



Earth Networks Lightning Sensor Technical and Installation Manual

A component of the Earth Networks Total Lightning System



September 2013

DISCLAIMER

The procedures, methods, and hardware outlined in this manual are intended to provide general guidelines for installing an Earth Networks Lightning Sensor. Individual sites often have unique requirements that require materials and specifications that are beyond the scope of this manual. All procedures, methods, and hardware used to install an Earth Networks Lightning Sensor must conform to all applicable building codes (local, state and national). Installation subcontractors are responsible for complying with all applicable codes. Buyer- and/or installer-provided hardware must be equivalent or better (according to industry standards) than that specified in the Earth Networks Lightning Sensor installation manual. The buyer/installer is responsible for any damage caused by installation of the Earth Networks Lightning Sensor. Furthermore, the buyer/installer is responsible for damage caused as a result of improper or faulty installation.

THINK SAFETY FIRST! READ SECTION 2 OF THIS MANUAL FOR HELPFUL SAFETY TIPS.

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1 Overview

1.1 Earth Networks

Earth Networks precisely monitors, organizes and disseminates global weather information. As a trusted source for live, local dynamic data, Earth Networks empowers society with weather intelligence for making decisions that are more informed. Millions of consumers and professional organizations, including the United States National Weather Service, rely on Earth Networks (and the Earth Networks consumer brand) to plan daily activities, safeguard lives and improve business operations.

1.2 Earth Networks Lightning Sensor (ENLS)

The Earth Networks Lightning Sensor (ENLS) is designed to be easily deployed and maintained, which greatly reduces the overall lifecycle cost of a network. By combining advanced lightning detection technologies with modern electronics, the ENLS detects lightning pulses from 1Hz to 12MHz, a wide frequency range that enables the detection of both in-cloud (IC) and cloud-to-ground (CG) lightning. IC lightning detection at high efficiencies enables the prediction of severe weather phenomena such as heavy rain, hail, high winds, tornadoes, downburst winds and damaging CG strikes. Instead of using only the peak pulses, whole waveforms are used in locating the pulses and differentiating between IC pulses and CG strokes. A Lightning Antenna located within the ENLS detects the unique radio frequency signature of static discharge caused by lightning. A GPS Antenna tracks time down to the level of a nanosecond in order to plot the geographic location with the highest accuracy. The lightning waveform and GPS data is then sent to the ENLS Digital Signal Processor (ENDSP) where it is processed and sent to the Earth Networks Network Appliance (ENNA) for transmission to the Central Processing and Management System (CPMS). Each ENLS in the network works as part of a team to pinpoint pulse locations based on time of arrival and geographic location. Sophisticated digital signal processing technologies are employed to ensure high-quality detections and to eliminate false locations.

1.3 ENLS Components

Each ENLS is comprised of four basic hardware components: the Lightning Antenna, GPS Antenna, ENLS Digital Signal Processor (ENDSP) and Earth Networks Network Appliance (ENNA). These hardware components are depicted below in Figure 1. The following sections explain each component in detail.

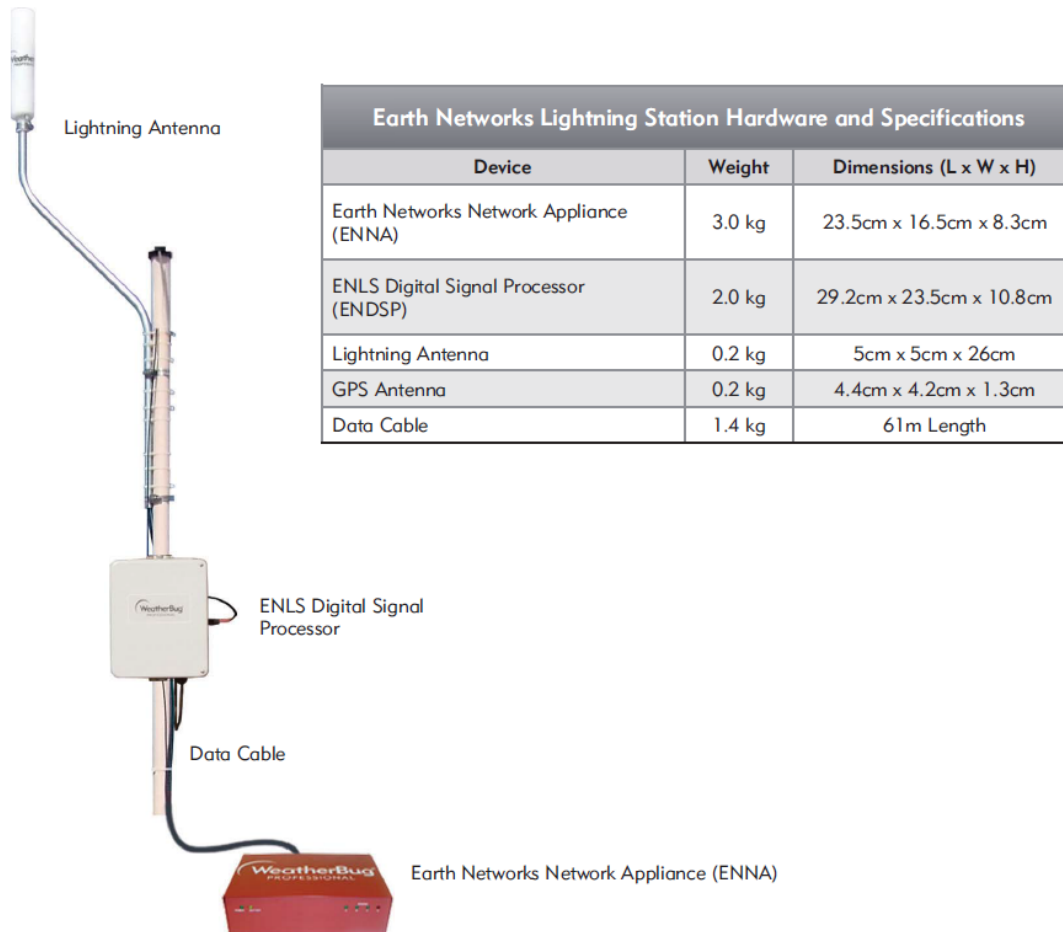


Figure 1 - ENLS Hardware and Specifications

1.3.1 Lightning Antenna

The Lightning Antenna captures lightning waveform data and transmits it to the Earth Networks Digital Signal Processor (ENDSP) via the Lightning Cable..

1.3.1.1 Antenna Cable

The Antenna Cable connects the Lightning Antenna to the ENDSP.

1.3.1.2 Grounding Cable

The Grounding Cable connects the Lightning Antenna to the ground to protect from electrical shocks.

1.3.2 GPS Antenna

The GPS Antenna captures the time of arrival for each flash with 2-nanosecond timing accuracy. It transmits the time and location data to the ENDSP via the attached GPS Data Cable.

1.3.3 ENLS Digital Signal Processor (ENDSP)

The ENDSP receives the waveform data from the Lightning Antenna and time and location data from the GPS Antenna and transmits all data to the ENNA via the Data Cable.

1.3.3.1 Data Cable

The Data Cable is UV-rated and can be run along the mast without a conduit; however, a conduit should be used to protect the cable when running it over the length of the roof or other surface and into the building. The Data Cable also powers all outdoor ENLS components.

1.3.4 Earth Networks Network Appliance (ENNA)

The core of the system is the Earth Networks Network Appliance (ENNA). The ENNA is a microprocessor-controlled computer with battery backup that uses your existing high-speed internet connection to transmit the lightning waveform and GPS data received from the ENDSP out to the Lightning Data Receiver (LDR) component of the Central Processing and Management System (CPMS). It also provides key diagnostics, calibration and data archival functionality and can be upgraded remotely.

The signals from the Lightning and GPS Antennas first travel to the ENDSP, which forwards the data to the ENNA via the Data Cable. It is essential that there are no sharp bends or crimps in the cable. The cable should be protected and stabilized where it passes through the exterior wall.

The ENNA requires the following outbound ports remain open at all times:

- Port 80 (HTTP) to check the Configuration Server for software updates. This is performed once an hour.

- TCP Port 9500 for live lightning and GPS data to transmit to the LDR component of the CPMS. Lightning data is transmitted in real-time.

1.3.4.1 Ethernet LAN Cable

The Ethernet LAN Cable connects the ENNA to the Ethernet.

1.3.4.2 ENNA Power Supply

The ENNA Power Supply provides power to the ENNA. The ENNA, in turn, provides power to all other ENLS components.

1.4 ENLS Requirements

Table 1 below outlines basic requirements for the ENLS components.

Table 1 - ENLS Component Requirements

ENNA (Indoor Box)	
Power Requirements	120 to 240 volts AC; 50 Hz to 60 Hz
Power Consumption	60 watts
Power Protection	Fused and multiple surge protection devices
Communications	Ethernet, Port 80 (HTTP) and TCP Port 9500
ENDSP (Outdoor Box)	
ENLS Digital Signal Processor (ENDSP)	NEMA 4X rated enclosure
Mounting	Exterior at base of mast
Weight	2kg. for ENDSP
Lightning Antenna and GPS Antenna (Outdoor)	
Lightning Antenna	Tubular, omni-directional
GPS Antenna	Active patch
Mounting	Mast mounted on the highest part of the roof, above or as close to the top part of mast as possible*

* Additional materials are required to build the mast and mount it.

2 Installing the Earth Networks Lightning Sensors

The Earth Networks Lightning Sensors (ENLSs) are generally roof mounted at a location with power, internet connectivity, uninterruptible power supply (UPS) and surge protection.

However, mounting locations may be modified to other types of structures such as towers. The pictures below show standard rooftop installations (Figure 2).



Figure 2 - Standard Roof Installations
(Complete Weather Stations with ENLS Digital Signal Processor and Lightning Antenna Highlighted)

2.1 Planning for Installation

This section provides details on selecting a sensor site location, safety tips and an overview of the installation steps. Please read this entire section before attempting installation.

2.1.1 Selecting a Sensor Site Location

The environmental and location parameters should be considered when installing the ENLS to avoid equipment malfunctions or faulty data. Table 2 below provides the environmental parameters for the outdoor and indoor components.

Table 2 - Environmental Operating Parameters for Outdoor Components

Environmental Condition	Parameter
Temperature (Storage and Operation)	-40°C to +85°C
Wind Speed	250 km/hr (mounting dependent)
Hail	5 cm
Rain	all rain, including wind driven
Humidity	100% condensed , 95% non-condensed
Ice	25 cm
Altitude	Up to 6 km.

Placement

Proper placement of the ENLS is essential to the quality of data that the system will output. The ENLS should be installed as far from local noise sources as possible. The most common noise sources are:

- Power Lines (especially high tension)
- Motors (elevator, HVAC, Exhaust/ventilation fans)
- Anything that produces a spark (automobile shops, welding shops, electric fences)
- Fluorescent lights (stadium lights, gym roofs)
- Power sub stations
- AM radio towers

Installation on or near AM radio towers or electromagnetic sources such as welding shops will generate unusable data. Excessively noisy sites, such as electrical substations or sites close to radio transmitters should also be avoided.

Example: HVAC Units generate Electrical / RF noise that can interfere with ENLS Performance. Based on the figure below(Figure 3), performance of sensors placed in red or dark red locations can significantly degrade the systems ability to detect lightning signals above the HVAC noise.

