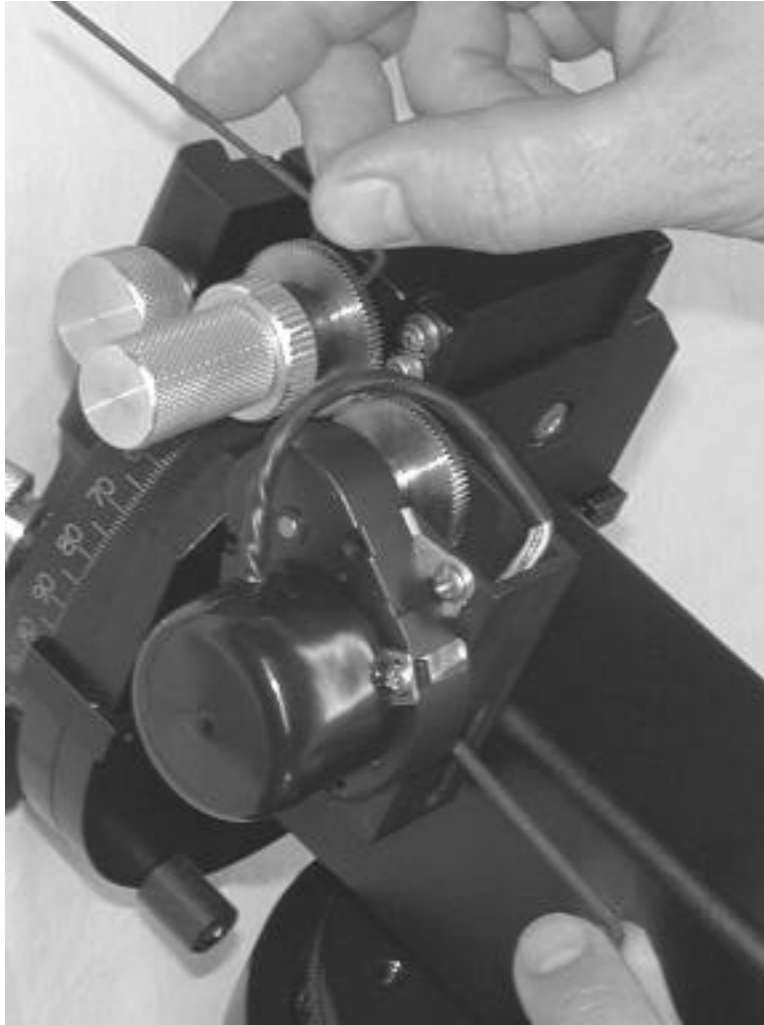


Figure 2

Step 3: Using the small sized Allen key, remove the Celestron slow-motion knob and attached clutch (top of figure 2). These components will not be used once the SkyWalker-Servo retrofit kit is installed.

Step 4: Using the supplied Phillips screwdriver, remove the CI 700 Drive Controller panel (4 Phillips-head screws). Save and set aside the screws. Store the Drive Controller panel in the anti-static bag that SkyWalker's handpaddle came packed in.

SkyWalker-Servo, Motor “Drive Units” and Handpaddle installation

Note: in the following steps you will install the Drive Units on the mount. It is important to handle the Drive Units with care, especially with regard to protecting against static electrical discharge. To assure this, always “discharge” yourself prior to touching the Drive Units **and** prior to touching the Drive Units (while in your hand) to conductive objects (such as the mount).

Step 5: Using the small Allen key, install the 80-tooth gear that is labeled “Dec” and is shipped in the “Worm Drive Spur Gears” bag. Be sure to install the gear with the hub towards the CI700 worm (as shown in the top of figure 3). Note: the setscrew should be tightened against the flat on the CI700 worm shaft.

