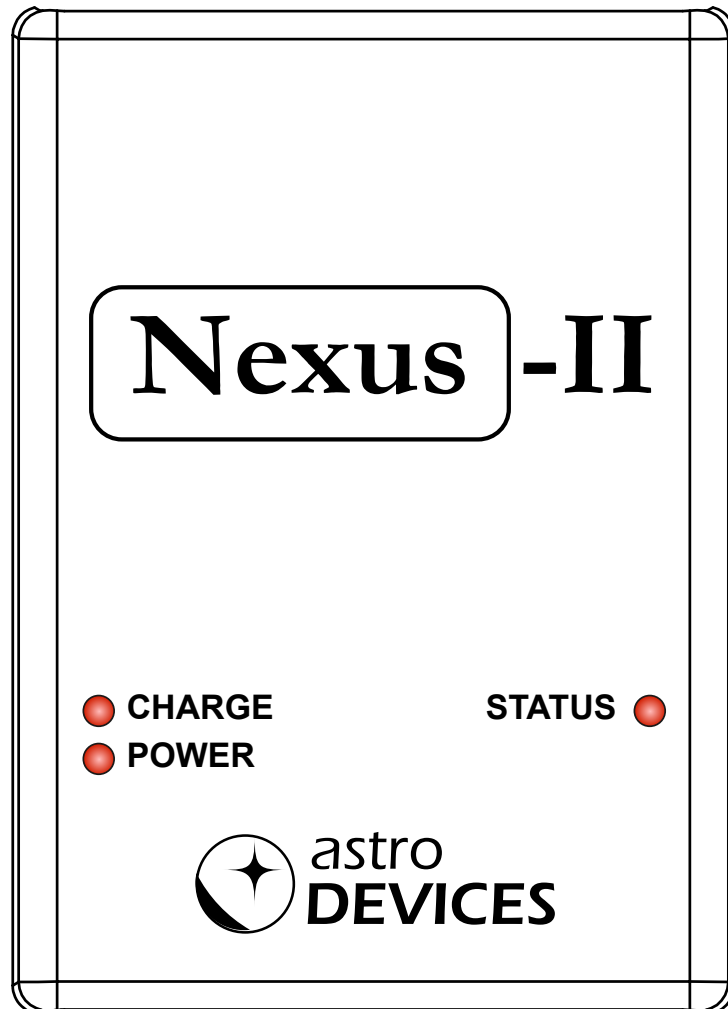


USER MANUAL



User Guide for Nexus-II

Version 1.2

Firmware version 1.x.x

Last revised on September 15th, 2020

Printed in Australia

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Precautions and Safety

Electricity



Nexus-II contains a rechargeable Lithium-ion battery. Lithium-ion batteries can explode or cause a fire if they are used incorrectly or if they are defective. Therefore, you are recommended to read the following instructions very carefully:

NEVER leave Nexus-II where it is subjected to extremes in temperatures. This includes low levels as well as high.

DO NOT leave Nexus-II where it is in direct sunlight or in an enclosed space, such as a car, that can become extremely hot very rapidly.

Do not drop or subject the Nexus-II to impact.



Do not handle power plug and adapter with wet hands. Electrical shock may result.

Immediately power off the product and unplug the DC adapter and/or batteries if smoke or odours emit from the product.

Immediately power off the product and unplug the DC adapter and/or batteries if water or other liquids are present.

Product

Do not drop or subject the device to impact.

Keep it away from harsh environments including humid, dusty, and smoky areas.

Do not use excessive force on the connectors or attempt to disassemble the device.

Do not place heavy objects on the product. Damage to your products may result from improper use.



Technical Support

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Thank you

Thank you for purchasing Nexus-II WiFi electronic telescope interface. We hope you enjoy it! This user manual will get you started and help you make the most of your Nexus-II.

Introduction

Nexus-II is a computerised WiFi wireless adapter for your telescope. It works with most popular telescopes – on equatorial or Alt-Azimuth mounts.

