Introduction to the Astrometric Telescope Control System

For Losmandy G-11, GM-8 and HGM-200 Telescope Mounts

last revision date: 22-July-2002

Please read this document first

This document can be ordered as Astrometric Instruments' part DOC-03C

Introduction

This document provides an introduction to, and installation instructions for, the Astrometric Telescope Control System (ATCS) on Losmandy G-11, GM-8 and HGM-200 telescope mounts. 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 G-11/GM-8/HMG-200 retrofit kit. **Note:** The installation procedure for the G-11, GM-8 and HGM-200 retrofit kits are identical. For the sake of brevity, the remainder of this document will only refer to the G-11.

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 G-11 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 *System mode* 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".

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 Losmandy G-11 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.

Losmandy G-11 Retrofit Kit

To control a Losmandy G-11 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 Losmandy G-11, and other, mounts. The SkyWalker-Servo retrofit kit used on the Losmandy G-11 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 Losmandy G-11 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 G-11 RetorKit™ 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 G-11 Retrofit Kit

This chapter describes how to install the SkyWalker-Servo system on the Losmandy 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 G-11 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 G-11 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
- Cables and Hardware (in bag likewise labeled)
- Power Cord
- Com Cable
- Tool Set
- OEM installation kit (optional: required for mounts without the Losmandy Drive System)

Important Installation Note

Allen key wrenches are included with the retrofit kit. 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.

G-11 Preparation

Mounts with Losmandy Drive System

Step 1. Disconnect all cables connected to the Losmandy Model 492 Digital Drive System control box and motors.

Step 2. Remove the flexible plastic covers from the Losmandy motors and remove both motors (use middle sized Allen key wrench)

Step 3. Remove and save the (shiny chrome) part of Oldham couplers attached to the end of the Losmandy supplied motors (use small Allen key wrench). This is shown in figure 2. Also save the nylon part of the coupler if it is attached to the motor side of the coupler.

Figure 2

Step 4. Remove the Losmandy Model 492 control box. It is no longer needed. Save the knobs (with ¼-20 screw threads) removed from the mount tabs.

Step 5. Slightly loosen the two small setscrews on the G-11's RA and Dec worm covers (use the small Allen key wrench) as shown in figure 3. Remove the covers and set aside.

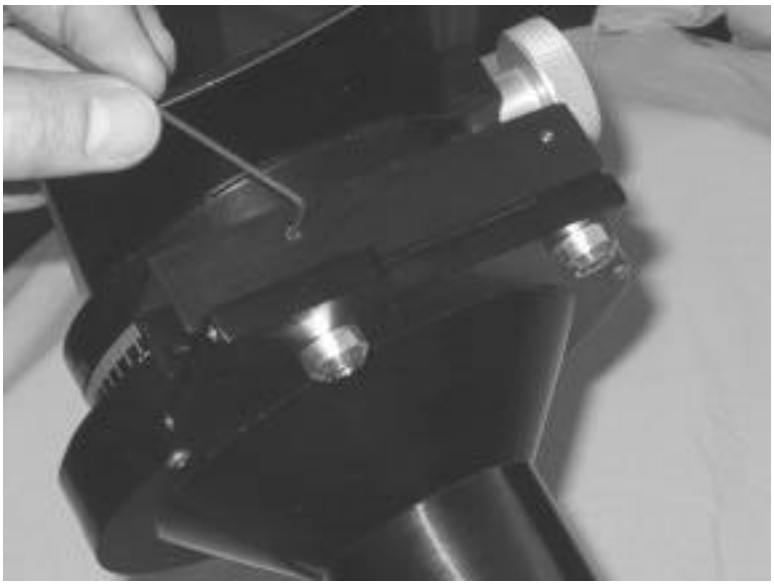


Figure 3

Mounts without Losmandy Drive System

Step 1A. Locate the pair of Oldham couplers supplied in the OEM installation kit. Each coupler consists of a metal shaft adapter at each end and the nylon piece between. Two of these three sections are shown in figure 2.

Step 2A. Slightly loosen the two small setscrews on the G-11's Dec worm cover (use the small Allen key wrench) as shown in figure 3. Remove the cover and set aside.

