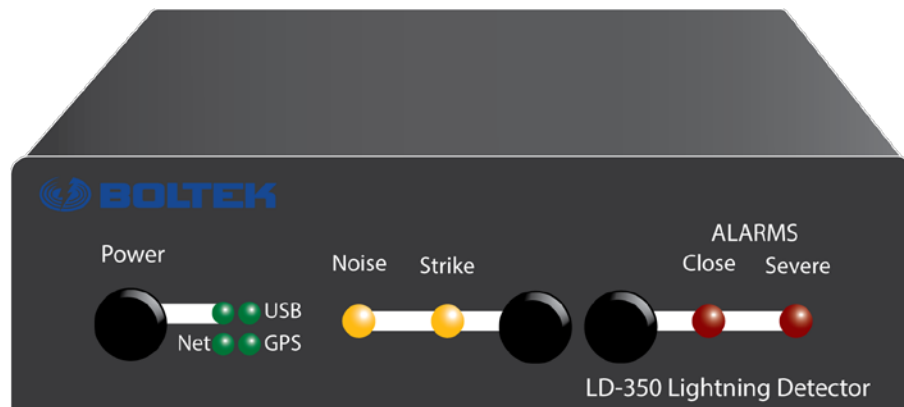# BOLTEK CORPORATION

Lightning Detection

LD-350 Lightning Detector
Installation/Operators Guide

SEE DISCLAIMER ON REVERSE

LD-350 Lightning Detector

Disclaimer

LD-350 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.

Neither Boltek Corporation nor its affiliates shall be liable to the purchaser of this product or third parties for damages, losses, costs, or expenses incurred by purchaser or third parties as a result of use, misuse, accident, or abuse.

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

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.

Table of Contents

Installation

T he LD-350 Lightning Detector puts a live lightning map on your laptop or desktop computer. The LD-350 is suitable for use with a computer or as a stand-alone lightning detector for fixed installations.

Your LD-350 package should contain:

1 LD-350 lightning detector
1 ANT-2 lightning sensor (pre-assembled with mast and mounting bracket)
3 x Stainless Steel Clamps (Range 1-13/16" to 2-3/4" / 46 to 70mm)
3 x Stainless Steel Clamps (Range 3-1/16" to 4" / 78 to 102 mm)
1 antenna cable (Cat6 Direct Burial),
      standard length 50 feet (15 meters)
1 AC wall adapter:
      120VAC to 12VDC or
      220VAC to 12VDC Universal Adapter
1 A/B USB cable
4 rubber feet for desktop mounting
USB Flash Drive containing Windows software, drivers, and manuals
1 User Manual (this is it)

Unpack your LD-350 and make sure all the parts are included.

Quick Start

1) Connect the USB cable from your computer USB port to the USB connector of your LD-350.

2) Plug in the AC power adapter into the lead of the LD-350 and into an AC outlet. Turn on the LD-350. The two yellow LEDs should blink three times, then the unit will beep and illuminate the indicator lights for 2 seconds.

3) After the power is turned on, the USB drivers for the LD-350 should automatically install if there is an active internet connection on the computer. If there is no internet connection, the USB driver install program can be found on the Boltek USB drive under:**\LD350\USB_DRIVER**.

4) Insert Boltek USB flash drive into available USB port on the desktop computer and open File Explorer

5) Navigate to the LD-350 folder, then into the 32 or 64 bit installation folder depending on your Windows Operating System.

6) Run the setup executable and follow the prompts to install the software. When you get to the Choose Components screen, ensure that "StormTracker PCI device" is deselected.

7) Run NexStorm software, along the top menu bar select Options, then Configuration.
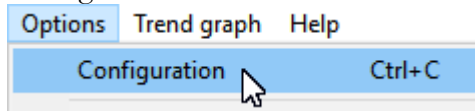
8) Select the Hardware tab, then select LD-350 under Receiver model
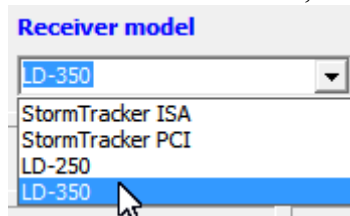
9) Under Receiver activation, check Enable on startup.

10) After clicking the Close button, you may need to click on "Receiver" under the date and time to connect the LD-350 to the software for the first time.

Receiver   Enabled
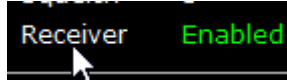
11) Connect the antenna cable to both the LD-350 and the antenna. Hold the antenna a few feet from a computer monitor or television. (A laptop computer display may not produce enough noise.) The LD-350 should detect the radio frequency noise from the monitor as a constant stream of noises and/or strikes. By moving the ANT-1 you should be able to find a position that produces strikes. Yellow strike dots should appear on the map display. Rotating the antenna should change the strike direction.

