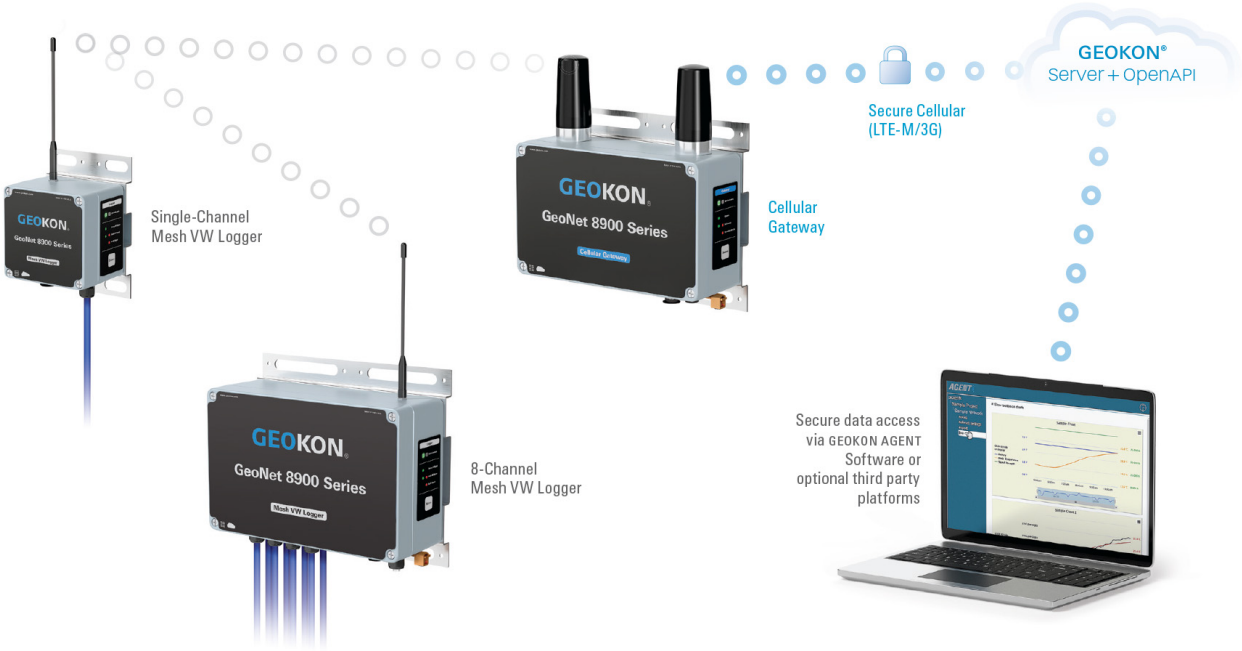
Model 8800, 8900 Series

GeoNet Wireless Mesh

Data Acquisition System

Instruction Manual



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Note: Only Model 8903 Series are CE approved.

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1. INTRODUCTION

The GeoNet Wireless Mesh Data Acquisition system consists of a gateway and subordinate wireless mesh data loggers that transmit data collected from the connected sensors. The gateway controls the network and is the aggregator of all the data from the data loggers in the system.

A local gateway (no cellular or Wi-Fi capabilities) is available for applications where the data is to remain local or a third-party modem or ethernet connection is desired.

The cellular and Wi-Fi gateways transfer the collected data to a secure cloud-based storage platform where it can be accessed through the GEOKON OpenAPI. Industry leading data visualization software, such as the free GEOKON Agent program can be used with the OpenAPI for data viewing and reporting. Commissioning, billing and configuration are accomplished via the easy-to-use GEOKON API Portal. The portal allows users to activate data loggers, change settings, configure sensor channels, and view current data logger status.

The API Portal can be found at api.geokon.com and the GEOKON Agent program can be downloaded at geokon.com/Software.

The system is compatible with most manufacturers' vibrating wire instruments and GEOKON addressable sensor strings (MEMS, VW, and thermistor). Sensor cables are connected through cable glands or 10-pin bulkhead connectors.

Tilt data loggers are also available and combine the functionality of a biaxial tiltmeter and a GeoNet Data Logger.

Model 8960 Digital Vibrating Wire Interfaces can be connected to GeoNet Multi-Channel and Addressable Data Loggers to expand the capacity of the data logger (See Section 4.10).

FEATURES:

- Automated data connection to servers (Cellular and Wi-Fi Gateways)
- Automated calculation of engineering units via Web API integration with the GEOKON database
- Up to 12 networks per area (using unique channels)
- Rugged, die-cast aluminum enclosure with pressure compensation vent to prevent condensation buildup in humid climates.
- USB connector for firmware updates, diagnostics, and more

1.1 8800 MODEL LIST

	Model Number	Description	Network	Sensor Cable Entry
Gateway	8800-*[1]-LTM-USB	Cellular Gateway, USB	Cellular, LTM	Not Applicable
	8800-*-SUP-232	Local Gateway, RS-232	Not Applicable	
	8800-*-SUP-USB	Local Gateway, USB		
	8800-*-WIFI-USB	Wi-Fi Gateway, USB	Wi-Fi	
Data Logger	8800-*-01C-CBL	Single-Channel Vibrating Wire Mesh Data Logger. Rechargeable models are also available.	Mesh/Star Topology to the Gateway	Cable Gland
	8800-*-01C-10P			10-pin
	8800-*-04C-CBL	Four-Channel Vibrating Wire Mesh Data Logger. Rechargeable models are also available.		Cable Gland
	8800-*-04C-10P			10-pin
	8800-*-08C-CBL	Eight-Channel Vibrating Wire Mesh Data Logger. Rechargeable models are also available.		Cable Gland
	8800-*-ADR-CBL	Addressable Mesh Data Logger		Cable Gland
	8800-*-TLT-NAP	Tilt Mesh Data Logger		Not Applicable

TABLE 1: *List of Model 8800 Data Loggers*

Note:

[1] First dash element is based on the installation location designated by country/continent: North America (NA), Australia (AU), Peru (PE), Chile (CL), and Brazil (BZ).

1.2 8900 MODEL LIST

	Model Number	Description	Network	Sensor Cable Entry
Gateway	890*[1]-*[2]-LTM-USB	Cellular Gateway, USB	Cellular, LTM	Not Applicable
	890*-*-SUP-232	Local Gateway, RS-232	Not Applicable	
	890*-*-SUP-USB	Local Gateway, USB		
	890*-*-WIFI-USB	Wi-Fi Gateway, USB	Wi-Fi	
Data Logger	890*-*-01C-CBL	Single-Channel Vibrating Wire Mesh Data Logger. Rechargeable models are also available.	Mesh/Star Topology to the Gateway	Cable Gland
	890*-*-01C-10P			10-pin
	890*-*-04C-CBL	Four-Channel Vibrating Wire Mesh Data Logger. Rechargeable models are also available.		Cable Gland
	890*-*-04C-10P			10-pin
	890*-*-08C-CBL	Eight-Channel Vibrating Wire Mesh Data Logger. Rechargeable models are also available.		Cable Gland
	890*-*-ADR-CBL	Addressable Mesh Data Logger		Cable Gland
	890*-*-TLT-NAP	Tilt Mesh Data Logger		Not Applicable

TABLE 2: *List of Model 8900 Data Loggers*

Note:

[1] Model Number will differ depending on the installation location designated by country/continent.

North America and Brazil: 8901
Europe: 8903

[2] First dash element is based on the installation location designated by country/continent: North America (NA), Europe (EU), Brazil (BZ)

1.3 INCLUDED ACCESSORIES

GeoNet Product Line	Part Number	Description	Quantity
Network (LTM or WIFI) Gateways	CHG-11	GeoNet Charger Kit, including: AC-DC power supply with barrel jack and multi-country AC adapter kit.	1
	COM-169	USB 2.0 A Male to C Male Cable	1
	ELC-824	Antenna	2
	TLS-111	#3 Phillips Head Screwdriver	1
	TLS-112	3/32" Flat Head Screwdriver	1
Local USB (SUP-USB) Gateways	COM-169	USB 2.0 A Male to C Male Cable	1
	8800-WW Models: ELC-803 8903 Models: ELC-826 All Other Models: ELC-819	Antenna	1
	S-BAT-111	Includes two Alkaline D-Cell Batteries	1
	TLS-111	#3 Phillips Head Screwdriver	1
	TLS-112	3/32" Flat Head Screwdriver	1
Local RS-232 (SUP-232) Gateways	8001-7	USB to RS-232 adapter	1
	B8800-5	Bootloader Cable	1
	COM-108	RS-232 Cable	1
	8800-WW Models: ELC-803 8903 Models: ELC-826 All Other Models: ELC-819	Antenna	1
	TLS-111	#3 Phillips Head Screwdriver	1
	TLS-112	3/32" Flat Head Screwdriver	1
	S-BAT-111	Includes two Alkaline D-Cell Batteries	1
Data Loggers, Non-Rechargeable Models	8903 Models: ELC-826 All other Models: ELC-819	Antenna	1
	S-BAT-111	Includes two Alkaline D-Cell Batteries	1
Data Loggers, Rechargeable Models (CHG)	8903 Models: ELC-826 All other Models: ELC-819	Antenna	1

TABLE 3: *List of Included Accessories by GeoNet Product Line*

1.4 ADDITIONAL ACCESSORIES (NOT INCLUDED)

Accessory Application	Part Number	Description
12 Volt Battery Conversion	8020-7-1	Solar Panel, 20-watt, regulated. For use with a 12V battery (customer supplied). Includes side-of-pole mounts, charge controller, and 4.5 m (15') interconnect cable with battery clips. Compatible with any gateway, data logger, or the cellular/ethernet add on module.
	8800-7 or -7V	External 12V battery conversion cable, 3 m (10') length. Used with Local (SUP) gateways and Data Loggers. Varied cable lengths are available (-7V model).
	8800-7B or -7BV	External 12V battery conversion cable, 3 m (10') length. Used with Network (LTM or WIFI) gateways. Varied cable lengths are available (-7BV model).
Cellular / Ethernet Modem Module Capability	8020-7-2	Solar Panel, 20-watt, Regulated, with side-of-pole mounts, charge controller, and 4.5 m (15') interconnect cable with connector, for GeoNet cellular or ethernet modem modules.
	8800-2-4A	Cellular Modem Option for GeoNet Local (SUP) Gateway, comprising of 12V 14Ah Lead Acid Battery, Modem Mounting Bracket, coax cable to SMA bulkhead, AC Charger, whip antenna, and a 1.2 m (4') interface cable, mounted in a rugged, fiberglass enclosure. **Note:** Modem, and modem power cable not included.
	8800-2-4B	Ethernet Option for GeoNet Local (SUP) Gateway, comprising 12V 14Ah Lead Acid Battery, RS-232 Serial Device Server, RJ45 Ethernet Bulkhead, AC Charger, and a 1.2 m (4') interface cable, mounted in a rugged, fiberglass enclosure.
Other	8900-SOL-10W-BRJ	10 Watt solar panel, for use with Network (LTM or WIFI) gateways.
	BAT-202	Includes **one** Lithium D-Cell battery, 1 Ah (Two batteries are required for operation)
	KIT-GEONET-C, including: COM-169 TLS-111 TLS-112	**Accessory Kit, including:** USB 2.0 A Male to C Male Cable #3 Phillips Head Screwdriver 3/32" Flat Head Screwdriver
	KIT-GEONET (For Legacy Products), including: COM-166 TLS-111 TLS-112	**Accessory Kit for Legacy Products, including:** Mini USB to STD A Cable #3 Phillips Head Screwdriver 3/32" Flat Head Screwdriver

TABLE 4: *Additional Accessories (Not Included)*

2. MODELS

2.1 GATEWAYS

Gateways control the network and are the central collection point for all data recorded by the data loggers.The gateway contains internal sensors for battery, temperature, signal strength, etc. gateways do not possess sensor-reading functionality; external sensors cannot be connected to a gateway.

2.1.1 CELLULAR AND WI-FI GATEWAYS

The cellular gateway transfers collected data to the GEOKON Cloud data storage platform via an LTM cellular network. (GeoNet Cellular Gateways are compatible with all major networks except Verizon.)

The Wi-Fi gateway transfers collected data to the GEOKON Cloud data storage platform via a Wi-Fi network.

Users can activate and deactivate the cellular/Wi-Fi data transmission online via the GEOKON API Portal at api.geokon.com.



FIGURE 1: *Cellular Gateway, Wi-Fi Gateway Not Shown*

2.1.2 LOCAL GATEWAY

Local gateways do not transfer collected data to the GEOKON Cloud data storage platform. Data must be collected on site by connecting a PC to the unit via an RS-232 or USB cable depending on model.



FIGURE 2: *Local Gateway*

2.2 WIRELESS MESH DATA LOGGERS

Wireless mesh data loggers collect data from connected sensors, then transmits this data to a gateway.

2.2.1 SINGLE-CHANNEL VIBRATING WIRE DATA LOGGER

Single-channel vibrating wire data loggers will read one GEOKON vibrating wire gauge and integral thermistor. Sensor cables are connected through a cable gland or a 10-pin bulkhead connector, depending on the model.



FIGURE 3: *Single-Channel Data Logger*

2.2.2 FOUR-CHANNEL VIBRATING WIRE DATA LOGGER

Four-channel vibrating wire data loggers will read up to four GEOKON vibrating wire gauges and integral thermistors. Sensor cables are connected through a cable gland or a 10-pin bulkhead connector, depending on the model.



FIGURE 4: *Four-Channel Data Logger*

A four-channel data logger can be configured as follows:

Maximum Number of Gauges	Maximum Number of Load Cells
Four	One 3-gauge **or** one 4-gauge load cell *Refer to Appendix K for load cell wiring tables*

TABLE 5: *Four-Channel Data Logger Gauge/Load Limits*

2.2.3 EIGHT-CHANNEL VIBRATING WIRE DATA LOGGER

Eight-channel vibrating wire data loggers will read up to eight GEOKON vibrating wire gauges and integral thermistors. Sensor cables are connected through a cable gland.



