

Scopedog

**Advanced Alt-Az 'GoTo' Telescope drive
and tracking system**



User Manual
(Nexus DSC Version)

Important Information

User Manual Version 2.2

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ScopeDrives reserves the right to make changes to and improvements to its products without notice.

Safety

ScopeDog is primarily designed to be powered from batteries. Any restrictions imposed by the chosen battery supplier must be observed. This is particularly true for high capacity Lithium types.

A suitable adapter may be used to power the system from ac mains, however due regard must be made to electrical safety in the presence of rain, dew or split liquids.

The drive motors can deliver very high torques and care should be exercised to ensure clothing or persons do not get caught in the drive mechanisms.

Product Care

Do not plug or unplug the drive motors with ScopeDog powered. Damage may occur to the servo cards.

Do not drop or otherwise treat any ScopeDog components harshly. Do not leave exposed to the effects of direct solar heating. All components have some limited protection against dew but none are sealed and should be protected from any excess moisture.

Warranty

ScopeDog is covered by a 12 month limited warranty. Please refer to the enclosed warranty certificate for full details.

Technical Support

You can find the latest version of the manual in the support section of www.scopedrives.com.

Certifications

The RF transmitting components (Nexus & Wifi dongle), Raspberry PI & USB hub of ScopeDog are FCC certified. Full compliance of the rest of the drive system is dependent on the installation which is under user control. The ScopeDog control box is a fully screened aluminum enclosure and we recommend keeping the motor cables as short as practical and using screened cable.

System Description

ScopeDog is an add-on drive kit for Dobsonian or AltAz telescopes

The ScopeDog system includes,

- High resolution optical encoders on each axis
- Encoder interface box & WiFi access point (Nexus DSC)
- Stepper motor drives engaging through a gearbox and toothed belt
- ScopeDog Control Box
- Joystick Hand-box
- Cables

The user interface is through a pc, tablet or smartphone running SkySafari or an equivalent planetarium software¹. This device connects to ScopeDog via an adhoc WiFi network generated by the Nexus DSC unit.

The ScopeDog system utilizes the Nexus DSC to drive the optical encoders, perform initial two star alignment, and calculate scope RA & Dec. These functions are independent of the rest of the ScopeDog system and can be used stand alone as a “push-to” configuration.

In full servo mode the ScopeDog controller receives telescope RA & Dec from the Nexus DSC and calculates and applies the appropriate Alt & Az tracking rates. The drive is accomplished by micro-stepping stepper motors with integral cyclic gearboxes. These engage through a final drive to the telescope via a toothed belt and pinion.

GoTo commands from the planetarium software are transferred by the Nexus DSC to the ScopeDog controller, which converts the commanded RA & Dec to AltAz coordinates and drives the telescope to the required position through a cycle of acceleration, fast slew and deceleration. At the end of the first slew operation the controller checks the accuracy of the achieved position and if necessary makes a further small slew motion.

The ScopeDog system includes a Joystick Hand-box to allow the telescope to be manually controlled. The hand-box has a long cable and can be handheld, or attached near the eyepiece. The hand-box provides three

¹ Currently supported Apps and programmes are SkySafari (Plus & Pro), Starry Night, Cartes du Ciel, TheSky

speeds of movement in any direction. The slowest speed direction is reversed in Azimuth to match the view in the eyepiece.

The stepper motor drive modules use current power control to maximize battery life while providing sufficient torque for any telescope size. A GPS module provides automatic and accurate sensing of location and time. The hand-box connects via standard USB cable allowing its length to be readily changed.

Installing and Connecting ScopeDog

Do not plug or unplug the drive motors with ScopeDog powered. Damage may occur to the servo cards.

All components should be installed where they are protected from knocks and direct rain or dew. Suggestions for mounting the encoders and drive motors are available on www.scopedrives.com. The ScopeDog system can be configured to suit most installations, if in doubt please contact support@scopedrives.com. Final system performance depends on the accuracy with which the encoders and drive components are installed.

The diagram opposite illustrates how the ScopeDog components are interconnected.