12) Mount the antenna away from televisions, computer monitors and other sources of electrical noise.
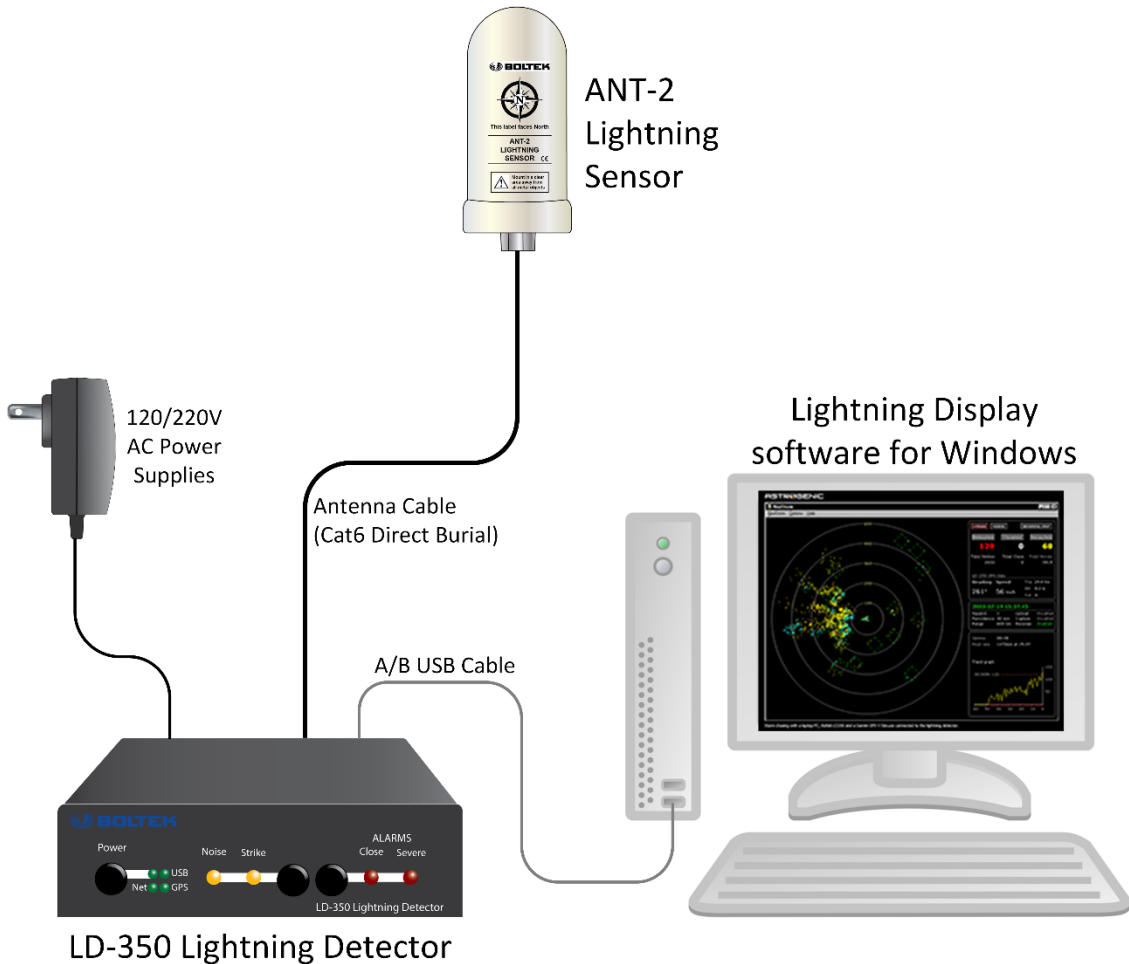
LD-350 Connection Diagram

Installing the Antenna

The ANT-2 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 cable inserts through the bottom of the mast and plugs into the RJ45 connector on the inside of the ANT-2. When mounting, ensure the ANT-2 is rotated until the label faces true north. The label on the antenna corresponds to the top of the computer screen. If the label on the antenna does not face north the strikes will not appear in the correct location in the display software.

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 LD-350 antenna 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 LD-350 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 modem try to find one that will protect your phone line as well. Lightning often enters through the telephone line. 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.