FIGURE 5: *Eight-Channel Data Logger*

An eight-channel data logger can be configured as follows:

Maximum Number of Gauges	Maximum Number of Load Cells
Eight	One 3-gauge **and** one 4-gauge load cell Two 3-gauge **or** two 4-gauge load cells One 6-gauge load cell *Refer to Appendix K for load cell wiring tables*

TABLE 6: *Eight-Channel Data Logger Gauge/Load Limits*

2.2.4 ADDRESSABLE (RS-485) DATA LOGGER

Addressable data loggers are compatible with GEOKON digital addressable MEMS products. Sensor cables are connected through a cable gland.



FIGURE 6: *Addressable Data Logger*

2.2.5 TILT DATA LOGGER

Tilt data loggers contain an integrated tiltmeter sensor. The two axes of the tiltmeter have a range of ±90° (the calibrated range is ±30°), based on a starting position of 0° (antenna pointing up).

Note: Tilt data loggers do not possess sensor-reading functionality; external sensors cannot be connected.



FIGURE 7: *Tilt Data Logger*

Tilt data loggers have two serial numbers, the tilt data logger serial number is the upper number, and serial number for the internal tiltmeter is the lower number. See the figure below.

Note: Tilt data logger serial numbers greater than 2047508 provide calibrated output and do not require post processing.

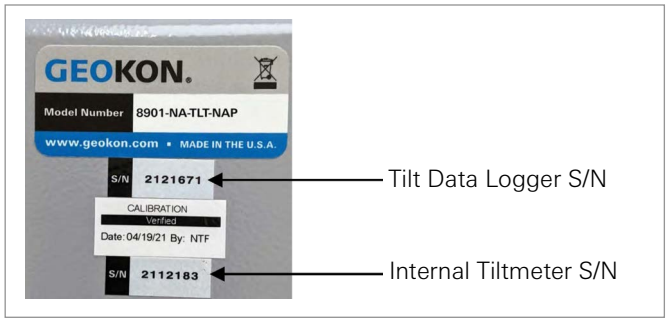


FIGURE 8: *Tilt Data Loggers Serial Number Placement*

3. NETWORK TOPOLOGY

Many networks use a star topology, where all data loggers can send data directly to the Gateway. Other networks use a mesh topology, in which data loggers will relay data from any data logger that might be blocked, or out of range from the Gateway.

GeoNet networks are self-healing. This means that GeoNet will switch to a mesh topology so that data loggers will automatically relay data from troubled data loggers to the Gateway, if needed.

GeoNet networks are self-configuring, meaning that the switch from a star topology to a mesh topology is automatic, and the data loggers will determine for themselves which will relay data to the Gateway.

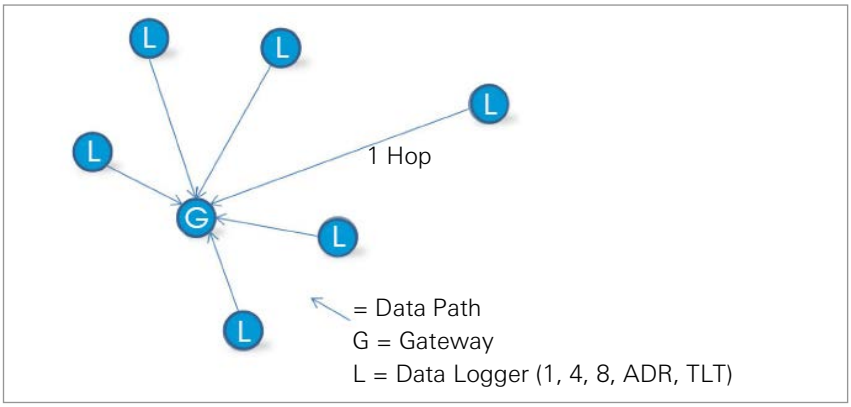


FIGURE 9: *Star Network Topology*

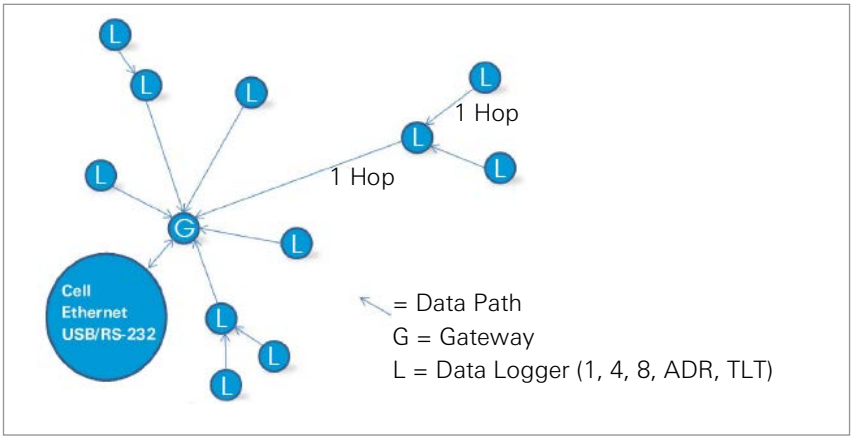


FIGURE 10: *Mesh Network Topology*

Each transmission from data logger to gateway or data logger to data logger is considered one "hop". Examples of hops are shown in the figures above and below. Up to four hops can be made between a data logger and the gateway. With the ability to hop comes the ability for the gateway to communicate with data loggers that have not established direct radio contact. GeoNet devices can operate around buildings or other barriers using hops.

If isolated from the rest of the network, a data logger will continue to sample and store data. When communication is reestablished, it will "catch up" by sending all collected data to the gateway.

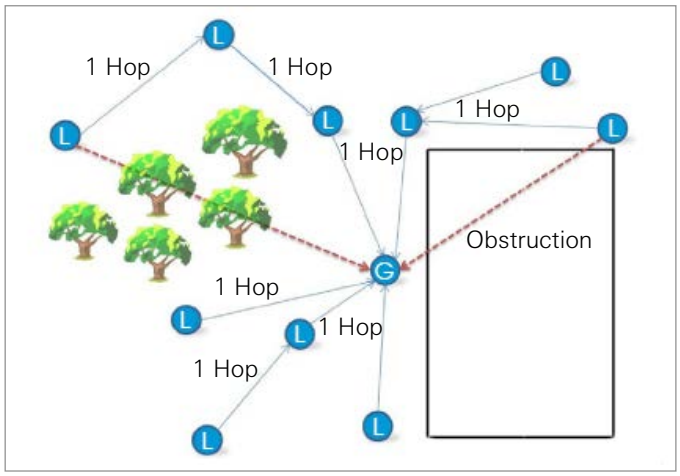


FIGURE 11: *Working Around Obstructions via Hops*

Fresnel zone is the geographic area between the sending antenna and the receiving antenna. Objects in the Fresnel zone can cause reflections of the transmitted signal. When these reflections arrive at the receiving antenna, they may be out of phase with the signal that took a straight-line path, and this can weaken the straight-line signal.

For optimum performance, GEOKON recommends creating as much vertical space as possible between the straight-line path and obstacles, including the ground.

The Fresnel zone must be at least 60% obstruction-free to ensure optimal wireless communication. The figure below illustrates the Fresnel zone.

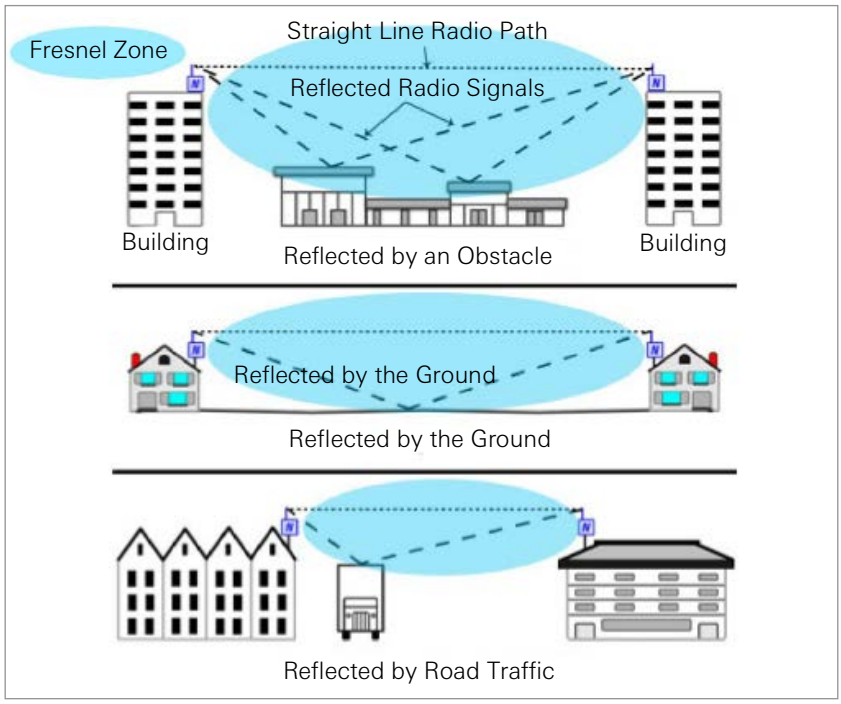


FIGURE 12: *Fresnel Zone*

Caution! To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 20 cm (7.9") or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

4. INSTALLATION

4.1 DEPLOYMENT MODE

There are two modes of network operation: Deployment mode and Normal mode. Deployment mode allows data loggers to be quickly added to a network and verified. Deployment mode must be used when setting up a network or making changes (adding data loggers, changing batteries, resetting a device, etc.)

Deployment mode is automatically activated when a gateway is powered on, reset, or the status button is pressed. When the network is in Deployment mode, the network status will be indicated by the LEDs on the gateway approximately every 10-15 seconds (see Section 4.2 for more information). By default, the network will stay in deployment mode for 60 minutes. When a new data logger joins the network the timer will reset, extending the deployment period for another hour. If more time is needed while deploying data loggers, the default deployment timeout may be changed using Agent software.

Caution! DO NOT power off or remove the gateway from a working network unless it is in Deployment mode.

4.2 STATUS BUTTON & LED STATUS INDICATORS

All GeoNet devices have red and green LED indicators to display their status. A reference key is printed on the side of each unit, below the LEDs. When pressed, the status button triggers the appropriate LED indicators to briefly illuminate.

The table below shows the meaning of the various LED indications.

LEDs		Gateway	Data Loggers
Green		Time set, Data Loggers present	Good radio signal (>30%)
Green	Red	Time set, no Data Loggers present	Marginal radio signal (>30%)
	Red	Network time not set	No radio signal

TABLE 7: *LED Indicator Meaning*

When the status button is pressed on the gateway, the LEDs briefly display the network status. If the network is in Deployment mode when the button is pressed, the Deployment mode timer will reset. If the network is not in Deployment mode, it will enter Deployment mode on the following radio cycle. This could take up to six minutes, as changes to the radio settings can only occur when all the radios in the network are awake. To provide timely feedback to the user, the network parameters are set to a 10-second radio interval while the gateway is in Deployment mode.

When the status button is pressed on a data logger, the LEDs briefly display the radio signal status. The data logger will indicate the status of the radio signal after each radio transmission for a period of 10 minutes. If a data logger has not yet joined the network, it will change its radio interval to approximately one second and search for an available network.

Device	Status Button Action	Function
Gateway or Data Logger	Press and hold until both LEDs illuminate (approximately 10 seconds)	✓ Reset the device
Gateway	Press and release	✓ Put the network into Deployment mode/extend Deployment mode ✓ Take a reading and send existing data immediately ✓ Display device status
Data Logger	Press and release	✓ Display the current status ✓ Indicate signal strength every radio cycle for 10 minutes

TABLE 8: *Status Button Functions*

4.3 INSTALLATION OVERVIEW

GEOKON recommends that you configure your network with the devices at the same location, in close proximity to each other, before you deploy them to their respective on-site positions.

Skipping or omitting steps, or performing them out of order, could complicate the installation of your network.

A general overview of the installation is shown in the steps below. Each step is described in detail in the sections that follow.

1. Remove the covers
2. Install the antennas
3. Configure the channels (if necessary)
4. Power the gateway
5. Set the network time
6. Seal the gateway
7. Expanding data logger capacity (optional)
8. Power the data loggers
9. Network configuration
10. Mount the devices
11. Connect an earth ground
12. Connect the sensors
13. Seal the data loggers
14. Connect to a Wi-fi network (Wi-fi gateways only)
15. Commission (activate) the data logger

4.4 REMOVE THE COVERS

Remove the covers from all devices in the network by unscrewing the four captive screws on the front of the enclosure.

Note: Ensure that no dirt, water, or other contaminants enter the enclosure.

4.5 INSTALL THE ANTENNAS

Remove the rubber caps from the antenna mounts. Position the antennas on the mounts and then rotate the antennas in a clockwise direction until tightened.

Note: Do not cross thread the antenna. The O-ring on the bottom of the cellular/Wi-Fi gateway antennae must be flush with the enclosure to prevent water entry.

4.6 CONFIGURE THE CHANNELS (IF NECESSARY)

Important! All GeoNet devices are set to operate on the same channel at the factory. Channels only need to be configured if multiple networks will be operating within radio range of one another.

If multiple networks are within radio range of each other, then each network (up to a limit of 13) must be configured to use a different channel. Devices of each network must be set to their respective channel.

Move the channel select DIP switches (shown in the figure below) to any of the twelve valid positions listed in the table below. The setting will take effect at power-up, or after the device is reset.