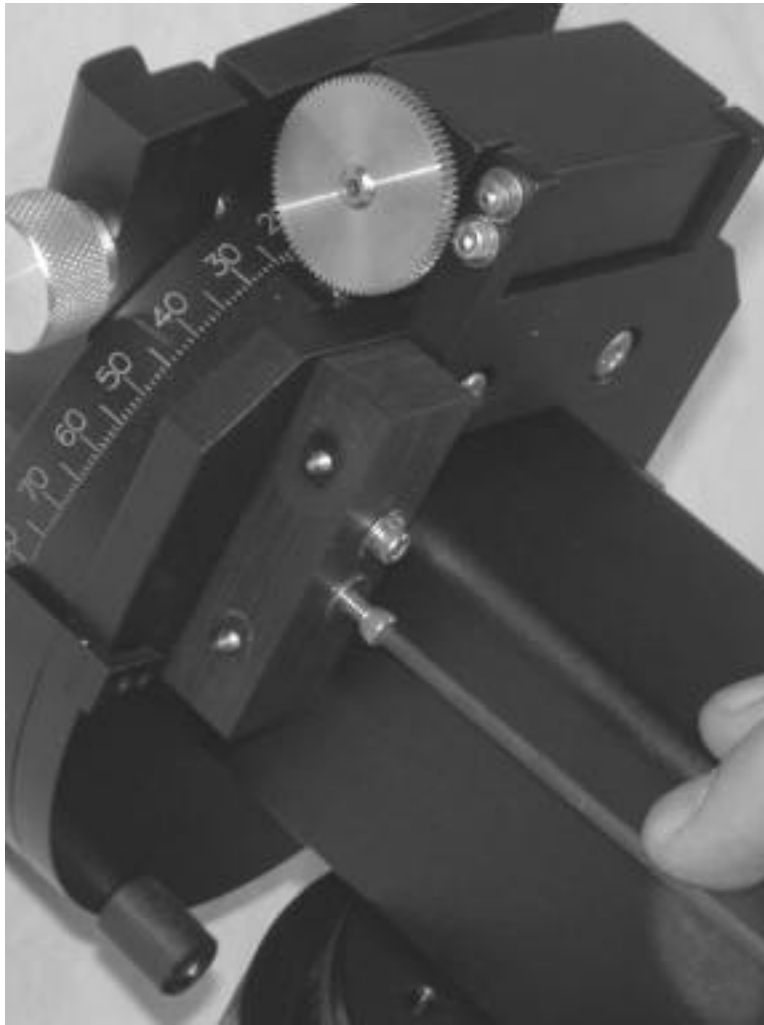


Figure 3

Step 6: Using the large Allen key, remove the Adapter Block from the Dec Drive Unit by unscrewing the #8-32 cap screws. Set the cap screws aside. Using the medium Allen key, and the two #6-32 cap head screws and washers supplied in the Drive Unit bag, install the Adapter Block under the CI700’s Dec axis gear plate as shown in figure 3.

Step 7: Using the large Allen key, and the two cap screws set aside in the previous step, install the Dec Drive Unit as shown in figure 4.



Figure 4

Step 8: Align the Dec Drive Unit's small spur gear with the large spur gear on the CI700 worm's shaft. The goal is to accomplish alignment as shown in figure 5. Note: figure 5 shows the gears with the gear cover removed for illustration purposes only.

Endeavor to have the spur gears intersect "square" and co-planer and engage such that their teeth are in full contact. Some misalignment is tolerated. The screws shown in figure 4 allow for movement of the Drive Unit in/out, the screws shown in figure 3 allow for slight rotation of the Drive Unit and the 80-tooth spur gear's setscrews allow for movement of 80-tooth gear in/out on the worm shaft.

Do not allow the gears to adversely "press" into each other. Leaving a small amount of backlash will assure this and will be insignificant compared to typical backlash between the CI700 worm and worm gear.

