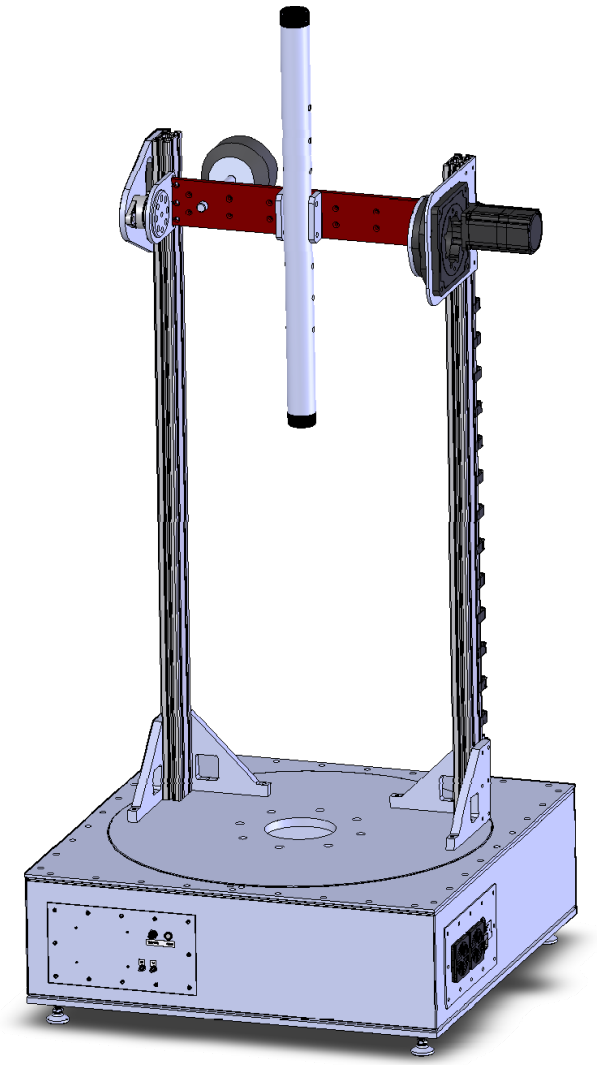
ETS·LINDGREN®
An ESCO Technologies Company

2301 Positioner

User Manual



January, 2021

1723531 Rev B

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Revision Record
MANUAL, 2301 | Part # 1723531 Rev B

Revision	Description	Date
A	Initial Release	December, 2020
B	Corrected Voltage	January, 2021

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Notes, Cautions, and Warnings

Note: Denotes helpful information intended to provide tips for better use of the product.

CAUTION

Caution: Denotes a hazard. Failure to follow instructions could result in minor personal injury and/or property damage. Included text gives proper procedures.

WARNING

Warning: Denotes a hazard. Failure to follow instructions could result in **SEVERE** personal injury and/or property damage. Included text gives proper procedures.

Safety Information

See the ETS-Lindgren *Product Information Bulletin* for safety, regulatory, and other product marking information.

Refer to Manual: When product is marked with this symbol, see the instruction manual for additional information. Manuals are available for download at ETS-Lindgren.com, or contact ETS-Lindgren Customer Service.

High Voltage: Indicates presence of hazardous voltage. Unsafe practice could result in severe personal injury or death.

Protective Earth Ground (Safety Ground): Indicates protective earth terminal. You should provide uninterruptible safety earth ground from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

Before power is applied to this instrument, ground it properly through the protective conductor of the AC power cable to a power source provided with the protective earth contact. Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal could result in personal injury.

Warning: HEAVY OBJECT. Unassisted lifting can cause injury. Mechanical assistance is required.

STAY CLEAR of moving components during operation of equipment.

KEEP CLEAR during operation. Falling equipment can cause serious injury.

KEEP HANDS CLEAR: Moving parts can crush and cut.

Before servicing: contact ETS-Lindgren – servicing (or modifying) the unit by yourself may void your warranty. If you attempt to service the unit by yourself, disconnect all electrical power before starting. There are voltages at many points in the instrument which could, if contacted, cause personal injury. Only trained service personnel should perform adjustments and/or service procedures upon this instrument. Capacitors inside this instrument may still be CHARGED even when instrument is disconnected from its power source.

Invisible Laser Radiation: Do not stare into beam or view directly with optical instruments.

Only qualified personnel should operate (or service) this equipment.

Introduction

ETS-Lindgren's 2301 Type Precision Positioner is designed to perform automated 3-dimensional pattern measurements. The positioner includes vertical support columns that will accommodate equipment under test (EUT) up to 25 kg (55 lb).

The positioner is equipped with two motors (one Azimuth, one elevation), 208-230 VAC 50 or 60 Hz single phase. An IEC receptacle is the standard power input. The IEC rocker switch illuminates red when in the ON position. Current draw is fused at 6.3 A maximum. The motor drive, in conjunction with the provided command set, controls the movement of the unit. 10 M (32.8 ft) fiber-optic cable provided.

The 208-230 VAC motor power inlet is operated by an illuminated switch, and the inlet for the customer's EUT is operated by a non-illuminated switch. Labels on the top surface of the motor base indicate the location of each inlet.

Standard Configuration

- Model 2301 Turntable Assembly
- 708043 Ethernet to Fiber Converter
- 705347-10 10.0 M (32.8 ft) Fiber-Optic Cable
- 257111 0.9 M (3.0 ft) Ethernet Cable
- 1723531 User Manual available as PDF

Optional Items

- EMQuest EMQ-100 Antenna Measurement Software (Standard Version)
- EMQuest EMQ-100 Lite Antenna Pattern Measurement Software
- RPI2, Remote Positioner Interface

ETS-Lindgren Product Information Bulletin

See the ETS-Lindgren *Product Information Bulletin* included with your shipment for the following:

- Safety, regulatory, and other product marking information
- Steps to receive your shipment
- Steps to return a component for service
- ETS-Lindgren calibration service
- ETS-Lindgren contact information

Maintenance

CAUTION Before installing any components, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment.

CAUTION Disconnect the power before proceeding with recommended maintenance. Do not perform maintenance while the positioner is operating

Warranty may be void if the housing is opened.

If you have any questions concerning maintenance, contact ETS-Lindgren Customer Service.

Positioner Maintenance Recommendations

Periodic Maintenance

Check cables for wear. Ensure they are clear of potential damage from moving parts.

Ensure bearing and pinion have adequate lubrication.

Replacement Parts

Following are the part numbers for ordering replacement parts for the 2301 Precision Positioner.

Part Description	Part Number
Laser	1723184
Fiber-Optic Cable	705347-10
Emergency Stop Switch Assembly (IEC inlet and IEC outlet power connections)	1719562

Service Procedures

For the steps to return a system or system component to ETS-Lindgren for service, see the *Product Information Bulletin* included with your shipment.