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.
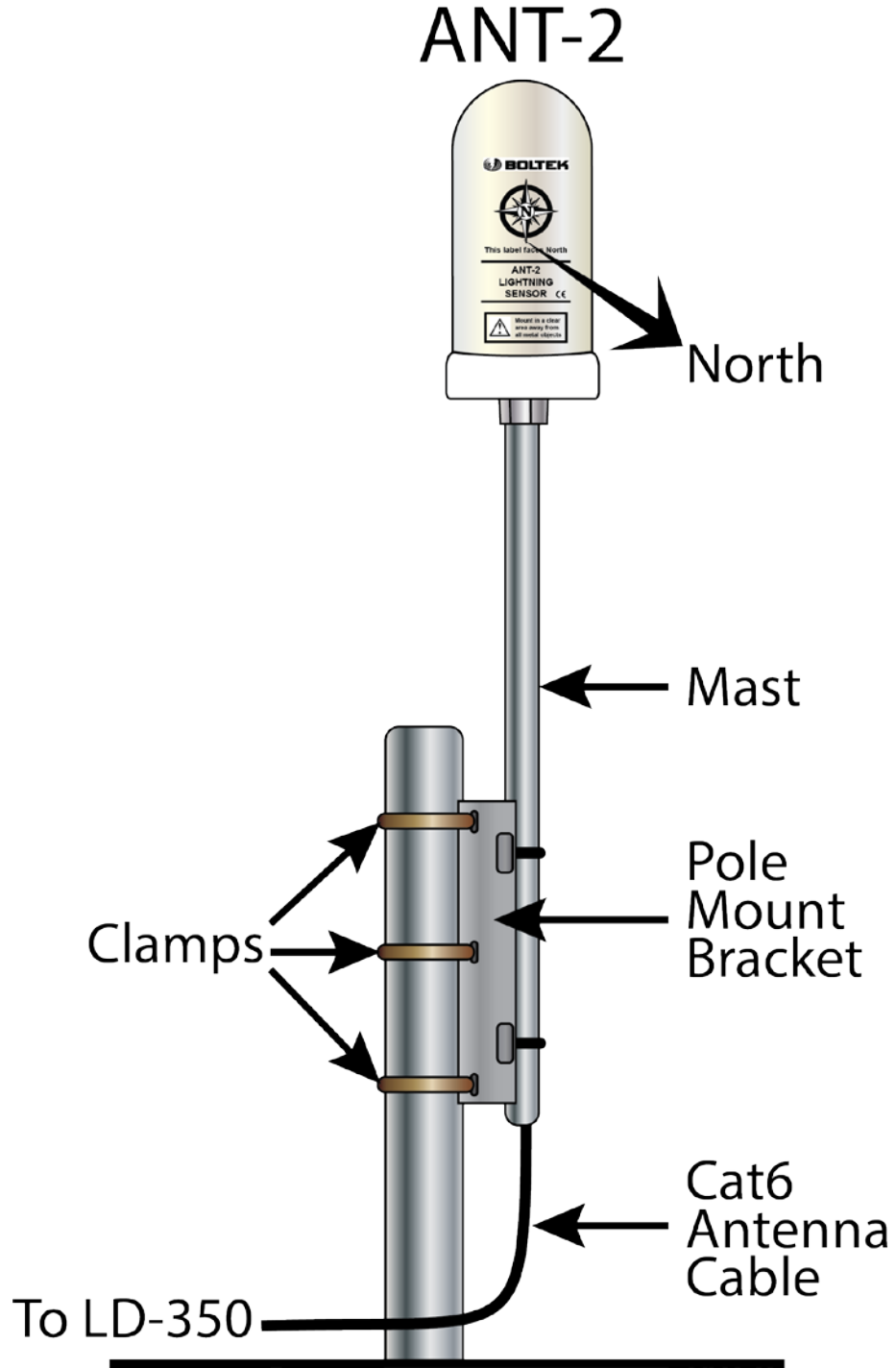
Attaching Cable to ANT-2

First remove the three screws and very carefully remove the white housing from the bottom cover plate.

Insert the cable into the bottom of the mast and push up until the cable comes all the way through to the other end.

Insert the cable connector into the RJ45 connector on the ANT-2.

Re-attach the antenna to the bottom cover plate with the three screws and affix mounting bracket to pole or tripod with three clamps.

Fasten the cable to the wall or support about 6-12" below the antenna. Leave a bit of slack in the cable near the antenna so that there is no strain on the connector from the wire.

If you find the 50' antenna cable provided is not long enough you may purchase a Boltek 50' extension cable. This allows you to locate the antenna up to 100' from your computer.

You may also purchase a replacement cable at any computer store selling network hardware. Any Category 5 cable up to 200 feet will work. See Appendix C for information on making your own antenna cable.