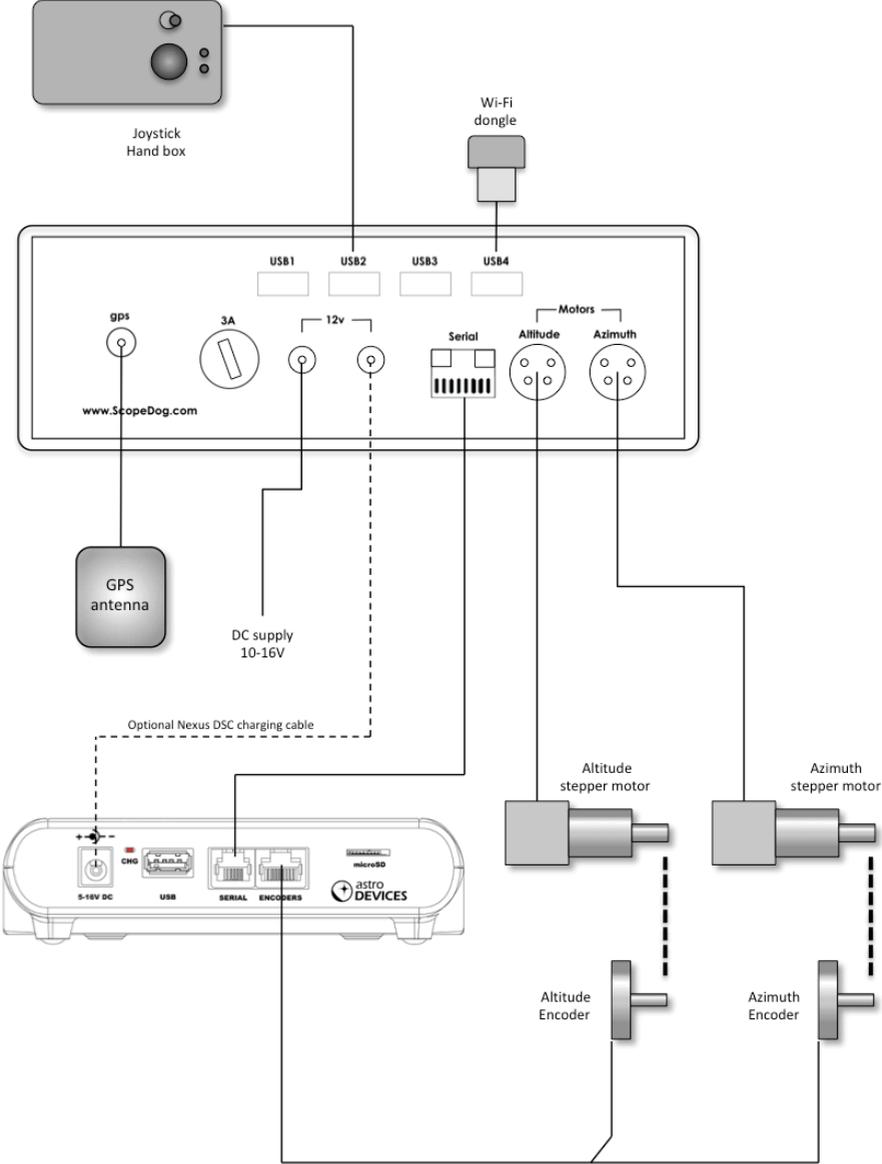
The GPS active antenna should be located so as to best receive signals from all the sky. To avoid possible interference, the supplied WiFi dongle should be plugged into the USB port furthest from the GPS antenna port and antenna. The wifi dongle is only required when inputting ScopeDog configuration parameters.

The joystick hand box may be plugged into any available USB port.

The spare USB ports may be used to power or charge other equipment up to 1 Amp total, subject to the capacity of the main ScopeDog Power supply being used.

The Nexus DSC can be powered from the 12V output on the rear of the ScopeDog unit, however it will draw up to 1A depending on its charge state. It is recommended that the Nexus DSC is fully charged separately before observing sessions.

ScopeDog System Interconnections



Initialisation

Turn on the ScopeDog control box and the Nexus DSC. Connect your controlling device (tablet, pc, etc) to the Nexus DSC WiFi adhoc network.

Follow the two star alignment procedure described in the Nexus DSC manual. The telescope can be driven to each alignment star by using the joystick on the ScopeDog hand box, or by pushing the scope if slip clutches are fitted.

When both alignments have been completed the ScopeDog control box will automatically start to read the scope RA & Dec and the motors will be driven at tracking rate. The accuracy of any 'GoTo' or position display is critically dependent on the success of the initial Nexus two star alignment procedure.

The front panel of ScopeDog has three LEDs to indicate status;

Power	Steady when power switched on
Serial	Flashes rapidly as ScopeDog & Nexus communicate
Tracking	Pulses when ScopeDog program is tracking
GPS Lock	Serial & Tracking LEDs pulse together when gps lock has not been achieved.

Open SkySafari (or equivalent) and connect to the telescope. The display should now correctly depict the position of the telescope sightline.