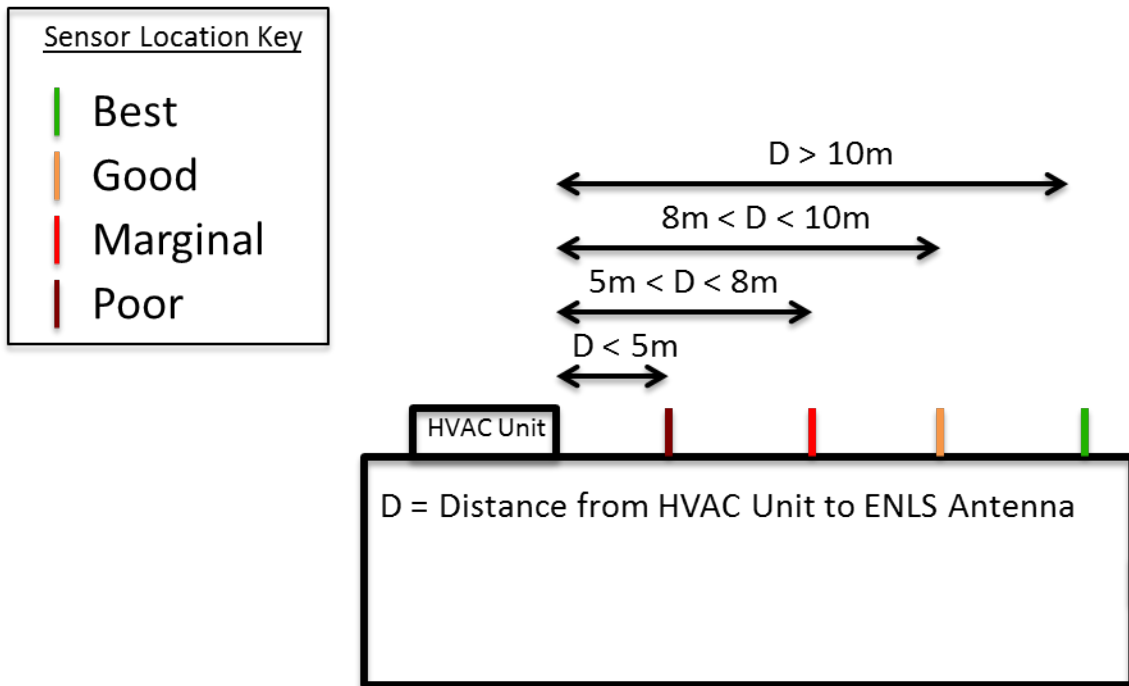


Figure 3 – Illustration of Noise Source and Shortest Optimal Distance of Install from Source

When choosing installation locations, the ENLS should have a clear, unobstructed view of the sky or sensor performance can be severely degraded. The Central Processing and Management System (CPMS) is able to compensate for this problem at times through local consistency measurements, but tall structures and buildings can be a concern for any lightning network because they often lead to significant electric field intensification.

Performance of sensors placed in red or dark red locations below (Figure 4) would range from completely “blind” to lightning from all directions to marginal detection of only large flashes. In order to reach the ideal clear view of the sky at a 20° angle, the distance from a wall must be three times the height of the wall. E.g. Sensor must be at least 15m away from a 5m wall.

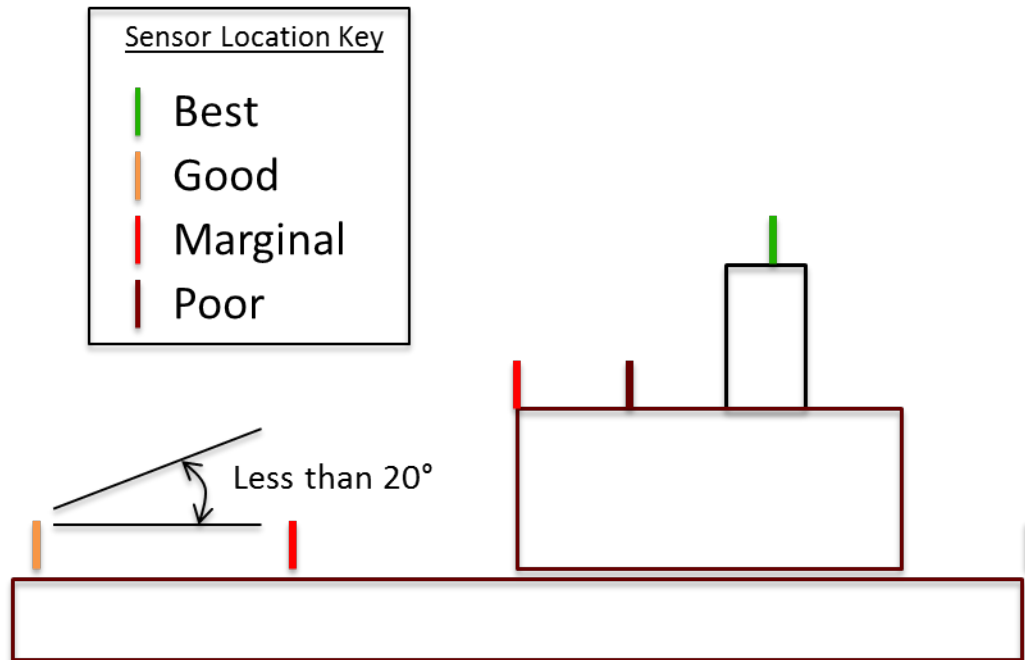


Figure 4 – Clear, Unobstructed View of Sky

The final consideration is that each ENLS should be close enough for the cables to connect to indoor equipment. Standard cable length is 61m, but additional lengths can be obtained from Technical Support in 30.5m sections up to the maximum length of 122m by calling 001 800 624 4205.

Sensor Distribution

Each ENLS should be distributed as asymmetrically as possible to achieve nominal desired density. They should never be in a straight line. Placement of an ENLS in 'perfect' geometric shapes such as circles does not materially affect performance and is, therefore, not necessary. It is important to place sensors in a network configuration that surrounds or encompasses a particular area of interest. This area, of course, can be rather large and performance metrics will adhere to the above stated baselines. The preferred spacing for local detection is 12 sensors over a 2000 km radius. Please refer to Table 3 below for baselines for distance between sensors. Outside of the network, while lightning activity will be detected, performance metrics will decrease with distance from the network.

Table 3 - Baselines for Distance between Sensors

Baseline (distance between sensors)	100km	200km	300km
Area Per Sensor	10,000km ²	40,000km ²	90,000km ²
Median Location Accuracy	<200m	<350m	<500m
CG Flash Detection	>98%	>95%	>90%
IC Flash Detection	>75%	>30%	>10%

Generally, by following the simple guidelines above, problem sites can be avoided at the outset.

2.1.2 Safety

While installation of the ENLS is not particularly difficult, it does usually require installation on a rooftop, which presents some amount of risk.

- Installation must conform to national, regional and local building code requirements.
- The ENLS should only be installed by qualified individuals who are comfortable with being on a high ladder or rooftop and who are authorized by the site administration to perform the installation.
- To limit risk to self and property, section 2.3 of this manual should be thoroughly read and understood before beginning installation.
- Stay as far away from other electrical wiring as possible. Never allow the mast, or any other item, to come in contact with electrical wires or conduit. Injury or death could result.

2.1.3 Installation Steps

It is important to adhere to the following installation steps as outlined below:

1. **Read Section 2, [Installing the Earth Networks Lightning Sensors](#), thoroughly.**

It is very important that you read this entire manual prior to installation. If all instructions are followed carefully, installation of the ENLS should be straightforward and problem free!

2. **Read Section 2.1.1, [Selecting a Sensor Site Location](#), and determine your placements before you start any installation.**

This will ensure that your sensors are placed in optimal locations, without need for relocation.

3. **Unpack and inventory all ENLS components.**

Carefully unpack and check all components using the packing list on the outside of your shipping container. Report any damaged or missing components to Earth Networks Technical Support immediately. Refer to Section 0, [Necessary Materials and Tools](#).

4. Install ENLS indoor and outdoor components.

Details are provided in Section 2, [Installing the Earth Networks Lightning Sensors](#).

5. Connect the Earth Networks Network Appliance (ENNA) to the CPMS.

The ENNA sends all data to the CPMS. Refer to Section 2.3, [Connecting the Earth Networks Network Appliance \(ENNA\)](#).

6. Set up Local Area Network (LAN).

Refer to Section 3, [Setting Up the Local Area Network \(LAN\)](#).

7. Register the ENLS with the CPMS.

All ENLSs must be registered with the CPMS in order to receive configuration details. Refer to Section 4, [Registering the ENLS with the CPMS](#).

2.2 Installing the Outdoor Components

The method of installation outlined in this section is designed for buildings and will not work for ceramic rooftops or overhangs. You may easily modify the design for other installation types such as towers.

The outdoor components consist of the Mast and Mast Mounts (hardware not included), Lightning Antenna (includes the Antenna Cable and Grounding Cable), GPS Antenna (with GPS Data Cable attached), ENLS Digital Signal Processor (ENDSP) and Data Cable.

When installing the mast for the ENLS, the top of the antenna must be mounted on your roof above any obstruction in the immediate vicinity and at a minimum of 3m. If the situation requires a taller mast, please alter the instructions in this section to make both the bottom mast portion, which is secured to the building, and the top mast portion, which is above the roofline, longer. In some situations, additional guy-wires may be necessary to help secure the mast.

The Lightning Antenna should be either above or as close to the top part of the mast as possible.

See **Figure 5**. for a diagram of the installed outdoor components.

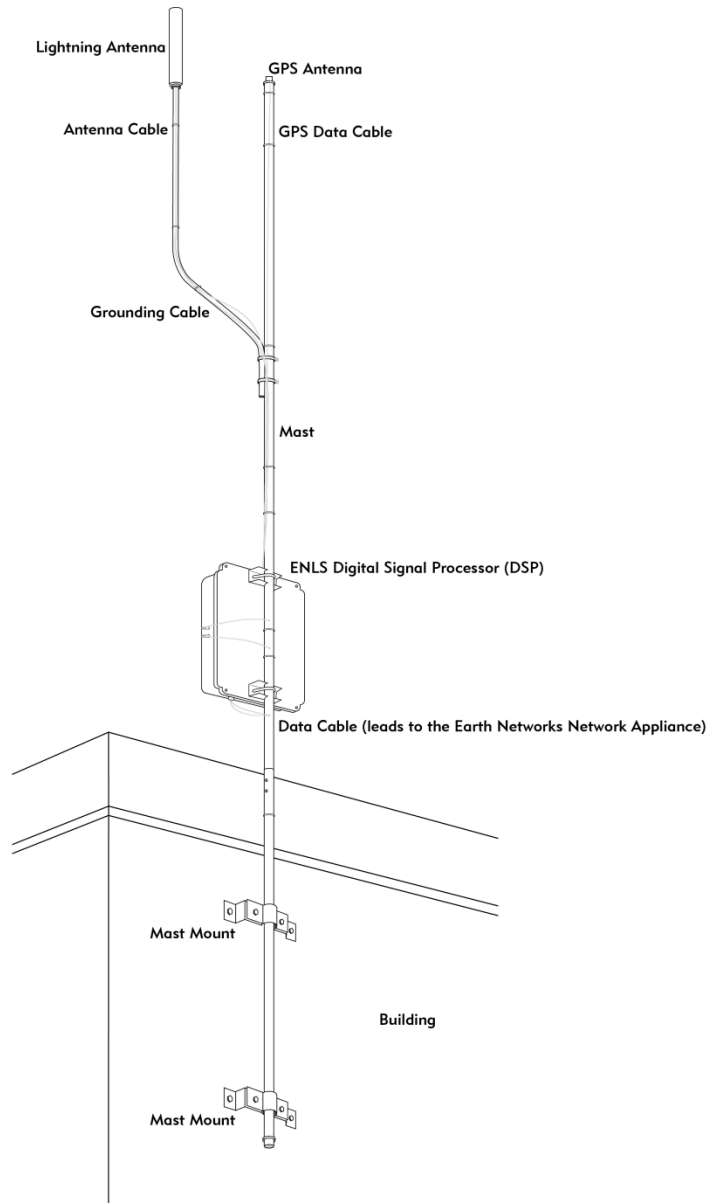


Figure 5 - Installed Outdoor Components

2.2.1 Necessary Materials and Tools

Before you attempt installation of the mast and components, please gather all materials and tools.

