BOLTEK CORPORATION

Lightning Detection

LRX-1 Lightning Network Detector

ANT-50 Lightning Sensor / GPS

Installation/Operation Guide

BOLTEK LIGHTNING DETECTION

LRX-1 Lightning Network Detector

ANT-50 Lightning Sensor / GPS

Disclaimer

LRX-1 based lightning data is only approximate and should not be used for safety applications. Strike and storm locations indicated and alarm statuses may be erroneous and should not be used to safeguard personnel, equipment or data.

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Notwithstanding the above Boltek Corp's liability shall not exceed the purchase price of the equipment.

THIS EQUIPMENT IS NOT TO BE USED FOR SAFETY PURPOSES

USE OF THIS PRODUCT SHALL BE DEEMED TO BE ACCEPTANCE OF BOLTEK'S STANDARD TERMS AND CONDITIONS (ENCLOSED AND AVAILABLE AT WWW.BOLTEK.COM). IF YOU DO NOT AGREE TO BE BOUND BY THESE TERMS AND CONDITIONS PLEASE RETURN THIS PRODUCT TO THE PLACE OF PURCHASE FOR A FULL REFUND.

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FCC Compliance Statement
For United States Users

This equipment is 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 or television reception. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio and television reception, which can be determined by turning the equipment on and off, 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 the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

WARNING

The connection of a non-shielded equipment interface cable to this equipment will invalidate the FCC Certification of this device and may cause interference levels which exceed the limits established by the FCC for this equipment. It is the responsibility of the user to use a shielded interface cable with this device. If this equipment has more than one interface connector, do not leave cables connected to unused interfaces. Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

For Canadian Users

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la class B respecte toutes les exigences du Règlement sur le materiel brouilleur du Canada.

CAUTIONS

LRX-1 based lightning data is only approximate and should not be used for safety applications. Strike and storm locations indicated and alarm statuses may be erroneous and should not be used to safeguard personnel, equipment or data.

Install the ANT-50 Sensor on a calm clear day when no thunderstorms are expected.

If you are not experienced in safe antenna installation using appropriate safety equipment you should refer installation to an experienced antenna installer. (See Television Antennas or Satellite Antennas in the Yellow Pages)

LIGHTNING HAZARD

ANT-50 connections are not optically isolated from the roof mounted sensors. Dangerous voltages may occur should lightning strike at or near the sensor.

ELECTROCUTION HAZARD

You can be killed if the ANT-50 mast or its mounting hardware comes in contact with an electrical power line. WATCH FOR AND STAY AWAY FROM ALL OVERHEAD WIRES.

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Chapter 1

Introduction

Congratulations on your purchase of a Boltek LRX-1 Lightning Detection Network Detector.

LRX-1 lightning data is only approximate and should not be used for safety applications. Strike and storm locations indicated and alarm statuses may be erroneous and should not be used to safeguard personnel, equipment or data.

The standard LRX-1 package contains the following items:

1: LRX-1

2: ANT-50 (Lightning Sensor & GPS)

3: 10 Ft Network Patch Cable

4: Lightning Sensor Cable (CAT6)

5: GPS Cable (CAT6)

6: 120/220V Power Adapter (N.A. or Int.)

7: 2 x Cable Grips

8: 3 x Large Mounting Clamps

9: 3 x Medium Mounting Clamps

Unpack your LRX-1 and check to ensure all parts listed are included before installation.

Theory of Operation

...