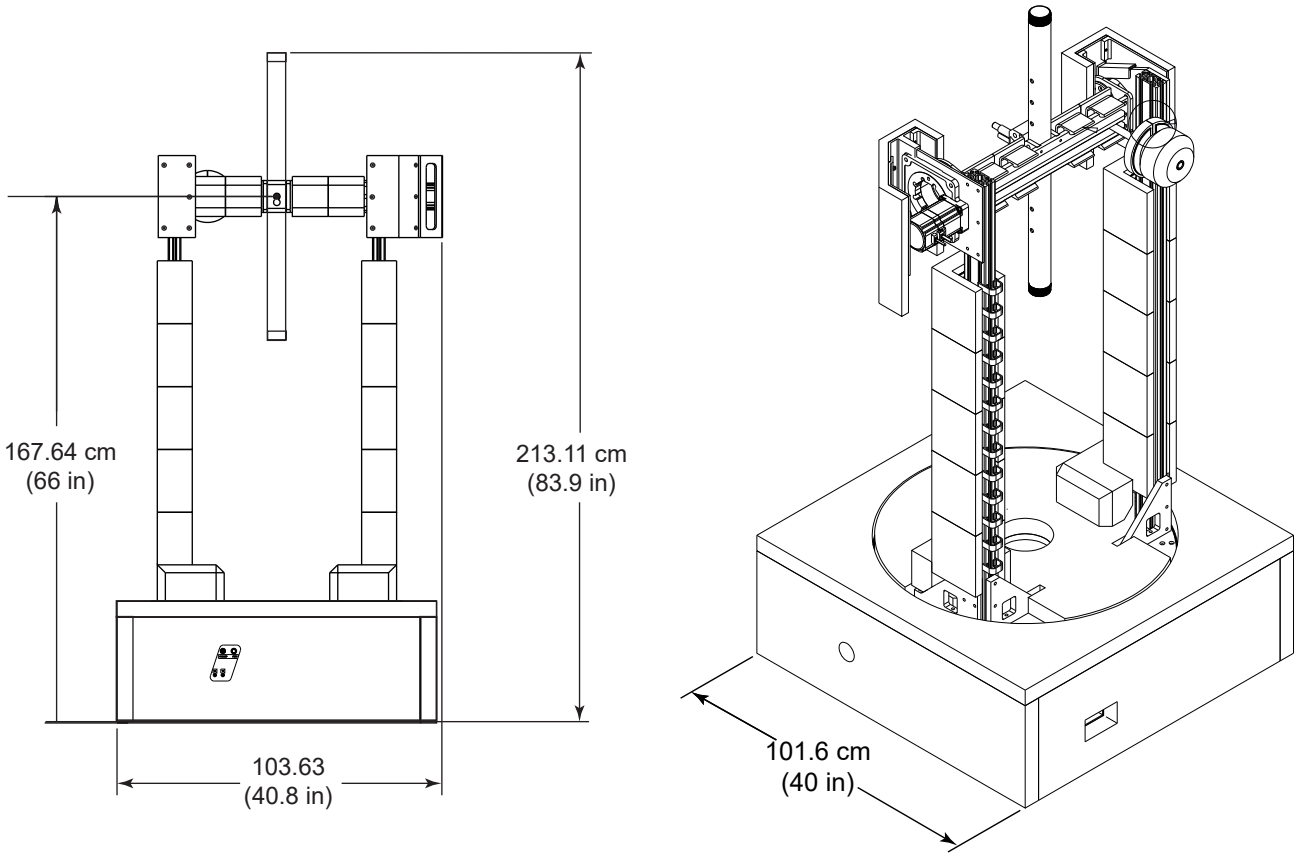
Safety Precautions

CAUTION Removing top panel will expose AC power.

WARNING Do not use damaged or crimped AC power cords.

Specifications

Physical Specifications



Mounting fixture not included in standard configuration. Contact ETS-Lindgren to request custom mount.

Height without Base Station Mount:	167.64 cm (66.0 in)
Height with Base Station Mount:	213.11 cm (83.9 in)
Width:	103.63 cm (40.8 in)
Depth:	101.60 cm (40.0 in)
Overall Weight:	90.72 kg (200.0 lb)
Maximum Load Capacity	24.95 kg (55 lb)

Electrical Specifications

Phase:	Single
Voltage:	208-230 VAC, 50/60 Hz
Amperage:	10 A

Assembly and Installation

Pre-Installation Tasks

Pre-planning is essential for successful installation. Discuss requirements with your sales representative and request dimensional drawings prior to construction of your site.

CAUTION Before installing any components, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment.

CAUTION Ensure power is off and base is secured before proceeding with installation.

Positioner Installation

Proper installation of the 2301 Precision Positioner unit directly affects performance of the positioning system as well as the accuracy of the test results.

1. Uncrate all parts. Check all parts for any shipping damage. Ensure a clear area is available to assemble the positioner unit safely.

Do not discard packing material until the Turntable is fully assembled and correct operation is verified.

The 2301 Precision Positioner consists of:

- Variable speed turntable
- Lossy foam absorber to cover the positioner
- Vertical columns with tilt positioner
- Laser for aligning system

Customer provides RF, power, and control cabling to the top of the unit and to the EUT.

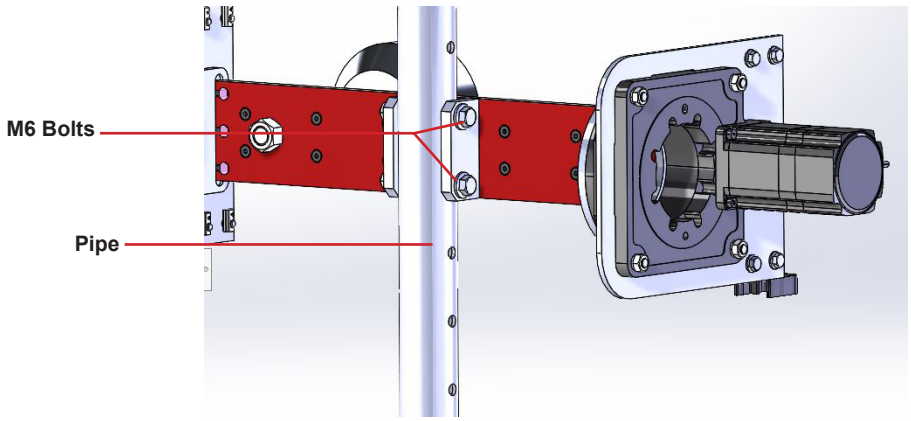
2. The center of rotation for the unit must intersect the line through the bore sight of the measurement antenna. Use the included laser to verify alignment.
3. Place the unit so the positioner connections are easily accessible and located closest to available feed through panels and power supply connections. Ensure the Model 2301 is connected to a power outlet that supplies 208-230VAC 50/60Hz. Use the power cord provided with the Model 2301 to make this connection to the system.

US shipments will include a NEMA type 6-15P electrical plug power cord.
International shipments will include a Schuko type electrical plug power cord.

The IEC power inlet assembly includes a filter and an illuminated power switch.

4. Connect the positioner to the included Ethernet-to-fiber optic converter using the included dual fiber optic cable with type ST connections. The converter connects to the host computer via the included 0.9 m (3.0 ft) Cat5 Ethernet cable. Ensure the fiber converter TX line is connected to the positioner RX input connector, and the fiber converter RX line is connected to the positioner TX output connector.