2.2.1.1 Required Materials (Provided)

The following table lists all materials that are provided in the shipment:

Table 4 - Required Materials (Provided)

Quantity	Material	Additional Details
1	Earth Networks Network Appliance (ENNA)	indoor
1	ENNA Power Supply	indoor
1	Data Cable—61m	longer cables available
1	Ethernet Local Area Network (LAN) Cable	indoor
1 bag	Cable Ties	
1	Earth Networks Lightning Antenna	outdoor
1	Antenna Cable	outdoor
1	Grounding Cable	for lightning antenna, outdoor
1	ENLS Digital Signal Processor (ENDSP)	outdoor
2	Hose Clamps	outdoor
1	3m Galvanized Rigid Conduit (GRC)—section of mast	approximately 0.85cm thickness and 2.5cm maximum outside diameter at top of mast (painted optional)
1	GPS Antenna	outdoor
1 roll	Grey, double-sided tape	

2.2.1.2 Required Materials (Not Provided)

The following table lists all materials not provided in the shipment:

Table 5 - Required Materials (Not Provided)

Quantity	Material	Additional Details
1	Heavy Duty Tripod Mount	See Table 6 for details
1	Grounding cable (minimum 8 AWG) and appropriate connectors	
1	Grounding rod	
3	Guy-wire	if necessary , to prevent top of mast from shaking.
1	Conduit for exterior data cable	select conduit based on building codes
1 tube	Silicone caulk	to seal conduit/data cable

		entry points into building
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Important Notes:

1. Electrical Metallic Tubing (EMT) is **NOT** recommended.
2. Properly securing the mast is critical for a successful installation. The mounts must withstand harsh elements including high winds. The buyer/installer is responsible for selecting the appropriate industry standard or better mounting hardware.

Table 6 - Website for Viewing Sample Mounting Hardware

Manufacturer	QTY	Part Number	Description
Video Mount Products http://www.videomount.com/pages/Satellite-and-Antenna-Mounts-and-Accessories/TR-Series/154	1	6-7385380821-7	TR-36 36" Heavy Duty Tripod (supports supplied mast)



Figure 6 – Recommended Heavy Duty Tripod Mount

2.2.1.3 Required Tools

The following is a suggested list of tools necessary to install the exterior sensor suite and route the data cables into the building (actual tool requirements may vary depending on site configuration):

- Compass
- Step ladder (1.75-2.5m)
- Level
- Electric drill and masonry drill bits

- Flathead and Phillips screwdrivers
- Adjustable wrench
- Pliers
- Socket set (optional)
- Wire cutters for cable ties

2.2.2 Step 1: Installing the Mast

Properly securing the mount with the mast is critical for a successful installation. The mounts must withstand harsh environments including high winds. When determining the appropriate mounting for the installation, consider the following:

- Building material to which the mast will be mounted (brick, block, siding, metal, etc.).

IMPORTANT: Ensure that all mounting equipment and mast components meet the local, state, and national building codes. The mounting equipment must also work with the installation site chosen.

Base Connections

1. Drill for and place quantity 3 M8-1.25 bolts based on diagram below(Figure 6). The bolts should stick out of the concrete by 50mm.

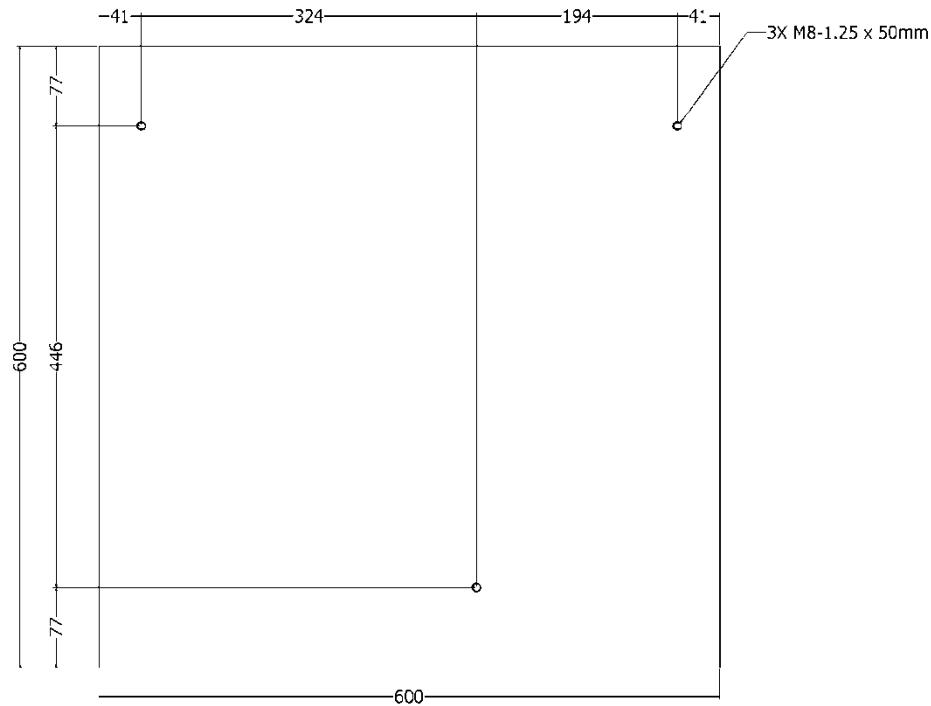


Figure 7 - Drill Location for Bolts Embedded in Concrete

Mount Assembly Instructions

2. Before connecting the tripod mount to the bolts embedded in the concrete, lay out all parts to your mount and match them to the parts list provided. Verify that you have all your parts before attempting to assemble the mount.
3. Set the mount over the M8-1.25 bolts. The bolts should go in the center hole of each foot of the mount. Secure the mount to the bolts using the appropriate nuts and lock washers.

Installing Mast Into Mount

4. Slip the 1 ¼" OD galvanized rigid conduit into the top ring of the mount, through the bottom ring until the mast rests on the concrete pad.
5. Secure the mast in the top ring using the M8 screws and the hex nut. Repeat the process for the bottom ring.

2.2.3 Step 2: Securing the Outdoor Components to the Mast

All outdoor components must be properly secured to the mast. Please ensure that the Lightning Antenna is either **above or as close to the top part of the mast** as possible.

1. If the mast is in more than one section, mount the components on the top section. Sections can be joined after securing the components and making the appropriate connections.
2. Assemble the Lightning Antenna. Insert the Antenna Cable and Ground Cable through the center of the Antenna Mount and push until cable comes out other end. Secure the antenna to the top of mount and tighten with tools (Figure 7).

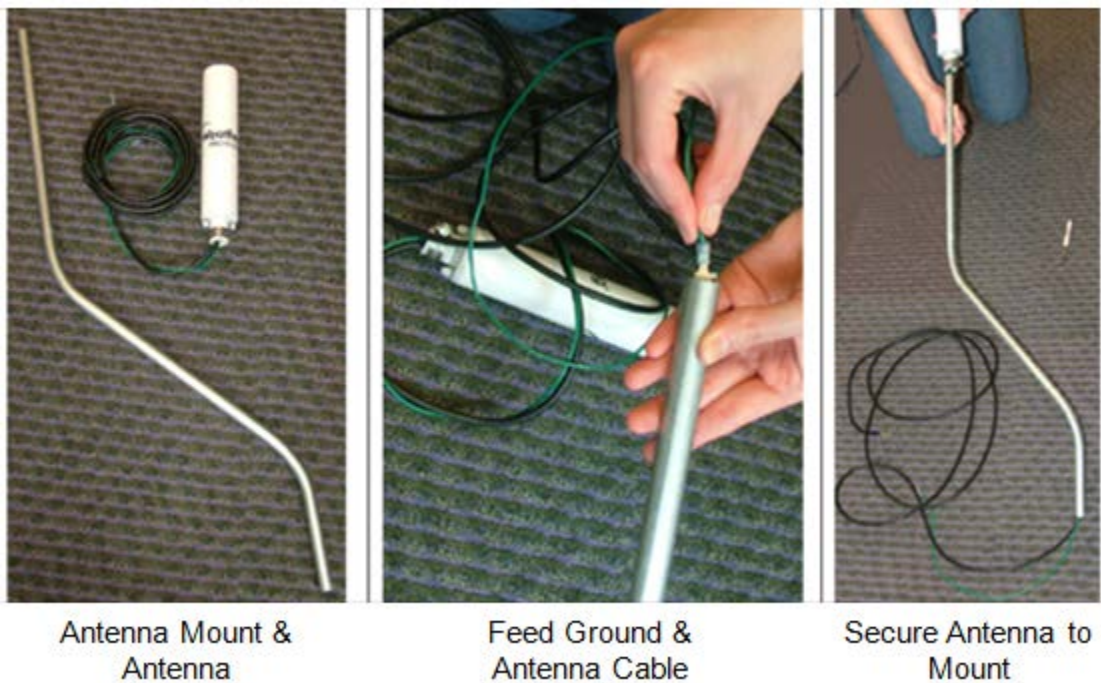


Figure 8 - Lightning Antenna Assembly

3. Attach the Lightning Antenna onto the mast using the 2 Hose Clamps (included). Ensure that the Lightning Antenna is facing away from the building/rooftop.
 - Attach one Hose Clamp 5cm from the bottom of the tube connected to the Lightning Antenna and the other Hose Clamp 5cm from the curve in the antenna mast.
 - Do not secure or connect the Lightning Antenna cable at this point.
4. Install the black GPS Antenna onto the top of cap cover of the mast using the grey double-sided sticky tape included with the unit. Do not secure or connect the GPS Data Cable at this point.

5. Install the ENDSP as low as possible on the mast so that the door can be opened for access to internal components.. Tighten the ENDSP to the mast using the enclosed U-bolts (**Figure 8**).



Figure 9 - Mounted ENDSP

2.2.4 Step 3: Connecting the Cables

The Lightning Antenna, GPS Data Cable and 61m Data Cable must be connected to the ENDSP. To do this:

1. Verify that the 8-pin connector is visible on the side of the ENDSP. If it is not visible, use a 13/16" wrench or adjustable wrench to remove the black plastic nut and white washer from the box. Open the ENDSP by unscrewing the 2 screws on the front right hand side of the box and push/pull the 8-pin connector back into the box. Making sure to align the flat portion of the connector with the flat portion of hole, shimmy the 8-pin connector through the opening. Once fully exposed, replace the white washer and finger tighten the black plastic nut. Gently tool tighten black nut to ensure that rubber washer is tightly in place to prevent water leaks (Figure 9).

