SkyWalker1 and SkyWalker2 Hardware Manual

For custom installations only

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Written for

Astrometric Instruments'
SkyWalker1
And
SkyWalker2
Motor and Accessory Controller

This document can be ordered as Astrometric Instruments' part DOC-04

Preface to the SkyWalker Hardware Manual

Notes

- Italicized words are names that are specific to Astrometric Instruments' Telescope Control System components.
- All release notes associated with the hardware setup of the present version of SkyWalker are included in the SkyWalker release notes file.

Other user's manuals

- SkyGuide User's Manual: Describes how to use the Astrometric Telescope Control System (SkyGuide, SkyWalker and Hand Paddle) in *System mode*.
- SkyWalker1 and SkyWalker2 User's Manual: Describes how to use SkyWalker1 or SkyWalker2 in *SkyWalker Mode*
- ATCS Untroubleshooting Guide: Assists new users in avoiding several common problems, difficulties and pitfalls.
- Introduction to the Astrometric Telescope Control System. Introduces the user to the Astrometric Telescope Control System and provides installation instructions for the SkyWalker2 RetroKits for several commercially available Telescope mounts.

Table of Contents

Chapter 1: Introduction

SkyWalker is a versatile telescope motor and accessory controller. The features, capabilities and operation of SkyWalker are described in the SkyWalker User's Manual.

This manual describes how to custom install SkyWalker as a telescope control system. Included are details on connecting SkyWalker to its Hand Paddle, an autoguider, optical encoders, motor drivers or motors, a PC (to run SkyGuide) and various other accessories through the "High Drive" outputs.

SkyWalker requires the following in order to operate as a telescope control system:

- 12VDC regulated power supply (11VDC to 14.2VDC)

  SkyWalker1 requires 0.5 to 2.75 Amps depending on HighDrive loading.

  SkyWalker2 requires 3 to 5 Amps depending on HighDrive loading.

  Note: a special variant of SkyWalker2 is available that can operate from a 24v supply. Appendix B ("Differences with 24v version of SkyWalker2") describes how the specifications for the 24v version differ from the specifications for the 12v version.

- Astrometric Instruments' "HP1" Hand Paddle (included with SkyWalker)
- Two Motors

  SkyWalker1 requires two external motor drivers.

  SkyWalker2 includes integrated dual axis microstepping motor drivers.

- Cabling to provide power and connections to motors/motor drivers.

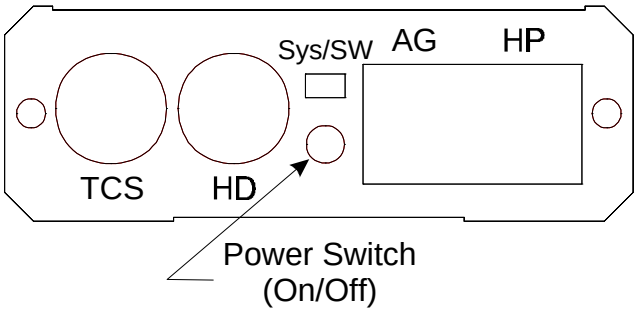
SkyWalker's functionality dramatically increases when the following (optional) devices are connected to SkyWalker:

- PC running SkyGuide connected via SkyWalker's Com (RS232) port. With SkyGuide, SkyWalker is used as part of a versatile and sophisticated telescope control system (refer to the SkyGuide User's Manual). Without SkyGuide, SkyWalker still provides basic telescope control in "SkyWalker Mode" (refer to the SkyWalker User's Manual).
- Autoguider
- Optical encoders. SkyWalker reads optical shaft encoders that track telescope position when the telescope is moved manually (when connected to SkyGuide).
- Devices controlled by the "High Drive" outputs. Six High Drive outputs are available and configurable to drive several accessories including:
  - Focus motor
  - Illuminated reticle eyepiece
  - Dew heaters
  - Camera Shutter control
  - Field De-rotator for photography on Alt/Az instruments

Chapter 2: SkyWalker Connections

Important: Do not operate SkyWalker with a telescope mounting that does not have axial limit switches (connected into SkyWalker's HardLimit inputs) on its axes. See the next chapter for details on how to properly use the HardLimit inputs.

Top end connections



TCS (Telescope Control System) Expansion Port - 6 pin MiniDIN:

- Regulated +5VDC
- +12VDC
- Proprietary two-wire serial communications for future device expansion.