Nexus-II can be configured to function as a DSC and/or USB serial to WiFi adapter.

Nexus-II, two optical encoders, encoder cable and a tablet or computer will transform your telescope into a computerised telescope making locating all those hard to find objects an easy task. Also Nexus-II communicates wirelessly with your tablet or personal computer so you will find no wires to trip over in the darkness.

You will need [planetarium software](#) in order to use Nexus-II.

Product Features

Below is a short outline of main features of your Nexus-II.

- Supports extended Ouranos, Bbox, Sky Commander and LX200 communication protocols
- Handles TTL quadrature optical encoders with practically unlimited number of pulses per second
- Dual power source – internal 3.7V Lithium battery or external 5-9V DC
- Operating temperature range from -20 °C to +50 °C (-5 °F to +120 °F)
- Humidity 10%-90% non-condensing
- FCC / CE/ IC certified 2.4GHz IEEE 802.11b/g transceiver
- Supports Access Point and infrastructure WiFi networks
- Secure Wi-Fi authentication schemes (WEP/WPA/WPA2)
- Class I WiFi device (up to 150 meters)
- Uses 2412 ~ 2484MHz Unlicensed ISM band (channels 1-14)
- USB providing up to 0.5A, 5V power
- Uses a 32-bit MIPS CPU.
- Power consumption (while charging) – 1.5 A from 5V
- Reverse polarity protection
- RoHS compliant

System Requirements

Nexus-II uses a WiFi communication module and requires one of the following to be connected to:

- iOS devices (iPhone, iPad, iPod touch) running iOS 3.0+
- Android devices with WiFi support
- PC with WiFi support (running Windows XP or Windows 7).
- Apple computers with WiFi support (running Mac OS X).

Please also refer to the system requirements for your favourite [planetarium software](#).

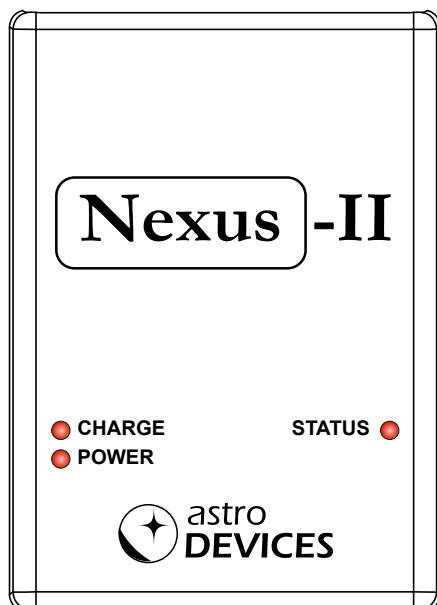
Package Content

The package contains:

- Nexus-II
- User manual
- DC 2.1mm to USB-A power cable

Controls

Status LEDs are situated on the front panel of Nexus-II:

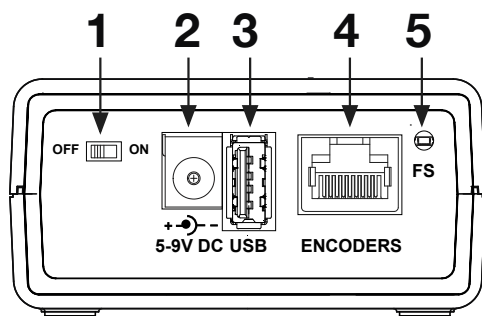


CHARGE – indicates if charging is in progress (ON if charging, OFF if charging is complete)

STATUS – Encoders RJ45 connector

POWER – indicates if the power source is valid (ON if the power source is between 5 and 9V DC and provides sufficient current)

Controls are situated on side panel of Nexus-II:



1 – ON/OFF slide switch

2 – 2.1mm DC connector

3 – USB

4 – Encoders RJ45 connector

5 – Factory settings button



WARNING:

Do not connect Nexus-II to an external power source that is not within the specified voltage range. Nexus has internal over-current protection but it is safer to use it with the power source specified. The USB port can be used to charge your portable computing device and Nexus-II can provide up to 0.5A.