200' Data Cable Connection

TRH Cable Connection



Figure 10 - Remote Lightning Box 200 Foot Data Cable Connection

2. Route the Lightning Antenna Cable and GPS Data Cable into the ENDSP. Remove the watertight cable connector from bottom of ENDSP by unscrewing. Push the Lightning Antenna Cable and GPS Data Cable through the cap and seal; work the plug through, as the fit is tight. Push the cables into the bottom of the box allowing extra cable inside the box to make connections. Tighten the watertight cap and verify that the watertight seal tightens around the cables (Figure 10).



Push through cap and seal.



Push into WeatherBug
Digital Signal Processor



Tighten cap and
check seal.

Figure 11 - Routing the Lightning Antenna & GPS Data Cables into the ENDSP

3. Connect the GPS Data Cable to the socket on the elevated board inside the ENDSP. A click should be heard to indicate the connection is complete (Figure 11).

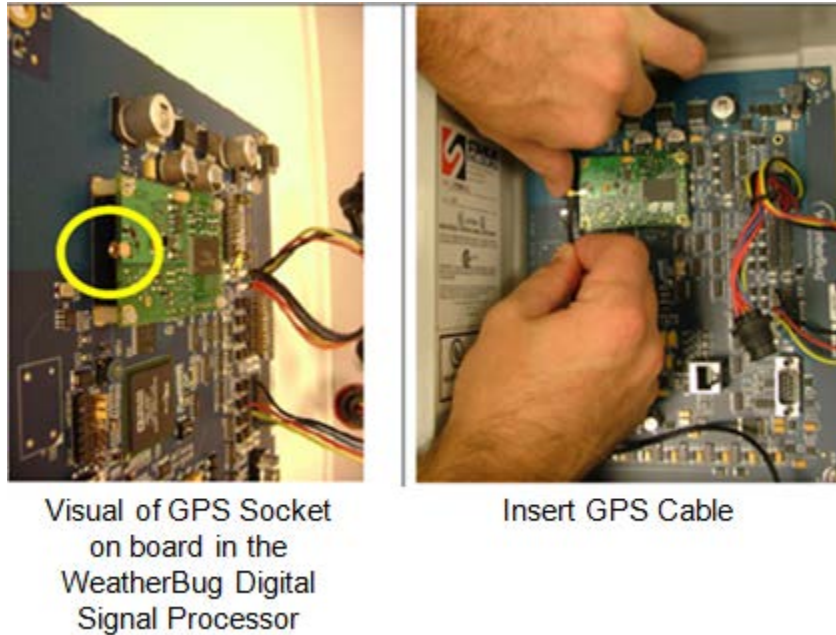


Figure 12 - Connecting the GPS Cable to the ENDSP

4. Connect the Lightning Antenna cable into the jack on the board.
5. Connect the green grounding wire from the Lightning Antenna Cable to a U-bolt on the ENDSP.
 - Grounding the Lightning Antenna to the mast, and the mast to a secure ground in/on the building is necessary to protect the system from lightning strikes.
6. Connect the “OUTDOOR” end of the 200' 8-Pin Data Cable from the ENDSP to the 8-Pin Male Connector on the top side of the ENDSP.
7. The 61m Data Cable is now ready to be routed inside the building. Plan your cable route carefully. Make sure you know exactly where your cables will be before committing to your route.
 - When routing cables and connectors, be careful not to damage or strain them. Run the Data Cable in a conduit (not included) across the length of the building and around sharp corners.

8. Securely attach a grounding cable to a metal part of the mast. The mast **MUST** be grounded to protect against lightning and static charge build-up. The ground wire must be connected to an appropriate location (consult an electrician to ensure proper grounding).
 - Where possible, the ENLS should be connected to its own independent ground and not share a ground with other equipment. This grounding cable should follow the shortest path available to “earth” ground.
 - Once a ground cable is connected to earth ground, you should measure the AC voltage between the ground cable and the mast before connecting the ground cable to the mast. The voltage should be 0.15 volts or less.
 - Ground cable and installation must conform to all applicable local building codes. The mast must be grounded to an “earth” ground and not an existing electrical ground. The buyer/installer is responsible for this procedure and for ensuring that materials and methods conform to all applicable building codes.

2.2.4.1 Additional Cable Tips

- Earth Networks recommends that you tape the connector ends together before running them inside the building (tape them fully to prevent damage or loosening individual wires). **Do not** cut connectors off. A single loose cable connection can cause system errors.
- Route the Data Cable through a 4.5cm inch outside diameter conduit on exterior of building (not included).
- Seal the building hole and both ends of conduit using caulk/putty.
- Because the Data Cable is UV-rated, conduit is not required along the length of the mast, but should be used along the length of the building.
- Use the shortest route possible when running cables inside the building.
- The Data Cable ends at the Earth Networks Network Appliance (ENNA). Excess cable should be coiled, tied and stored near the ENNA.

2.2.5 Step 4: Raising and Securing the Top of the Mast

This step is only necessary for a 2-section mast.

1. Raise the top section of the mast and secure it in place by inserting the final two 0.64-50.8cm x 5cm in length into each of the holes.
2. Tool-tighten the bolts.

2.3 Connecting the Earth Networks Network Appliance (ENNA)

The ENNA is the core of the system and is responsible for receiving all ENDSP data and transmitting it to the CPMS.

1. Open the ENNA by removing the 2 screws on each side of the side of the box. Lift off the lid to expose the circuit board. Touch something metal to remove any static charge from your body; this will prevent damage to the board. Verify the appropriate jumper settings: LX and 12V. If either jumper is not in the appropriate location, relocate by pulling up on the jumper, moving to the appropriate pins and pushing down gently. If one of the switches is not in the appropriate location, gently push the switch to the appropriate location using a small paperclip (Figure 12).

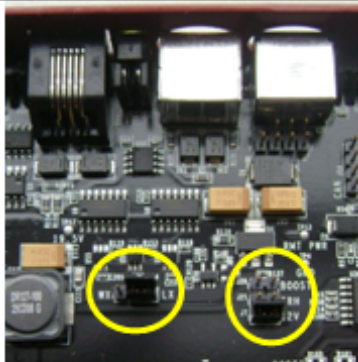

Installation	Jumper Switch Location	Jumpers Illustration RBB-09-XXXX – RBB-10-2085	Switch Illustration > RBB-10-2086
Weather Station & Lightning System – 8 Pin Data Cable	LX 12V		

Figure 13 - Jumper Settings

WARNING!

Incorrectly assigning jumpers could result in damage to the equipment.
Please verify correct alignment before powering unit.

2. Close the ENNA by replacing the lid and the 2 screws on each side of the ENNA.

3. Connect the Power Supply to the ENNA and ensure that power is in OFF position (Figure 13).
4. Find the end of Data Cable coming from your outdoor sensor. Place the connector so that the arrow is on top and connect it to the back of the ENNA, under the "Data Cable" label, being sure to match the appropriate 8-Pin connection (Figure 13).
5. Using the supplied Ethernet LAN Cable, plug the ENNA into your Local Area Network (LAN) or Internet Connection (Figure 13).

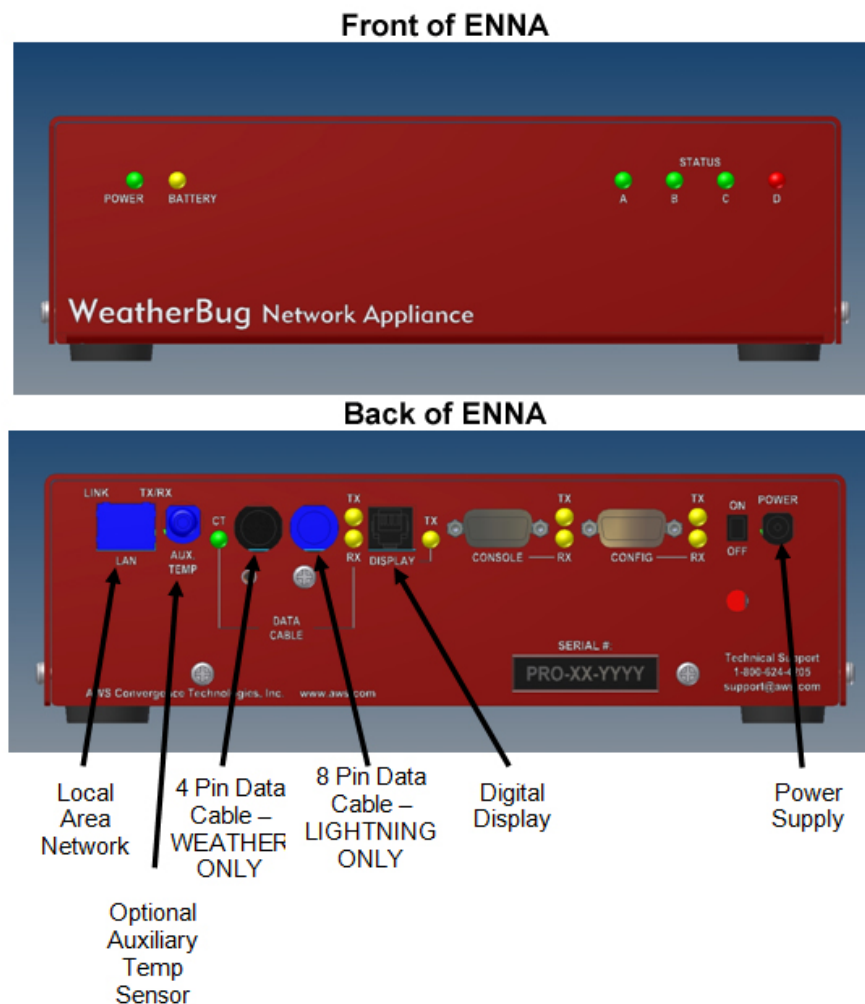


Figure 14 - Front and Back View of ENNA

6. Plug the ENNA into the Power Strip.

3 Setting Up the Local Area Network (LAN)

The Earth Networks Network Appliance (ENNA) transmits all data to the Central Processing and Management System (CPMS) Lightning Data Receiver (LDR). There are 4 methods of setting

up the ENNAs internet connection, depending on how your LAN is configured: Dynamic Host Configuration Protocol (DHCP) Network, DHCP Network with Proxy Server, Static IP Network or Static IP Network with Proxy Server. The instructions for each method are provided below.

3.1 Dynamic Host Configuration Protocol (DHCP) Network

The ENNA should be connected and ready to be turned on (before powering any component, check to ensure that all connections are correct).

1. Using the “On/Off” switch, turn on the ENNA.
2. Five quick flashes of the status lights on the right hand side of the front of the ENNA will occur.
3. Verify that the Green LED lights on the back of the box, next to the “LAN” connection, are illuminated or flashing to indicate a live internet connection.
4. During the next minute, the lights A, B, and C will come on in sequence.
5. Call Earth Networks Support at 001 301 250 4004 to confirm that data is being received and to ensure proper calibration.

3.2 DHCP Network with Proxy Server

1. Using an existing computer on the site’s local network, determine the Proxy Settings by following these steps:
 - a. Open Internet Explorer web browser.
 - b. Select Tools from the Internet Explorer menu.
 - c. Select Internet Options.
 - d. Select Connections Tab.
 - e. Select LAN Settings.
 - f. You will use the Proxy settings that appear in the Proxy Server Box at the bottom of the screen.