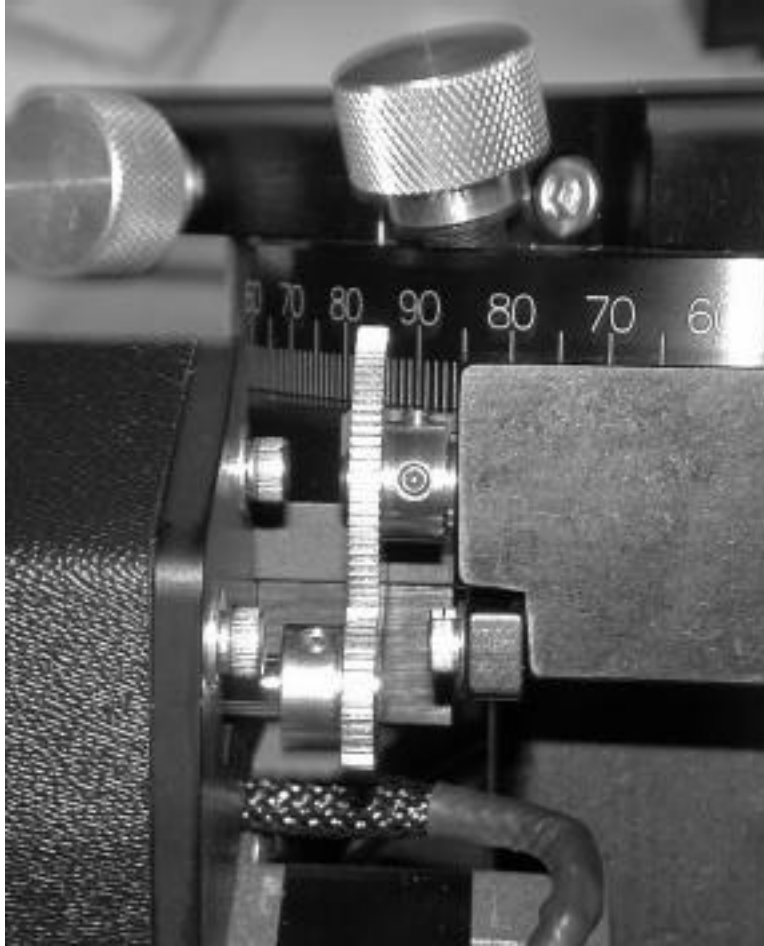


Figure 5

Step 9: Verify that the Dec worm rotates freely. Do not skip this important step! Turn the 80 tooth spur gear, attached to the worm, to make sure no binding or tightness is felt: excessive friction will lead to motor stalls and accelerated gear wear.

If binding or excessive friction is noticed, the worm is adjusted by loosening the cap screws (using medium Allen key) adjacent to the 80-tooth spur gear (top of figure3) and on the opposite end of the worm housing. This critical adjustment should be made very carefully and slowly.

Step 10: Repeat steps 5-9 for the RA Drive Unit.

Note: there is one important additional step when installing the RA Drive Unit: the 80-tooth gear that is labeled “RA” (and is shipped in the “Worm Drive Spur Gears” bag) has a small magnet glued to its outer circumference. The 80-tooth gear and the 40-tooth gear on the RA Drive Unit must mesh so that the dark dot on the 40-tooth gear lines up with the position of the small magnet on the 80-tooth gear (as shown in figure 6). If this adjustment is not properly made, periodic error correction will not work properly. You may find it necessary to make this

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alignment after the system is operational so that you can rotate the 40-tooth gear under handpaddle control.

Important: never loosen the set screw on the small 40-tooth gear on the RA Drive Unit since the location of the dark dot (shown in figure 6) will change and periodic error correction will not work properly and/or false RA motor stalls will be detected.

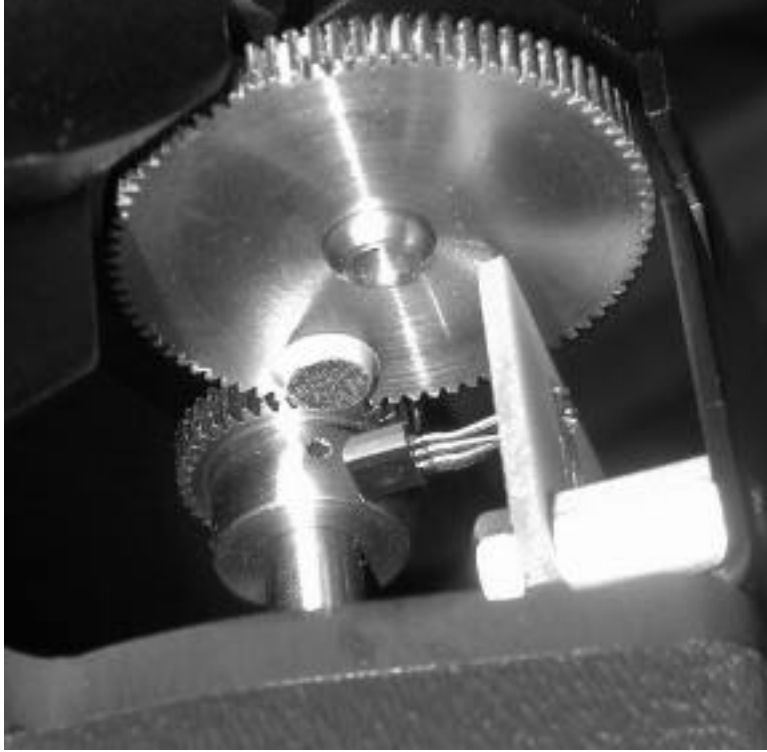


Figure 6

Step 11: Attach SkyWalker-Servo's handpaddle bracket to the tripod head.