The status LED reports different states of Nexus-II:

Blinking type	Description
Slow pulsating blinking (once every two seconds)	Nexus-II is operating
ON	Updating firmware
Flashing (once a second)	Error/Change Mode

Charge the battery

The battery may not be fully charged at first. We advise to fully charge the battery.

Please use either the provided optional power adapter or one of the recommended power adapters to charge the battery.

Please use the supplied USB to DC 2.1mm cable to charge the battery from a power adapter with a USB socket. The power adapter should be capable of supplying at least 1.5A at 5V otherwise it will take much longer to fully charge the battery in Nexus-II.

Connect the power adapter to Nexus-II and plug the adapter into a power point.

It is recommended to keep Nexus-II turned off during charging to reduce charging time.

WARNING:

Do not connect Nexus-II to an external power source that is not within the specified voltage range. Nexus-II has internal over-current protection but it is safer to use it with the power source specified.



The internal Lithium battery can only be charged at a temperature range of 0 °C to +30 °C (32 °F to 86 °F)



Power source must have the following minimum ratings:

- 5-9 V DC – 1A minimum, 2A is recommended

Some inexpensive power adapters do not have an over-current protection and when connected to Nexus-II will fail and damage the unit and that will void the warranty

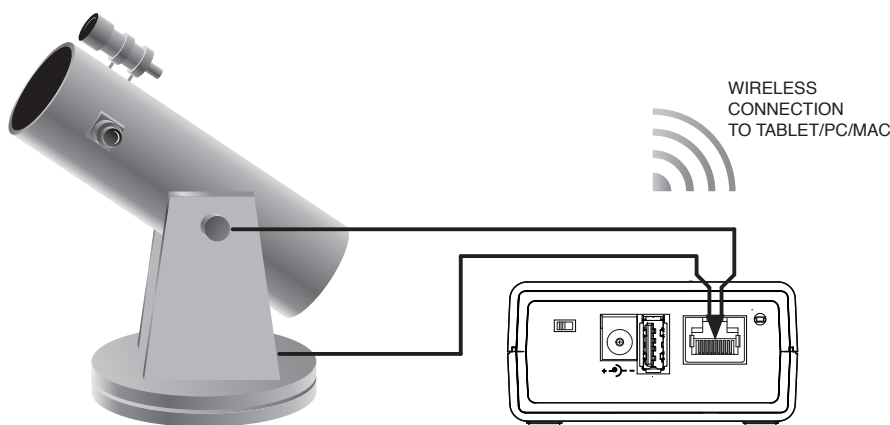
Connecting Nexus-II to Your Telescope/Other Devices

Nexus can operate in various modes:

- Wireless DSC
- Wireless DSC and USB serial to WiFi adapter
- USB serial to WiFi adapter

Wireless DSC

The following diagram illustrates how Nexus-II is connected to a telescope:

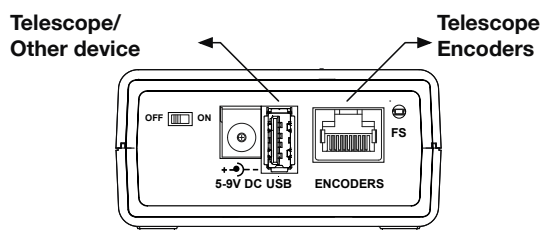


Nexus-II constantly detects pulses sent by the encoders and translates them into absolute angular positions. Planetarium software periodically (depending on the settings) requests the encoders' current position and converts it to real sky coordinates. Then the position of the telescope is usually reflected on the screen by a cross hair. An alignment procedure needs to be performed before the planetarium software can start showing where the telescope is pointing. Please refer to the user manual of the planetarium software for details on performing the alignment procedure.

Please note that the connection to a telescope mounted on an equatorial mount is the same except the Azimuth cable is connected to the RA (right ascension) encoder while the Altitude cable is connected to the Declination encoder.