ANT-2 shown with pole mount installation

ANT-2 shown with tripod installation

USB Drivers

The USB drivers will create two USB controllers for your computer. Once the cable and drivers are installed on your computer the extra controllers will show up on your System Device Manager as LD-350 Lightning Detector A & LD-350 Lightning Detector B.
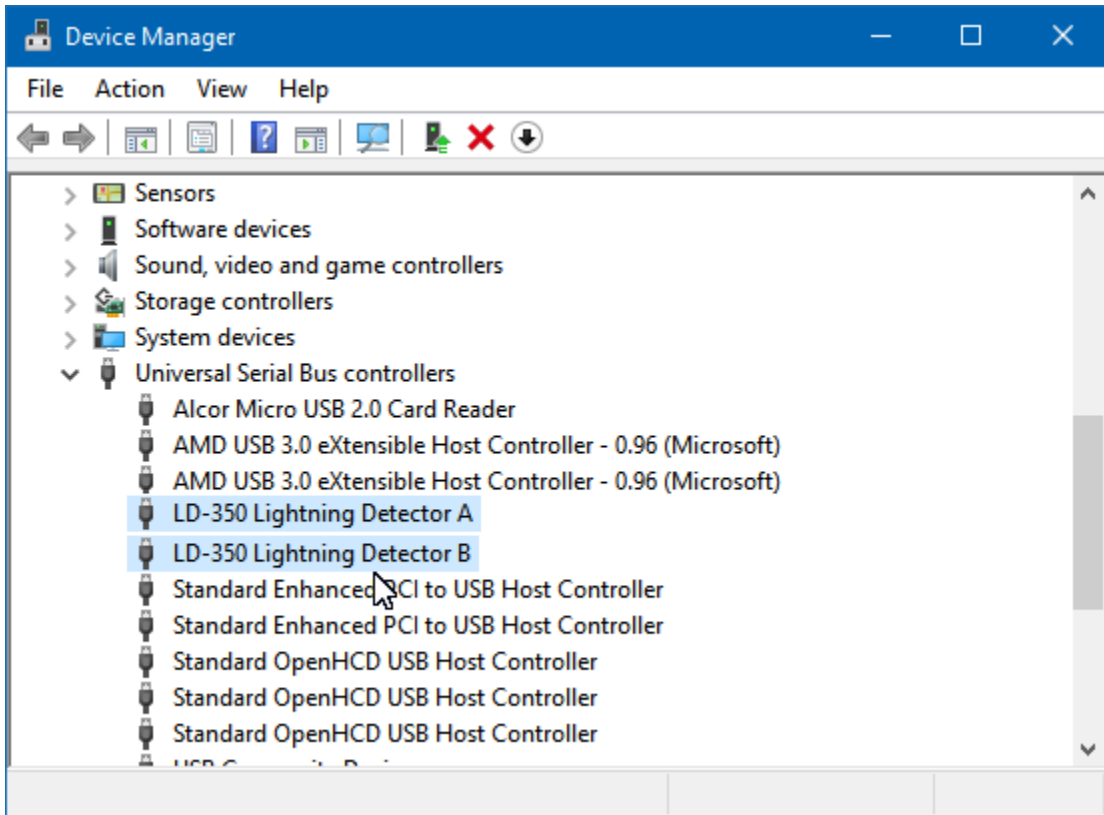
Installing the LD-350 USB Device Drivers:

With your computer and LD-350 turned on, plug the USB adapter cable into a spare USB port on your computer or hub. USB devices may be plugged and unplugged with the power on.

Windows will detect the new device and will automatically install the device drivers if you have an active internet connection. If there is no internet connection, the USB driver install program can be found on the Boltek USB drive under:**\LD350\USB_DRIVER**.

Stand Alone Operation

The LD-350 can also be used as a stand-alone lightning detector with or without the need of a computer. When used with a computer, a real-time lightning display will plot strike locations, and provide relevant strike information and display and sound any alarms set in the software. Alternatively, with the LD-350 not connected to a computer, the indicators and internal beeper can be monitored for approaching storms to determine incoming lightning. It can initially be connected to a computer to change the default alarm values, and squelch level if they aren't suitable.