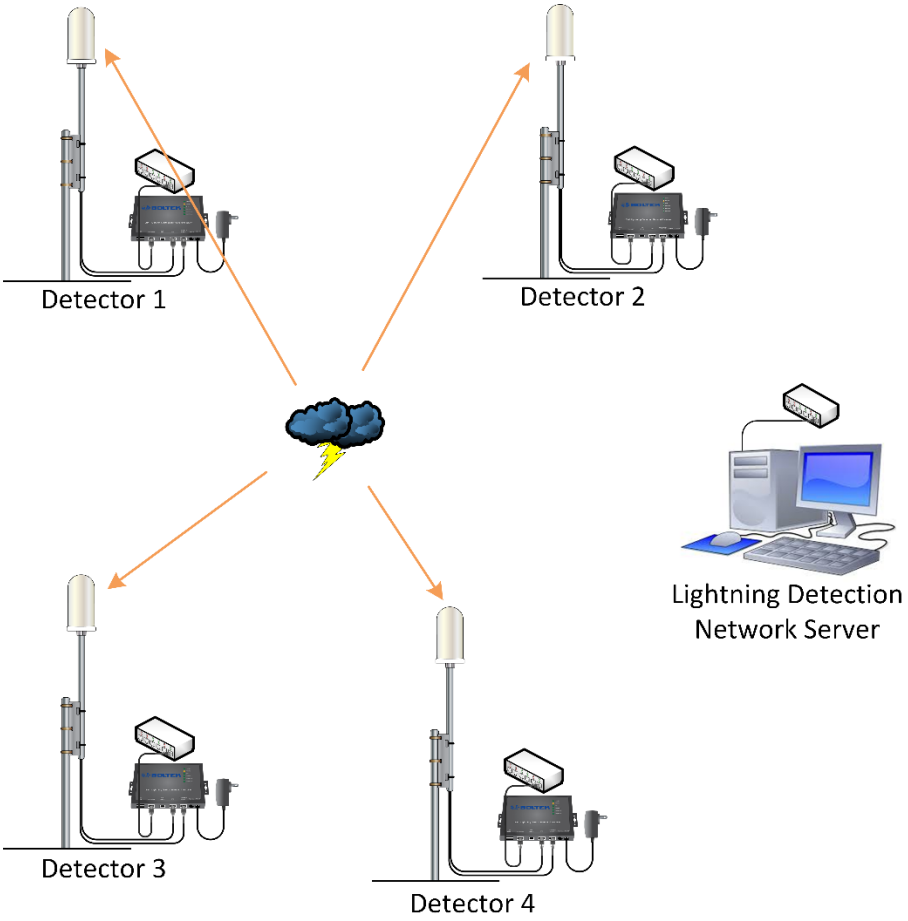


Figure 1: Lightning Detection Network Diagram

Chapter 2

Installation

Installing the Antenna

The ANT-50 is housed in a white enclosure attached to a mast and mounting bracket that is to be secured vertically to a pole or tripod. The antenna and GPS cable are pre-installed on the inside of the ANT-50. The antenna can be mounted with the supplied clamps. Two different sizes of clamps are provided to allow for various diameter sizes of the pole or tripod the antenna is being mounted to.

Provided there are no large metal objects to block the radio signals, mounting the antenna 6 feet high is ok. Mounting the antenna 12 feet high is good. 20-25 feet is better.

LIGHTNING

Receiving lightning signals does not cause lightning to strike. Your ANT-50 is less likely to be struck by lightning than your anemometer, since the antenna does not need to be above the roof line. Still though you must exercise common sense when choosing a location for your antenna. If you mount the antenna on a ten foot pole on the highest point on your roof, with no trees or television tower nearby you are asking for lightning to strike.

Your best protection against lightning is to mount the antenna indoors. Radio waves will pass right through a wood building. Lightning is more likely to strike a tall tree, television antenna, copper plumbing vent, satellite dish, telephone line, power lines, or CB antenna. If you do mount the antenna outdoors make sure there are plenty of ground paths for lightning nearby (such as those just mentioned), and higher than the antenna.

The LRX-1 receiver board has surge suppression in its input to protect against voltages induced into the antenna cable. It is also a good idea to purchase a surge suppressor to plug your computer into. If you have a network card try to find one that will protect your LAN line as well. Both your computer and surge suppressor will need to be grounded.

The antenna may be mounted indoors or outdoors. Try to mount the antenna as high as possible (without making it a lightning rod). Mounting the antenna high will keep it away from noise sources and will improve the maximum range. In a wood framed house, the second floor or attic is often a good location for the antenna.
This places the antenna above the most common sources of interference: televisions, lights and appliances, yet leaves it in a good location to receive lightning signals. Mount the antenna to the drywall or attic rafter away from screws, nails, electrical wiring, and other metal objects. If your house has aluminum siding (vinyl siding is ok), foil-lined insulation, or any other metal coating, you might have problems receiving with the antenna indoors, as the metal may shield radio waves from the antenna.

DO NOT MOUNT THE ANTENNA SO AS TO ATTRACT LIGHTNING. The antenna does not need to be the highest object in the area to receive lightning signals.

DO NOT LOCATE THE ANTENNA NEAR AN OBJECT WHICH IS LIKELY TO BE STRUCK BY LIGHTNING. Objects such as television antennas, CB antennas, power lines, phone lines and tall trees are natural targets for lightning. Keep the antenna and cable away from anything which might be struck by lightning. Lightning can jump from one object to another in its search for ground.