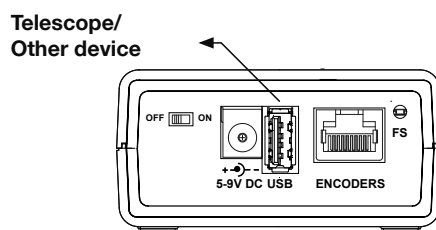
Wireless DSC and USB serial to WiFi adapter

Nexus-II can be used as a wireless DSC and a USB serial to WiFi adapter. In this mode Nexus-II is used for a 'push-to' DSC on a telescope while USB can be connected to another telescope/device.



USB Serial to WiFi adapter

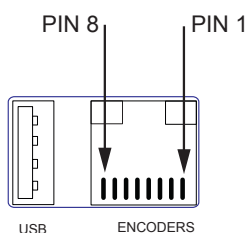
In this mode only the USB port is used. The USB port is connected using a standard USB cable to a telescope with a USB interface. Nexus-II supports a number of telescopes with a USB interface based on FT232x (ServoCAT, SiTech), CP210x (iOptron) and PL2303 (iOptron, Meade) chips.



Ports Pin Descriptions

Encoders

Nexus has a standard RJ-45 connector to connect it to the rotary encoders of your telescope. The pins are numbered according to the following diagram:



The pin descriptions are in the following table:

Pin	Description
1	Channel B of Azimuth or RA encoder
2	+5 V
3	Channel A of Azimuth or RA encoder
4	Ground
5	Channel B of Altitude or Declination encoder
6	+5V
7	Channel A of Altitude or Declination encoder
8	Ground



WARNING:

While Nexus-II's encoders' port has an input protection, care must be taken not to exceed the maximum input voltage of +5V DC on any input, and the inputs should never be driven to negative voltages below GROUND. This will cause permanent damage to the internal circuits of Nexus-II.

Nexus-II only works with TTL (Transistor-Transistor Logic) [rotary encoders](#) with quadrature output.

Connecting To Tablet/PC/Mac

Nexus-II communicates with planetarium software using one or more TCP/IP ports. Nexus-II's default TCP/IP ports' configuration is described in the following table:

TCP/IP port	Port	Connection	Serial port parameters, baudrate, data bits, stop bits, parity
4060		Astro Devices communication protocol	
4061		LX200 communication protocol	
4062		USB	9600, 8, 1, no
4070		Configuration protocol	

Nexus-II is operating in Access Point mode by default. The default SSID of Nexus is **ADNexusII_XXXXX** where **XXXXX** is the serial number of your Nexus. The serial number is printed on the back of your Nexus-II. The SSID can be changed using the configuration utility.



The default IP address of your Nexus is **10.0.0.1**.



Note: The WiFi Configuration setup may differ based on the brand of the computer used and on the OS running on that device. Please refer to the user manual of the devices and the OS. The TCP/IP port used for configuration is always 4070 and cannot be changed.

Please refer to the user manual of your planetarium software for the explanation on setting up the communications with telescope. Some software is designed to operate a telescope directly through a serial port. You can use a special utility – virtual serial port driver for your computer. A number of utilities of this type are available, with many of them free:

COM2TCP - with a 45-day free trial, by [AstroGeeks](#)

HW VSP 3 - Free for personal use

Operating Nexus-II

Updating Firmware

Nexus-II's firmware can be updated using a USB memory stick. Please download the latest firmware from the support section of our website and copy it to the root folder of the USB memory stick. Please follow these steps:

- Turn Nexus-II OFF
- Insert the USB memory stick into USB connector of Nexus-II
- Press and hold the 'Factory Setting' button (using a pin/pen)

- Turn Nexus-II ON
- Wait for two seconds
- Release the 'Factory Setting' button
- The firmware will be updated. Once the update is complete the Status LED will start 'pulsating' blinking
- Turn Nexus OFF
- Remove the USB memory stick

Please note that Nexus-II may reset all of its settings with a firmware update.