NOTE: A-F above are specifically for PC based Internet Explorer browser. Consult your internet browser’s documentation to follow a similar procedure.

2. Using the “On/Off” switch, turn on the power to the ENNA.
3. Five quick flashes of the status lights on the right hand side of the front of the ENNA will occur.
4. Verify that the Green LED lights on the back of box, next to the “LAN” connection, are illuminated or flashing to indicate a live internet connection.

5. Using another PC computer on the network (same subnet), download the latest Earth Networks Network Appliance (RBB) Finder Tool from the PC Software section of <http://download.aws.com/> and save it to the computer desktop. Note: It will be saved as "lightning.exe" by default.
6. Double click on the lightning.exe icon on your desktop.
7. The Earth Networks Network Appliance Config Tool will open (Figure 14)



WeatherBug Network Appliance Config

MAC	SN#	DHCP	IP	Mask	Gateway	PDNS	SDNS

Station: None
☐ Obtain an IP address automatically
☐ Obtain DNS server address automatically

IP address:

Mask:

Gateway:

Primary DNS:

Secondary DNS:

MDU Serial #:

Version: NA

HTTP Proxy: :

User name:

Password:

Outdoor HW Rev.

Outdoor Serial Number

Indoor HW Rev.

Antenna HW Rev. NA

Antenna Serial Number

Antenna Mode

Change Identify Search Options... Close

Figure 15 - Earth Networks Network Appliance Config Tool

8. Select Search to seek out the ENNA on the network. The Earth Networks Lightning Sensor (ENLS) will be displayed in the upper part of the window.

NOTE: If the Earth Networks Network Appliance Config Tool was unable to find the ENNA select the Options button, change the number of seconds from 5 to 50, and select OK. Select Search again from the Earth Networks Network Appliance Config Tool.

9. Select the MAC address for the ENNA (Figure 15).

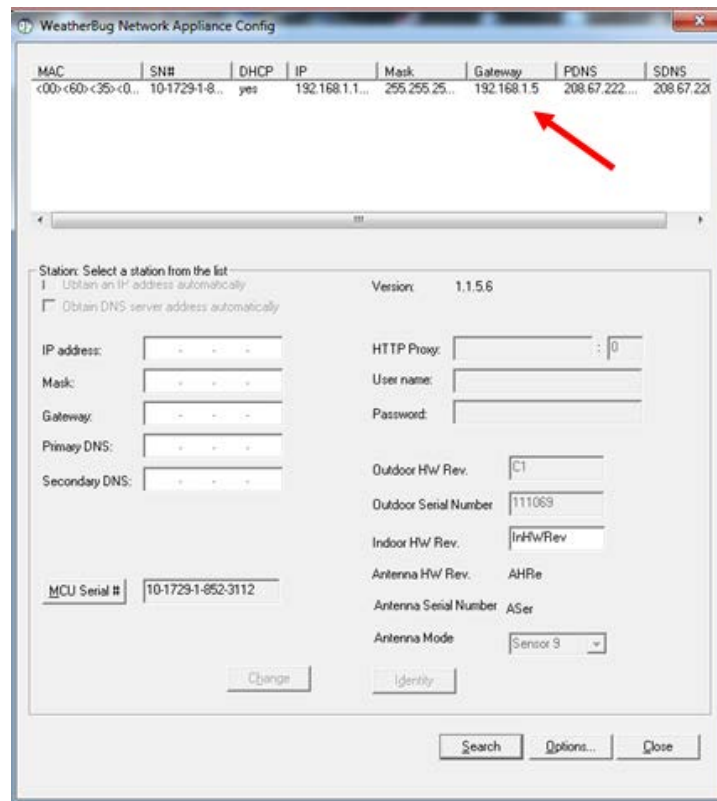
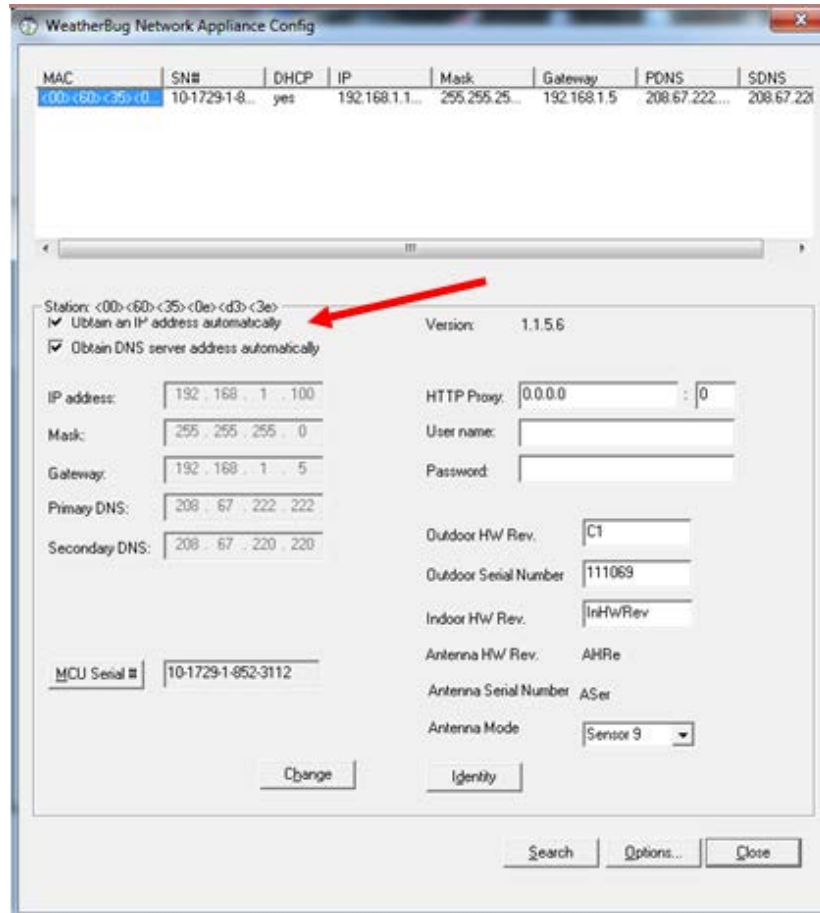


Figure 16 - MAC Address Display within the Earth Networks Network Appliance Config Tool

10. Verify that the “Obtain an IP address automatically” and “Obtain DNS server address automatically” checkboxes are selected (Figure 16).



MAC	SN#	DHCP	IP	Mask	Gateway	PDNS	SDNS
<00><60><35><0>	10-1729-1-8...	yes	192.168.1.1...	255.255.25...	192.168.1.5	208.67.222...	208.67.220...

Station: <00><60><35><0e><d3><3e>
☒ Obtain an IP address automatically
☒ Obtain DNS server address automatically

Version: 1.1.5.6

IP address: 192.168.1.100
 Mask: 255.255.255.0
 Gateway: 192.168.1.5
 Primary DNS: 208.67.222.222
 Secondary DNS: 208.67.220.220

HTTP Proxy: 0.0.0.0 : 0
 User name:
 Password:

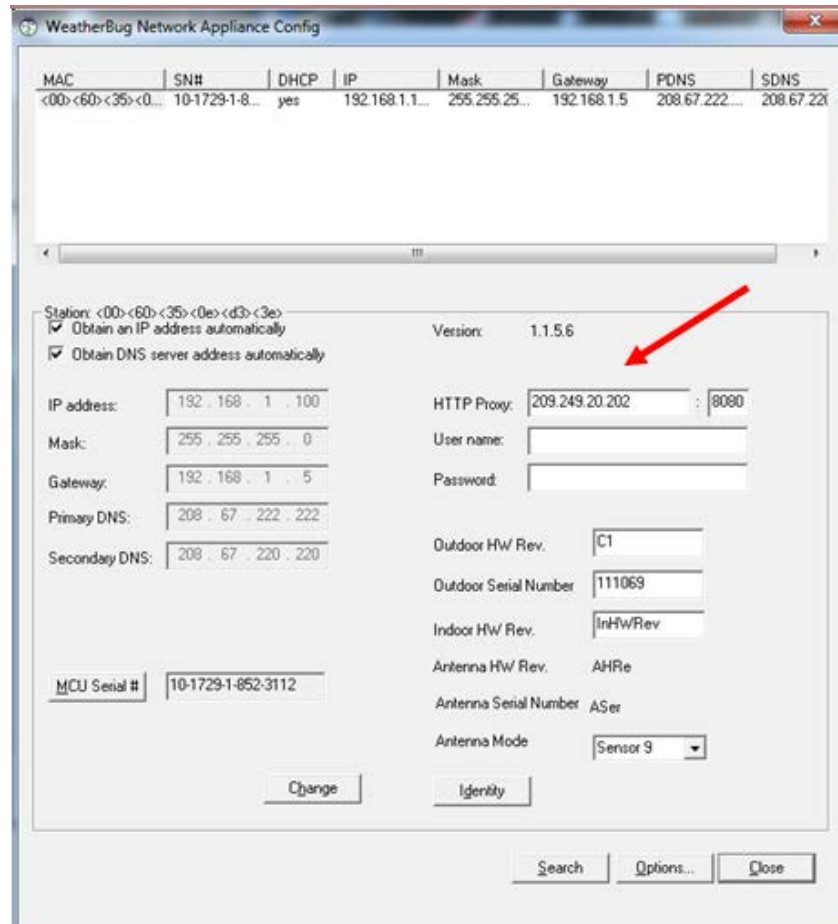
Outdoor HW Rev. C1
 Outdoor Serial Number 111069
 Indoor HW Rev. InHwRev
 Antenna HW Rev. AHR
 Antenna Serial Number ASer
 Antenna Mode Sensor 9

MCU Serial # 10-1729-1-852-3112

Change Identify Search Options... Close

Figure 17 - Checkbox Selection within Earth Networks Network Appliance Config Tool

11. Using the boxes on the right side of the screen, type in the Proxy information obtained in Step 1 (Figure 17).
 - Proxy address can be set using standard IP format (ex. 209.249.20.202) or DNS Proxy. DNS Proxy must be less than 75 characters and contain at least one period/dot.



MAC	SN#	DHCP	IP	Mask	Gateway	PDNS	SDNS
<00><60><35><0>...	10-1729-1-8...	yes	192.168.1.1...	255.255.25...	192.168.1.5	208.67.222...	208.67.222...

Station: <00><60><35><0e><d3><3e>
☒ Obtain an IP address automatically
☒ Obtain DNS server address automatically

Version: 1.1.5.6

IP address: 192.168.1.100
 Mask: 255.255.255.0
 Gateway: 192.168.1.5
 Primary DNS: 208.67.222.222
 Secondary DNS: 208.67.220.220

HTTP Proxy: 209.249.20.202 : 8080
 User name:
 Password:

Outdoor HW/Rev: C1
 Outdoor Serial Number: 111069
 Indoor HW/Rev: IntHWRev
 Antenna HW/Rev: AHRP
 Antenna Serial Number: ASer
 Antenna Mode: Sensor 9

MCU Serial #: 10-1729-1-852-3112

Change Identity Search Options... Close

Figure 18 - Entering the HTTP Proxy into the Earth Networks Network Appliance Config Tool

12. If your Proxy requires a login, enter the User Name and Password in the appropriate boxes.
 - The User Name is limited to 50 characters and Password field is limited to 20 characters. If no User Name and Password are required, leave the fields blank.
13. Select the Change button from the center hand portion of the Earth Networks Network Appliance Config Tool. A window will pop up confirming the changes. Click OK to save your changes.
 - After the OK button is selected the box will confirm the changes and the ENNA will automatically restart. It will take a few minutes to reappear on the network.
14. After approximately one minute, the A, B, and C LEDs on the ENNA should be solid green (no flashing).