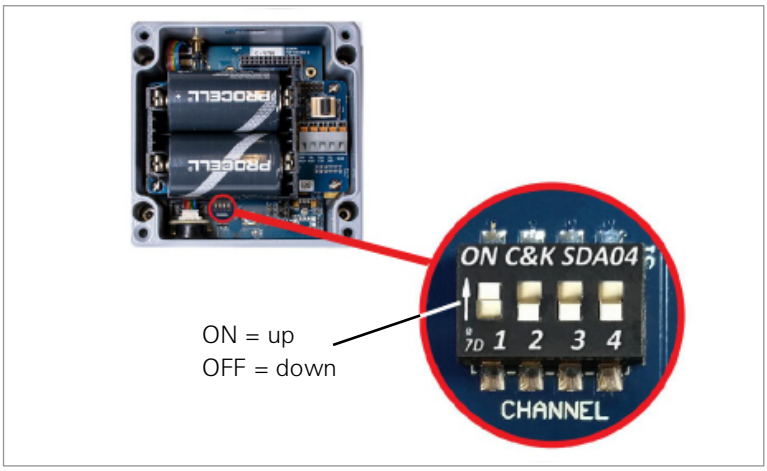


FIGURE 13: *Channel Select Switches*

Channel	1	2	3	4
1	OFF (down)	OFF	OFF	OFF
2	ON (up)	OFF	OFF	OFF
3	OFF	ON	OFF	OFF
4	ON	ON	OFF	OFF
5	OFF	OFF	ON	OFF
6	ON	OFF	ON	OFF
7	OFF	ON	ON	OFF
8	ON	ON	ON	OFF
9	OFF	OFF	OFF	ON
10	ON	OFF	OFF	ON
11	OFF	ON	OFF	ON
12	ON	ON	OFF	ON
13*	OFF	OFF	ON	ON
*Sensemetrics / Worldsensing Thread compatibility mode, not for use with GEOKON Gateways.				

TABLE 9: *Channel Selection*

4.7 POWER THE GATEWAY

For ease of installation, it is highly recommended that the gateway be powered before any of the data loggers.

4.7.1 CELLULAR AND WI-FI GATEWAYS

Connect the AC adaptor, solar panel, or other external power source. (Though equipped with an internal battery, cellular and Wi-Fi gateways must have an external power source.)

Move the battery switch (Figure 14) to the EXT BATTERY or INT BATTERY position, according to the chart below. (The battery switch is located on the battery board inside the enclosure.) The green LED on the right side of the box will flash twice, indicating the unit has power.

	Geographic Zone	
Power Source	Sub Polar	Temperate
Mains or solar with external battery	EXT BATTERY	INT BATTERY
Solar without external battery	N/A	

TABLE 10: *Cellular/Wi-Fi Gateway Battery Switch*

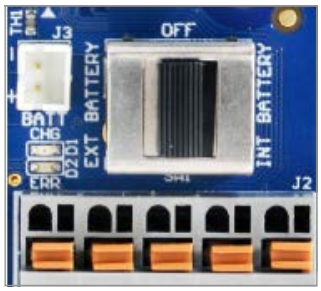


FIGURE 14: *Cellular/Wi-Fi Gateway Battery Switch*

4.7.2 LOCAL GATEWAYS

Align the positive (+) side of the batteries with the + indicator in the battery holder. Push the batteries straight down into the holder.

Move the battery switch (Figure 15) to either the ALKALINE or LITHIUM position depending on the type of battery being used. (The battery switch is located on the battery board inside the enclosure.) The green LED on the right side of the box will flash twice, indicating the unit has power.

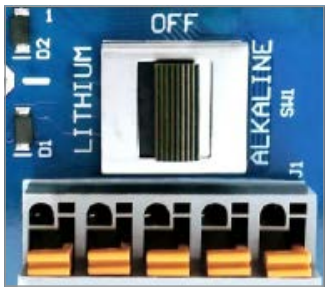


FIGURE 15: *Local Gateway Battery Switch*

4.8 SET THE NETWORK TIME

4.8.1 CELLULAR AND WI-FI GATEWAYS

Cellular and Wi-Fi gateways will set the network time automatically when they connect to the network.* Verify the network connection has been made by pressing the status button. The LEDs should flash both green and red. If only the red LED flashes, wait several minutes and then check again.

Note: *GeoNet Cellular Gateways are compatible with all major networks except Verizon.

4.8.2 LOCAL GATEWAYS

Connect the local gateway to a computer using the supplied USB cable or RS-232 cable. Open Agent software and set the network time.

The network will not begin collecting data until the network time is set using Agent software. (For instructions regarding setting up a network in Agent, please read the Agent Software Instruction Manual, geokon.com/8800-GNA.)

Once the network time has been set, press the status button. The LEDs should flash both green and red. If only the red LED flashes the network time has not been set correctly.

4.9 SEAL THE GATEWAY

1. Make sure the cover gasket and the mating ridge on the enclosure are clean and that the gasket is properly seated inside the groove.
2. Place the cover on the unit, making sure the orientation is correct.
3. Tighten the cover screws a little at a time, working in a diagonal pattern.

4. Check that the cover has closed tightly and evenly.
5. Record the serial number of the gateway. (The serial numbers are used for identification purposes in the API portal and Agent software.)

4.10 EXPANDING DATA LOGGER CAPACITY (OPTIONAL)

Model 8960 Digital Vibrating Wire interfaces can be connected to GeoNet multi-channel and addressable data loggers to expand the capacity of the data logger. Multiple VW interfaces can be used to bus the data to a single data logger. The bus limit is 32 units or 64 Channels.

Refer to the Model 8960 Instruction Manual (geokon.com/8960-Series) for information on how to connect a data logger to an interface, how to address the interfaces, and other applicable steps. To get immediate software recognition the interfaces must be connected before the data logger has been powered on.

4.11 POWER THE DATA LOGGERS

For ease of installation, it is recommended that the gateway be powered before any of the data loggers.

If installing a non-rechargeable model, align the positive (**+**) side of the batteries with the **+** indicator in the battery holder. Push the batteries straight down into the holder.

Move the battery switch (Figure 16) into either the ALKALINE or LITHIUM position depending on the type of battery being used. (The battery switch is located on the battery board inside the enclosure.) The green LED on the right side of the box will flash twice, indicating the unit has power.

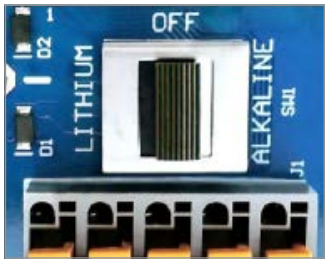


FIGURE 16: *Data Logger Battery Switch*

The data logger will join the network approximately 30 seconds after power up, as indicated by the LED(s) on the data logger flashing in unison with the gateway. If the data logger does not join the network within 30 seconds of power up, the gateway may have left deployment mode (see Section 4.1), or the channel switches have been set incorrectly (see Section 4.6).

Repeat the above procedure with the other data loggers in the network. Verify that the LED indicators on the data loggers and the gateway are flashing green only. This may take several minutes depending on network configuration.

The gateway and data loggers can now be moved to their respective installation sites. Watch the LEDs while moving the data loggers, to ensure the signal isn't lost. (After 10 minutes, the LEDs on the data loggers will stop indicating their status to conserve batteries. Pressing the status button on a data logger will reactivate the LEDs for another 10 minutes.)

4.12 NETWORK CONFIGURATION

It is best practice to place the gateway in a location central to the distribution of the data loggers. This configuration will minimize the number of hops (data relays) required, which will improve battery life. When installing data loggers, start with those closes to the gateway and work outwards (Figure 17).

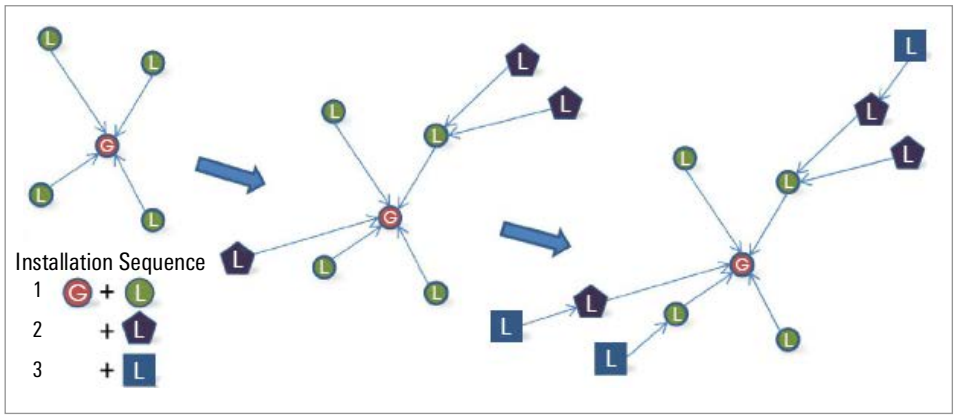


FIGURE 17: *Installation Sequence*

If communication cannot be established when GeoNet is deployed to a site, it may be necessary to elevate the devices or their antennas, or to move them to a location where a radio link can be established. This may require extending the readout cable of the attached sensors, adding an antenna cable extension, or adding additional data loggers to the network. See Appendix A for troubleshooting.

4.13 MOUNT THE DEVICES

GeoNet mounting brackets are designed to be used with U-bolts, hose clamps, screws, etc. Mount all devices vertically, with the antenna pointing up. GEOKON recommends a mounting height of at least two meters. Lower than two meters may compromise performance. As a rule, higher is usually better.

Select the mounting location with care. Certain mounting configurations can hinder or even completely block wireless signal transmission or can introduce electrical noise to the signal. (Large structures, such as walls, buildings, hills, etc. can block and/or reflect RF signals. See Section 3 for more infotmation) Keep in mind that data loggers communicate with each other, not just with the gateway.

Note: A high Received Signal Strength Indicator (RSSI) level does not guarantee trouble-free communication.

Examples of incorrect mounting configurations are shown in the figures below.

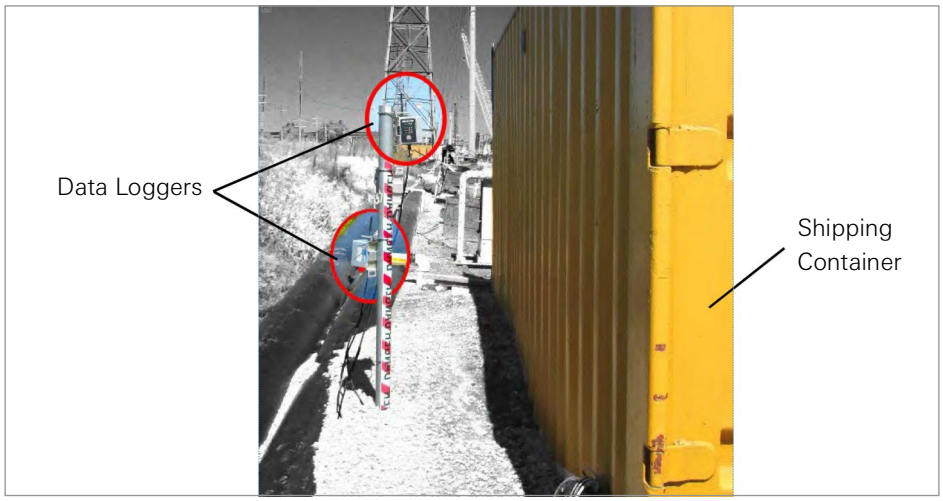


FIGURE 18: *Installing Near a Large or Metallic Object*



FIGURE 19: *Installing Close to Buildings or Fences/Walls, and/or Horizontally*

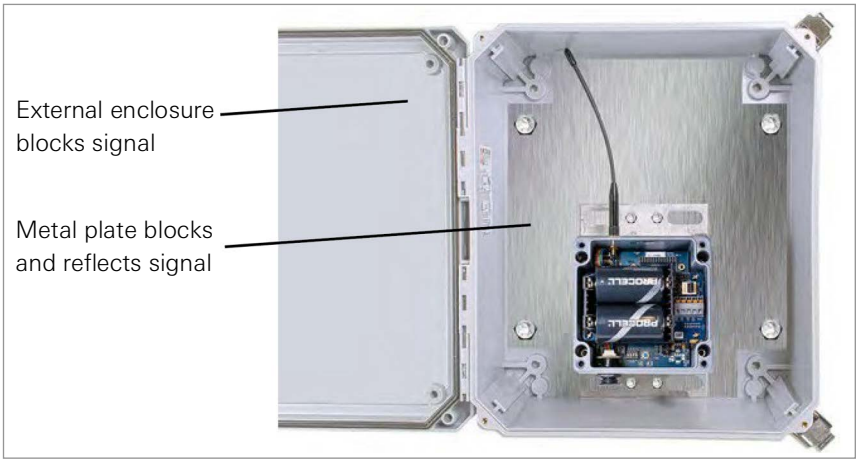


FIGURE 20: *Mounting onto a Metal Plate and/or Inside an Enclosure*

4.14 CONNECT AN EARTH GROUND

Properly grounding GeoNet devices will lessen the chance of them being damaged from nearby lightning strikes or other large transient voltages. Each vibrating wire (VW) channel is protected by a 230V gas discharge tube, followed by a high-speed surge protector and a transient voltage suppression diode. Each thermistor (TH) channel is protected by a 230V gas discharge tube, followed by an inductor (lower resistance than high-speed surge protectors) and a transient voltage suppression diode.

For these components to safely divert lightning energy to ground, a solid electrical connection to earth ground is required. All GeoNet devices can be grounded by connecting a suitable earth ground to the mounting bracket. Some GeoNet devices can also be grounded via the copper ground lug on the bottom of the enclosure.

A copper grounding rod at least six feet in length should be driven into the soil to a minimum depth of three feet, as close to the device as possible. Alternatively, any other suitable earth ground attachment may be used. Connect the grounding rod to the mounting bracket or the copper grounding lug on the exterior of the device with a 12 AWG or larger wire. This will provide a path from the device to earth ground in the event of a lightning strike.