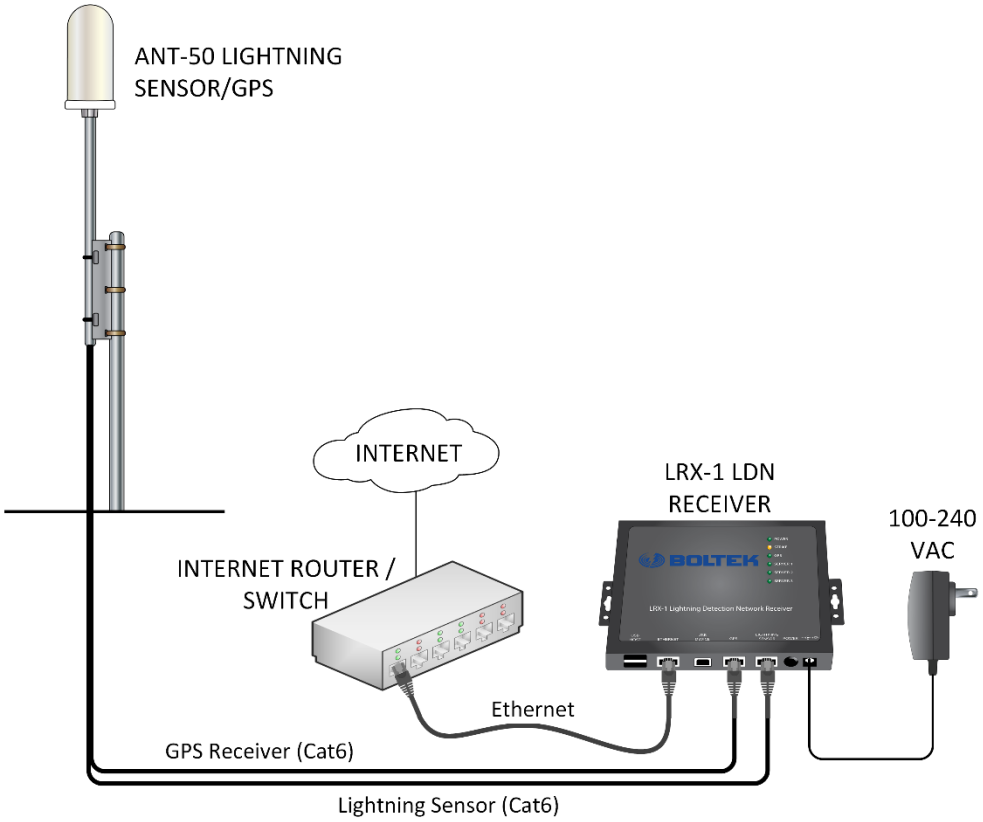
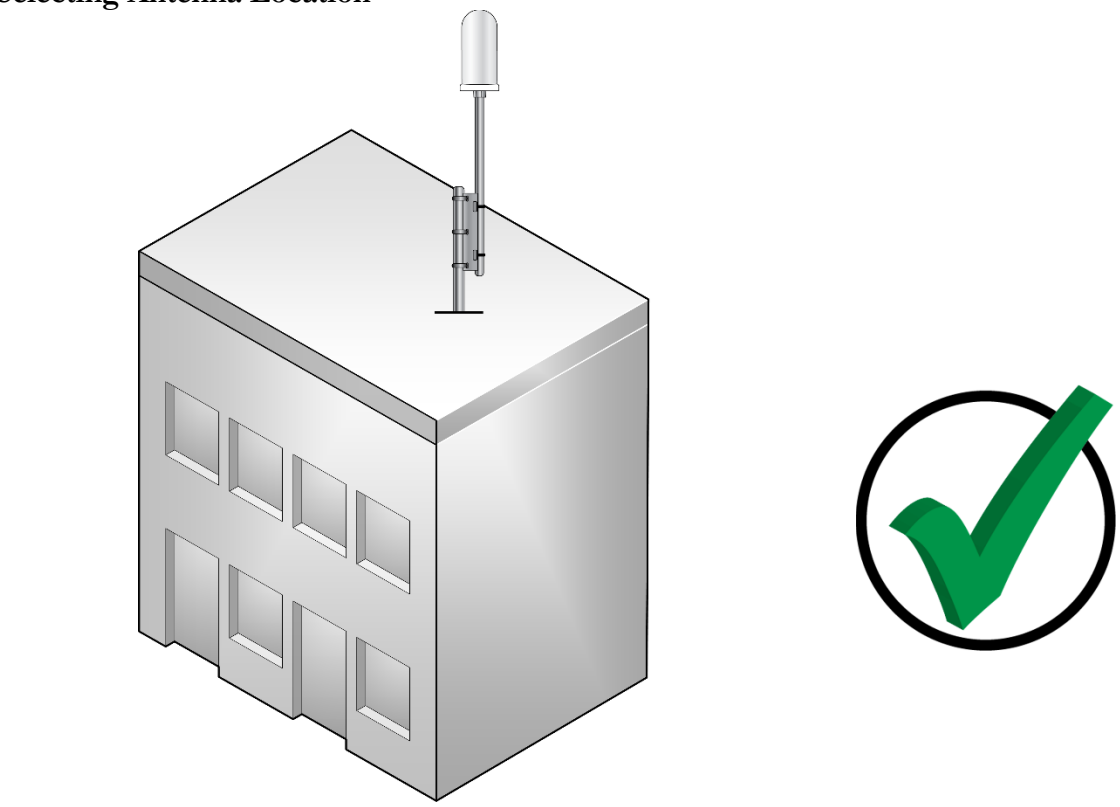