Step 3A. Separate the metal shaft adapter from one of the Oldham couplers. Install this shaft adapter on the shaft of the Dec worm (use small Allen key wrench).). Make sure that one of the two Allen screws tightens against the flat on the worm shaft. These Allen screws should be quite snug but do not strip-out their threads. The remaining two parts of the Oldham coupler will be used later in the installation procedure.

Step 4A. Repeat steps 2A-3A using the second Oldham coupler for the RA worm.

Step 5A. Locate and set aside the knobs (with ¼-20 screw threads) supplied in the OEM installation kit.

For all Losmandy mounts

Step 6. Adjust the Dec worm. Do not skip this important step! The purpose of this step is to have enough clearance between the worm and the worm gear that no binding or tightness (indicating excess friction) is present. This is a critical adjustment and should be made very carefully and slowly.

The worm is adjusted by loosening the cap screws under the blocks that hold the ends of the worm shaft (use largest Allen key supplied) as shown in figure 4. Rotate (by hand) the end of

the Oldham coupler, attached to the worm shaft, to gauge when the clearance is sufficient. Make sure no binding or tightness is felt: excessive friction will lead to motor stalls and/or motor over-current conditions and/or accelerated gear wear. The Oldham coupler should rotate with ease.

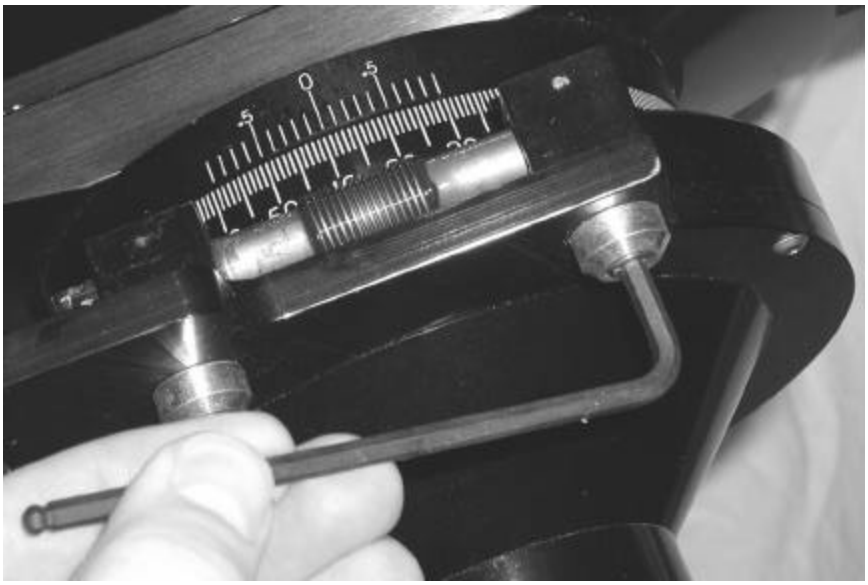


Figure 4

SkyWalker-Servo 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 7. Locate the Dec Drive Unit (in bag labeled "Dec Drive Unit") and install the part of the Oldham coupler set aside in Step 3 (or 3A) onto the shaft of the Drive Unit (use small Allen key wrench). Make sure that one of the two Allen screws tightens against the flat on the Drive Unit's shaft. These Allen screws should be quite snug but do not strip-out their threads.

Step 8. Install the Dec Drive Unit onto the G-11 using two of the four flat-head Phillips screws provided in the "Cables and Hardware" bag. Make sure the slots in the Oldham coupler line up. It is convenient to line-up the slots in the Oldham coupler and push to engage the two halves of the coupler (left side of figure 5) and then rotate the Drive Unit until the flat-head screw holes line up (right side of figure 5). Using the Phillips screwdriver, run the screws all the way in but do not tighten them yet.