4.15 CONNECT THE SENSORS

Note: Multi-channel and addressable data loggers will stop trying to read an empty channel after two attempts. The data logger will read all channels at the top of every hour and will resume sampling when it detects a sensor. (Reset the data logger to initiate an immediate retry.)

4.15.1 CABLE GLAND CONNECTIONS

For ease of wiring, sensor cables should be inserted into the cable glands on multi-channel data loggers in order from left to right and wired into the VW terminal blocks in sequence, starting with channel one.

To connect a sensor using a cable gland connection:

1. Loosen the nut on the cable fitting and remove the white plastic dowel.
2. Slide the sensor cable through the cable gland nut and fitting.
3. Connect the cable leads to the terminal block by holding down an orange tab, inserting the lead, and then releasing the tab. The wiring order is shown in the tables and figures below.

Important! To prevent a short circuit, do not allow the cable leads to touch each other during or after wiring.

4. Pull gently on each conductor to ensure it is secure.
5. Tighten the cable gland nut until it firmly grips the outer jacket of the cable. The cable gland nut must be properly tightened to prevent water entry. Do not overtighten, as this might strip the plastic threads.
6. Pull gently on the gauge cable to ensure it is held in place by the cable gland.
7. Repeat these steps for each gauge cable to be connected.

Single/Multiple.Channel Vibrating Wire Data Logger		
Position	**Color**	**Description**
VW+	RED	Vibrating Wire+
VW-	BLACK	Vibrating Wire-
TH+	WHITE	Thermistor+
TH-	GREEN	Thermistor-
SHD	BARE	Analog Ground (Shield)

TABLE 11: *Vibrating Wire Data Logger Wiring*

Addressable (RS-485) Data Logger		
Position	**Color**	**Description**
485+	WHITE	RS-485 Data+
485-	GREEN	RS-485 Data-
12V	RED	12 Volt Bus
GND	BLACK	Bus Ground
SHD	BARE	Analog Ground (Shield)

TABLE 12: *Addressable (RS-485) Data Logger Wiring*

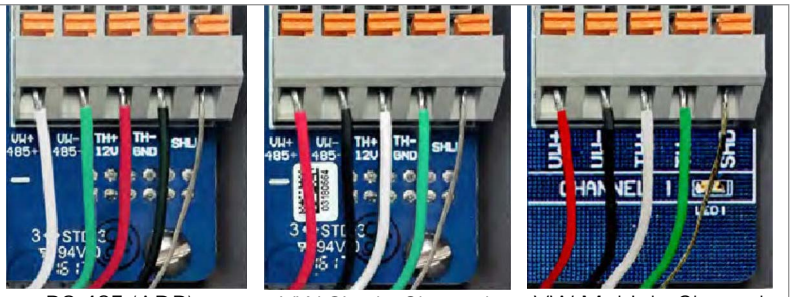


FIGURE 21: *Terminal Connections*

4.15.210-PIN CONNECTIONS

To connect a device using a 10-pin connection:

1. Remove the cover from the 10-pin connector.
2. Align the grooves on the sensor connector (male), with the connector on the data logger (female).
3. Push the connector into place and then twist the outer ring of the male connector until it locks.

4.16 SEAL THE DATA LOGGERS

1. Record the serial number of the data loggers and the attached sensors. For multiple-channel data loggers, also record the channel to which each sensor has been connected. (The serial numbers are used for identification purposes in the API portal and Agent software.)
2. Make sure the cover gasket and the mating ridge on the enclosure are clean and that the gasket is properly seated inside the groove.
3. Place the cover on the unit, making sure the orientation is correct.
4. Tighten the cover screws a little at a time, working in a diagonal pattern.
5. Check that the cover has closed tightly and evenly.

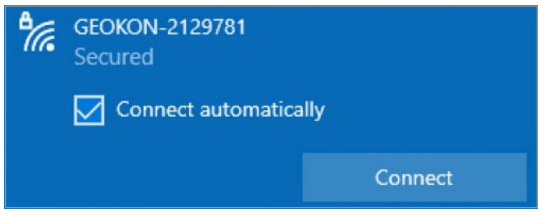
Note: Make sure any unused openings are plugged with the provided dowel and the cable gland nut is tightened.

4.17 CONNECT TO A WI-FI NETWORK (WI-FI GATEWAYS ONLY)

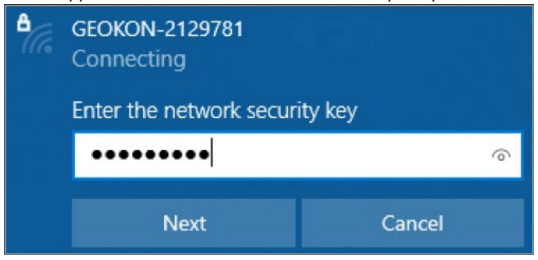
1. Turn on power to the GeoNet Wi-Fi Gateway.
2. Open Wi-Fi settings in Windows.
3. Select Show available networks.



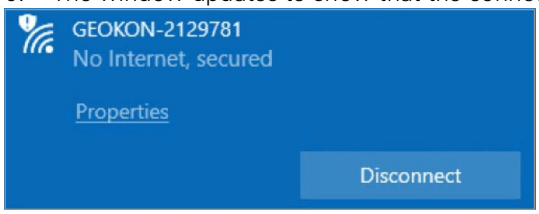
4. Select the network that starts with GEOKON, and then select the Connect button.



5. Type i<3GeoNet for the security key, and select the Next button.



6. The window updates to show that the connection was made.



7. Open a web browser and enter 18.0.1.2 in the window, and then press the Enter key.



8. Enter the name of your Wi-Fi network, and then click Submit.



9. Enter your network password, and then click Submit.



10. A message is shown when the connection is complete.
11. If desired, a static IP address can be set in the GEOKON API portal after commissioning the gateway using the Wi-Fi Configuration.

4.18 COMMISSION (ACTIVATE) THE GATEWAY

Gateways (Cellular and Wi-Fi) are commissioned (activated) using the GEOKON API portal: api.geokon.com.

Make sure all data loggers have joined the network before activating the gateway. If data loggers are added to the network after the gateway has been commissioned, the commissioning process must be repeated.

5. MAINTENANCE

5.1 WEATHER PROOFING

GeoNet devices are designed to be splash proof and rain proof but **are not submersible**. The enclosures are sealed by a gasket. The gasket will only prevent water entry if the screws that hold the lid in place are properly tightened, and the gasket is properly aligned inside the lid.

Always mount the devices so that the cable entries are on the bottom. Ensure the cable gland fittings are securely tightened and that the white plastic dowels provided are used to plug cable entries which are not in use. For models that feature a 10-pin connector, the watertight cap must be installed when the connector is not in use.

Despite these precautions, the data loggers may encounter leakage along the cable if the cable is cut, or if the unit is installed in an especially humid environment.

5.2 BATTERY LIFE

Battery life is affected by the quantity and physical configuration of the data loggers, along with weather conditions and the radio environment (as related to retries).

Data loggers that are the only communication link between other data loggers and the gateway will have a shorter battery life than those that have no routing responsibility.

Table 13 shows an estimate of battery life in a network of fewer than 20 data loggers based on the number of readings collected and forwarded to the gateway. More than 1,000 days of battery life are possible when using a scan rate of one hour or higher, with only one hop. A more frequent scan rate will reduce this estimate. If greater battery life is needed, a 12-volt nominal input is available from GEOKON.

	Alkaline	Lithium
Readings Transmitted	25,000	70,000
Radio Cycles	500,000	1,400,000
Scan Rates (minutes)	**Days**	**Days**
12	208	583
20	347	972
30	521	1458
60	1042	2915

TABLE 13: *Battery Life Estimates*

5.3 REPLACING BATTERIES

The network must be put into deployment mode prior to replacing the batteries in the gateway. This is also best practice when replacing batteries in data loggers.

Replace D cell batteries when their measured voltage drops below 2.0 VDC. Replace external 12-volt batteries when the measured voltage drops below 11 VDC.

All data is retained in nonvolatile flash memory. Data will not be lost even if the batteries are removed for an extended period (e.g., years).

Replace the batteries as follows:

1. Place the network in deployment mode by pressing the status button on the gateway. Within six minutes the green LED will begin flashing every 10 seconds.
2. Open the data logger by unscrewing the four captive screws on the front of the enclosure. Make sure that no dirt, water, or other contaminants are allowed to enter the enclosure.
3. Set the battery select switch to the OFF (middle) position.
4. Remove the existing batteries.

5. Install the new batteries by aligning the positive (+) side of the D cells with the (+) indicator in the battery holder. Push the batteries straight down into the holder.
6. Move the battery select switch to either the Alkaline or Lithium position depending on the type of battery being used. An LED will flash on the right side of the box indicating the unit has power. Once the data logger reconnects to the network, the green LED will blink every 10 seconds in unison with the LED on the gateway.

Note: If replacing the batteries in a network gateway and power is restored promptly, the gateway will remain active. If power is not restored promptly the network time will be lost and must be reset using the Agent software. The data loggers within the network will reconnect automatically.

6. MODEL 8800-2-4B ADD-ON MODULE

6.1 INTRODUCTION

Model 8800-2-4B (Ethernet compatibility) is an add-on module for the gateway to allow the end user to easily add remote communications and data download functionality. Each module comprises a weatherproof enclosure 305 x 254 x 152 mm (12" x 10" x 6") in size, a 7 amp hour rechargeable battery, a charger, and the necessary cables to interface with a GeoNet Gateway.

When an add-on module is paired with a gateway, the gateway is powered by the rechargeable battery inside the module. The charge level of the battery can be monitored using Agent software.

6.2 INSTALLATION OVERVIEW

Modules are shipped with the batteries uninstalled and the fuse distribution board switch in the OFF position. To deploy modules, install the batteries and set the switch to the ON position. Use the provided black 10-pin to 10-pin connecting cable to connect the module to the gateway.

D-cell batteries should still be installed in the gateway, and the battery switch set to the appropriate position (see Section 4.7), so that if the module battery is depleted, the communication between the gateway and the data loggers will not be interrupted.

6.3 IP ADDRESS CONFIGURATION

GEOKON sets the module to communicate with a GeoNet Gateway; however, the user must finish the setup so that it works with their network. Configure an IP address by following the instructions below.

The following steps should only be performed by your network administrator. NPort Administrator software (available at geokon.com/Software) should be installed and used to configure the required IP changes.

Note:

1. Connect a PC to the onsite network. Connect the ethernet module to the network as the PC. (Connecting the ethernet module directly to a PC is not recommended because the IP address of the module rarely matches the IP address of the computer.)
2. Open NPort Administrator and click Search. (By default, the MOXA 5110A IP Address 192.168.127.254 will be displayed.)
3. Double-click on the IP Address under the configuration window.
4. In the configuration window, click on the Network tab.
5. Check the boxes next to **Modify IP address** and **Modify Netmask**.

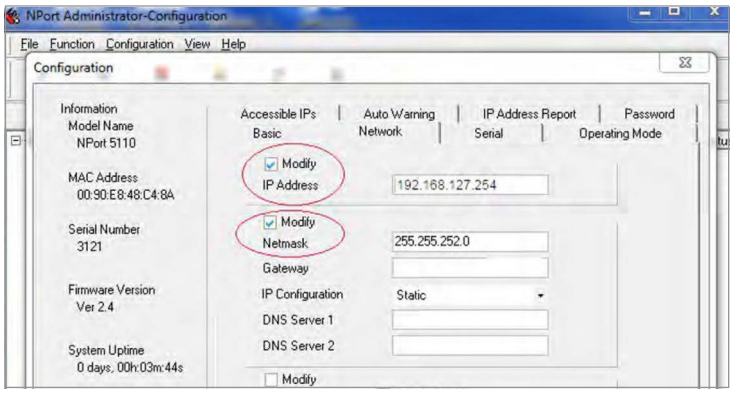


FIGURE 22: *Nport Configuration*

6. Update the IP Address, Netmask, Gateway, and DNS Server 1 fields to match your network.

Note: Do not make any other changes to the settings because it may hinder proper communications with the gateway.

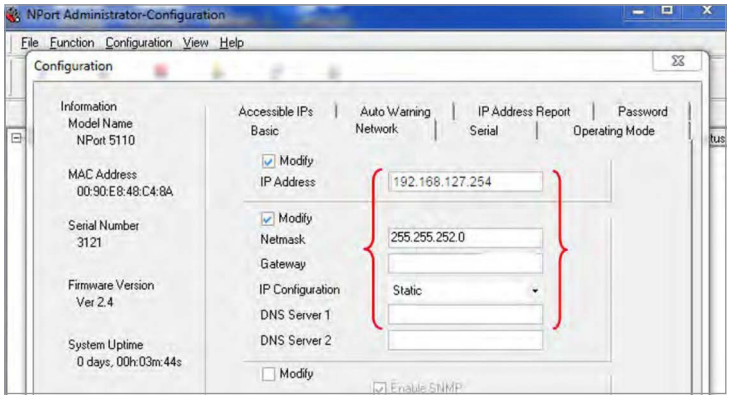


FIGURE 23: *Update Fields*

7. Click OK.
8. Use the ON/OFF switch to restart the module.
9. Connect the add-on module to the gateway.
10. Enter the new IP address followed by :4001 in the Network Address field in Agent software.

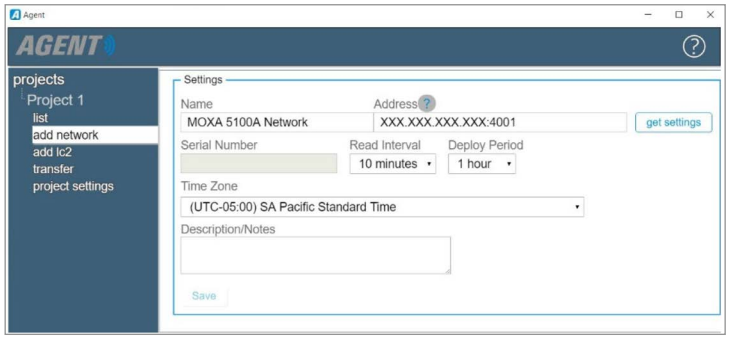


FIGURE 24: *Enter the IP address followed by :4001*

For more information on using Agent software, please refer to the Agent Software Instruction Manual (geokon.com/8800-GNA).