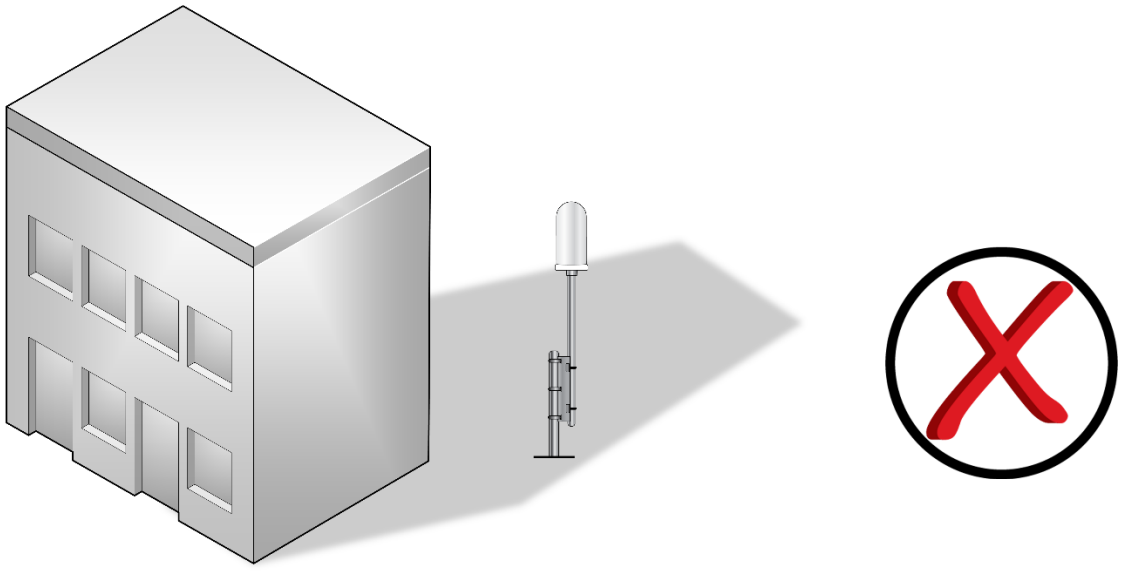
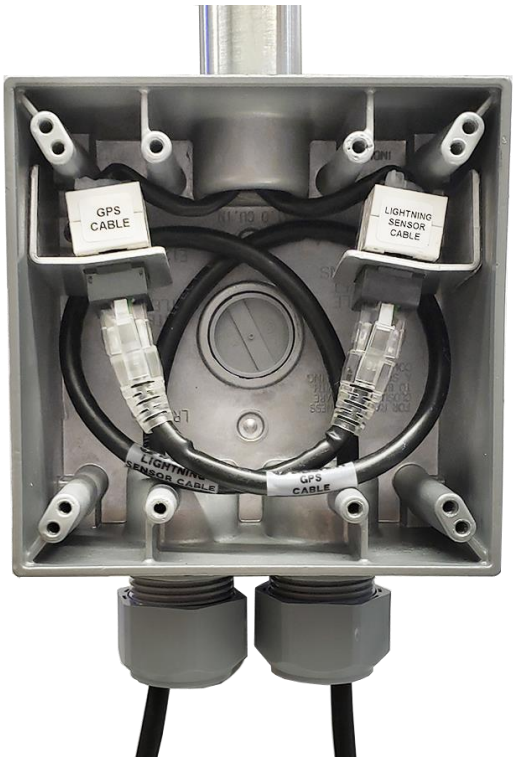