Note: The GPS receiver in ScopeDog has an internal rechargeable battery that speeds up initial lock. However if the battery has become drained, or the system has been significantly re-located then a few minutes may be required to achieve lock. In most circumstances turning on ScopeDog before checking collimation, finder alignment and Nexus two star alignment will give enough time to achieve lock. If not then ScopeDog will automatically wait for lock before starting to track.

The GPS battery will be drained after 1 month without use and takes approximately 24 hours to recharge fully.

Observing

Joystick Control

The hand-box has a joystick that allows the scope to be driven manually in at a choice of three speeds. The Planetarium software display will continually update to show the current position of the telescope.

Speed: The two LEDs on the hand box show the selected speed. The speed is changed by pressing the joystick paddle to sequence through the range:

Number of LEDs	Speed
None	Slow, normally used when looking through the eyepiece for small corrections
One	Medium
Both	Fast Slew

The drive speeds can be further adjusted via the ScopeDog configuration page, described on page 10 of this manual. The maximum slew speed is first set for both axes. This setting is used for GoTo and joystick Fast Slew. The medium and slow joystick speeds are then set as a fraction of the fast speed. The choice of fast slew speed will largely depend on telescope mount dynamics, whilst the medium and slow speeds will be down to personal preference when observing.

Direction: Move the joystick in any direction, including a combination of both axes and the motors will be commanded accordingly. (Joystick direction can be flipped using the ScopeDog configuration set-up page.)

The toggle switch on the hand-box has two functions –

Emergency stop: While the scope is performing a 'GOTO', moving the switch away from the 'Track' position will cause the telescope drives to immediately stop slewing. The 'GOTO' command can then be cancelled on the initiating planetarium programme or Nexus DSC.

Spiral Search: While the scope is tracking, moving the switch away from 'Track' will cause the telescope to perform a gentle expanding spiral search away from the current position. Returning the switch to 'Track' at a point on the spiral will cause the motion to stop and tracking to continue from that point.

The parameters of the spiral are initially set via the ScopeDog configuration set-up utility, described on page 10 of this manual. Based on telescope aperture and f/no, ScopeDog will calculate a step size for the spiral. The user can also input a dwell time after each step. Setting this to zero will produce a continuous spiral motion. Setting it to 2 seconds for example gives the user 2 seconds to visually search the field with the scope stationary, before the spiral is continued by another step, and so on.

Whilst the spiral is in motion, the user can manually change the step size by pressing the joystick paddle. The step size sequences through small, medium and large. The current step size being indicated by none, one or two LEDs being illuminated.

GoTo Control

For SkySafari (similar functions apply in other planetarium programmes), any object in the display may be highlighted and then the 'GoTo' command engaged. This command may also be done from the object search result.

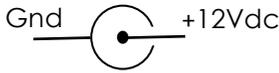
A 'GoTo' command can also be initiated from the Nexus DSC once an object has been recalled from an installed catalogue.

ScopeDog will then calculate the required change of telescope position, smoothly accelerate the drives up to the fast slew speed, and decelerate as the computed target nears. When the first slew has been completed, ScopeDog reads the encoders (via Nexus) to compare against the intended target. If necessary another small slew is performed to close any gap. This is repeated automatically until the target position is reached.

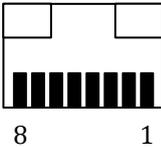
In normal use, a GoTo command should result in the target object being found in the eyepiece field of view. A number of factors strongly affect GoTo performance.

If the target object is consistently not in the field of view after ScopeDog has finished all slew steps, then the initial Nexus two star alignment may not have been successful, the encoders are not secure, or the mount axes are not orthogonal. If the target object is in the field of view, but ScopeDog needed significantly large second or third steps to get there, then the drives may be slipping, or the Gear Ratios in the configuration set-up may be inaccurate.

Connections

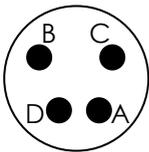


Serial port
socket view



3	ScopeDog Rx
4	ScopeDog Tx
5	Gnd

Motor
socket view



Pin	Motor wire
A	Black
B	Green
C	Red
D	Blue

Specification

Encoder Resolution	$\geq 10,000$	will depend on encoders selected
Drive Speeds	Fast Medium Slow	Up to 10 deg/sec depending on telescope size and mount typically 1/3 of fast (user adjustable) typically 1/40 of medium (user adjustable)
Drive resolution steps	typically less than 10 arcsec, depending on final output drive ratio.	
Power supply	10 -16 Vdc	
Power consumption	typically 5-7W depending on scope size	
Motor Torque (max)	30kg-cm continuous, 80kg-cm for short periods	