APPENDIX A. TROUBLESHOOTING

Listed below are a few commonly experienced problems and remedial action. For additional troubleshooting help, please visit geokon.com/Technical-Support.

SYMPTOM: UNIT WILL NOT RESPOND TO COMMUNICATIONS

- ☐ Network connection lost. Verify that the green status LED in the gateway is flashing.
- ☐ Wrong connection type, or incorrect address specified in Agent software.
- ☐ The batteries may be improperly installed. Check their placement.
- ☐ The batteries inside the unit may be dead. Replace the batteries.

SYMPTOM: DATA PRESENT (E.G., BATTERY/SIGNAL STRENGTH) BUT NO VW GAUGE DATA AVAILABLE

- ☐ Verify that the gauge leads are wired correctly inside the data logger. (See Section 4.15.1).
- ☐ Check the gauge for proper operation with a readout, such as a GK-404 or GK-406.

SYMPTOM: VW GAUGE READING IS UNSTABLE

- ☐ Move any sources of electrical noise away from the transducer cable, such as generators, motors, arc welding equipment, high voltage lines, etc.

SYMPTOM: THERMISTOR DISPLAY SHOWS -273.15 DEGREES C

- ☐ This indicates an open circuit to thermistor leads. Verify that the thermistor leads are properly connected inside the data logger. (See Section 4.15.1).
- ☐ Check the thermistor for proper operation with a readout, such as a GK-404 or GK-406.

SYMPTOM: DATA LOGGER HAS WEAK COMMUNICATION

- ☐ If the signal is consistently weak (indicated by red and green LEDs illuminated at the same time but not intermittently red), proceed with the installation. If the signal is frequently lost (red flash) it will be necessary to improve it. Try to get the data logger as high as possible, with plenty of clear space around the antenna. Extending the sensor cable may enable moving the data logger to a better location. If the signal does not improve, a higher gain directional antenna may be necessary. Contact GEOKON for assistance.

SYMPTOM: DATA LOGGER WILL NOT SYNCHRONIZE WITH NETWORK

- ☐ If the red status light on a data logger is flashing at 10 second intervals, it means the data logger was once connected to a network, but the network is not present now, or the gateway has been reset, resulting in an equal but not overlapping radio cycle.
- ☐ Ensure that the network is functioning in deployment mode (see Section 4.1), and that the channel setting is correct (see Section 4.6).

SYMPTOM: NO DATA FROM DATA LOGGER

- ☐ Be sure data logger is powered.
- ☐ With the network in deploy mode, observe either red and green lights only, or green lights every 10 seconds, on the data logger.
- ☐ Make sure the network time is set.

SYMPTOM: GREEN LIGHT FLASHING ONCE PER SECOND

Bootloader is activated, complete the following:

1. Change channel switches to a valid setting.
2. Press the reset button on the circuit board.

SYMPTOM: GREEN AND RED LIGHT ALTERNATING

- ☐ Device malfunction, contact GEOKON

APPENDIX B. SOLAR PANEL KIT

The GEOKON Solar Panel Kit enables you to power a cellular or Wi-Fi gateway in an area that has no access to mains / domestic power.



FIGURE 25: *Solar Panel 8900-SOL-10W-BRJ*

Inside the kit box are the following:

- One envelope containing technical documents and instructions
- One mounting bracket
- One solar panel complete with power regulation circuitry and power cable



FIGURE 26: *Solar Panel Kit Box Contents*

Install the solar panel by following the steps listed below. Each step is described in detail in the sections that follow.

1. Select a location for the solar panel.
2. Assemble and adjust the mounting bracket to the proper angle.
3. Install the mounting bracket onto the mounting surface or pole.
4. Secure the solar panel to the mounting bracket.
5. Connect the power cable to the data logger and set the power switch accordingly.

B.1 SELECT A LOCATION

Choose a location for the solar panel that is clear of obstructions and anything that might cast a shadow on the panel.

B.2 ASSEMBLE THE MOUNTING BRACKET

When assembling the two sections of the mounting bracket, be sure to set the sections to the desired angle before tightening the nuts. The angle of the mounting bracket will dictate the angle of the solar panel.

- Ensure the angle is at least 10 degrees, to aid in water control.
- In general, choose the best angle for the latitude of your location.
- Mounting on a horizontal surface will require a reverse configuration of the two sections compared to mounting vertically, as shown below.

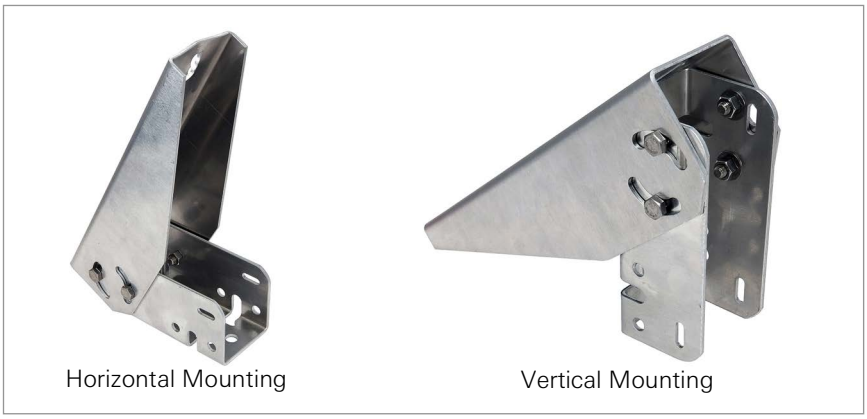


FIGURE 27: *Mounting Options*

B.3 INSTALL THE MOUNTING BRACKET

Mount the bracket on a flat surface (roof, wall, etc.) using locally supplied bolts or lag screws. If mounting to a pole, use locally supplied U-bolts and retaining clamps.

B.4 SECURE THE SOLAR PANEL TO THE MOUNTING BRACKET

Use the included nuts and screws to secure the solar panel to the mounting bracket. Use the centrally located holes provided for this purpose on the back of the solar panel.

Note: Be sure to mount the solar panel with the cable coming out the bottom of the panel, as shown below.

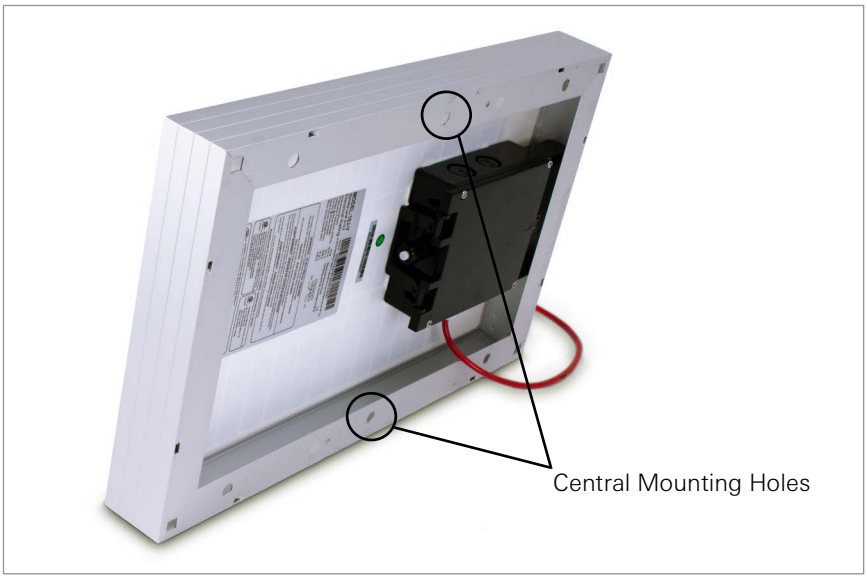


FIGURE 28: *Centrally Located Mounting Holes*

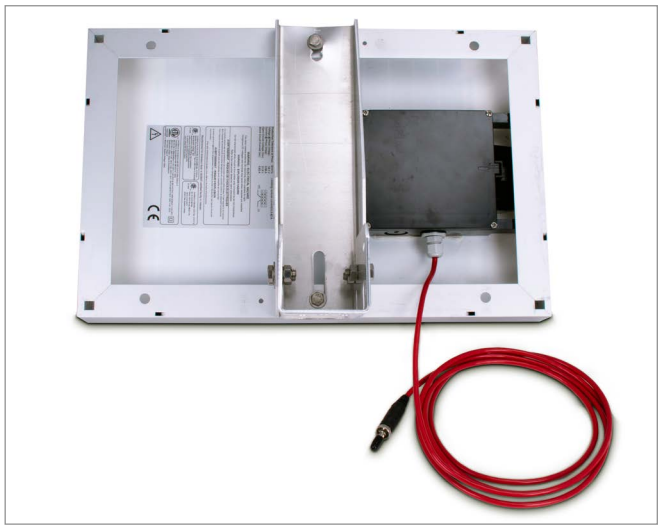


FIGURE 29: *Mounting Brackets Fastened Centrally*

B.5 CONNECT THE POWER CABLE

B.5.1 BATTERY SWITCH

Before connecting the power cable, be sure you have set the battery switch appropriately, as indicated in Section 4.7.

- When not using an external battery, set the battery switch inside the gateway to the INT BATTERY setting.
- When using an external battery between the solar panel and the gateway, set the battery switch inside the gateway to the EXT BATTERY setting.

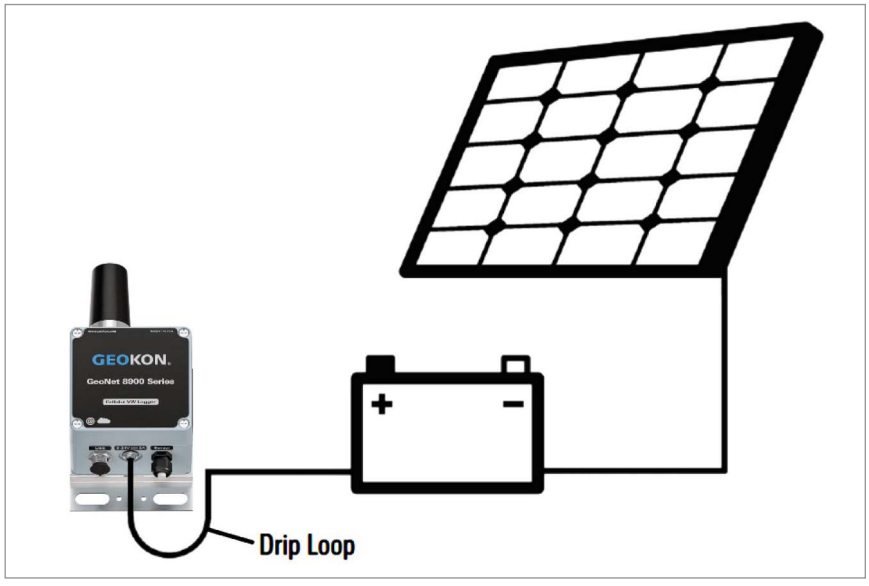


FIGURE 30: *Solar Panel with External Battery*

B.5.2 MAKING THE CONNECTION

Remove the plastic cap from the cable connector, then attach it to the EXT BATTERY plug on the data logger. Tighten the retaining ring on the EXT BATTERY plug, for strain relief.

Note: Be sure to implement a drip loop, as indicated in the previous figure, to prevent water ingress through the power connector.

APPENDIX C. SPECIFICATIONS

C.1 NETWORK SPECIFICATIONS

Topology	Star/Mesh/Cluster Tree (Auto)
Radio Technology	FHSS
Radio Frequency, ISM Band	902-928 MHz (North America) 915-928 MHz (Australia, Chile, Peru) 863-870 MHz (Europe) 902-906, 915-928 MHz (Brazil)
Channels	12
Range[1]	8800 (All): Up to 26 km (6.5 km × 4 hops) 8900 (N. America, Brazil): Up to 60 km (15 km × 4 hops) 8900 (Europe): Up to 22 km (5.5 km × 4 hops)
Transmit Power	8800 (All): 250 mW 8900 (North America, Brazil): 1 W 8900 (Europe): 20 mW
Receiver Sensitivity	8800: -101 dBm 8900: -106 dBm
Antenna (Half-Wave Dipole)	2.1 dBi (North America, Brazil) 1.6 dBi (Europe)

TABLE 14: *Network Specifications*

Note:

[1] Outdoor, clear line-of-Sight, maximum 4 hops

C.2 GATEWAY SPECIFICATIONS

Data Memory	32 MB
Storage Capacity	>1.04 M Arrays
Direct Connection Type	USB, RS-232
Communication Speed	115.2 kBits/second
Communication Parameters	8, N, 1 (data bits, parity, stop bits)
Scan Interval	Min: 10 minutes; Max: 1 day
USB Driver	FTDI
Power Supply	Cellular/Wi-Fi Gateway: 3.7V 6,600 mAh Internal Lithium Battery Pack1, or 9-24V External Local Gateway: D Cell, Alkaline or Lithium (2x), or 12V External
Battery Life	Please Contact GEOKON
Operating Temperature[1]	-40 °C to +85 °C (range varies by power source)
Enclosure Material	Die-cast aluminum
Enclosure Dimensions	See Appendix E

TABLE 15: *Gateway Specifications*

Note:

[1] Internal lithium battery will not charge below 0 °C

C.3 SUPPORTED CELLULAR FREQUENCIES

	Band	Frequency (MHZ)	Uplink (MHZ)	Downlink (MHZ)
LTM[1]	2	1900	1850-1910	1930-1990
	4	1700	1710-1755	2110-2155
	8	900	880-915	925-960
	28	700	703-748	758-803