Figure 2: LRX-1 / ANT-50 Connection Diagram

Selecting Antenna Location







Remove tightening nuts and rubber inserts from the cable grips, then screw cable grips into the bottom of the junction box slide a nut on each cable, then make a large loop in each cable and insert into the proper connector. Insert rubber into cable grip and tighten each nut until cables are no longer able to move.

If the cables are not inserted into the correct connectors the LRX-1 will not function properly.

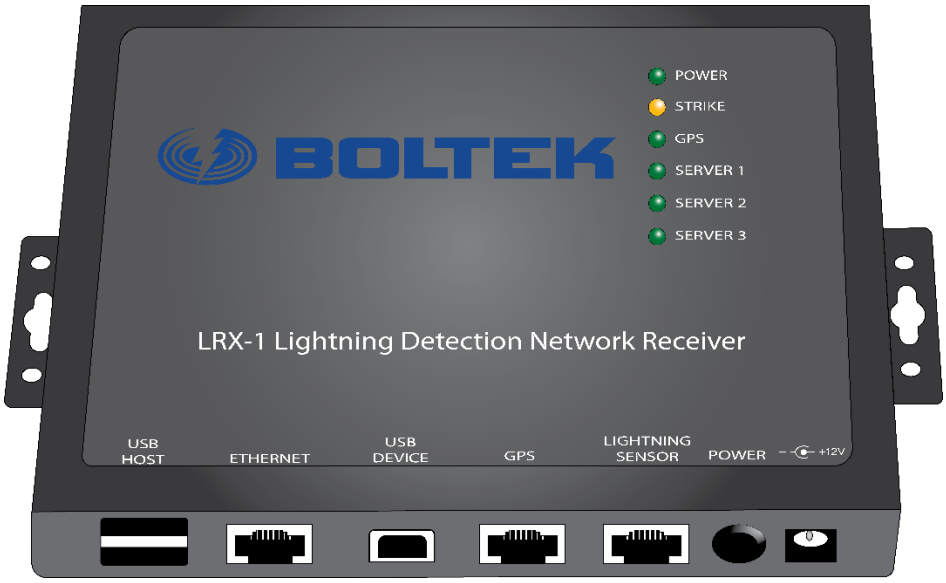


Figure 3: Front View of LRX-1

Front Panel

Power LED
This green LED illuminates when the LRX-1 has 12VDC power and is turned on.

Strike LED
The yellow Strike LED flashes whenever the ANT-50 and LRX-1 detects an RF signal, usually lightning.

GPS LED
This green LED illuminates when data is received from the GPS and pulses off once per second when the GPS PPS signal is received.

Server 1, 2, 3 LEDs
The Server 1, 2 and 3 LEDs flash and illuminate to show the connection status to the lightning detection network servers. Flashing indicates a connection is in progress. Solid illumination indicates a successful connection.

Servers 4, 5 and 6 do not have status LEDs. Servers 1, 2 and 3 are control servers and have the ability to control and configure the LRX-1. Servers 4, 5 and 6 are data only servers and cannot control or configure the LRX-1.

Connectors

Power Connector
Connect the provided 12VDC power supply to the LRX-1's power connector.

Power Switch
This switch controls 12VDC power to the LRX-1. The switch is on when depressed, off when extended.

Lightning Sensor Connector
Connect the Lightning Sensor cable from the ANT-50 Sensor/GPS.

GPS Connector
Connect the GPS cable from the ANT-50 Sensor/GPS.

USB Device Connector
Connect the LRX-1 to your computer using this USB port for the initial configuration of the Server List. Once the LRX-1 has successfully connected to at least one control server the Server List can be updated remotely.

The default entries in the Server List connect the LRX-1 to Boltek LDN servers. If you prefer we can remotely configure your LRX-1 to point at your servers, or configure the server list before shipment.

Ethernet Connector
This is the Internet connection to the LRX-1. The LRX-1 is configured for DHCP by default.

USB Host Connector
This connector is not normally used.

Chapter 3

Configuring the LRX-1

The LRX-1 is a Linux based lightning detector.

After booting the script `/etc/rc.local` is executed, which starts the LRX detection software.

LRX software reads its configuration file LRX.ini, then connects to the server(s) listed in the file.

The LRX-1 supports up to 6 LDN servers. The connection status of Server 1, 2 and 3 are indicated on the front panel LEDs. Flashing indicates a connection is being attempted. Solid indicates an established connection.

Servers 1, 2 and 3 are Control Servers and have the ability to remotely configure the LRX-1. Servers 4,5 and 6 are Data Only Servers and do not have the ability to make any changes to the LRX-1 other than disconnecting their own connection, triggering an automatic reconnect.

```
Serial Number=10000
Trigger Level=250

[Server1]
Enabled=1
Server=yourserver.com
Port=9734
Password=yourpassword
Mode=1

[Server2]
Enabled=1
Server=yourserver2.com
Port=9734
Password=yourpassword
Mode=1

[Server3]
Enabled=0
Server=
Port=9734
Mode=1
Password=

[Server4]
Enabled=0
Server=
Port=9734
Mode=1
Password=

[Server5]
Enabled=0
Server=
Port=9734
Mode=1
Password=

[Server6]
Enabled=0
Server=
Port=9734
Mode=1
Password=
```

Figure 4: Default LRX Configuration File
`/home/lrx/LRX.ini`

Editing the LRX.ini file

If your LRX-1 receiver was not pre-configured for you at the factory you will need to make a terminal connection to the LRX-1 and edit the configuration file yourself.