3.3 Static IP Network (with or without Proxy Server)

1. Talk to your Network Administrator to gather the following for the ENNA:
 - IP Address

- Subnet Mask
- Default Gateway
- Primary DNS
- Secondary DNS
- Proxy Settings

You will need this information in steps 12 and 13.

2. Complete this step **ONLY** if you have a Proxy Server. Determine if Proxy Settings are necessary:
 - a. Open Internet Explorer web browser.
 - b. Select Tools from the Internet Explorer menu.
 - c. Select Internet Options.
 - d. Select the Connections Tab (Figure 18).
 - e. Select LAN Settings.
 - f. You will need the Proxy settings that appear in the Proxy Server Box at the bottom of the screen for later use.

NOTE: Items A-F above are specifically for PC based Internet Explorer browser. Consult your internet browser's documentation to follow a similar procedure.

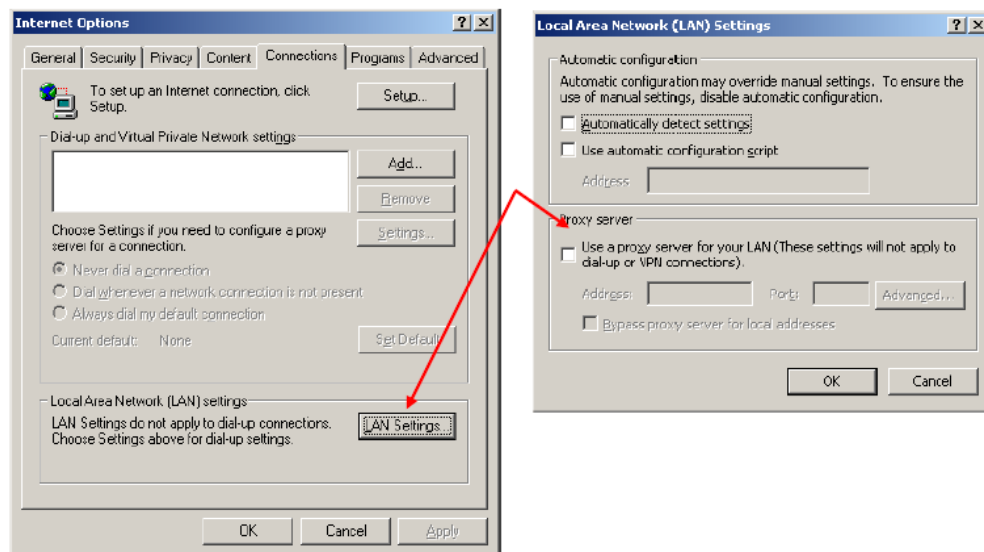


Figure 19 - Local Area Network (LAN) Settings

3. Using the “On/Off” switch, turn on the power to the ENNA.
4. Five quick flashes of the status lights on the right hand side of the front of the ENNA will occur.

5. Verify that the Green LED lights on the back of the box, next to the “LAN” connection, are illuminated or flashing to indicate a live internet connection.
6. Using another PC computer on the network (same subnet), download the latest Earth Networks Network Appliance (ENNA) Finder Tool from the PC Software section of <http://download.aws.com/> and save it to the computer desktop. Note: It will be saved as “lightning.exe” by default.
7. Double click on the lightning.exe icon on your desktop.
 8. The Earth Networks Network Appliance Config Tool will open (Figure 19).

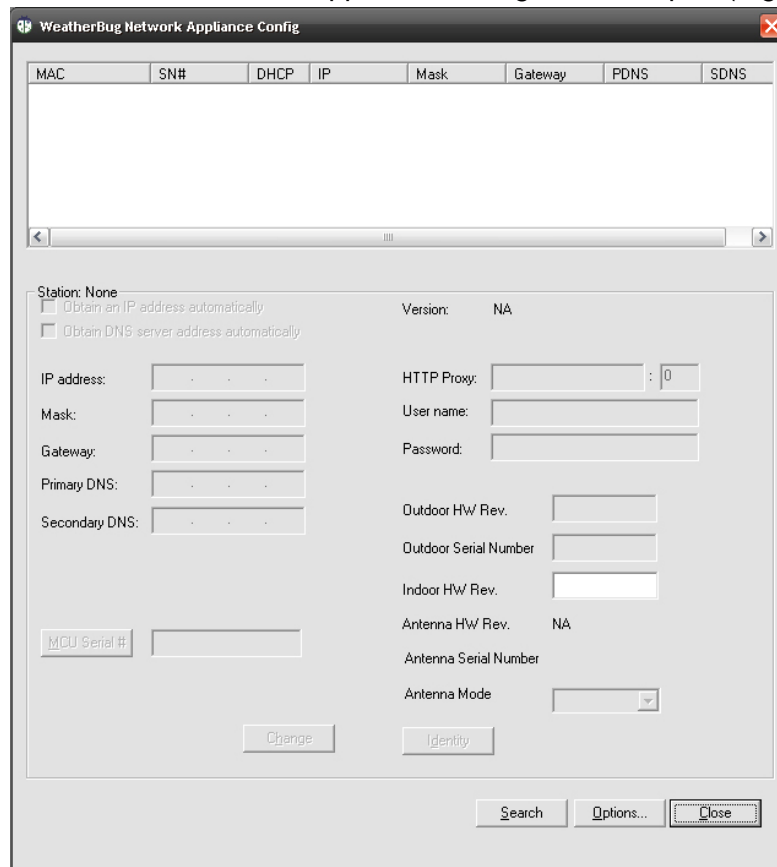
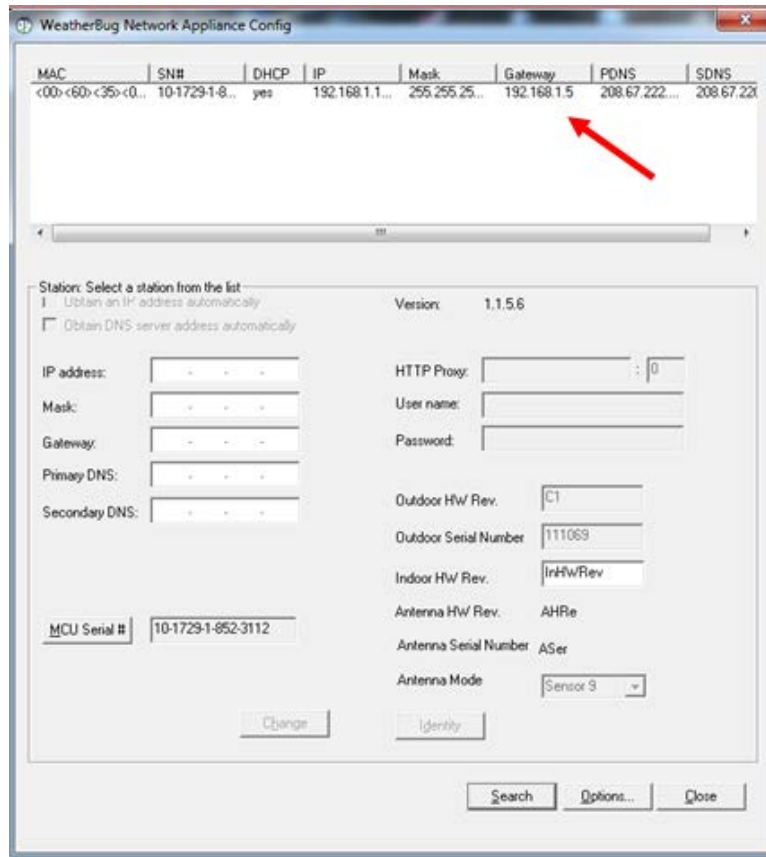


Figure 20 - Earth Networks Network Appliance Config Tool

9. Select Search to seek out the ENNA on the network. The ENNA will be displayed in the upper part of the window.

NOTE: If the Earth Networks Network Appliance Config Tool was unable to find any ENNAs select the Options button, change the number of seconds from 5 to 50, and select OK. Select Search again from the Earth Networks Network Appliance Config Tool.

10. Select the MAC address for the ENNA (Figure 20).



The screenshot shows the 'WeatherBug Network Appliance Config' window. At the top, there is a table with columns: MAC, SN#, DHCP, IP, Mask, Gateway, PDNS, and SDNS. A red arrow points to the 'Gateway' column in the first row. Below the table, there are checkboxes for 'Obtain an IP address automatically' and 'Obtain DNS server address automatically'. The 'IP address' section includes fields for IP address, Mask, Gateway, Primary DNS, and Secondary DNS. The 'MCU Serial #' field contains the value '10-1729-1-652-3112'. The 'Version' is '1.1.5.6'. The 'HTTP Proxy' section has a field for the proxy address and a port field set to '80'. The 'User name' and 'Password' fields are empty. The 'Outdoor HW/Rev.' field contains 'C1'. The 'Outdoor Serial Number' field contains '111069'. The 'Indoor HW/Rev.' field contains 'InHw/Rev'. The 'Antenna HW/Rev.' field contains 'AHRRe'. The 'Antenna Serial Number' field contains 'ASer'. The 'Antenna Mode' dropdown menu is set to 'Sensor 3'. At the bottom, there are buttons for 'Change', 'Identify', 'Search', 'Options...', and 'Close'.

MAC	SN#	DHCP	IP	Mask	Gateway	PDNS	SDNS
<00><60><35><0>...	10-1729-1-8...	yes	192.168.1.1...	255.255.25...	192.168.1.5	208.67.222...	208.67.221...

Station: Select a station from the list
☒ Obtain an IP address automatically
☐ Obtain DNS server address automatically

Version: 1.1.5.6

IP address:
Mask:
Gateway:
Primary DNS:
Secondary DNS:

MCU Serial #: 10-1729-1-652-3112

HTTP Proxy: : 80
User name:
Password:

Outdoor HW/Rev.: C1
Outdoor Serial Number: 111069
Indoor HW/Rev.: InHw/Rev
Antenna HW/Rev.: AHRRe
Antenna Serial Number: ASer
Antenna Mode: Sensor 3

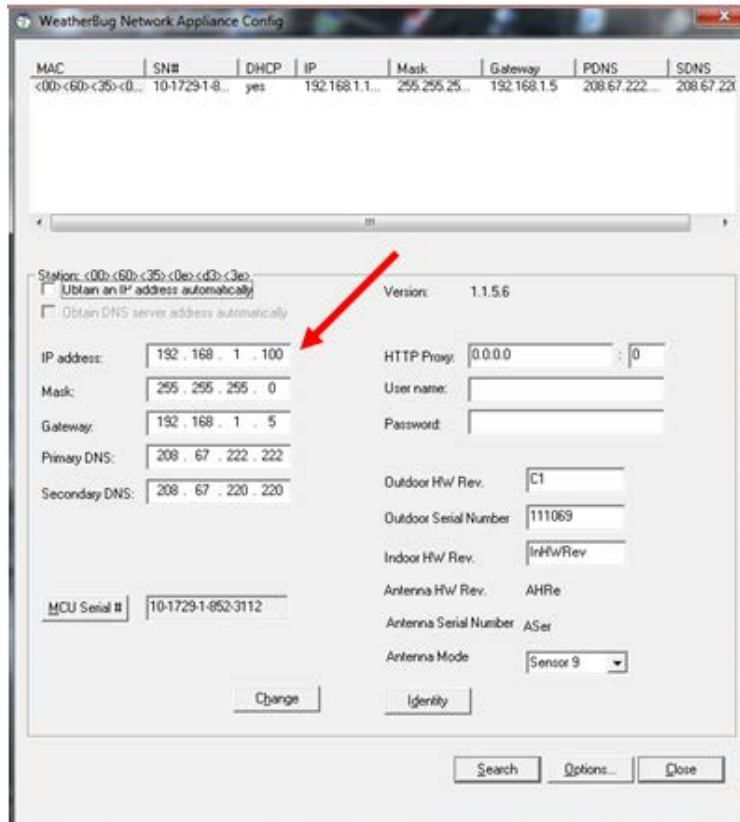
Change Identify Search Options... Close

Figure 21 - MAC Address Display within the Earth Networks Network Appliance Config Tool

11. Uncheck the “Obtain an IP address automatically” and the “Obtain DNS server address automatically” checkboxes if they are checked.