TABLE 16: *Supported Cellular Frequencies Specifications*

Note:

[1] GeoNet Cellular Gateways are compatible with all major networks except Verizon

C.4 WI-FI SPECIFICATIONS

Protocol	IEEE 802.11 b/g/n IEEE 802.11 d
Band Support	Station Mode: 2.4 GHz, Channel 1–13 Access Point Mode: 2.4 GHz, Channel 1–11

TABLE 17: *Wi-Fi Specifications*

C.5 VIBRATING WIRE DATA LOGGER SPECIFICATIONS

Data Memory	32 MB
Storage Capacity	Varies By Model
Trueness	0.082 Hz
Frequency Precision	±0.146 Hz (99% CI)
Frequency Resolution	±0.002 Hz
Thermistor Accuracy	1% (0.5° C thermistor point match)
Thermistor Resolution	0.032 °C
Scan Interval	Min: 10 minutes; Max: 1 day
Power Supply	2x D cell, Alkaline or Lithium, 12V Auxiliary
Operating Temperature	-40 °C to +85 °C (range varies by power source)
VW Frequency Range	400-6,500 Hz
Battery Life	Refer to Section 5.2
Enclosure	Die-cast aluminum 120 × 122 × 91 mm (single-channel) 160 × 260 × 91 mm (four-channel) 180 × 280 × 101 mm (eight-channel)

TABLE 18: *Vibrating Wire Data Logger Specifications*

C.6 ADDRESSABLE (RS-485) DATA LOGGER SPECIFICATIONS

Data Memory	32 MB
Storage Capacity	Varies by sensor sting connected
MEMS Sensor Limit	32 Sensors
Communication Protocol	RS-485 Modbus
Thermistor Accuracy	1% (0.5° C thermistor point match)
Thermistor Resolution	0.032 °C
Scan Interval	Min: 10 minutes; Max: 1 day
Power Supply	2x D cell, Alkaline or Lithium, 12V Auxiliary
Operating Temperature	-40 °C to +85 °C (range varies by power source)
Battery Life	Refer to Section 5.2
Enclosure	Die-cast aluminum 120 × 122 × 91 mm

TABLE 19: *Addressable (RS-485) Data Logger Specifications*

C.7 TILT DATA LOGGER SPECIFICATIONS

Range[1]	±90°
Resolution[2]	0.00025° (0.004 mm/m)
Precision[3]	±0.0075° (±0.13 mm/m)
Nonlinearity	±0.005° across ±30° range (±0.09 mm/m)
Temperature Dependent Uncertainty	±0.001° across ±5° range (±0.016 mm/m) ±0.0016° across ±15° range (±0.026 mm/m) ±0.0026° across ±30° range (±0.042 mm/m)
Axis	2
Data Memory	32 MB
Storage Capacity	500,000 readings
Thermistor Accuracy	1% (0.5 °C thermistor point match)
Thermistor Resolution	0.032 °C
Scan Interval	Min: 10 minutes; Max: 1 day
Power Supply	2x D cell, Alkaline or Lithium, 12V Auxiliary
Operating Temperature	-40 °C to +65 °C (range varies by power source)
Battery Life	Refer to Section 5.2
Enclosure	Die-cast aluminum 120 × 122 × 91 mm

TABLE 20: *Tilt Data Logger Specifications*

Note:

[1] Calibrated Range: ±30°

[2] 99% confidence interval (i.e., 99 out of 100 individual readings fall within this tolerance).

[3] Includes random walk (changes between consecutive readings that have no discernible cause) and seismic noise during testing.

APPENDIX D. CONNECTOR PINOUTS

D.1 GAUGE CABLE CONNECTIONS

D.1.1 VW DATA LOGGERS WITH CABLE GLAND CONNECTION

Terminal Strip Position	Description	Cable Wire Color
VW+	Vibrating Wire+	RED
VW-	Vibrating Wire-	BLACK
TH+	Thermistor+	WHITE
TH-	Thermistor-	GREEN
S	Analog Ground (Shield)	BARE WIRE

TABLE 21: *VW Data Logger, Cable Gland Connection*

D.1.2 VW DATA LOGGERS WITH 10-PIN BULKHEAD CONNECTION

10-Pin Bulkhead	Internal Wire Color	Description	Cable Wire Color
A	Brown	Vibrating Wire+	RED
B	Red	Vibrating Wire-	BLACK
C	Orange	Thermistor+	WHITE
D	Yellow	Thermistor-	GREEN
E	Green	Analog Ground (Shield)	BARE WIRE
F	Blue	+VCC Supply	N/A
G	Violet	Digital Ground	N/A
H	Grey	Mux Reset	N/A
J	White	Mux Clock	N/A
K	Black	Digital Ground	N/A

TABLE 22: *VW Data Logger, 10-Pin Bulkhead Connections*

D.1.3 ADDRESSABLE (RS-485) DATA LOGGERS

Terminal Strip Position	Description	Cable Wire Color
485+	RS-485 Data+	WHITE
485-	RS-485 Data-	GREEN
12V	12 Volt Bus	RED
GND	Bus Ground	BLACK
S	Analog Ground (Shield)	BARE WIRE

TABLE 23: *Addressable Data Logger, Cable Gland Connections*

D.2 COMMUNICATION CONNECTIONS

D.2.1 GATEWAY WITH RS-232 CONNECTION

10-Pin Bulkhead	Internal Wire Color	Description	Connection
A	Brown	GND	J1-1
	Green		J1-5
B	Red	RX	J1-2
C	Yellow	TX	J1-4
J	Red and Black (Twisted Pair)	12V Aux In (Red)	J3-1
K		GND (Black)	J3-2

TABLE 24: *Communication Connections, RS-232 Gateways*

D.2.2 VW DATA LOGGERS WITH 10-PIN BULKHEAD CONNECTION

10-Pin Bulkhead	Internal Wire Color	Description	J9
A	Red	+5V	2
B	Orange	D-	3
C	Yellow	D+	4
D	Brown	GND	1
	Green		5

TABLE 25: *Communication Connections, USB Gateways*

APPENDIX E. UNIT DIMENSIONS

E.1 SINGLE-CHANNEL (01C), ADDRESSABLE (ADR), AND LOCAL GATEWAY (SUP) MODELS

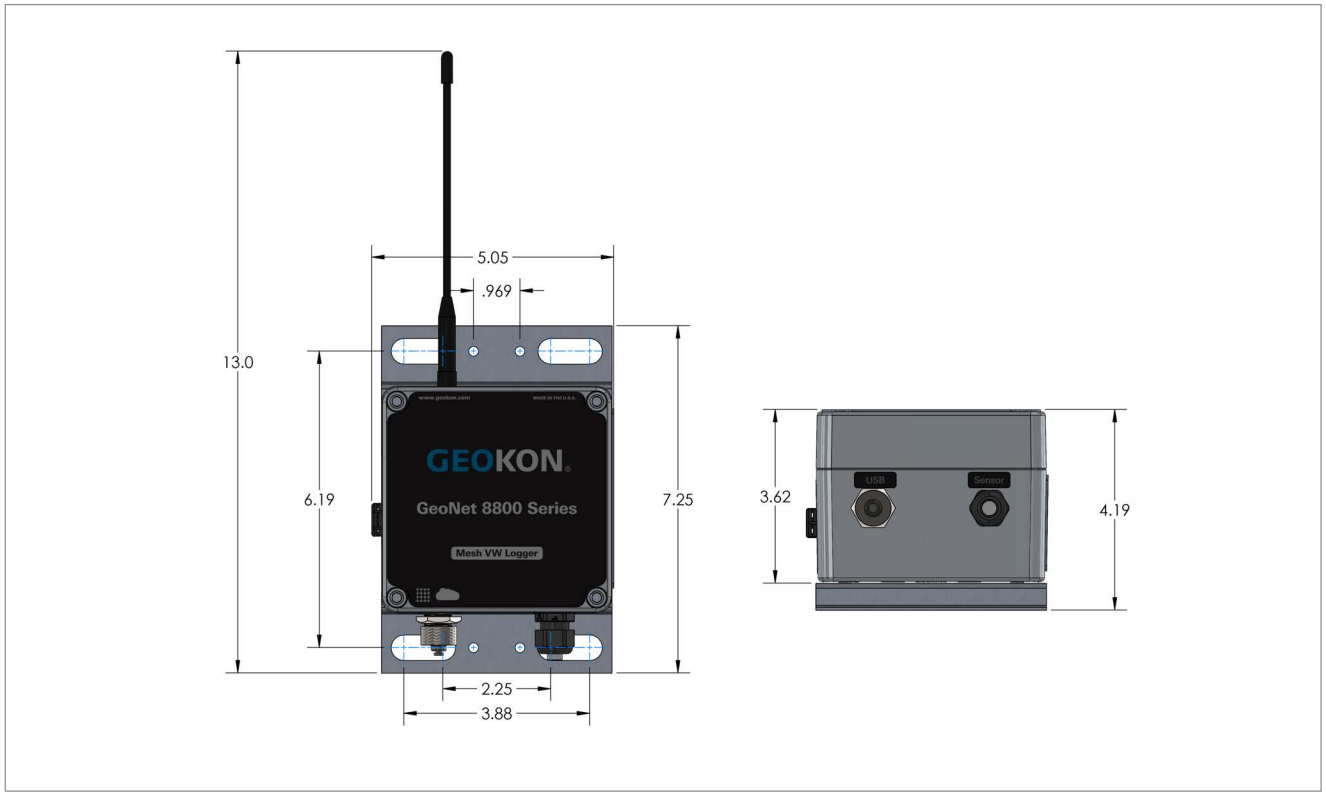


FIGURE 31: *Single-Channel (01C) and Addressable (ADR), and Local Gateway (SUP) Models*