5. Loosen M6 bolts on the placeholder pipe.
6. Remove the two larger ones.
7. Take out the pipe.
8. Place the laser or antenna in place of the pipe.
9. The counterweight is adjustable via threaded rod it is mounted on.
10. The upper axis is limited to ±30°.
11. The turntable is limited to ±120°.
12. The separate, support bearing pinion drive is spring loaded. It eliminates slip between pinion and bearing.
13. Leveling feet can be adjusted in order to level unit.



Electrical Installation

CAUTION Electrical connection should only be performed by a qualified electrician and subject to location electrical codes.

The Model 2301 Precision Positioner is designed to operate using 208-230 VAC single phase 50 or 60 Hz AC power. The motor drive will not operate on a lower voltage, such as 110 VAC. The power inlet assembly has an integral 10 A fuse, however the branch circuit supplying power to the motor drive must be protected from excess current according to local electrical codes. Normal current draw for the drive is less than 6 A.

Ensure the distance from the mains power source is appropriate for the wire gauge used and that the wire gauge is adequate for the motor load.

CAUTION Using undersized wire gauge will result in a higher than expected voltage drop in the power conductors, reduced starting torque, and potentially premature motor failure.

CAUTION Prior to servicing the turntable, remove the power connection.

Input / Output Connections

Trigger

The positioner is equipped with a TTL-compatible output. This output is capable of driving a 50 ohm load that can be used to trigger a measurement sweep on a network analyzer (or other measurement device equipped with a TTL-compatible external trigger input option).

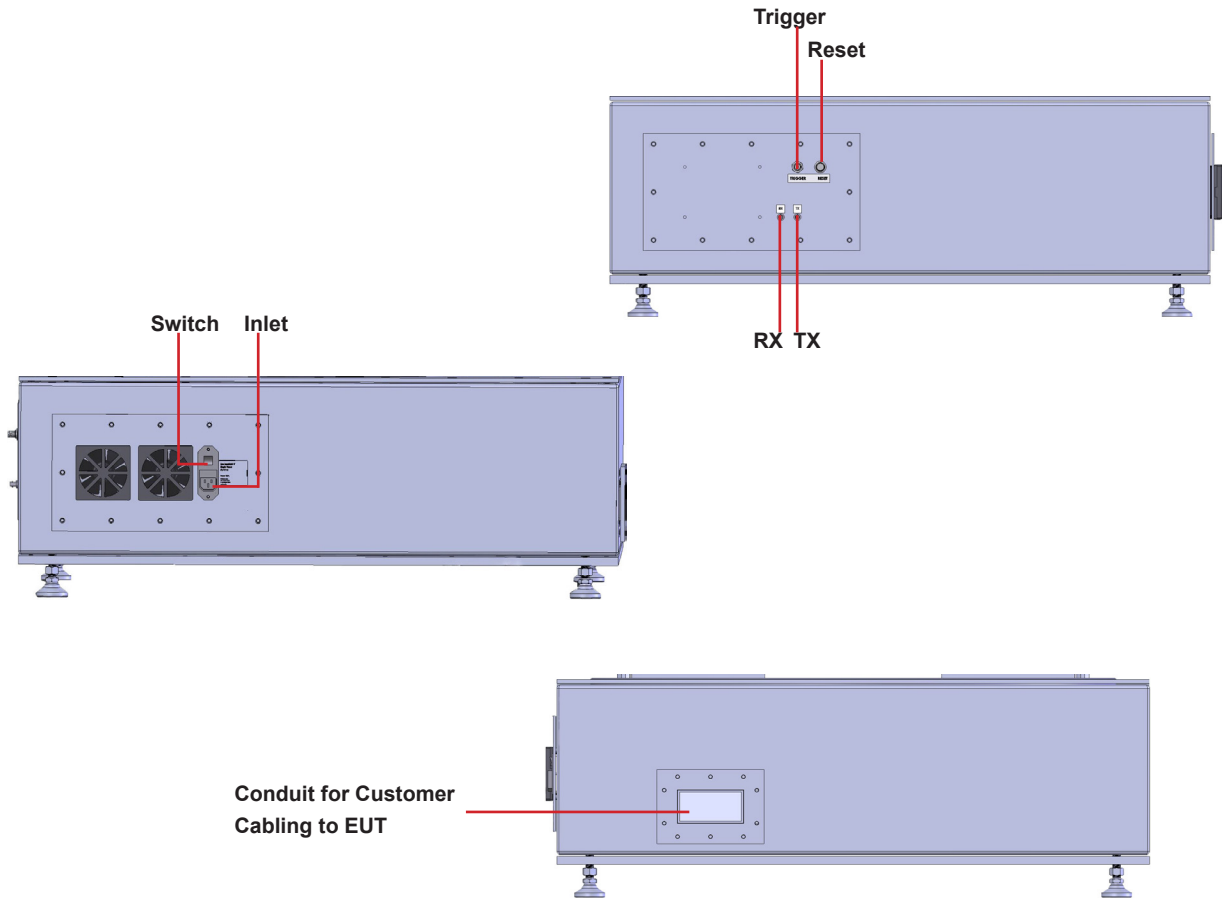
Reset

Pressing Reset for more than 6 seconds resets the device IP address and mask to factory default, 192.168.0.100, 255.255.255.0. Used in case the IP address of the device is unknown.

Fiber Optic

The positioner is equipped with a fiber-optic inlet and a fiber-optic outlet. Connect the positioner to the included Ethernet-to-fiber optic converter using the included dual fiber optic cable with type ST connections. The converter connects to the host computer via the included 0.9 m (3.0 ft) Cat5 Ethernet cable. Ensure the fiber converter TX line is connected to the positioner RX input connector, and the fiber converter RX line is connected to the positioner TX output connector.

Power Panel



Operation

CAUTION Before installing any components, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment.

2301 Precision Positioner Command Set

WARNING Ensure the current travel limit settings will not cause damage to existing cables.

WARNING Do not operate the 2301 Precision Positioner in a stalled condition. Doing so can cause damage to the drive unit and will void the warranty. Ensure the positioner will continue to rotate under load at all speeds.

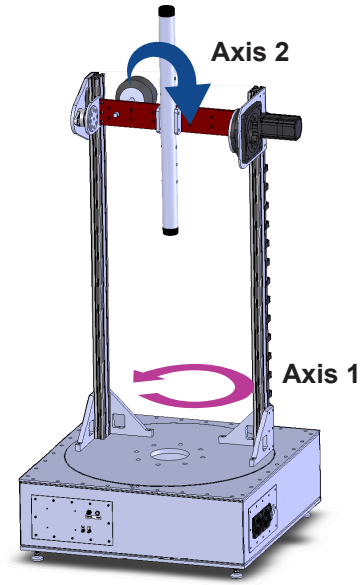
General Command Structure

Most of the following commands use this general structure:

[SUBSET:]AXIS<n[-m]>:COMMAND <argument_n>[,<argument_m>]

Where:

[ ]	Indicates optional.
< >	Indicates required.
COMMAND	The backwards compatible Model 2090 Multi Device Controller command. When used by itself, controls the first device in a multi axis system, and, when arguments are required, supports only a single argument.
The command prefix in optional brackets [ ]	Required to access a specific axis or multiple axes at a time.
SUBSET	The particular command grouping subset (e.g. configure, control, etc.).
AXIS<n[-m]>	Selects the desired axis or axes to control. A single index specifies a single axis (e.g. AXIS1 or AXIS2) with a single argument, while a range (e.g. AXIS1-2) specifies a range of axes with a corresponding range of arguments. Note that some commands only support single axis control.
<argument_n>	The single argument required for a single axis command.
[,<argument_m>]	Represents the additional arguments required for an optional multi axis command (e.g. SUBSET:AXIS1-2:COMMAND 1,2).