Connect the LRX-1 to a computer using the LRX-1 USB Device. The computer should automatically load the device driver and create a new virtual COM port.

On your computer open the Windows Device Manager (type Device Manager on the Ask me anything line)

Open the Ports (COM & LPT) section. You should see at least two USB Serial Ports listed. If you see more than two unplug and re-plug the USB cable from the LRX-1. The ports that disappear and reappear belong to the LRX-1.

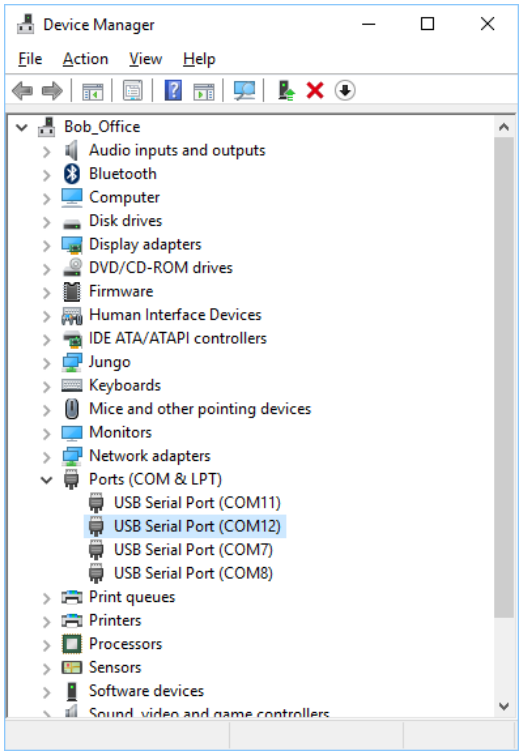


Figure 5: Windows Device Manager

Use a terminal program such as PuTTY (free from www.putty.org) to connect to the higher number of the two COM ports.

115200 bps
8 data bits
1 stop bit
No parity
No flow control

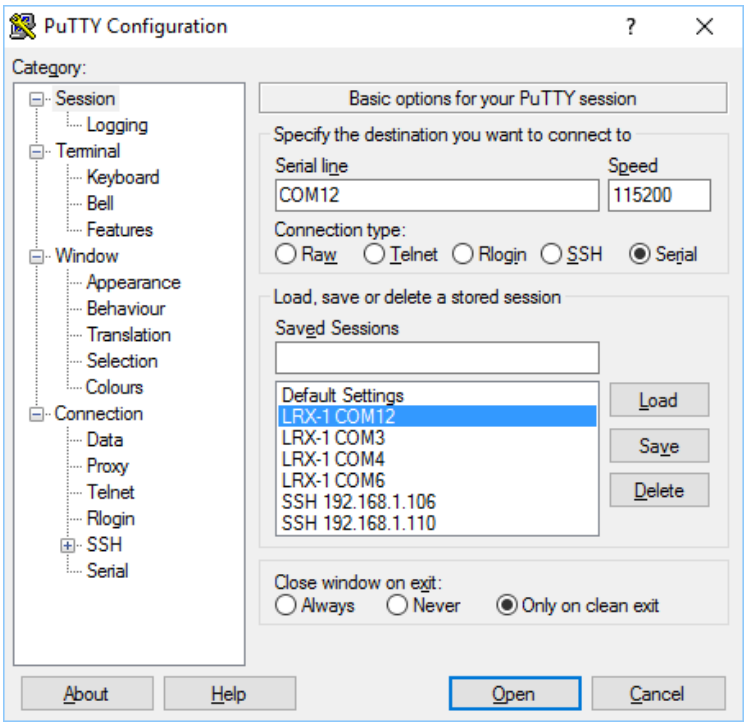


Figure 6: PuTTY Configuration

Putty can also be used to make a SSH connection if desired once your LRX-1 is installed in a remote location (although you may need to configure the remote router or firewall).