Front Panel Controls
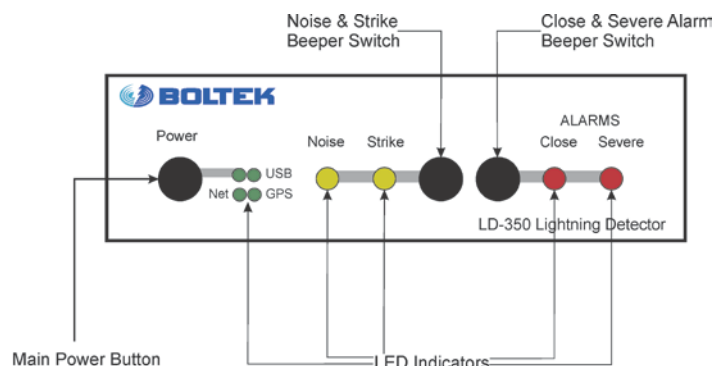
Main Power Button
The main power button disconnects 12V power from the LD-350, the antenna, the USB connector, and the LTS-3 connector (if option installed) on the rear of the LD-350.

Note: Lightning Display software will need to be started/restarted **after** the LD-350 is powered on, or if there are any power interruptions to the LD-350 during use as strikes may not display on the screen as they are detected.

Main Power Indicator
The power indicator illuminates to indicate 12V power is present at the LD-350. If the indicator does not light when the unit is turned on check your 12V power source.

USB Indicator
The USB indicator illuminates when the USB cable is connected from the LD-350 to a computer, and flashes as data is transmitted between the LD-350 and the computer.

Net Indicator
The Net indicator illuminates when the LD-350 is connected to the Boltek Lightning Network with the optional LTS-3 timestamp card installed.

GPS Indicator
The GPS indicator illuminates when the optional LTS-3 timestamp card is installed, and the LD-350 is connected to a Timestamp GPS receiver.

Strike Indicator
The Strike Indicator emits a short flash when a lightning strike is detected. If the Strike Tone Button is pressed the detector also emits a short beep.

Noise Indicator
The Strike Indicator emits a short flash when a noise signal is detected. If the Strike Tone Button is pressed and Noise Beeps have been turned on in software the detector will also emits a short beep.

Noise & Strike Beeper Switch
The Noise & Strike Beeper Switch located on the right side of the Strike indicator when pushed in, will enable the internal beeper to sound a short beep when a strike or noise is detected. The internal beeper is disabled for noise and strikes when the button is pushed out.

Close & Severe Beeper Switch
The Close & Severe Beeper Switch located on the left side of the Close indicator when pushed in, will enable the internal beeper to sound a long beep when either the Close Storm alarm or Severe Storm alarm is activated. The internal beeper is disabled for the two alarms when the button is pushed out.
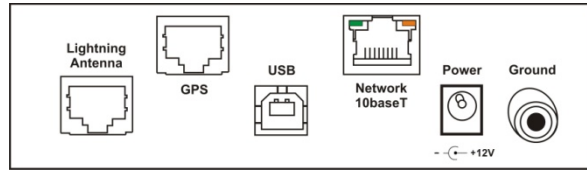
Close Storm Indicator
The Close Storm Indicator illuminates when a strike signal is detected within the user specified close storm range set in the software.

Severe Storm Indicator
The Severe Storm Indicator illuminates when the strikes per minute that are detected exceed the rate specified by the user set in the software.

Rear Panel Connectors

Lightning Antenna
Connect the supplied Antenna cable (standard Cat5e) from the antenna to this connector.

GPS
If the optional LTS-3 Timestamp card is installed, the RJ45 connector end from the GPS cable connects here. The other end of the cable will have a round metal connector that attaches to the GPS receiver.

USB
Connect the provided USB cable here and attach other end to an available USB port on a Laptop or PC. This connection is needed to display lightning strikes on the NexStorm or Lightning/2000 software.

Network 10baseT
 Used for connecting the LD-350 to a LAN hub or router when optional LTS-3 Timestamp card is installed. This port transmits data to a lightning detection network server for higher accuracy strike location when used with multiple detectors. The LD-350 is preconfigured to automatically connect to the Boltek Lightning Network if an internet connection is detected. **Note:** This connection is only enabled with the LTS-3 Timestamp Card installed.

Power
Connect supplied 12V DC power supply to this connector

Ground
Connect a grounding wire to a suitable ground point for proper operation and to provide better protection against external electrical noise and interference.

Noise

Noise signals can be either a signal that did not appear to be lightning, or a signal for which the LD-350 could not determine a distance or direction.
Operation noise can come from noisy overhead power lines, or noisy electronic devices.

Receiver Range

LD-350 has a range of about three hundred miles. Occasionally, strong storms farther than 300 miles away may be detected.

The receiver's maximum range will be affected by antenna height. While you can receive storms with the antenna at virtually any height, you will have maximum range with antenna mounted at least 25 feet above ground.