12. Enter all information obtained in step 1 in the appropriate fields (Figure 21):

- Enter the IP Address value into the IP address field.
- Enter the Subnet Mask value into the Mask field.
- Enter the default Gateway into the Gateway field.
- Enter the Primary DNS into the Primary DNS field.
- Enter the Secondary DNS into the Secondary DNS field.



MAC	SN#	DHCP	IP	Mask	Gateway	PDNS	SDNS
<00><60><35><00>...	10-1729-1-8...	yes	192.168.1.1...	255.255.25...	192.168.1.5	208.67.222...	208.67.22...

Station: <00><60><35><00><d3><3e>
☐ Obtain an IP address automatically
☐ Obtain DNS server address automatically

Version: 1.1.5.6

IP address: 192.168.1.100
 Mask: 255.255.255.0
 Gateway: 192.168.1.5
 Primary DNS: 208.67.222.222
 Secondary DNS: 208.67.220.220

HTTP Proxy: 0.0.0.0 : 0
 User name:
 Password:
 Outdoor HW Rev.: C1
 Outdoor Serial Number: 111063
 Indoor HW Rev.: InHw/Rev
 Antenna HW Rev.: AHRc
 Antenna Serial Number: ASer
 Antenna Mode: Sensor 9

MCU Serial #: 10-1729-1-852-3112

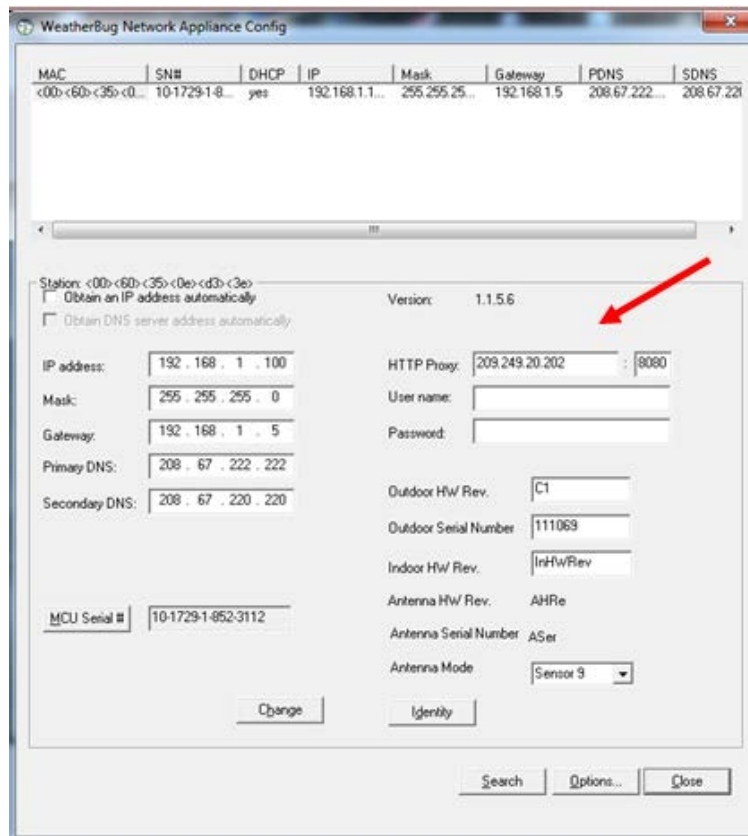
Change Identify

Search Options... Close

Figure 22 - Entering ENNA Details into the Earth Networks Network Appliance Config Tool

13. Complete this step **ONLY** if you have a Proxy Server. Using the boxes on the right side of the screen, type in the Proxy information obtained in Step 1 (Figure 22).

NOTE: Proxy address can be set using standard IP format (ex. 209.249.20.202) or DNS Proxy. The DNS Proxy must be less than 75 characters and contain at least one period/dot.



The screenshot shows the 'WeatherBug Network Appliance Config' window. At the top, there is a table with network configuration details:

MAC	SN#	DHCP	IP	Mask	Gateway	PDNS	SDNS
<00><60><35><0>	10-1729-1-8...	yes	192.168.1.1...	255.255.25...	192.168.1.5	208.67.222...	208.67.221

Below the table, there are several configuration fields:

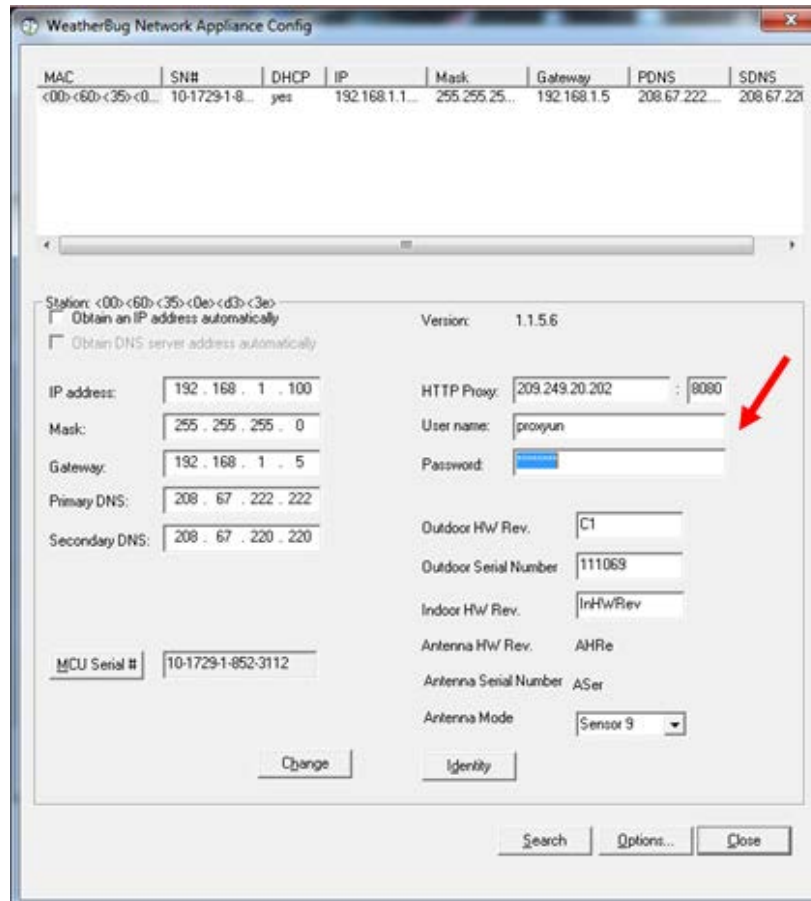
- Station: <00><60><35><0e><d3><3e>
- ☐ Obtain an IP address automatically
- ☐ Obtain DNS server address automatically
- Version: 1.1.5.6 (indicated by a red arrow)
- IP address: 192 . 168 . 1 . 100
- Mask: 255 . 255 . 255 . 0
- Gateway: 192 . 168 . 1 . 5
- Primary DNS: 208 . 67 . 222 . 222
- Secondary DNS: 208 . 67 . 220 . 220
- HTTP Proxy: 209.249.20.202 : 8080
- User name: [empty]
- Password: [empty]
- Outdoor HW Rev: C1
- Outdoor Serial Number: 111069
- Indoor HW Rev: InHwRev
- Antenna HW Rev: AHRc
- Antenna Serial Number: ASer
- Antenna Mode: Sensor 9
- MCU Serial #: 10-1729-1-852-3112

At the bottom, there are buttons for 'Change', 'Identify', 'Search', 'Options...', and 'Close'.

Figure 23 - Entering the HTTP Proxy into the Earth Networks Network Appliance Config Tool

14. If your Proxy requires a login, enter the User Name and Password in the appropriate boxes (Figure 23).

NOTE: The User Name is limited to 50 characters and Password fields is limited to 20 characters. If no User Name and Password are required leave fields blank.



MAC	SN#	DHCP	IP	Mask	Gateway	PDNS	SDNS
<00><60><35><0>	10-1729-1-8	yes	192.168.1.1	255.255.25...	192.168.1.5	208.67.222...	208.67.221

Station: <00><60><35><0e><d3><3e>
☐ Obtain an IP address automatically
☐ Obtain DNS server address automatically

Version: 1.1.5.6

IP address: 192 . 168 . 1 . 100
 Mask: 255 . 255 . 255 . 0
 Gateway: 192 . 168 . 1 . 5
 Primary DNS: 208 . 67 . 222 . 222
 Secondary DNS: 208 . 67 . 220 . 220

HTTP Proxy: 209.249.20.202 : 8080
 User name: proxyun
 Password: [redacted]

Outdoor HW Rev.: C1
 Outdoor Serial Number: 111069
 Indoor HW Rev.: InHWRev
 Antenna HW Rev.: AHRc
 Antenna Serial Number: ASer
 Antenna Mode: Sensor 9

MCU Serial #: 10-1729-1-852-3112

Change Identity Search Options... Close

Figure 24 - Entering the User Name and Password

15. Select the Change button from the center hand portion of the Earth Networks Network Appliance Config Tool. A window will pop up confirming your changes. Click OK to save your changes.

NOTE: After the OK button is selected the box will confirm the changes and the ENNA will automatically restart. It will take a few minutes to reappear on the network.

16. After approximately one minute, the A, B, and C LEDs on the ENNA should be solid green (no flashing).

4 Registering the ENLS with the CPMS

Registering the Earth Networks Lightning Sensor (ENLS) with the Central Processing and Management System (CPMS) assigns the Station ID to the ENLS and tells it where to send data and gather configuration settings. This must be completed for each ENLS in the network. An existing computer on the same Local Area Network (LAN) as the Earth Networks Network Appliance (ENNA) needs to be used. To do this:

1. The lightning.exe icon should remain on the desktop from when the LAN setup. However, if it is no longer available, follow Step A.
 - A. Using another PC computer on the network (same subnet), download the latest Earth Networks Network Appliance (RBB) Finder Tool from the PC Software section of <http://download.aws.com/> and save it to the computer desktop. Note: It will be saved as "lightning.exe" by default.
2. Double click on the lightning.exe icon on the desktop.
3. The Earth Networks Network Appliance Config Tool will open (Figure 24).