E.2 FOUR-CHANNEL (04C) MODELS

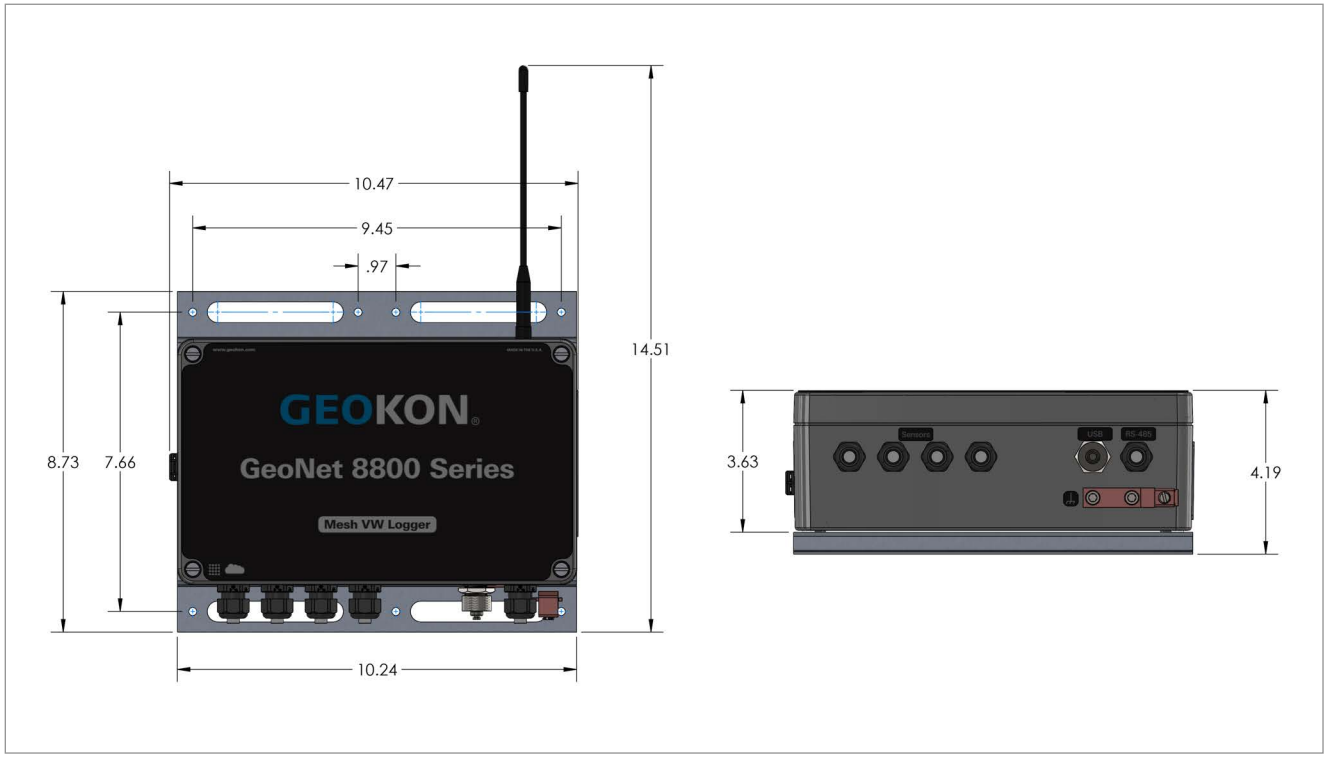


FIGURE 32: *Four-Channel (04C) Models*

E.3 EIGHT-CHANNEL (08C) MODELS

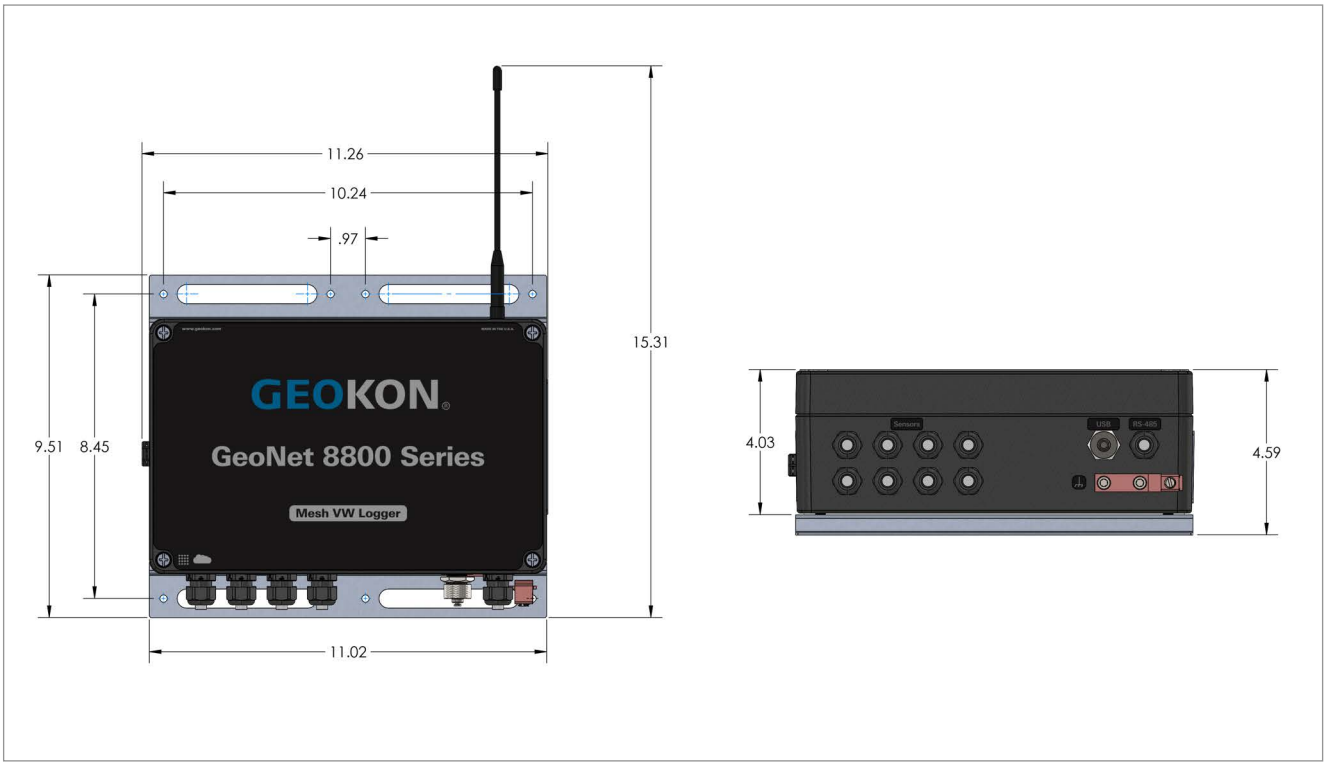


FIGURE 33: *Eight-Channel (08C) Models*

E.4 TILT (TLT) MODELS

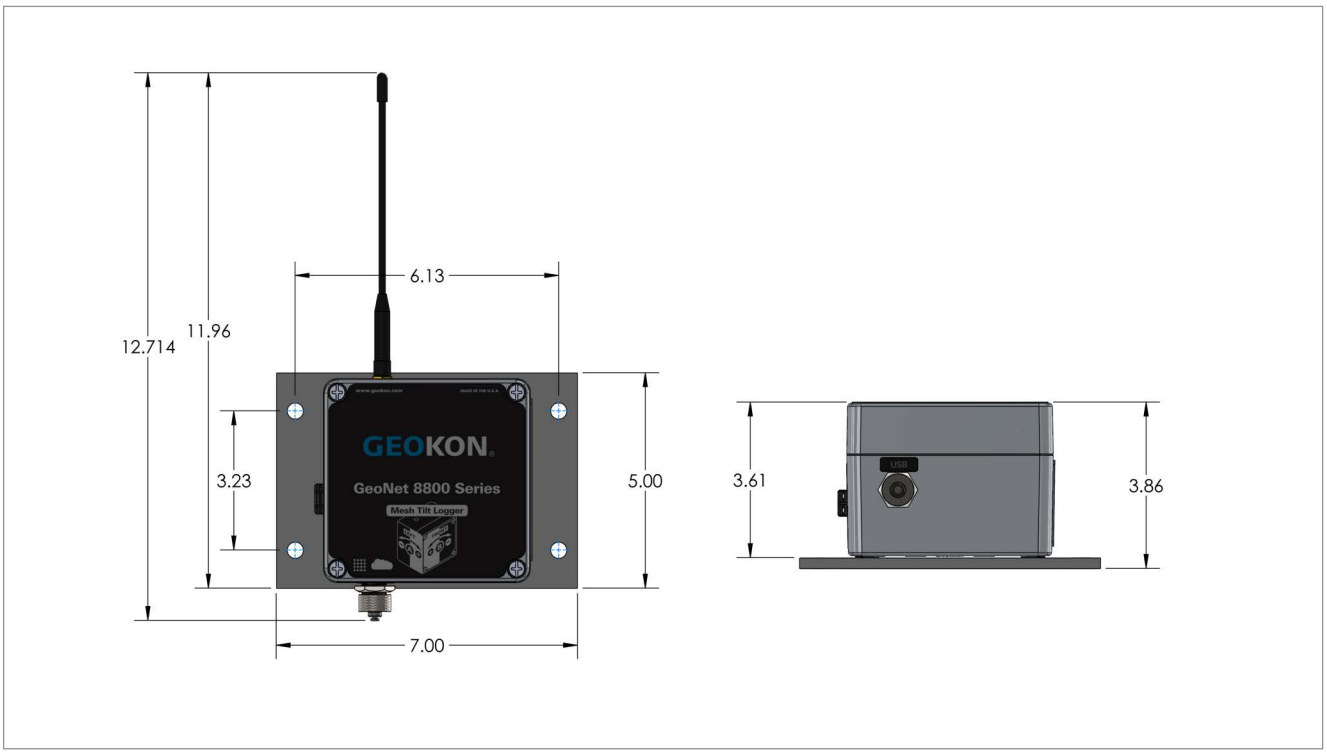


FIGURE 34: *Tilt (TLT) Models*

E.5 NETWORK GATEWAY (LTM AND WIFI) MODELS

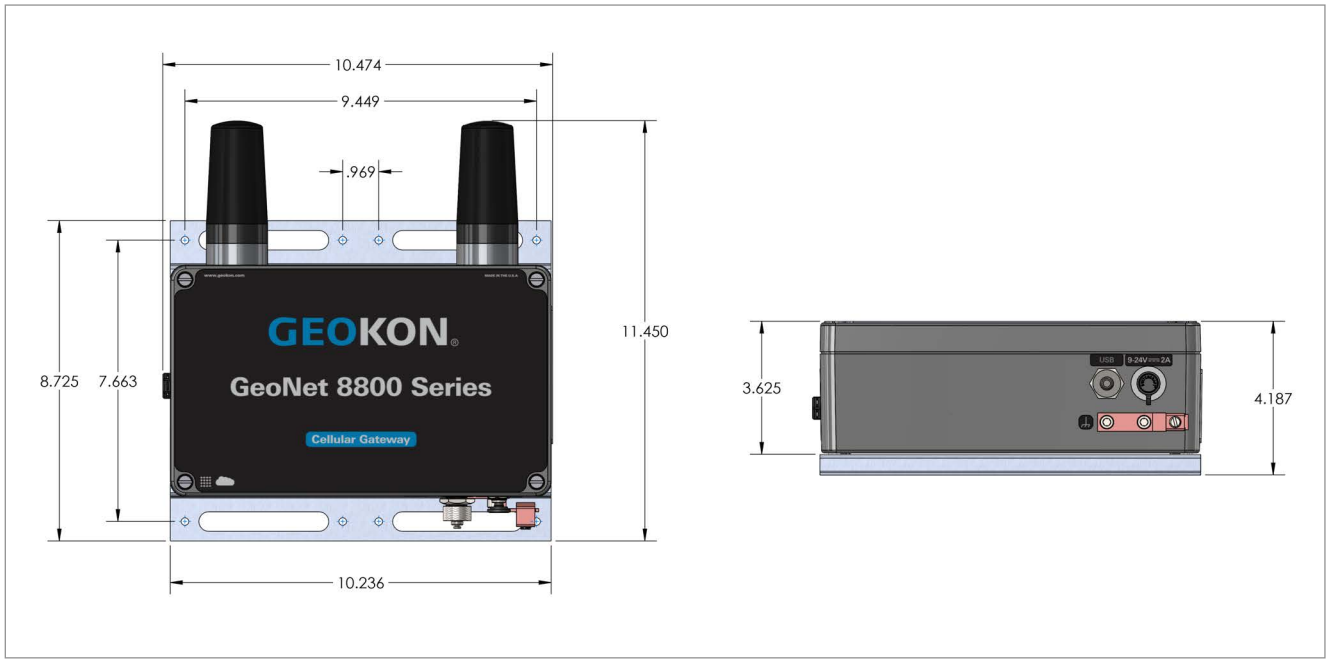


FIGURE 35: *Network Gateway (LTM and WIFI) Models*

APPENDIX F. MOUNTING BRACKET DIMENSIONS

F.1 SINGLE-CHANNEL (01C), ADDRESSABLE (ADR), AND LOCAL GATEWAY (SUP)

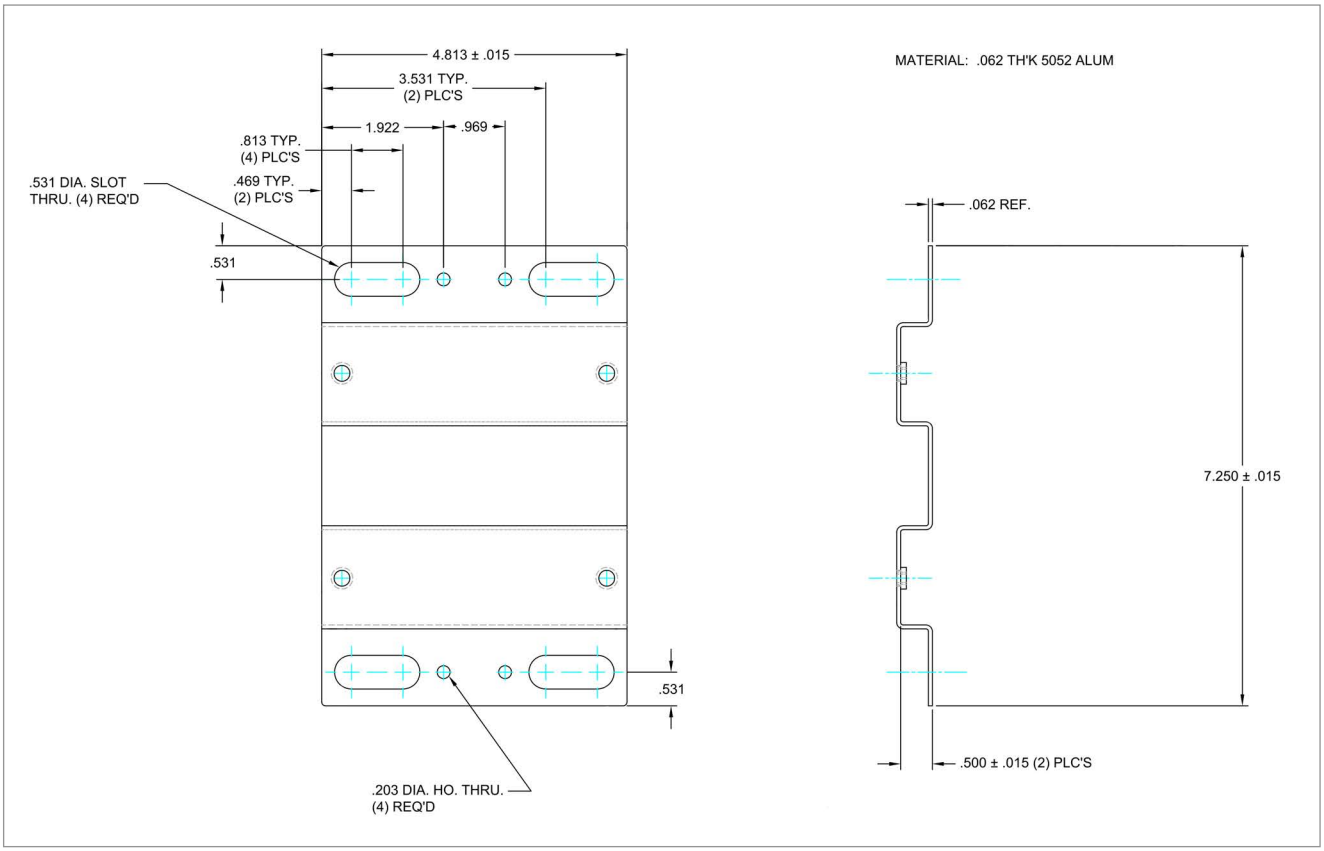


FIGURE 36: *Single-Channel (01C), Addressable (ADR), and Local Gateway (SUP) Models*