Other factors that could affect range are metal objects located near the antenna. Metal objects can block the radio waves from getting to the antenna, reducing the range. A large steel shed or other metal object nearby could block lightning signals, resulting in reduced range in that direction. Try to mount the antenna as far as possible from large metal objects, preferably above the object.

Lightning Network Operation

Lightning Detection Network Mode

The Lightning Detection Network Mode is automatically enabled when the LTS-3 Timestamp Card is present on the LD-350 Lightning Detector. To determine if the LD-350 is in this mode, the Close and Severe red LEDs will both light up when the Alarm beeper switch is pushed in.

The LTS-3 Timestamp Card is an optional board that plugs directly into your LD-350 to capture the exact time the LD-350 receives the lightning radio signals. Using a high accuracy timing GPS receiver the data is timestamped with an accuracy of hundreds of nanoseconds (billionths of a second).

The LD-350/LTS-3 has the advantage of not requiring a host PC for operation as a lightning network detector. Once configured for the URL or IP address of up to two central servers the LD-350 will automatically maintain the data connection using its built-in Ethernet.

In the usual configuration, data from multiple distributed lightning detectors are sent over the internet to a central server for processing. Once the exact strike location is calculated the data is both stored in a database on the server and sent back over the internet to live display clients. Static and animated lightning maps can also be created for display on a web site.

In order for the Boltek Lightning Detection Network to calculate the location of a strike, it needs to be detected by a minimum of four detectors. It is recommended to have at least five or six which is more ideal in case of missed strike by a detector either due to a power, network or other temporary failure. To provide adequate coverage to an area, it would be ideal to place the detectors in a grid spaced approximately 50-150 miles apart. Those locations should also have reliable internet connections.

Configuration Utility

To modify the settings on the LD-350 without using a Lightning Display software program, the LD-350 Config utility program can be run from **Start -> Programs -> Boltek** and the following window should appear:
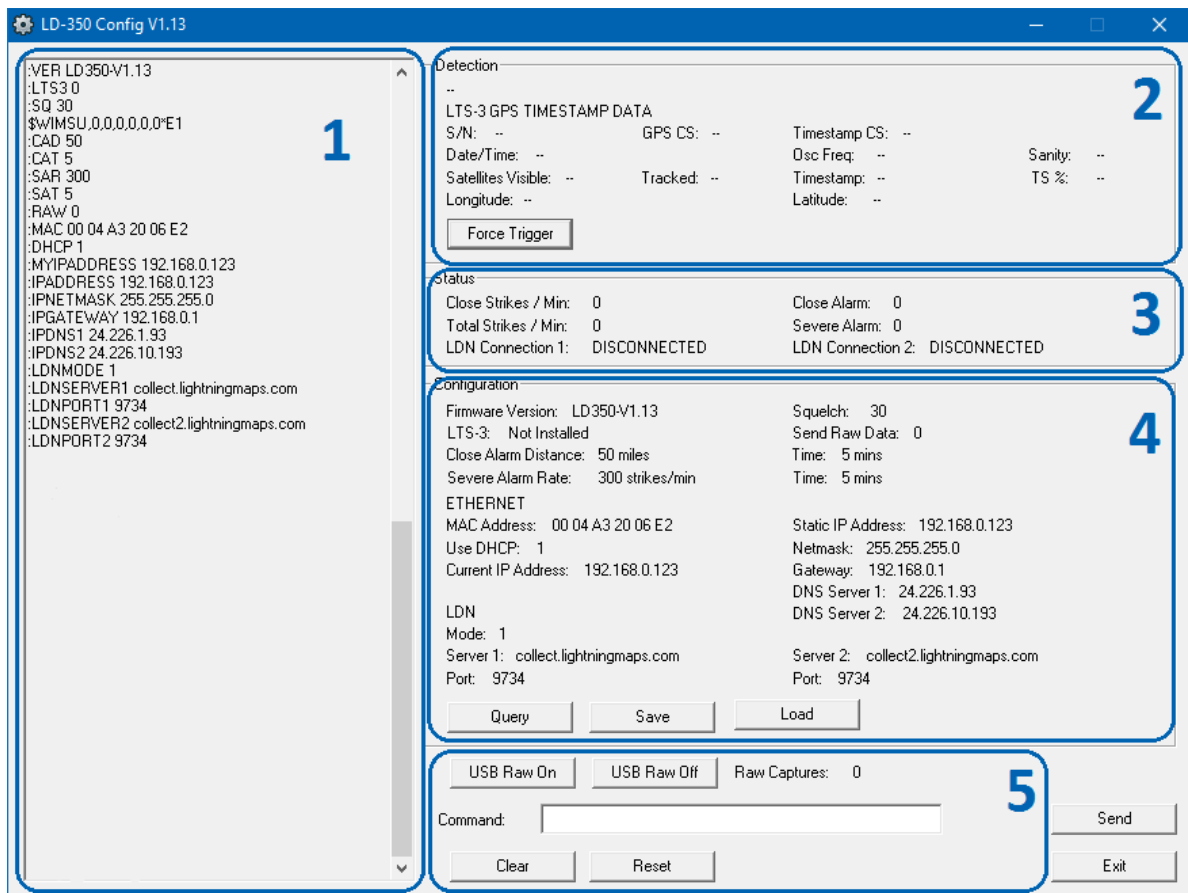
1. **Output Display**