Restoring WiFi factory settings

From time to time you may need to restore the WiFi settings of your Nexus-II. The following steps will allow you to reset them:

- Turn Nexus OFF
- Press and hold the 'Factory Setting' button
- Turn Nexus-II ON (the status LED will start flashing)
- Release the button
- The WiFi settings are restored as soon as the status LED will start 'pulsating' blinking



Note: Please make sure that no device is connected/joined to Nexus-II's WiFi network when restoring WiFi factory settings.

List of Compatible Planetarium Software

Nexus-II is compatible with most planetarium software packages that support Ouranos or Bbox protocols. You can also use planetarium software that supports ASCOM platform (<http://ascom-standards.org>). The table below lists just a few software packages that Nexus-II was tested with.

Software Name	Platform	Protocol	Website
Deep Sky Browser	iOS	Astro Devices Nexus	http://www.astrodevices.com/
Cartes du Ciel	Windows	Orion IntelliScope Mounts (ASCOM platform)	http://sourceforge.net/projects/skychart/
DeepSky	Windows	Orion IntelliScope Mounts (ASCOM platform)	http://www.deepsky2000.net
Hallo northern sky	Windows	Orion IntelliScope Mounts (ASCOM platform)	http://www.hnsky.org/
Megastar	Windows	Bbox/Sky Wizard CTI	http://www.willbell.com/
SkySafari Plus/Pro	Android iOS MacOS X	Basic Encoder System	http://www.southernstars.com/
Starry Night®	Windows	Orion IntelliScope Mounts (ASCOM platform)	http://www.starrynightstore.com
TheSky 6	Windows	BBox	http://www.bisque.com
Voyager-4.5	Windows MacOS X	Basic Encoder System	http://www.carinasoft.com

FREQUENTLY ASKED QUESTIONS (FAQ)

Q: How long does the battery last?

A: That depends on a number of different factors – type of encoders used, and operating temperature to some extent. It also depends on the mode Nexus-II is running in. For example, the internal battery (fully charged) will last for around 11 hours with Nexus operating as a WiFi DSC with US Digital S2/S6, 10000 steps encoders

Q: Can I use non-optical encoders?

A: Yes, the firmware processes pulses from standard quadrature encoders. They can be optical, capacitive or magnetic encoders. Any of them can be used as long as they provide TTL level quadrature output.

Q: Does Nexus-II use external power when external is connected?

A: Nexus-II uses only external power source to operate and to charge the battery. If the battery is fully charged then the external power will be used to power Nexus-II. If the battery is not fully charged then external power will be used to charge the battery and to power Nexus-II.

Q: Does Nexus-II have a built-in charger for the installed battery?

A: Yes, Nexus-II has a built-in charger with a temperature sensor and high precision voltage output required to charge Lithium batteries. It also has a built-in safety timer that will disconnect the battery under charge in 5 hours.

Q: How can I determine the resolution of my encoder?

A: Just multiply the CPR (counts per revolution) of your encoder by four and then multiply the result by the ratio of the gears it is connected to your telescope (if you have any).

Q: Does Nexus-II work with a standard Android based device (without any modifications to the device's firmware)?

A: Yes, Nexus-II works with any recent Android based phone/tablet without any need to modify the firmware on that device. Nexus is working as a WiFi access point.

Suppliers of Encoders/Telescope Encoder kits

Nexus-II is compatible with most quadrature rotary encoders with TTL level outputs and powered with 5V. The following table lists just some of suppliers selling encoders or telescope encoder kits.

Supplier	Hardware	Country	Website
Astro Devices	Encoders/ Telescope encoder kits	Australia	http://www.astrodevices.com/
Intercon Spacetec	Encoders/ Telescope encoder kits	Germany	http://www.intercon-spacetec.de/
Sky Engineering, Inc	Encoders/ Telescope encoder kits	USA	http://skyeng.com/
US Digital	Encoders	USA	http://www.usdigital.com/

Warranty

Nexus-II is covered by a one-year limited warranty. Please refer to the enclosed warranty certificate for full details.