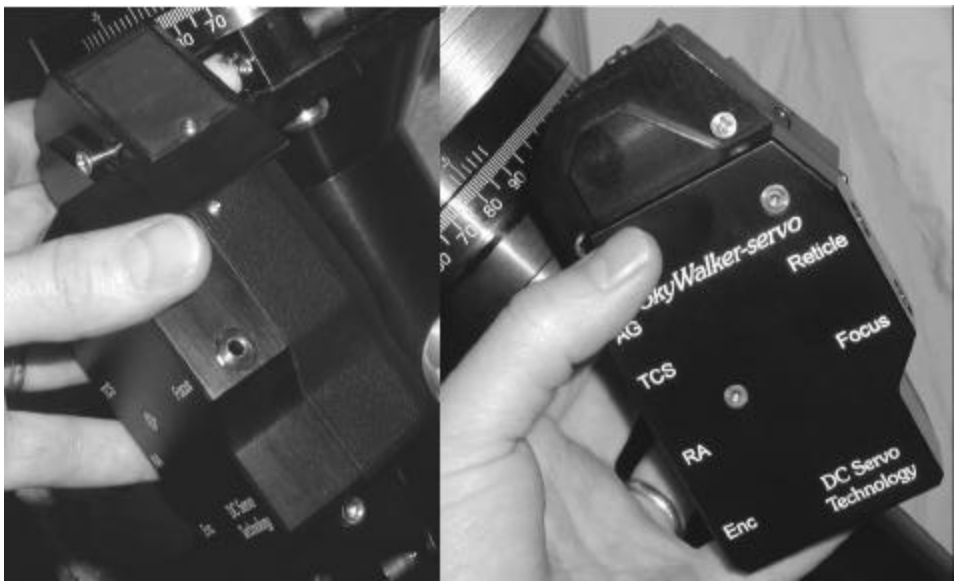
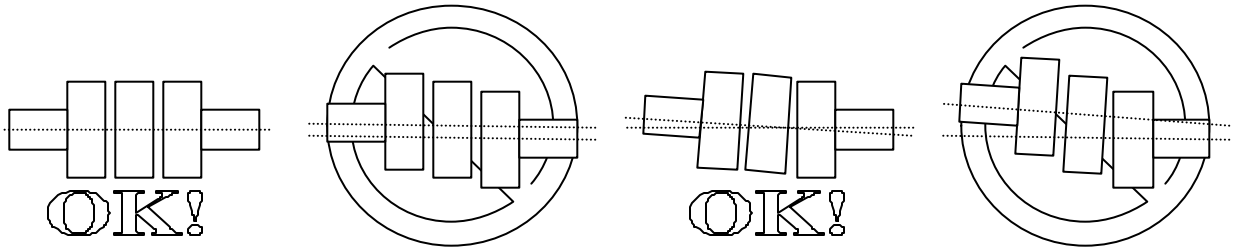


Figure 5

Step 9. Tighten the screws modestly but don't over do it since you can strip the (aluminum) threads out of the mount if to forceful. Verify that the Drive Unit is orientated so that the three sections of the Oldham coupler are best lined up (see the figure shown below). It may be necessary to adjust the position of both ends of the Oldham coupler along the axis of the motor and/or worm shafts.



Step 10. Re-install the Dec worm cover.

Step 11. Repeat steps 6-10 for the RA Drive Unit.

Step 12. Locate the Handpaddle magnetic mounting bracket and attach between the mounting tabs on the Losmandy tripod and secure with the knobs set aside in step 4 (5A). Mount the Handpaddle onto the magnet attached to the bracket.

Step 13. Plug the Handpaddle into the connector (labeled "HP") at the bottom of the RA Drive Unit.

Installing Cabling

Step 14: 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 15: (this step is only necessary if axial optical encoders are installed on the mount) Locate the shorter of the two encoder cables that includes 6 pin (MJ12) connectors at each end. Connect this between the RA optical encoders and the RA Drive Unit connection labeled "Enc". Repeat for Dec using the longer encoder cable.

Step 16: 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 DU Cable (i.e. side of mount away from the Dec Drive Unit).

Step 17: Locate the SkyWalker-Servo power cord and insert the 2.5mm plug into the connector labeled "Pwr" on the RA Drive Unit. Plug the other end into an appropriate 12v power source.

Step 18: For use with SkyGuide: plug the small 4 pin connector found on the Com Cable into the connector labeled "Com" at the bottom of the RA Drive Unit. Plug the other end of the Com Cable into an available PC DB-9 Com port (adapter may be required).

Step 19: Balance the telescope and adjust the G-11 clutches to allow for slip in the event you want to move the telescope by hand. This will also provide "give" if the telescope inadvertently strikes something.

Note: The TCS port on the Dec Drive Unit has a dummy plug installed. This prevents accidental installation of the Autoguider cable into the TCS port.

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

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 retrofit kit 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".