System Commands

Command Complete Query	
Command:	*OPC
Description:	Informs if a seek of home command have been completed. Please see home command for an example of how to use the *OPC query.
Query:	*OPC? Returns: 1 if a seek of home command have been completed, 0 otherwise.
Example:	AXIS3:*OPC?

Device Identification Query	
Command:	*IDN?
Description:	Identification query. Determines the nature of device located at a given address on the network. The string returned ("ETS-Lindgren Inc.,2301 Precision Positioner,<Module Name>,PCA120518 FW N.NN") identifies this device as a 2301 Precision Positioner. The <Module Name> parameter is a place holder to identify a specific module. The N.NN parameter is a place holder for the firmware version identification.
Query:	*IDN?
Returns:	ETS-Lindgren Inc.,2301 Precision Positioner,<Module Name>,PCA120518 FW n.nn
Example:	*IDN? ETS-Lindgren Inc.,2301 Precision Positioner,Comm,PCA120518 FW 4.14

Error Query	
Command:	ERR?
Description:	Queries the axis error register. The error register is cleared on read.
Query:	ERR?
Returns:	An error code (See list at the end of command set.)
Example:	AXIS3:ERR?

Module IP Address	
Command:	MOD:IP <nnn.nnn.nnn.nnn>
Description:	The device default IP address and subnet mask is 192.168.0.100, 255.255.255.0. The default address and subnet mask are assigned to the device by ETS-Lindgren and do not change even if your computer reboots. The IP address can be changed using the MOD:IP command. The new address will not change even if your computer reboots. The port number is 1206.
Query:	MOD:IP?
Returns:	nnn.nnn.nnn.nnn
Example:	MOD:IP 192.168.0.55

Module Name	
Command:	MOD:NAME <Module Name>
Description:	The <Module Name> parameter in the *IDN? query response is a place holder to identify a specific device in a network. If you have more than one device you might want to identify them with different module names. For instance, “EMC LAB1” and “EMC CHAMBER”.
Query:	MOD:NAME?
Example:	MOD:NAME EMC LAB1

Module Subnet Mask	
Command:	MOD:NETMASK <nnn.nnn.nnn.nnn>
Description:	The device default IP address and subnet mask is 192.168.0.100, 255.255.255.0. This address and mask are assigned to the device by ETS-Lindgren and does not change even if your computer reboots. The subnet mask can be changed using the MOD:NETMASK command. The new subnet mask will not change even if your computer reboots.
Query:	MOD:NETMASK?
Returns:	nnn.nnn.nnn.nnn
Example:	MOD:NETMASK 255.255.0.0

Control Commands

Acceleration in Milliseconds	
Command:	A <nnnn>
Description:	Acceleration setting for variable speed devices. The number nnnn represents the time in milliseconds for the positioner to reach max speed. For high inertial loads, a longer acceleration time might be required.
Query:	A?
Returns:	The time in milliseconds for the positioner to reach max speed.
Example:	AXIS1:A 1000

Acceleration in Seconds	
Command:	ACC nn.n
Description:	Acceleration setting for variable speed devices. The number N.N represents the time in seconds for the positioner to reach max speed. For high inertial loads, a longer acceleration time might be required.
Query:	ACC?
Returns:	The time in seconds for the positioner to reach max speed.
Example:	AXIS2:ACC .5

Homing Procedure	
Command:	HOME
Description:	The device has a mechanical home sensor. Every time the positioner is turned on, a home procedure must be performed so the current position is known by the firmware. To home the positioner, send the following commands: HOME *OPC? Keep querying the positioner by sending the *OPC? until it returns 1. *OPC? Will return 0 if the turntable is still being homed. *OPC? will return 1 if the home procedure is done. After *OPC returns 1, send the query HOME? to confirm that the positioner found the mechanical home sensor. HOME? returns 0 if the home procedure was not successful; result of a faulty sensor.
Query:	HOME?
Returns:	1 if the AXIS1 has been homed, 0 otherwise
Example:	AXIS1:HOME

Lower Limit	
Command:	LL nnn.n
Description:	Sets the lower/counterclockwise limit of the device. The specified value nnn.n must be less than the upper/clockwise limit.
Query:	LL?
Returns:	Lower or counterclockwise limit of the device in degrees.
Example:	AXIS1-2:LL 0,-10

Motion Direction	
Command:	DIR?
Description:	Queries the motion direction for the device.
Query:	DIR?
Returns:	<direction> Value indicating the current motion of the queried device. +1 Device is moving up/clockwise. 0 Device is stopped. -1 Device is moving down/counterclockwise
Example:	AXIS1-2:DIR? Response: 0,+1

Move Clockwise	
Command:	CW
Description:	Instructs the positioner to move in the clockwise direction. In non-continuous mode this movement is limited by the clockwise (upper) limit.
Example:	AXIS1-2:CW

Move Counterclockwise	
Command:	CCW
Description:	Instructs the positioner to move in the counterclockwise direction. This movement is limited by the counterclockwise (lower) limit.
Example:	AXIS2:CCW

Operation Complete Query	
Command:	*OPC?
Description:	Returns an ASCII "1" when a pending operation is completed. In this positioner *OPC? is used to indicate when a home operation has completed. See Homing Procedure, p. 14.
Example:	AXIS1: *OPC?

Scan	
Command:	SCAN
Description:	Instructs the positioner to begin scanning between preset lower and upper limits.
Example:	AXIS1:SCAN

Seek Negative	
Command:	SKN <nnn.n>
Description:	Instructs the device to begin seeking the specified target value in the negative (down/counterclockwise) direction only. This command primarily supports continuous rotation mode. It allows forcing seeking a position from a particular direction. Thus, a SKN from 180.0 to 181.0 will rotate counterclockwise to reach the target value. In non-continuous rotation mode if the target is up/clockwise from the current position, no motion occurs. The target must be located between the current upper/clockwise and lower/counterclockwise limits.
Example:	AXIS1:SKN 30

Seek Position	
Command:	SK nnn.n
Description:	Instructs the device to begin seeking for a target position. In continuous rotation mode, the device will seek the target value by the shortest possible path. Thus, a seek from 350.0 to 10.0 will rotate clockwise, not direction.
Example:	AXIS1-2:SK 90,30

Seek Positive	
Command:	SKP <nnn.n>
Description:	Instructs the device to begin seeking the specified target value in the position (up/clockwise) direction only. This command is provided primarily to support continuous rotation mode. It allows forcing seeking a position from a particular direction. Thus, a SKP from 181.0 to 180.0 will rotate clockwise to reach the target value. In non-continuous rotation mode if the target is down/ counterclockwise from the current position, no motion occurs. The target must be located between the current upper/clockwise and lower/counterclockwise limits.
Example:	AXIS2:SKP 90