Technical Support

You can find the latest version of the manual and firmware in the support section of our website. Please feel free to e-mail us should you require further technical assistance.

Technical Support

You can find software updates and user documentation on the Astro Devices website.

<http://www.astrodevices.com>

e-mail: <mailto:support@astrodevices.com?subject=Nexus-II support>

FCC Statement for Nexus-II

Contains: FCC ID: 2AC7Z-ESPWROOM02

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: To comply with FCC RF exposure compliance requirements, the antenna used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver



DECLARATION OF CONFORMITY

We, Astro Devices, ABN 75 270 616 917, 198 The Esplanade, SYLVANIA, NSW 2224, AUSTRALIA, E-mail: info@astrodevices.com,

As manufacturer/producer declare that:

Product Name: Nexus-II
Product Series: NXIIW12
Product Description: Wireless digital setting circles/multifunctional adapter for telescopes

conforms to the following directives and standards therein

Directives:

WEEE- Waste from Electrical and Electronic Equipment - 2002/96/EC

Radio Equipment & Telecommunications Terminal Equipment (R&TTE) - 1999/5/EC

RoHS- Restriction of use of Hazardous Substances in Electrical and Electronic Equipment - 2002/95/EC

Standards:

EMC: EN 55022: EN 301 489-1 V1.8.1:2008-04, EN 301 489-17 V2.1.1:2009-05

RADIO: EN 300 328 V1.7.1:2006-10

Immunity: EN 55024: EN 61000-4-2:2001, EN 61000-4-3:2002

Safety: EN 60950-1:2006+A11:2009+A1:2010

Supplementary Information:

This unit is a battery-operated appliance.

Date of issue:

March 20th 2016

Communication Protocols

Astro Devices Protocol

The following table lists the main command set supported by Nexus DSC communication protocol.

Command	Description	Example of input	Returns
V or V	Return the firmware version information	V	Astro Devices Nexus v1.0<CR>
R# #<CR> or R#<tab>#<CR>	Set encoders' resolution. Please note that the values set are not saved into flash memory and will be reset upon a power cycle.	R10000<tab>9000<CR>	R
Z# #<CR> or Z#<tab>#<CR>	Set encoders' resolution. Please note that the values set are not saved into flash memory and will be reset upon a power cycle.	Z10000 9000<CR>	*
I# # or I#<tab>#<CR>	Set initial encoders' positions	I0<tab>0<CR>	R
Q	Query encoders' positions	Q	+1888 -2190<CR>
H or r	Query encoders' resolutions	H	8192 8192<CR>
A<0 1>_<RA>_<Dec><cr>	Align on an object. Please note that the coordinates should be using epoch 2000 if Nexus is used with ServoCat.	A0_45.123_78.245<cr>	Y - success E - error
T_<0 90><cr>	Initial telescope alignment at 0 degrees (horizontal) or at 90 degrees (vertical)	AI_0<cr>	Y - success E - error
O	Release shutter	O<cr>	
o	Close shutter	o<cr>	
F	Activate 'focus'	F<cr>	
f	Deactivate 'focus'	f<cr>	
<CR>	Query the current position. The current position will be valid only once the star alignment is performed	<CR>	12.345_67.890<CR>

Where

- <CR> - carriage return (or 'Enter') character with a decimal value of 13
- <tab> - tab character with a decimal value of 9.
- _ - space character with a decimal value of 32.

Nexus-II Configuration Protocol

Nexus-II can be configured to operate in different modes. The configuration is performed by communicating with Nexus-II using TCP/IP port number 4070.

Each command has the following syntax:

<set/get>_<parameter 1>[_<parameter 2>]_<value><CR>

Nexus-II will send back the value requested or 'OK' in case of a 'set' command. The returned packet will be equal 'ERR' in case of invalid requests. The return packets are always terminated with <CR>.