HD (HighDrive) port - 8 pin MiniDIN:

- 2 BiDrive outputs each capable of sourcing or sinking 250 mA from each other in a push-pull configuration. These two outputs are powered by SkyWalker's 12VDC input supply voltage or by the internal 3VDC/9VDC regulator (ideal for NGF motorized focusers).
- 4 UniDrive outputs each capable of sinking 500mA. The 4 UniDrive outputs are limited to a total draw of 1.0Amp. These UniDrive outputs are powered by SkyWalker's 12VDC power supply or by the internal 3VDC/9VDC regulator.

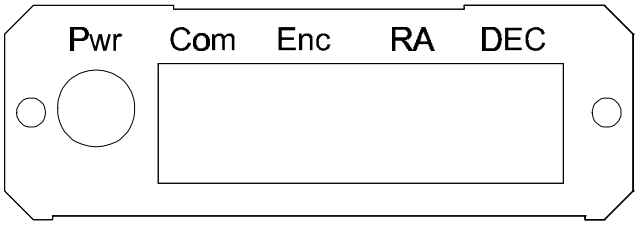
AG (AutoGuider) port – 6 pin MJ12:

This connection is for an AutoGuider and uses the industry standard 6 pin MJ12 modular connector pinout. The SBIG relay adapter box is **not** required.

HP (HandPaddle) port – 8 pin MJ45:

Provides the connection to SkyWalker's HP1 hand paddle. The required cable is included with HP1.

SkyWalker1 Bottom end connections



Pwr – 2.5mm x 5.5mm:

Connection for 12VDC to 13.8VDC power supply. Two power cable models are available:

- Power cable with fused lighter connector, center conductor 12VDC.
- Power cable with fuse and terminated with color coded banana plugs
  Red – 12VDC
  Black – GND

Com port – Handset MJ:

Provides RS-232 connection to the PC running SkyGuide. The Com cable provides the industry standard 9-pin female D-Sub (DB-9F) RS-232 pinout. Two models of Com cables are available:

- 14ft coiled (extended length)
- 25 ft flat

Encoder port – MJ45:

Connection for two optical shaft encoders and optional two encoder indices. The industry standard Tangent/BBox pinout is supported or optionally the pinout can configured to provide separate index inputs for Right Ascension (or Azimuth) and Declination (or Altitude) axis. 5VDC power for encoders and optional index circuitry is limited to 100mA for each axis.

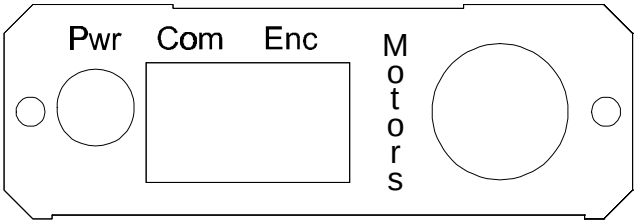
Right Ascension (RA) Motor driver port – MJ12:

This port provides Step and Dir signaling via 20mA current loops to external motor drivers. Also includes "HardLimit" and "GearIndex" inputs (The use of the RA GearIndex is required for Periodic Error Correction). 5VDC power for the HardLimit and GearIndex circuitry is limited to 50mA.

Declination (Dec) Motor driver port – MJ12:

This port provides Step and Dir signaling via 20mA current loops to external motor drivers. Also includes "HardLimit" and "GearIndex" inputs. 5VDC power for the HardLimit and GearIndex circuitry is limited to 50mA.

SkyWalker2 Bottom end connections



Pwr – 2.5mm x 5.5mm:

Connection for 12VDC to 13.8VDC power supply. Two power cable models are available:

- Power cable with fused lighter connector, center conductor 12VDC.
- Power cable with fuse and terminated with color coded banana plugs
  Red – 12VDC
  Black – GND

Com port – Handset MJ:

Provides RS-232 connection to the PC running SkyGuide The Com cable provides the industry standard 9-pin female D-Sub (DB-9F) RS-232 pinout. Two models of Com cables are available:

- 14ft coiled (extended length)
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Encoder port – MJ45:

Connection for two optical shaft encoders and optional two encoder indices. The industry standard Tangent/BBox pinout is supported or optionally the pinout can configured to provide separate index inputs for Right Ascension (or Azimuth) and Declination (or Altitude) axis. 5VDC power for encoders and optional index circuitry is limited to 100mA for each axis.