Seek Relative	
Command:	SKR [+|-]nnn.n
Description:	Instructs the device to begin seeking the specified target value relative to the current position. The specified value is added to the current position to obtain the target position. Thus, a positive value will cause up/clockwise motion and a negative value will cause down/ counterclockwise motion.
Example:	AXIS1-2:SKR -10,10

Speed	
Command:	Sn Where n is a number between 1 and 8. The factory speed settings configuration is: RPM Axis 1 Axis 2 S1 - 0.25 0.5 S2 - 0.5 0.75 S3 - 0.75 1.0 S4 - 1 1.25 S5 - 1.25 1.5 S6 - 1.5 2.0 S7 - 1.75 2.5 S8 - 2.0 3.0
Description:	Changes the device speed
Query:	S?
Returns:	A number between 1 and 8
Example:	S3 Set AXIS1 current speed to .75 RPM

Speed Preset	
Command:	SS<n> <speed>
Description:	Assigns a preset speed setting 0-255 to n, where n is a number 1-8. **Warning:** There can be no white space between the command and the register number. However, there must be white space between the register number and the speed value.
<speed>	Value from 0-255 representing the desired speed setting for the specified speed selection. A value of 0 represents the minimum available speed of the device. A value of 255 represents the maximum speed of the device. The actual speed of the device is given approximately by the formula: Actual Speed = <speed> (MaxSpeed – MinSpeed) / 255 + MinSpeed Axis 1: Turntable Max Speed: 2 RPM; Axis 2: Tilt Max Speed: 3 RPM
Query:	SS#?
Returns:	Value between 0 (minimum) and 255 (maximum) speed.
Example:	SS2 127 Set speed 2 to half speed SS5 63 Set speed 5 to quarter speed

Stop Motion	
Command:	ST
Description:	Causes device motion to stop.
Example:	AXIS1-2:ST

Trigger Configuration	
Command:	TRIGGER (<ON|OFF>, <step size>,<reference>,<pre trigger delay>, <pulse length>,<post trigger delay>,<polarity>)
Description:	Use this command to configure the trigger. Where step size is the angular distance between trigger pulses in degrees, reference position is one of the positions where a trigger should occur (not necessarily a starting position), pre-trigger delay is the time between reaching the target encoder position and producing a trigger pulse, trigger pulse length is the active period of the trigger pulse, post trigger delay is the minimum inactive period after the trigger pulse before another trigger event can occur, and High/Low sets the polarity of the trigger signal.Time unit is milliseconds.
Query:	TRIGGER?
Returns:	Trigger configuration
Example:	TRIGGER (ON,15.00,0.00,0.10,1.00,0.00,LOW)

Upper Limit	
Command:	UL nnn.n
Description:	Sets the upper/clockwise limit of the device. The specified value nnn.n must be greater than the lower/counterclockwise limit.
Query:	UL?
Returns:	Upper or clockwise limit of the device in degrees.
Example:	AXIS2:UL 90

Error Codes

1 – Controller board Flash memory malfunction

2 – Axis not moving

3 - Motor not stopping

4 – Motor moving on wrong direction

5 – Hardware Limit hit

6 – Polarization limit violation

7 – Lost communication

9 – Encoder failure

10 – Trigger failure

11 – Motor overheat

12 – Relay failure,

13 – Position out of bounds

32 - Motor driver fault

100-399 – Command syntax error

400-499 – Home procedure failure

500-599 – Trigger command malformed

1000- - Firmware upgrade failure

Network Configuration

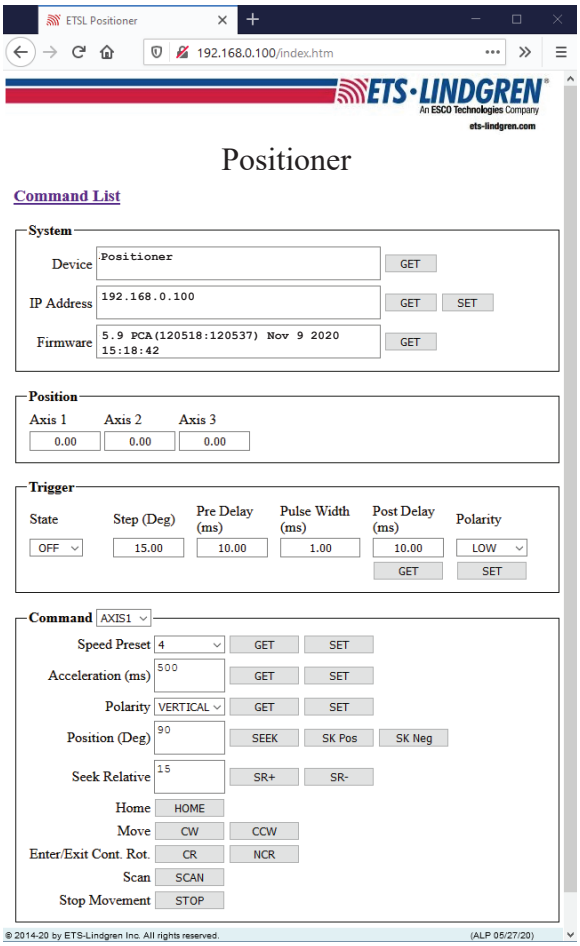
Network Factory Configuration

- IP Address……..: 192.168.0.100
- Net Mask…….: 255.255.255.0
- Gateway……..: 192.168.0.1
- Command Port...: 1206

Changing the Positioner IP Address

In a Local Area Network (LAN), there cannot be more than one device using the same IP address. The IP address of the device will need to be changed if more than one device is in the same (LAN). To change the IP address of an ETS-Lindgren Ethernet device, use its embedded web page.