   This window displays status messages, processed lightning strike information, and LD-350 configuration settings. This is a display only and contents cannot be modified here. Status messages will display automatically once per second, strike and noise signals will appear as they are detected. Pressing the **Clear** button will clear this display window.

   Note: Messages will not appear if the LTS-3 timestamp card is installed but can be seen with **'*STATUS*'** command.

2. **Detection**

   Displays GPS Timestamp information when LTS-3 Timestamp is installed on LD-350. This data will only display or update when **USB Raw On** button is pressed and either a signal is detected or the **Force Trigger** button is pressed.

3. **Status**

   When the LD-350 is in Stand-Alone Mode (no LTS-3 Timestamp installed) it will display Close and Severe storm alarm status, as well as the Close Strike and Strike rate strike count. This mode will show LDN connections as DISCONNECTED.

   When the LD-350 is in LDN mode (with LTS-3 Timestamp installed) the alarm status and strike counts are disabled and will only display the connection status of the LDN Servers.

4. **Configuration**

   This section displays the configuration and alarm settings of the LD-350. Press the **Query** button to view the current settings or any updated settings after commands have been entered. The **Save** button should be pressed before the LD-350 is powered off to save any configuration changes. The **Load** button will revert the settings back to the last saved configuration.

5. **Command**

   This box is where the commands are typed. Pressing the **Send** button after typing a command will update the corresponding setting on the LD-350. The commands are case sensitive and should all be capitalized or the settings will not update. See Appendix A for a full list of commands that can be used. The **Reset** button restarts the LD-350, this is mainly used for confirming that any changes to the settings have been saved properly. The **Exit** button will shut down the Config Utility program.

ppendix

A

USB Commands and Messages

Commands

KA<cr> : keeps USB connection alive

VER<cr> : query firmware version

STATUS<cr> : display status message with LTS-3 installed

RESET<cr> : resets LD-350

DEFAULTS<cr> : restores LD-350 to factory default settings

FT<cr> : sends a forced trigger signal to LD-350

RAW<cr> : query raw data state
RAW <0,1><cr> : disable (0) or enable (1) raw data to be sent through USB

NB<cr> : query noise beep state
NB<0,1><cr> : disable (0) or enable (1) noise beeps when signal is detected

SQ<cr> : query squelch level
SQ<value 0-100><cr> : set squelch level

CAD<cr> : query close alarm distance
CAD<distance 0-250><cr> : set close alarm distance

SAR<cr> : query severe alarm rate
SAR<0-999><cr> : set severe alarm rate

SAVE<cr> : saves current configuration to LD-350
READ<cr> : reads current LD-350 configuration

LDNSERVER1<cr> : query LDN server 1
LDNSERVER1 <URL or IP address><cr> : set address of LDN server 1

LDNPORT1<cr> : query LDN server 1 port
LDNPORT1 <port number><cr> : set LDN server 1 port number

LDNPASSWORD1 <password><cr> : set password of LDN server 1

D1<cr> : Disconnect LDN server 1

LDNSERVER2<cr> : query LDN server 2
LDNSERVER2 <URL or IP address><cr> : set address of LDN server 2

LDNPORT2<cr> : query LDN server 2 port
LDNPORT2 <port number><cr> : set LDN server 2 port number

LDNPASSWORD2 <password><cr> : set password of LDN server 2

D2<cr> : Disconnect LDN server 2

MAC<cr> : query MAC address

DHCP<cr> : query DHCP state
DHCP <0,1><cr> : set DHCP off (0) or on (1)

MYIPADDRESS<cr> : query current IP address of LD-350 (could be dhcp assigned)

Note: the following commands should be used when DHCP is set to 0

IPADDRESS <cr> : query static IP address of LD-350
IPADDRESS <xxx.xxx.xxx.xxx><cr> : set IP address of LD-350