Setting Configurations

Nexus DSC

The Nexus DSC manual (<http://www.astrodevices.com/Support>) has guides for configuring the Nexus unit. Specific ScopeDog parameters are:

Nexus DSC serial comms protocol is set to:

Scope Dog, 9600,1,8,None

Nexus DSC wifi comms protocol is set to:

LX200. TCP port 4060

SkySafari

Equipment Selection

Scope Type is set to

Meade LX-200 Classic

Mount type is set to

Alt-Az. GoTo

Communication Settings

Auto-Detect SkyFi

Off

IP Address

10.0.0.1

Port Number

4060

SkyFi Settings Web Page

not used

Set Time & Location

Off

Readout rate at least 4 per second

Tilt Device to Slew

Off

Save Log File

Optional

ScopeDog

Access to ScopeDog configuration data is via wifi.

1. Start with ScopeDog switched off
2. Turn on the supplied TripMate wifi router
3. Plug the supplied wifi dongle into one of the ScopeDog USB ports.
4. Turn on ScopeDog
5. Using a pc, tablet or similar, connect to the TripMate wifi. Its SSID will be TripMate-XXXX, the password is written on the TripMate box, please make a safe note of it.
6. Using the tablet browser, connect to the ScopeDog configuration page at 10.10.10.X, where X will be 1, 2 or 3, or possibly higher.
7. The configuration page will be similar as shown below. Make a note of the current parameters before making any changes!
8. *Autostart* must be left at True, and *Test* set at False. These are used for accessing advanced features at factory set-up.
9. After making changes, save them using the button at the bottom of the page.
10. Changes take affect after a re-start.

Example screen, actual values will vary according to the installation.

ScopeDog.config file

AutoStart:	True <input type="radio"/> False <input checked="" type="radio"/>	If true...next restart Scope Dog will automatically start
Az_Gear_Ratio:	<input type="text" value="27.02"/>	Number of teeth on belt divided by Number of teeth on drive gear
Alt_Gear_Ratio:	<input type="text" value="24.92"/>	Number of teeth on belt divided by Number of teeth on drive gear
Alt_Gear:	A <input checked="" type="radio"/> B <input type="radio"/>	If your Alt direction is wrong change this
Az_Direction:	A <input checked="" type="radio"/> B <input type="radio"/>	If your AZ direction is wrong change this
Current_Limit:	<input type="text" value="5"/>	Max Amps Motors allowed to draw...3.0 is maximum but only set this as high as necessary or motors will get very very hot and reduce the life of the motor
azVelocity:	<input type="text" value="23000"/>	As a starting point change value to 29593. The larger the value the faster the max Az speed. Starting Value will change if you have changed gear ratio above. Save to refresh.
altVelocity:	<input type="text" value="25000"/>	As a starting point change value to 27293. The larger the value the faster the max Alt speed. Starting Value will change if you have changed gear ratio above. Save to refresh.
SlewSpeedSlow:	<input type="text" value="40"/>	If when centering object the slew is too fast increase this number...too slow decrease it
SlewSpeedMed:	<input type="text" value="3"/>	If when moving to object the medium slew is too fast increase this number...too slow decrease it
Test:	True <input type="radio"/> False <input checked="" type="radio"/>	This is for testing purposes...please leave False
mirror_Size:	<input type="text" value="20"/>	This is your mirror size in inches
f_Ratio:	<input type="text" value="3.5"/>	This is your mirror's f_ratio
spiral_Delay:	<input type="text" value="3"/>	This is length of delay of each spiral move in seconds
flip_AltF:	<input checked="" type="checkbox"/> Flip	Flip Alt directions on joystick at Medium and Fast slew speeds
flip_AltS:	<input type="checkbox"/> Flip	Flip Alt directions on joystick at Slow speeds
flip_AzF:	<input checked="" type="checkbox"/> Flip	Flip Az directions on joystick at Medium and Fast slew speeds
flip_AzS:	<input checked="" type="checkbox"/> Flip	Flip Az directions on joystick at Slow speeds

[Save Config File](#)

Owner Configuration Data

Use this table to record your own config data.

	Original Setting	Changes	Notes
Az Gear Ratio			
Alt Gear Ratio			
Alt Gear			
Az Direction			
Current Limit			
Az Velocity			
Alt Velocity			
Slew Speed Slow			
Slew Speed Medium			
Mirror size			
F ratio			
Spiral delay			
flip_AltF			
flip_AltS			
flip_AzF			
flip_AzS			