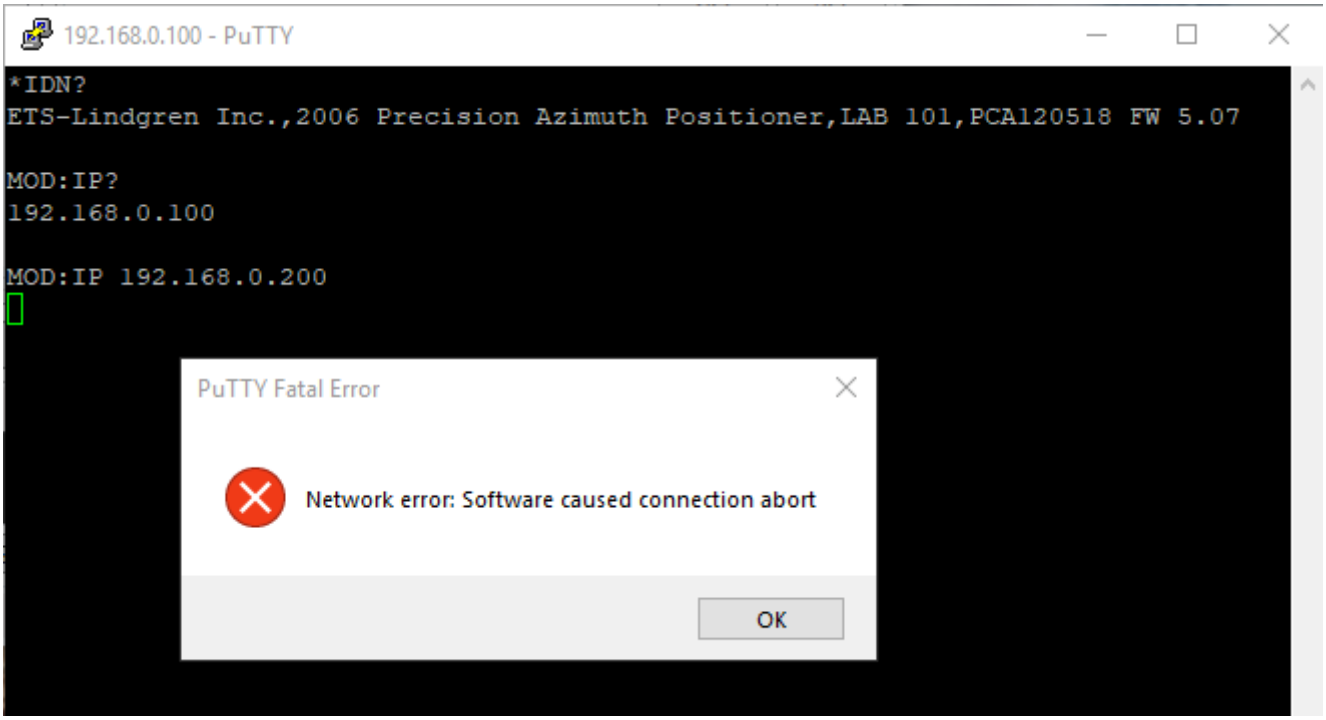
1. Point your browser to 192.168.0.100 or the address you have previously set your device to.
2. Type the new IP address as highlighted below and click ‘SET’.



A second method for reseting the IP configuration of the device is to connect to the device using any TCP/IP capable terminal application, and sending commands to it. PuTTY is a terminal emulator available for use. PuTTY is a free (MIT licensed) Windows Telnet and SSH client and can be downloaded from https://www.putty.org/.

Run PuTTY, and point it to Host 192.168.0.100 Port 1206. Then set Connection type to Raw and click Open.

Ensure the connection is working by typing *IDN? then pressing the Enter key on the keyboard. The device will respond with an identification string such as the one shown below.



The IP address can be changed using the **MOD:IP** command. To check the current IP address by typing ***MOD:IP***?

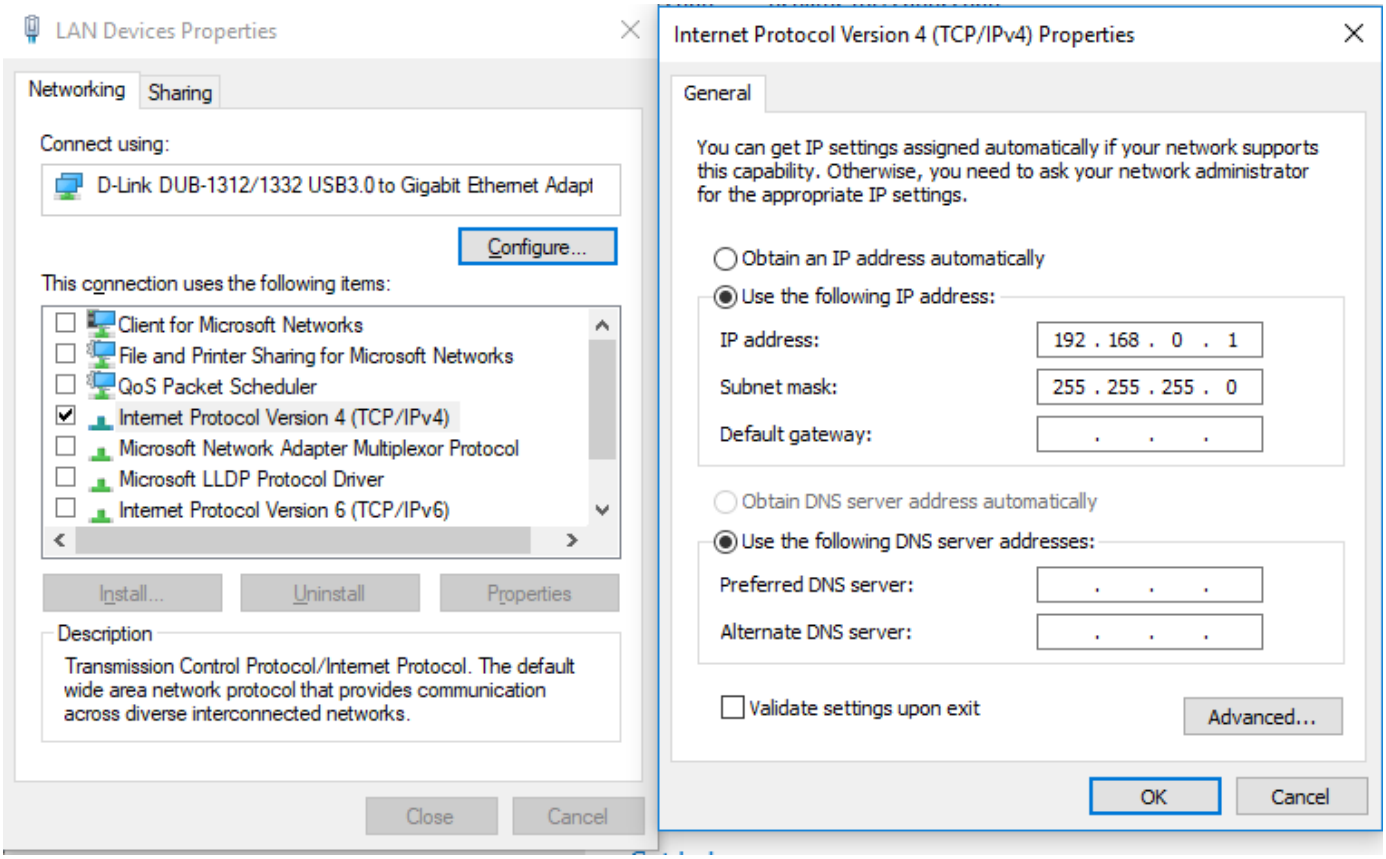
To change the IP address to 192.168.0.200, type ***MOD:IP 192.168.0.200*** and press the Enter key on the keyboard. The device will set the new address and reset the connection.

Reset to Factory Default

To reset configuration, press the reset button for at least 6 seconds. It will reset the IP address back to factory configurations, 192.168.0.100, Mask = 255.255.255.0.

Computer Network Configuration

Connect to an ETS-Lindgren Ethernet by setting the computer Ethernet interface to the selections shown below.