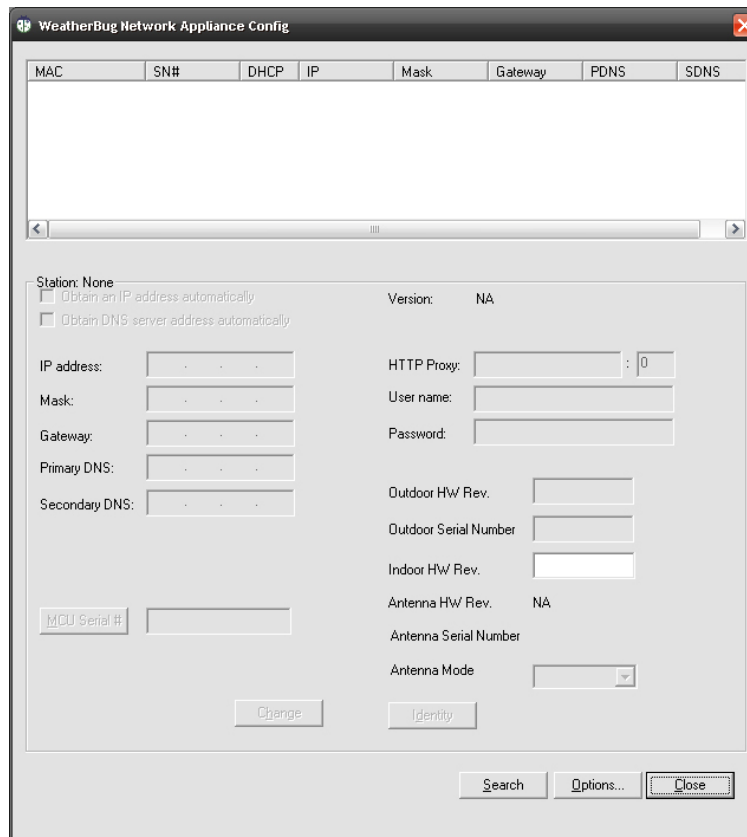


Figure 25 - Earth Networks Network Appliance Config Tool

4. Select Search to seek out the ENNA on the network. The ENLS will be displayed in the upper part of the window (Figure 25).
 - If the Earth Networks Network Appliance Config Tool was unable to find the ENNA select the Options button, change the number of seconds from 5 to 50, and select OK. Select Search again from the Earth Networks Network Appliance Config Tool.

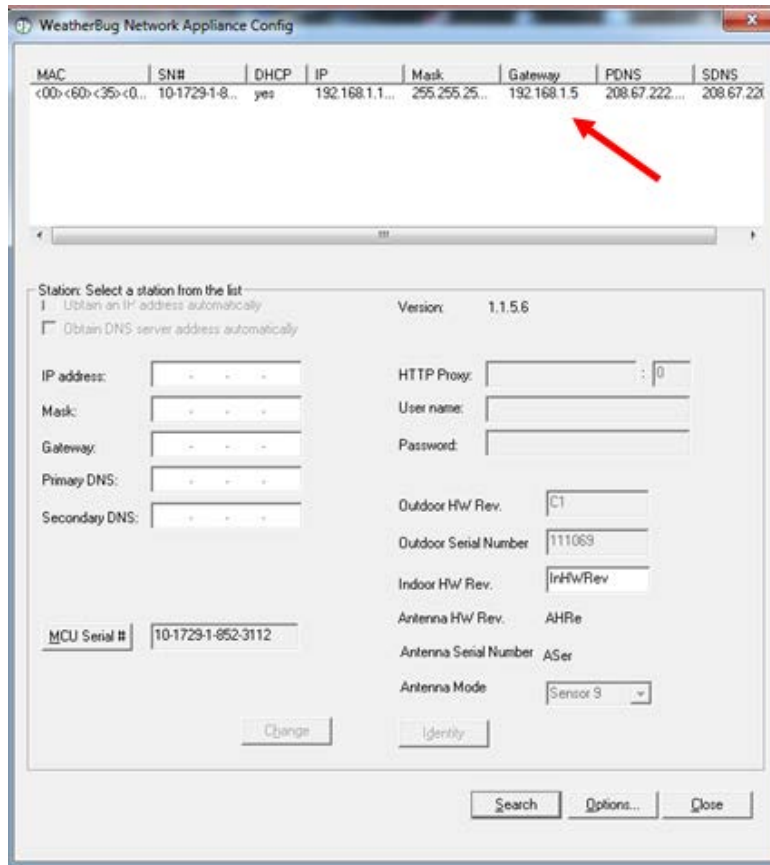


Figure 26 - MAC Address Display within the Earth Networks Network Appliance Config Tool

- Open your web browser and enter the IP address that is show for the station in the following format: `http://<IP address>/admin.asp` and press Enter.

6. The Earth Networks Tracking Station Log In page will appear (Figure 26).

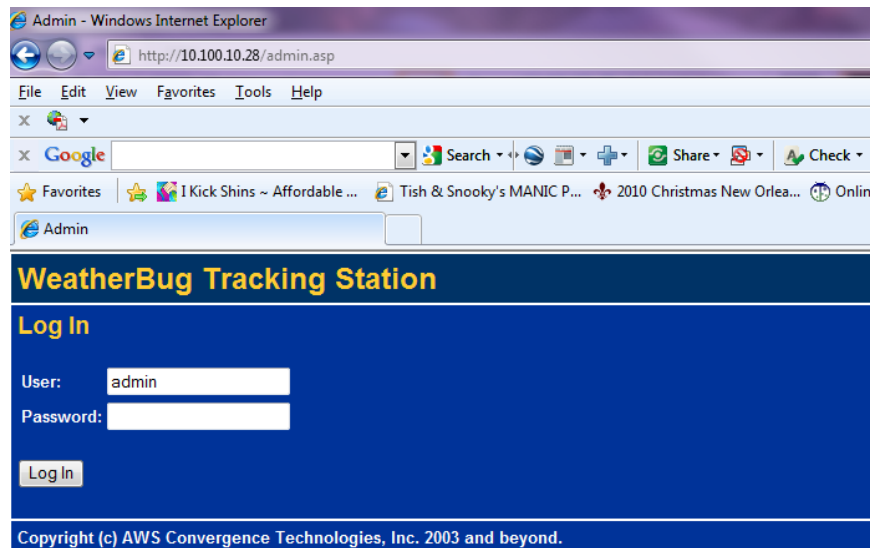


Figure 27 - Earth Networks Tracking Station Log In Page

7. The User Name is “admin” and should already be auto-filled. Enter the Password, which is **tini** (case sensitive) and click the Log In button.
8. The Earth Networks Tracking Station admin page will open.
9. Change the Configuration Server value in the Host Settings section to the IP or DNS name of the Configuration Server, which is located on CPMS 1A of the CPMS. It must be entered as follows: `http://<IP address>/` or `http://<DNS name>/` (Figure 27).



Figure 28 - Configuration Server Value in Host Settings Section

10. Click Save and a confirmation message will be displayed and the ENNA will reboot. The web browser may be closed at this point.

5 System Operation

Under normal conditions, the Earth Networks Lightning Sensor (ENLS) should never be turned off. It is designed to operate 24 hours daily, every day, without operator input or assistance. The ENLS needs power to continue operating.

5.1 Firewall

The Network Administrator at the installation location must be contacted to make changes in the firewall. If there is difficulty understanding information concerning Internet requirements, please pass all of this information along to the Network Administrator.

6 System Maintenance

Under normal conditions, the ENLS will require very little maintenance. All components are “Plug-and-Play”. Defective sensors can be removed simply by disconnecting them from the cable connections

7 Support Services

Please refer to the Support section of your contract for support service details. You may contact Technical Support at 001 866 992 8448 (phone) or support@earthnetworks.com (email).

8 Glossary

Central Processing and Management System (CPMS): A group of critical software components that are responsible for processing the raw electromagnetic waveforms and timing data from remote Earth Networks Lightning Sensors at site locations and determining the location, amplitude and type of the detected lightning flash. The CPMS is also responsible for archiving raw waveform data, lightning stroke location data and gathering system statistics and performance over time.

Configuration Server (CS): A computer that each Earth Networks Lightning Sensor accesses to get configuration information and post-performance data. Information such as GPS Antenna and critical sensor status information is sent to the CS over time. The CS also adjusts sensor gain levels based on the strength of received waveform data.

Dynamic Host Configuration Protocol (DHCP): A protocol for assigning dynamic IP addresses to devices on a network from a master list stored on the server.

Eastern Standard Time (EST): The fifth time zone west of Greenwich, used in the eastern United States.

Firewall: A technological barrier that prevents unauthorized communications between sections of a computer network, ensuring only lightning traffic reaches your system.

Internet: A vast, global system of interconnected computer networks that use the standard Internet Protocol Suite to serve billions of end-users worldwide.

Lightning Data Receiver (LDR): A computer that gathers waveform data from multiple sensors in memory and aligns the waveforms in time before forwarding to the Lightning Location Processor (LLP). If the LDR cannot connect to the LLP, then it will cache waveforms in memory and then to disk up to pre-defined thresholds of data. The LDR is also programmed to push lightning waveforms to other redundant LDRs and is also configurable to save raw waveform data for long periods of time for further analysis or playback into the LLP system.

Lightning Flash: A contiguous conducting channel and all current pulses that travel through it. Flashes are grouped into two categories based on the shape of the waveform:

In-Cloud (IC): A lightning flash that occurs within a cloud, from a cloud to another cloud or from a cloud to a point in the air.

Cloud-to-Ground (CG): A lightning flash that extends from the parent thunderstorm to the ground.

Lightning Location Processor (LLP): The main processing software responsible for determining flash location, amplitude and classification (IC vs. CG) using proprietary mathematical techniques. The LLP also rates each flash with a confidence factor based upon how many sensors saw the flash, among other factors.

Lightning Pulse: A concentration of charge that travels through a conducting channel; a pulse consists of a complete waveform.

Local Area Network (LAN): A local computer network for a small group of computers. Most LANs are confined to a single building or a group of buildings that are close together.

Return Stroke (RS): A type of pulse traveling from the ground to the thunderstorms cloud. Many RSs make up CG flash.

Switch: A common connection point for all servers and network devices.

Waveform: An electromagnetic representation of a lightning pulse showing amplitude over time. Recorded waveforms are very useful in differentiating CG strokes from IC pulses. The Earth Networks Central Processing and Management System (CPMS) is the only lightning detection network that records waveforms for every pulse.

Earth Networks Lightning Sensor (ENLS): A sophisticated instrument that detects both CG and IC lightning data with high detection efficiencies and sends complete waveform data to the Lightning Data Receiver (LDR). The sensors are optimized to reduce system noise and to broaden the frequency range (1Hz to 12 MHz) in order to create an integrated unit capable of detecting both CG and IC flashes with very high detection efficiencies.

Earth Networks Network Appliance (ENNA): The core of the ENLS is the ENNA. The ENNA is a microprocessor-controlled computer with battery backup that uses your existing high-speed internet connection to transmit the lightning waveform and GPS data received from the ENLS Digital Signal Processor (ENDSP) out to the Lightning Data Receiver (LDR) component of the CPMS. It also provides key diagnostics, calibration and data archival functionality.

ENLS Digital Signal Processor (ENDSP): The ENDSP receives the waveform data from the Lightning Antenna and time and location data from the GPS Antenna and transmits all data to the Earth Networks Network Appliance (ENNA) via the Data Cable.