The following table lists all command parameters:

Parameter 1	Parameter 2	Value	Description	Examples
WiFi configuration				
CHANNEL		0-14	Specifies the WiFi channel to be used. Please note that the value of 0 should only be used when Nexus is setup to operate in infrastructure mode.	set CHANNEL 7<cr> get CHANNEL<cr>
DHCP		0,1	Specifies whether to use DHCP: 0 – disabled, 1 – enabled	set DHCP 0<cr> get DHCP<cr>
IPADDRESS		xxx.xxx.xxx.xxx	Specifies the IP address to be used. The IP address will only be used when DHCP is disabled.	set IPADDRESS 169.254.1.1<cr>
IPMASK		xxx.xxx.xxx.xxx	Specifies the IP mask.	set IPMASK 255.255.0.0<cr>
NTYPE		0 - infrastructure 7 – Access Point	Specifies the network mode to be used by Nexus.	
PASSWORD		up to 32 bytes	Specifies the password to be used to connect to a WiFi network.	set PASSWORD Pass123<cr> get PASSWORD<cr>
SSID		up to 64 bytes	Specifies SSID	set SSID MyNexus<cr> get SSID<cr>
TRANSPower		1÷12	Specifies the transmission power to be used by the WiFi module. Please note that the value of 1 specifies the minimum power and the battery will last longer at that level.	
Physical Port				
USB	baudrate	9600÷230400	Sets the baud rate to be used on the port specified. The value specified is in bits per second.	set PORTI baudrate 19200<cr> get PORTII baudrate<cr>
	databits	8,9	Sets the number of data bits.	set PORTII databits 8<cr> get PORTI databits<cr>
	parity	0, 1, 2	Sets the parity to be used on the ports specified: 0 – none 1 – odd 2 – even	set PORTII parity 0<cr> get PORTI parity<cr>
	protocol	0÷2	Specifies the communication protocol to be connected to the physical port 0 - Astro Devices communication protocol 1 - SkyCommander communication protocol 2 - ServoCat communication protocol	set PORTI protocol 1<cr> get PORTI protocol<cr>
	stopbits	1,2	Specifies the number of stop bits.	set PORTI stopbits 8<cr> get PORTII stopbits<cr>
Port Routing				
PORT	0÷5	1024÷65535	Sets the TCP/IP port number to be used with virtual port (0÷5)	set PORT 0 4060<cr> get PORT 5<cr>

Parameter 1	Parameter 2	Value	Description	Examples
PORTCONNECT	0÷5	0÷7	Specifies the connection type for the virtual port (0÷5), The connection type can be equal to one of the following values: 0 - Astro Devices communication protocol 1 - SkyCommander communication protocol 2 - ServoCat communication protocol 3 - Configuration communication protocol 6 - Connect to USB 7 - no connection	
Digital Setting Circles				
AZENCRES RAENCRES		128÷4294967296	Specifies the azimuth/RA encoder resolution. The default value is set to 10000. The value specified is in ticks per revolution. Please note that both commands (AZENCRES and RAENCRES) set the same value.	set AZENCRES 10000<cr> get RAENCRES<cr>
ALTENCRES DECENCRES		128÷4294967296	Specifies the altitude/declination encoder resolution. The default value is set to 10000. The value specified is in ticks per revolution. Please note that both commands (ALTENCRES and DECENCRES) set the same value.	set DECENCRES 8192<cr> get ALTENCRES<cr>
MOUNTERR		Z1 Z2 Z3	Specifies the mount fabrication errors in degrees.	set MOUNTERR 0.12 0.3 0.1<cr> get MOUNTERR<cr>
MOUNTTYPE		0 – Alt/Az 1 - Equatorial		set MOUNTTYPE 0<cr> get MOUNTTYPE<cr>
CONFIGURE			Saves the configuration into flash memory.	set CONFIGURE<cr>

Glossary

CPR stands for Counts Per Revolution.

PC is a personal computer. It includes computers running Windows, Linux or Mac OS.

SSID (Service Set Identifier) is the name of a wireless local area network (WLAN),

Standby mode is when the Nexus is passively waiting for a connection with a Tablet/PC.

TTL stands for Transistor-Transistor Logic

WPS stands for WiFi Protected Setup

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