IPNETMASK<cr> : query subnet mask
IPNETMASK <xxx.xxx.xxx.xxx><cr> : set subnet mask

IPGATEWAY<cr> : query gateway address
IPGATEWAY <xxx.xxx.xxx.xxx><cr> : set gateway IP address

IPDNS1<cr>: query DNS server 1
IPDNS1<xxx.xxx.xxx.xxx><cr> : set DNS server 1 address

IPDNS2<cr> : query DNS server 2
IPDNS2 <xxx.xxx.xxx.xxx><cr> : set DNS server 2 address

USB Messages

Strike Sentence

$WIMLI,<ddd>,<uuu>,<bbb.b>*<cs><cr><lf>

<ddd> - corrected strike distance 0-300 miles
<uuu> - uncorrected strike distance 0-300 miles
<bbb.b> - bearing to strike 000.0-359.9 degrees
<cs> - checksum in hex
<cr> - carriage return
<lf> - line feed

Noise Sentence

$WIMLN*<cs><cr><lf>

<cs> - checksum in hex
<cr> - carriage return
<lf> - line feed

Status Sentence

$WIMSU,<ccc>,<sss>,<ca>,<sa>,<ldns1>,<ldns2>,*<cs><cr><lf>

<ccc> - close strike rate 0-999 strikes/minute
<sss> - total strike rate 0-999 strikes/minute
<ca> - close alarm status (0: not active, 1: active)
<sa> - severe alarm status (0: not active, 1: active)
<ldns1> - lightning network 1 connection state
<ldns2> - lightning network 2 connection state
<cs> - checksum in hex
<cr> - carriage return
<lf> - line feed

Making an Antenna Cable

The LD-350 uses standard Category 5 (Cat5) 10baseT network cable for the antenna cable. You can purchase a replacement antenna cable from any computer store selling network hardware. Antenna cables may be up to 200 feet long.
If you have access to a crimper for RJ-45 connectors and a source of RJ-45 connectors and Category 5 network cable you can make your own custom antenna cable. Making your own cable means you are able to pull the cable through conduits, walls, etc. before you attach the connectors. This lets you drill smaller holes for the cable and protects the connectors from damage during installation.

If you make your own antenna cable you must ensure that the wire pairing is done correctly. The connectors must not only be wired straight through (non-reversing), but the twisted pairs must be located in the correct positions. If the pairing is not done correctly there will be crosstalk between the different signals on the cable and your unit will not work properly. The correct pair locations are:

Wire position `12345678`
Pair   `33211244`

What this means is: one pair is in the center (positions 4&5), another pair is split and surrounds the first (positions 3&6), another pair is on the left (positions 1&2) and another pair is on the right (positions 7&8).

The actual color positions do not matter as long as you use the same color assignments on both ends, and you split the pairs correctly.

The wire color assignments we use is

POSITION	PAIR	COLOR
1	3	White/Green
2	3	Green
3	2	White/Orange
4	1	Blue
5	1	White/Blue
6	2	Orange
7	4	White/Brown
8	4	Brown

You can have up to 200 feet of antenna cable without using a separate antenna power supply. In special circumstances we have made custom cables up to 500 feet in length that used a separate 12VDC power supply for the antenna.

Do NOT use the pairing: 11223344. That is, wire pairs placed next to each other. This will not work.

Appendix

C

Specifications

LD-350 Hardware Specifications

Power Supply Voltage:	11.8-18 VDC, 0.8 Amp
AC Adapter:	120 VAC, 60Hz (220VAC 50 HZ in Europe)
USB Port:	1.0/2.0 Compatibility
Antenna:	Standard Boltek Lightning Detector Antenna (LD-250/StormTracker compatible)
Antenna Cable:	Standard CAT5 Network Cable. 50 feet included. Custom lengths available on request.
LD-350 Dimensions:	5.0" x 6.5" x 1.5" (127 x 165 x 38 mm)
Antenna Dimensions:	1.5" x 2.0" 3.7" (38 x 51 x 94 mm)
LD-350 Weight:	0.8 lbs (375 gm)
Antenna Weight:	0.45 lbs (200 gm)
Shipping Weight:	5.6 lbs (2.6kg)
Shipping Dimensions:	9.0" x 11.5" x 6.5" (229 x 292 x 165 mm)

Software Specifications

Operating Systems:	Windows 10, 8, 7, Vista, 2000, XP
Display Ranges:	0 to 750 mi (0 to 1200 km)
Severe Storm Alarm Setpoint:	0-999 Strikes / Minute
Close Alarm Setpoint:	0-300 miles