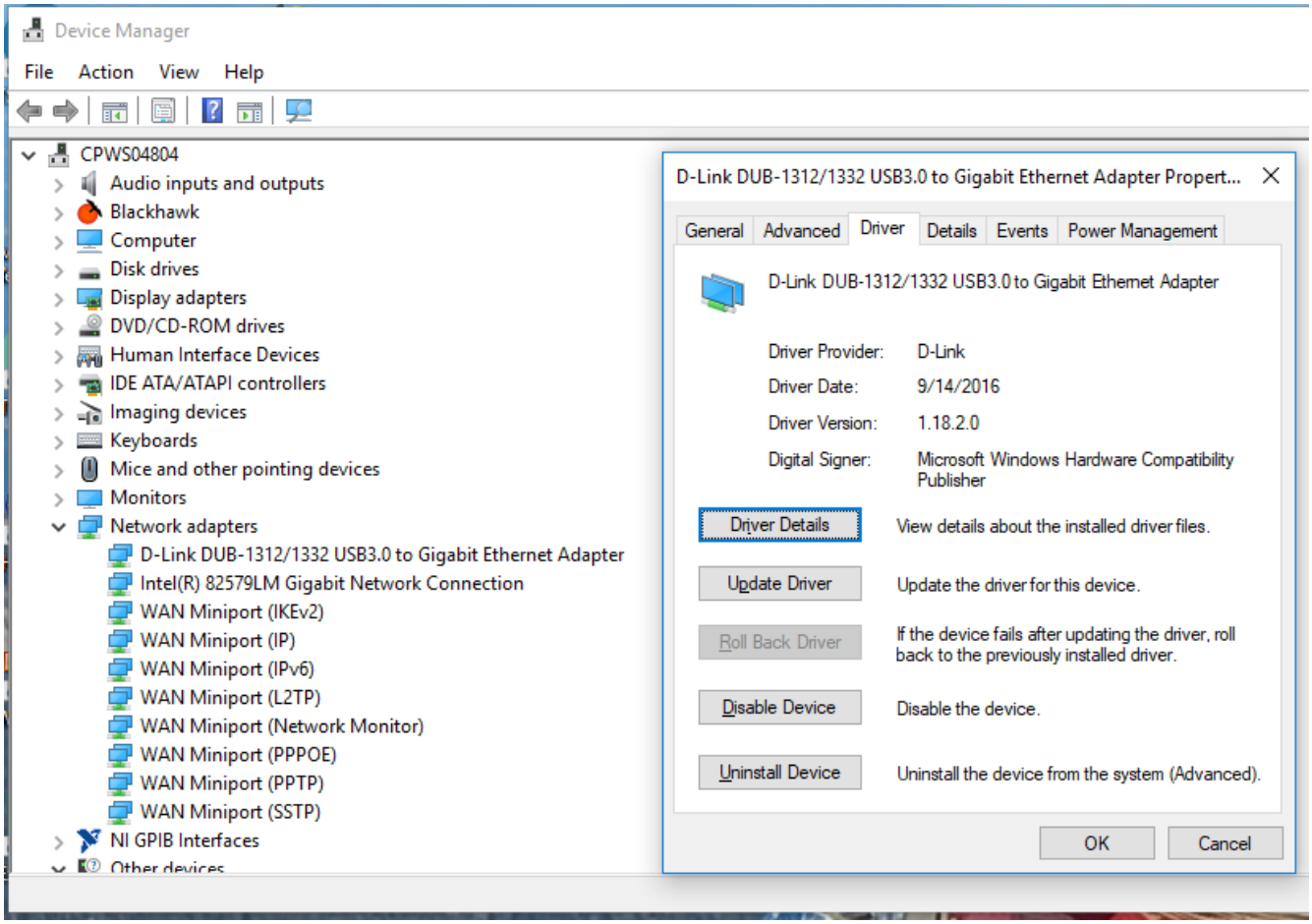


Background Information

Preparing a computer for connection is relatively simple if you have an Ethernet adapter installed. An Ethernet adapter, also called a network card, network interface card or network interface controller, provides a physical port for networking mediums such as Ethernet cables. It also communicates with the computer and allows it to access a network device. Follow these steps on a Windows 10 PC to configure the Ethernet adapter.

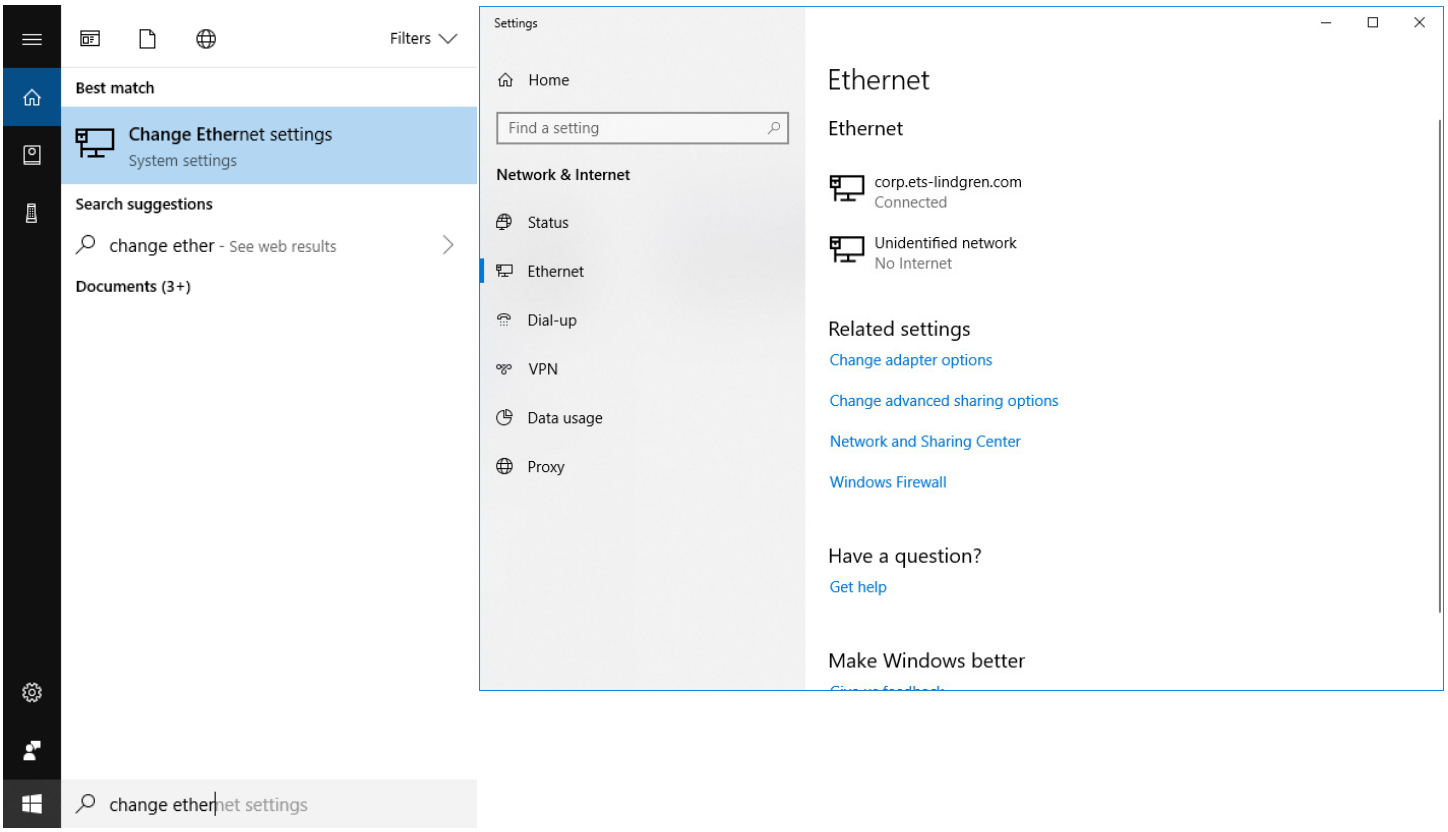
1. Ensure that the Ethernet adapter is installed

To verify the Ethernet adapter driver is already installed, Open Device Manager and select Network adapters. Right-click the network adapter, then click Properties. The information in the Properties window will indicate whether or not your Ethernet adapter is installed and working.