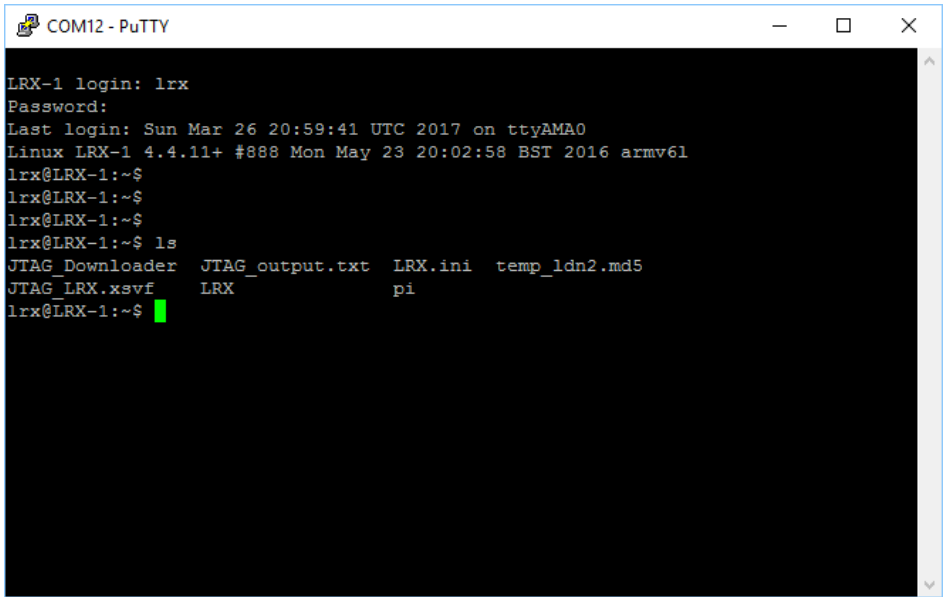


Figure 7: LRX-1 Login Screen

Editing the LRX.ini Configuration File

Once you are logged in as shown above you can enter commands to configure your detector.

To edit the LRX.ini configuration file type:

```
sudo nano LRX.ini
```

The program is quite easy to use. Simply make the changes desired and type Control-O to save and Control-X to exit.

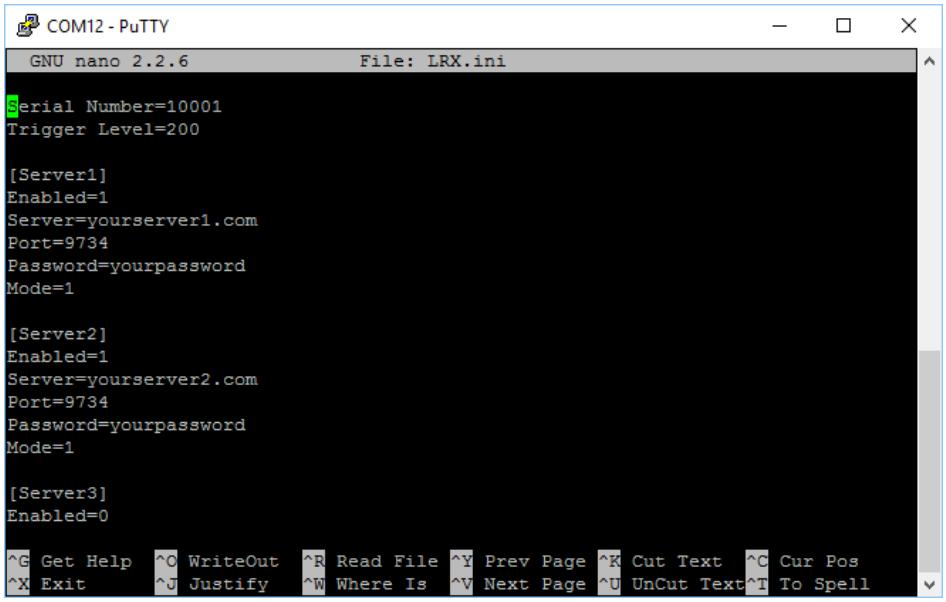


Figure 8: Editing the LRX.ini Configuration File using nano

Assigning an Ethernet IP Address

The LRX-1 has DHCP enabled by default so it will automatically try to obtain an IP address if a DHCP server is available.

Manually Configuring an IP Address

If a DHCP server is not available on the local network it will be necessary to manually configure the IP address. First an available IP address needs to be assigned to the LRX-1 by the local network administrator. The network administrator will also provide the local netmask and gateway address.

Connect to your LRX-1 over USB as described earlier.

Edit the `/etc/dhcpcd.conf` file as shown below:

```
$sudo nano /etc/dhcpcd.conf
```

Add the following four lines to the end of the file. Substitute the IP address, gateway and domain name servers (DNS) values given to you by the network administrator. The /24 after the IP address is equivalent to a netmask of 255.255.255.0

```
interface eth0
static ip_address=192.168.1.101/24
static routers=192.168.1.1
static domain_name_servers=192.168.1.1
```

Save the modified file and exit the nano editor.
Reboot the LRX-1 with the following command:

```
$sudo reboot
```

When the reboot is finished login and check the eth0 settings:

```
$ifconfig
```

You should see something like:

```
eth0    Link encap:Ethernet  HWaddr b8:27:eb:a2:6b:95
        inet addr:192.168.1.101  Bcast:192.168.1.255  Mask:255.255.255.0
        inet6 addr: fe80::1021:bd51:72ff:209a/64 Scope:Link
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:1064 errors:0 dropped:30 overruns:0 frame:0
        TX packets:189 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:120195 (117.3 KiB)  TX bytes:20600 (20.1 KiB)
```

The inet address should match the IP address assigned by your network administrator.