Motor port – 14 Pin Circular:

This port provides connection to the stepper motors, the HardLimit and the GearIndex inputs for each axis. The use of the RA GearIndex is required for Periodic Error Correction. 5VDC power for the HardLimit and GearIndex circuitry is limited to 100mA.

Chapter 3: SkyWalker Front Panel Indicators:

All indicators will dim/brighten on command from the hand paddle. The purpose of each indicator is described in the SkyWalker User's Manual.

Chapter 4: Hardware Setup

Internal jumpers:

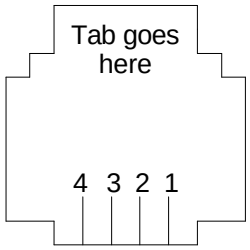
There are several jumpers internal to SkyWalker used to select the operating voltage for the UniDrive and BiDrive outputs and to configure the Encoder. These jumpers can only be changed in the factory and are set for the following configuration (can be re-configured prior to shipment or by returning SkyWalker to the factory):

- 9VDC for the BiDrive outputs, ideal for JMI NGF series of focusers. Optionally 3VDC can be selected for many of the newer NGF-DX series. 12VDC can also be selected but this will require that a 12VDC +/- 5% power supply be used to power SkyWalker.
- 12VDC for the UniDrive outputs, suitable to control SkyRad, Astrometric Instruments' modified SkyRad which provides connection to several commonly used telescope accessories such as cable powered reticle, Kendrick Dew Heaters and SkyRad's reticle and Dew Heater.
- Tangent/BBox pinout for the Encoder port. Optionally the Encoder port can be configured to receive separate index inputs for each of the telescope's axis.

Chapter 5: Interface Pinouts

Connector pinouts

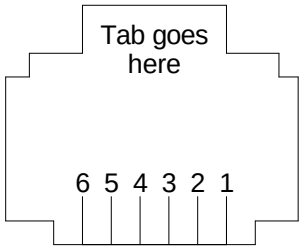
1. 4-Pin MJ Handset connection



View into SkyWalker

- Com port

Pin 1	RxD (receives RS-232 on this pin)
Pin 2	Signal ground
Pin 3	no connection
Pin 4	TxD (transmits RS-232 on this pin)



2. 6-Pin MJ12 connections

View into SkyWalker

- AG (AutoGuider) port

Pin 1	No connection
Pin 2	Signal ground
Pin 3	Right
Pin 4	Down
Pin 5	Up
Pin 6	Left

- SkyWalker1 RA and DEC motor ports

Pin 1	Step
Pin 2	Dir
Pin 3	5VDC (50mA max)
Pin 4	Signal ground
Pin 5	GearIndex
Pin 6	HardLimit

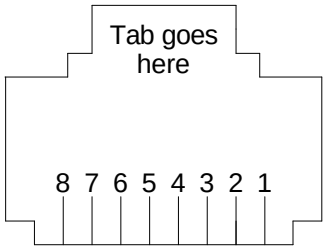
The Step and Dir signals are designed to interface directly to 20mA current loop interfaces.

The HardLimit connections are inputs that must be pulled to signal ground in order for the Drive Signals to be active. Series-connected mechanical limit switches placed on the telescope must be used to pull the HardLimit inputs to signal ground for ordinary operation. These HardLimit switches must be placed to protect against telescope movement beyond safety or mechanical limits. When a HardLimit switch is opened (or the connection from the HardLimit input to Signal ground is broken for any reason), the Step and Dir outputs are disabled.

The GearIndex signal inputs are pulled high within SkyWalker so that both “open collector” or “push-pull” index outputs can be used. The use of the RA GearIndex is required for Periodic Error Correction.

5VDC is available to power the HardLimit and GearIndex circuitry but is limited to 50mA for each motor port..