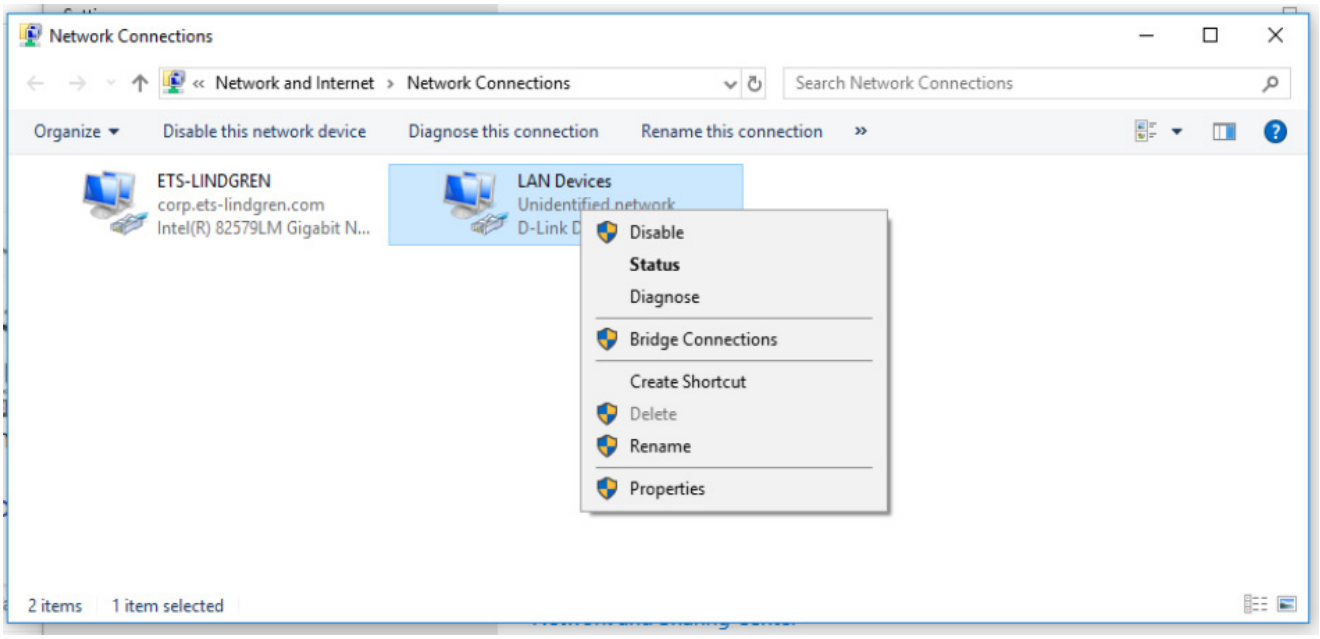


2. Configure the Ethernet Adapter

In Windows, click in the Start toolbar, then type in “change Ethernet settings.” In the search results, click “change Ethernet settings.” In the Settings window, click “Change adapter options.”



Right click on the Ethernet Adapter you intend to configure, and select “Properties”. Ensure you are logged into an administrator account to change the configuration.



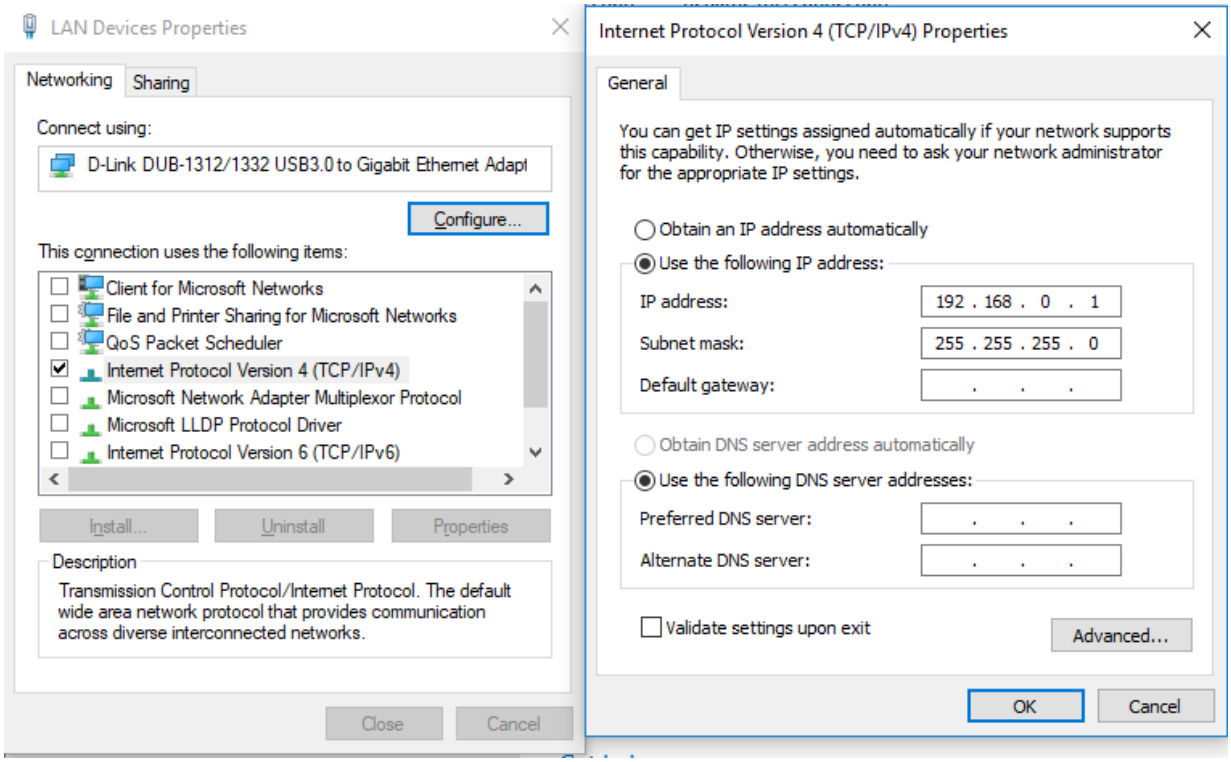
Select “Internet Protocol Version 4 (TCP/IPv4)", then click “Properties”. Select “Use the following IP address”, then enter the addresses as follows:

IP address: 192.168.0.1

Subnet mask: 255.255.255.0

Default gateway: blank

Select “Use the following DNS server addresses” and leave Preferred and Alternate DNS server fields blank. Then, click OK.



Information about subnet mask can be found online at the following two locations:

https://www.iplocation.net/subnet-mask

https://searchnetworking.techtarget.com/definition/subnet