Chapter 4

Operation

Once connected to the local network and to the ANT-50 Lightning Sensor/GPS the LRX-1 only requires power.

The LRX-1 will automatically connect to the configured networks and report lightning detected within range.

Once connected to a server all further configuration can be done remotely from the server (Server 1, Server 2 and Server 3 only).

Proper operation of the LRX-1 can be observed by a solid green server indication (Server 1, Server 2 and/or Server 3) and periodic flashing of the yellow Strike LED. A flashing green server LED indicates the LRX-1 is trying to connect to the server but is not connected. A mostly solid yellow strike indicator means either a local interference problem at the site or a trigger level set too low. The situation needs to be determined at the server.

No maintenance is required beyond a periodic inspection of the ANT-50 installation and cables for damage.

Chapter 5

Maintenance

The LRX-1 and ANT-50 will not normally require maintenance beyond a periodic inspection.

During inspection verify that the ANT-50 mounts are secure and not corroded and that cables are not damaged or abraded.

UPS batteries should be replaced every three years, or tested every six months. If the UPS is installed in a location that experiences high temperatures the batteries should be replaced annually for best reliability.

Appendix A

Troubleshooting

Problem:
The Strike light is constantly flashing.

Solution:
There is either an interference problem at the detector site or the trigger level is set too low. This can only be evaluated at the server.

Problem:
The Strike light flashes once per second. The GPS light never comes on.

Solution:
The Lightning Sensor and GPS cables are swapped. Unplug them from the LRX-1 and swap the connections.

Problem:
The Server light(s) never stops flashing. No server lights are illuminated constant green.

Solution:
This indicates the LRX-1 cannot connect to a server. Since the LRX-1 comes preconfigured for a valid server, either Boltek's servers by default or customer server by special order, this probably indicates a network problem.

Appendix A

Specifications

LRX-1 LED Indicators

Power (green)	On when power is applied
Strike (yellow)	Flashes as strikes are detected
GPS (green)	Flashes once per second from GPS
Server 1 (green)	Flashes when connecting to server On when connected
Server 2 (green)	Flashes when connecting to server On when connected
Server 3 (green)	Flashes when connecting to server On when connected

LRX-1 Communications

Ethernet (10/100Base-T)	Main data port for connections to servers, remote ssh & sftp access
USB Client	TTY connection to laptop (configuration)
USB Host	USB accessories (not normally used)
GPS	ANT-50 GPS (RS485) over Cat 5 cable
Lightning Sensor	ANT-50 lightning sensor (differential analog) over Cat 5 cable

LRX-1 Power

Connector	2.1mm/5.5mm coaxial
Voltage	11.5VDC - 14VDC
Power Consumption	8W (including ANT-50)
Source	120VAC US plug or 100-240VAC International multi-plug wall adapter provided. Plugging into a UPS recommended. 12VDC battery operation possible.

Enclosure

Material LRX-1	Aluminum
IP Rating LRX-1	20
Dimensions LRX-1	6.3” x 4.5” x 1.1” / 160 mm x 114 mm x 28 mm
Dimensions ANT-50	4.9” diameter x 10” / 124 mm diameter x 254 mm 3/4” NPT Pipe Mount, 24” / 610 mm long mast provided Pole mount bracket provided for poles 1.5” to 4” / 38 mm to 100 mm diameter

Environmental

Operating Temperature	-40 to 60 C / -40 to 140 F
Operating Humidity	0 to 99% non-condensing
Agency Approvals	CE, FCC, cULus, C-tick
Warranty	1 Year

Ordering Information

LRX1-KIT-120V-100FT	LRX-1/ANT-50 kit for 120VAC
LRX1-KIT-220V-100FT	LRX-1/ANT-50 kit for 100-240VAC

Standard kit includes 100’ / 30 m sensor cables. Additional cable lengths available on request.

Kits include:

- LRX-1 Lightning Network Detector
- ANT-50 Lightning Sensor / GPS
- Pole Mount Bracket / Mast for ANT-50
- 120VAC or 100-240VAC Power Supply
- 100 ft (30 m) CAT6 Cable for ANT-50 Lightning Sensor
- 100 ft (30 m) CAT6 Cable for ANT-50 GPS
- 10 ft (1.8m) CAT5 Cable for Network