- Using the four screws set-aside in step 4, attach the CI700 Adapter Bracket where the CI700 Drive Controller panel was attached.
- Mount the Handpaddle on the magnet attached to the bracket.

Step 12: Plug the Handpaddle into the connector at the top of the SkyWalker-Servo labeled "HP".

Installing Cabling

Step 13: Locate the DU Cable in the "Cables and Hardware" bag: includes 9-pin D-Sub connectors on each end. Connect the cable between the RA and Dec drive units. Screw down the connectors using the small flat blade screwdriver provided in the "Tool Set" bag,

Step 14: Optical encoder connections

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Encoders are optional for operation of ATCS. The standard (pin connector) Celestron optical encoders and other vendors Digital Setting Circle encoders can be used with ATCS with optional encoder cable adapters (contact Astrometric Instruments).

Note: When using the Celestron encoders a CI700 Encoder Adaptor Cable (available from Astrometric Instruments) must be used.

Step 15: Loosen the mount's clutch knobs and manually move the mount through its entire range of motion. Verify that the cabling is tangle-free. It may be necessary to place the Declination axis dovetail knobs on the side of the mount away from the cable harness.

Step 16: Locate the SkyWalker-Servo power cord and insert the 2.5mm plug into the connector labeled "Pwr" on SkyWalker-Servo. Plug the other end into an appropriate power source.

Step 17: For use with SkyGuide: plug the small 4 pin connector found on the Com Cable into the connector labeled "Com" at the bottom of SkyWalker-Servo. Plug the other end of the Com Cable into an available PC DB-9 Com port (adapter may be required).

Step 18: Balance the telescope and adjust the CI700 clutches as follows:

- For no slip, if optical encoders are not used.
- For a comfortable "manual override" slip torque if optical encoder feedback is used.

Testing the system

Verify that the Sys/SW switch on the top of SkyWalker-Servo is set to SW (i.e. SkyWalker mode). Turn on SkyWalker-Servo. The RA Drive Unit should produce a slight noise as it tracks. Push the Up, Down, Left and Right buttons and verify that both Drive Units' motors freely turning.

Manually move (by slipping the clutches) the telescope to a position where significant motion in both RA and Dec will not lead to collision of the telescope with the tripod or pier. Press and release the Slew button. The Handpaddle will now be in Slew mode. Verify that the red LED over the Slew button is lit. Alternately, push the Up, Down, Left and Right buttons and verify that the Drive Unit's motors are freely turning. The telescope will accelerate to the maximum slew velocity of 6.5 degrees/second if a given direction button is held for a few seconds. If the motors stall or if an "over current" warning is issued during this process refer immediately to the "Problems with motor stall" section in the Frequently Asked Questions section of our support web page.

As a final step, read chapters 1 and 2 of the "SkyGuide User's Manual". These chapters provide quick up-to-speed information on using SkyGuide. Once the system is working in *System mode*, with SkyGuide running on the PC, you should verify that the RA and Dec MotorLoad values (on the Status *Console tab*) do not exceed 1000 when tracking. If they do then there is a problem with telescope balance and/or the adjustment of the worm/worm-gear. You can compare the MotorLoad value when moving one direction versus the other direction as an indicator of balance. Note: the telescope should be reasonably well balanced. If it is

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significantly out of balance then stalls and/or “chatter” in the drive system will occur. The chatter can occur when SkyWalker-Servo is driving a “following” load and is due to slight slack in the mount’s and SkyWalker-Servo gearing.

NOTE: It is recommended to slew the worm gear to a half dozen equally spaced positions around its circumference to ensure that the MotorLoad value is within limits at each position.

Installation is complete!

Congratulations! The RetroKit™ installation is now complete.

If ATCS is to be used in *SkyWalker mode* then proceed to read the “Operation in SkyWalker mode” section of the “SkyWalker-Servo Owner’s Manual”.

If ATCS is to be used in *System mode* then be sure to read at least Chapter 1 (“Introduction”) and Chapter 2 (“Getting Started with SkyGuide”) in the “SkyGuide User’s Manual”.

Note: *System mode* operation is a superset of *SkyWalker mode* operation therefore the “SkyGuide User’s Manual” supercedes all operational information in the “SkyWalker-Servo Owner’s Manual”.