3. 8-Pin MJ45 connections



View into SkyWalker

- Encoder port

Pin 1	RA_QuadB
Pin 2	Regulated 5VDC (or optional RA_EncIndex)
Pin 3	RA_QuadA
Pin 4	Signal ground
Pin 5	DecQuadB
Pin 6	Regulated 5VDC
Pin 7	DecQuadA
Pin 8	Signal ground (or optional DecEncIndex)

The DecQuadA and DecQuadB inputs are attached to the Declination (or Altitude) optical shaft encoder and the RA_QuadA and RA_QuadB inputs are attached to the Right Ascension (or Azimuth) optical shaft encoder. The DecEncIndex and RA_EncIndex inputs are attached to once-per-telescope axis revolution indices. The index inputs are pulled high within SkyWalker so that both "open collector" or "push-pull" index outputs can be used

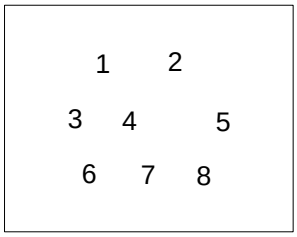
5VDC is available to power the optical encoders but is limited to 200mA.

- HP (Hand Paddle) port: Proprietary connections.

4. 6 Pin MiniDIN

- TCS (Telescope Control System) port: Proprietary expansion bus for future Astrometric Instruments products.

5. 8 Pin MiniDIN

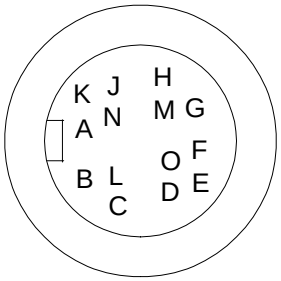


View into SkyWalker

- HD (HighDrive) Port

		SkyRad Usage
Pin 1	Vs (supply voltage used as source for UniDriveA & B)	
Pin 2	UniDriveA	Cable powered reticle control
Pin 3	UniDriveB	Kendrick Dew Heater control
Pin 4	Vs (supply voltage used as source for UniDriveC & D)	
Pin 5	BiDriveA	Focus motor + (tip)
Pin 6	UniDriveC	SkyRad dew heater control
Pin 7	UniDriveD	SkyRad reticle control
Pin 8	BiDriveB	Focus motor – (ring)

6. 14 Pin Circular



View into SkyWalker

- SkyWalker2 Motor port

		Motor wire color code (for motors supplied by Astrometric Instruments)
Pin A	DEC motor B winding - Minus	GRN/WHT
Pin B	Signal ground	
Pin C	Dec GearIndex	
Pin D	RA GearIndex (required for Periodic Error Correction)	
Pin E	5VDC @ 100mA	
Pin F	RA motor B winding - Plus	GRN
Pin G	RA motor B winding - Minus	GRN/WHT
Pin H	RA motor A winding - Plus	RED
Pin J	DEC motor A winding - Plus	RED
Pin K	DEC motor B winding - Plus	GRN
Pin L	DEC HardLimit	
Pin M	RA motor A winding - Minus	RED/WHT
Pin N	DEC motor A winding - Minus	RED/WHT
Pin O	RA HardLimit	

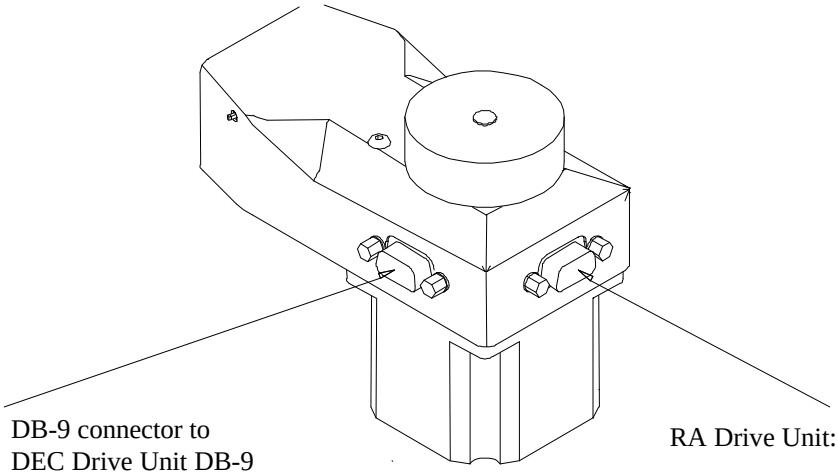
The RA and Dec motors are connected to the appropriate pins as shown in the table above. Minimum required wire gauge is 22AWG and the maximum run length is 6 ft (1.5 meters).

The HardLimit connections are inputs that must be pulled to signal ground in order for the Drive Signals to be active. Series-connected mechanical limit switches placed on the telescope must be used to pull the HardLimit inputs to signal ground for ordinary operation. These HardLimit switches must be placed to protect against telescope movement beyond safety or mechanical limits. When a HardLimit switch is opened (or the connection from the HardLimit input to signal ground is broken for any reason) the motor windings are disabled.

The GearIndex signal inputs are pulled high within SkyWalker so that both “open collector” or “push-pull” index outputs can be used. The use of the RA GearIndex is required for Periodic Error Correction.

5VDC is available to power the HardLimit and GearIndex circuitry but is limited to 100mA.

Appendix A: SkyWalker2 Drive Unit Connections



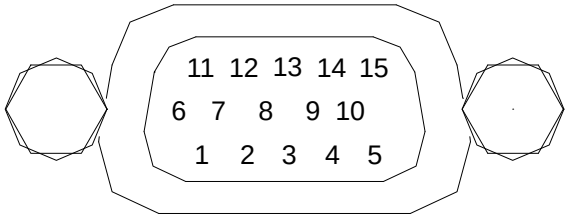
RA Drive Unit: DB-9 connector to DEC Drive Unit DB-9

DEC Drive Unit: DB-9 connector from RA Drive Unit DB-9

RA Drive Unit: DB-15HD from SkyWalker2

DEC Drive Unit: Not Installed

DB-15HD

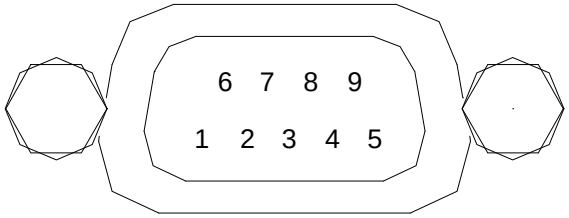


View into Drive Unit

- RA Drive Unit

Pin 1	RA GearIndex (required for Periodic Error Correction)
Pin 2	RA motor A winding - Plus
Pin 3	RA motor A winding - Minus
Pin 4	RA motor B winding - Plus
Pin 5	RA motor B winding - Minus
Pin 6	Signal ground
Pin 7	5VDC @ 100mA
Pin 8	DEC HardLimit
Pin 9	RA HardLimit
Pin 10	N/C
Pin 11	DEC GearIndex
Pin 12	DEC motor A winding - Plus
Pin 13	DEC motor A winding - Minus
Pin 14	DEC motor B winding - Plus
Pin 15	DEC motor B winding – Minus

DB-9



View into Drive Unit

- RA and DEC Drive Unit

Pin 1	DEC GearIndex
Pin 2	DEC HardLimit
Pin 3	N/C
Pin 4	5VDC @ 50mA
Pin 5	Signal ground
Pin 6	DEC motor B winding - Minus
Pin 7	DEC motor B winding – Plus
Pin 8	DEC motor A winding – Minus
Pin 9	DEC motor A winding - Plus

Appendix B: Differences with 24v version of SkyWalker2

Astrometric Instruments provides a separate SkyWalker2 model for use with input power up to 24v.

The following differences exist between the 24v and 12v SkyWalker2 models:

- The 24v SkyWalker2 has a 2.1mm x 5.5mm Pwr connector rather than the 2.5mm x 5.5mm Pwr connector included on the 12v SkyWalker2 and on SkyWalker1. The smaller center pin diameter is used because:
  - It is important to avoid inadvertently plugging 24v into a 12v SkyWalker2. Astrometric Instruments provides a power cable with the 24v SkyWalker2 that, it is expected, will be used with a 24v power supply. These 24v power cables, designed to accommodate a 2.1mm center pin, cannot be inadvertently plugged into a 12v SkyWalker (due to its 2.5mm center pin).
  - The 2.5mm center pin in the 12v model has a somewhat higher current rating: this is consistent with the 12v model's somewhat higher supply current requirement.
- The 24v SkyWalker2 can operate with an input power supply from 11VDC to 28.4VDC). The supply current requirement in full slew without any HighDrive loading is approximately 1 Amp lower than for the 12v SkyWalker2. The 24v SkyWalker2 requires 2 to 4 Amps depending on HighDrive loading.
- The two BiDrive outputs that are each capable of sourcing or sinking 250 mA in the 12v SkyWalker2 are only capable of 150 mA each in the 24v SkyWalker2.
- The internal (factory settable) jumper setting that provides 12VDC for the BiDrive outputs is not available in the 24v SkyWalker2. Only the 9VDC and 3VDC settings are available. This is set to 9VDC at the factory by default.