F.2 FOUR-CHANNEL (04C) AND NETWORK GATEWAY (LTM AND WIFI) MODELS

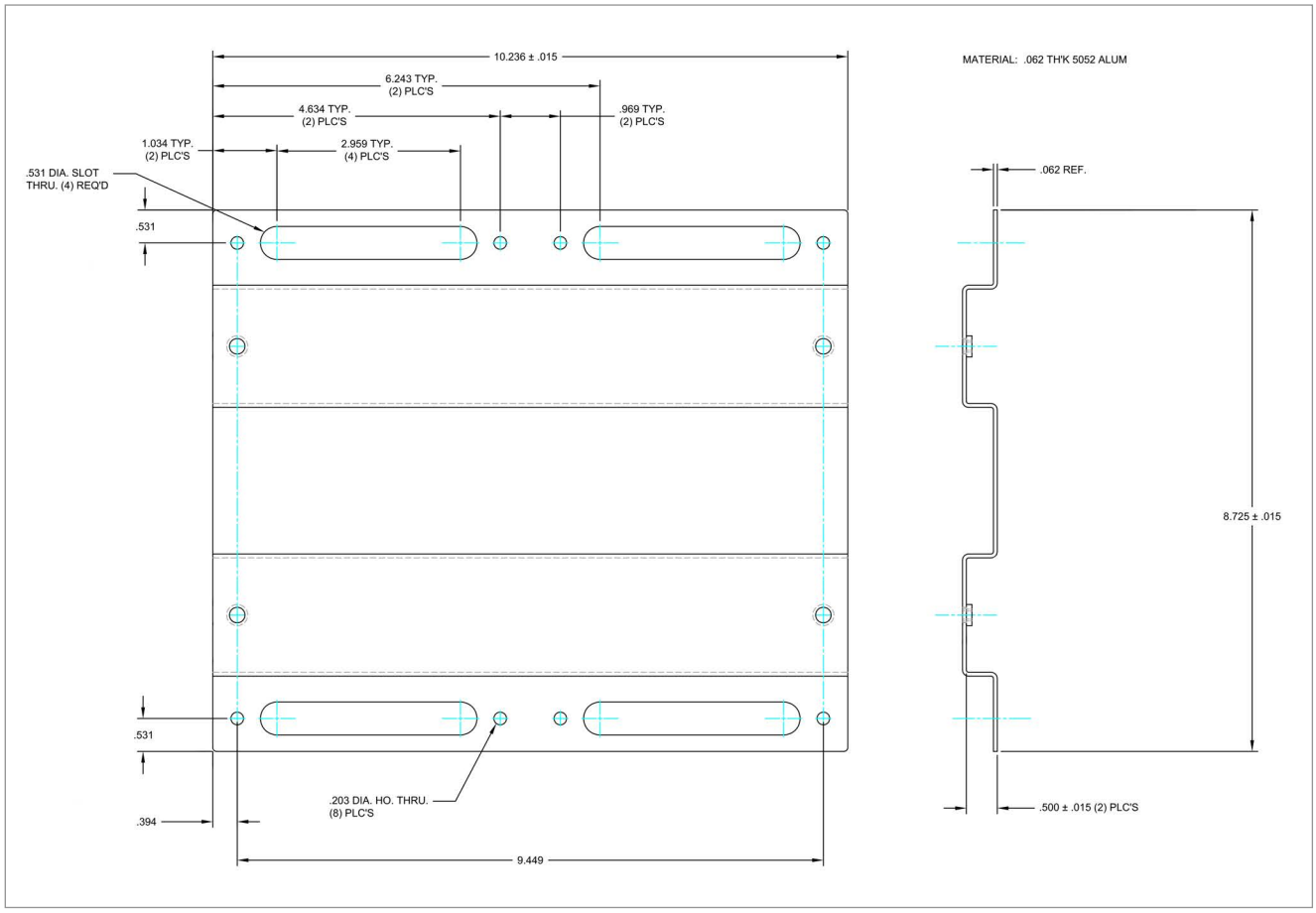


FIGURE 37: *Four-Channel (04C) and Network Gateway (LTM and WIFI) Models*

F.3 EIGHT-CHANNEL (08C) MODELS

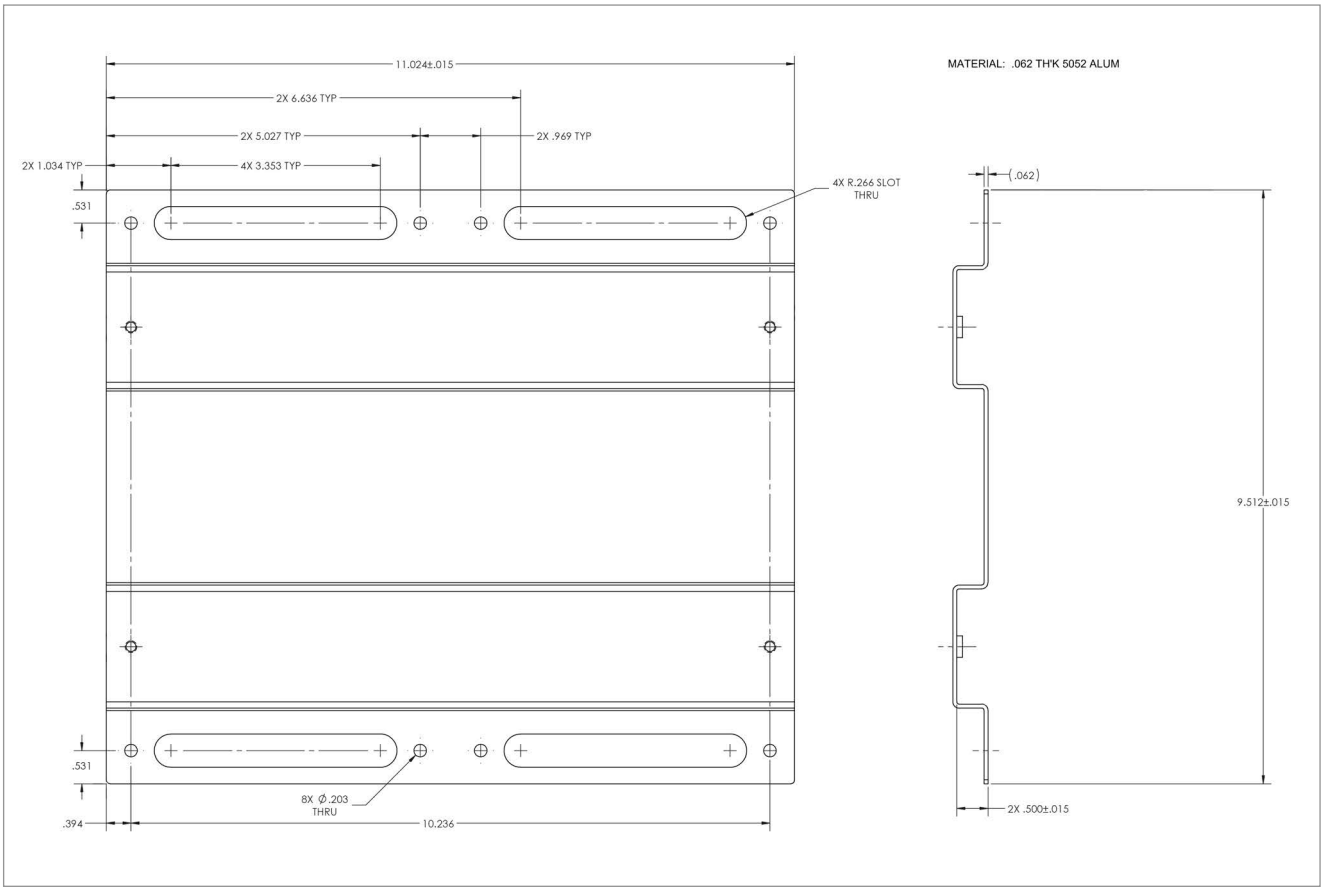


FIGURE 38: *Eight-Channel (08C) Models*

F.4 TILT (TLT) MODELS

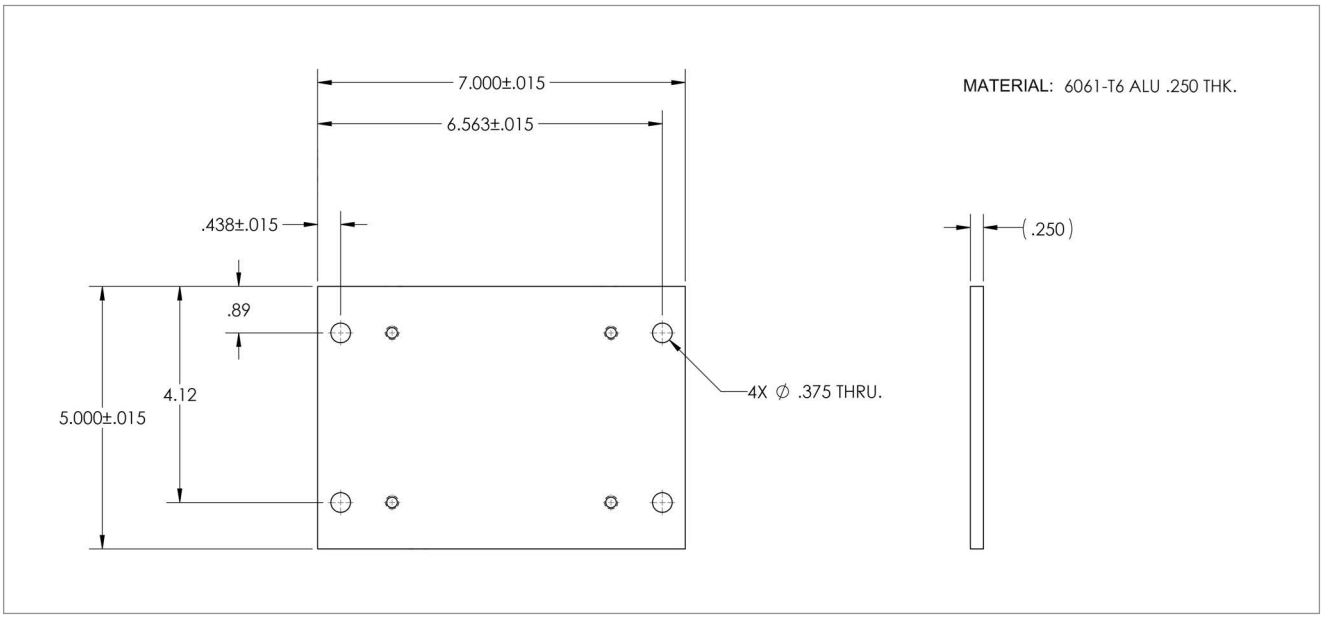


FIGURE 39: *Tilt (TLT) Models*

APPENDIX G. COMPONENTS (TYPICAL REPLACEMENT PARTS)

G.1 SINGLE-CHANNEL (01C) AND ADDRESSABLE (ADR) MODELS

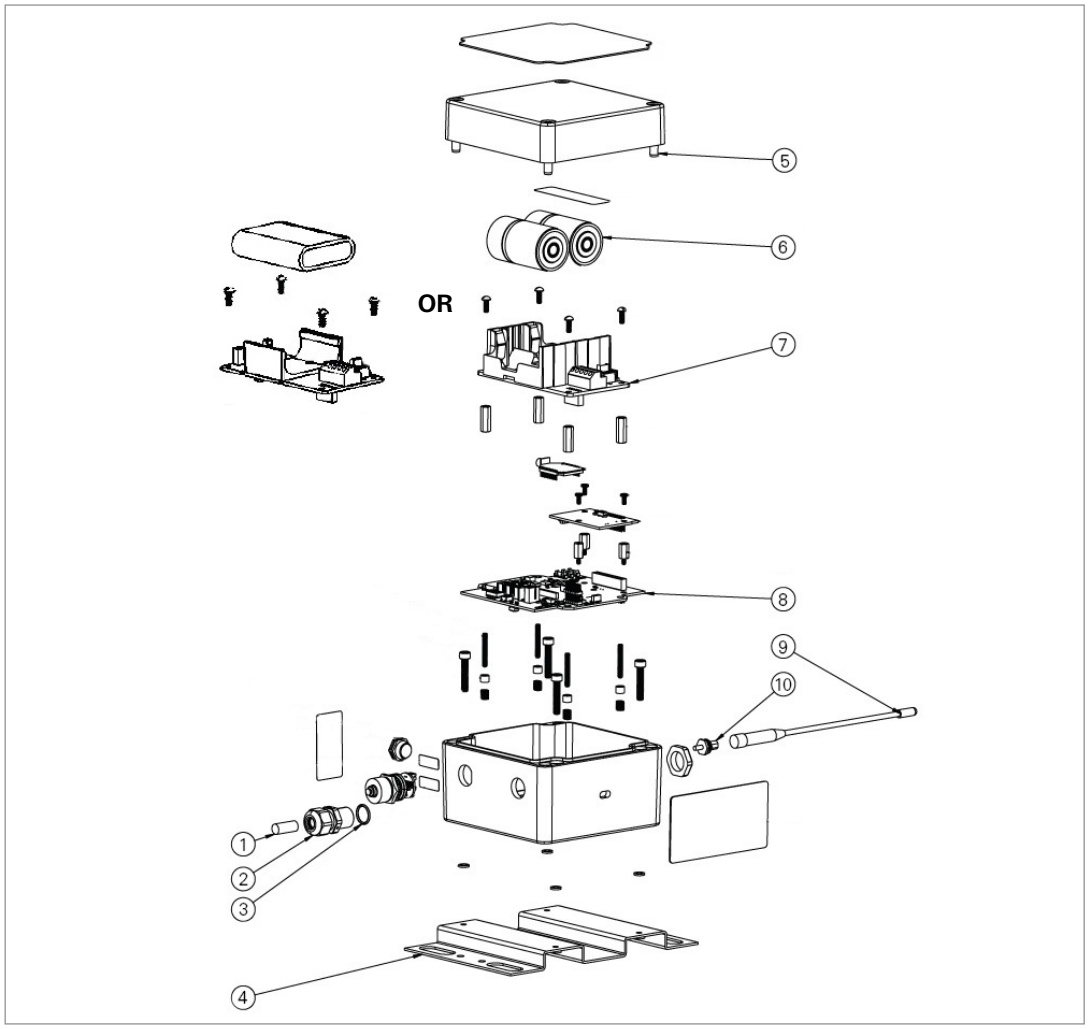


FIGURE 40: *Single-Channel (01C) and Addressable (ADR) Models*

Item No.	Part Number	Description
1	CON-A342	Dowel Pin
2	CON-A331	Cable Fitting
3	SEAL-09	Seal Ring for CON-A331
4	C8800-1	Mounting Bracket
5	HRD-A2009	M6 x 35 mm Allen Head Screw. When any replacements are required from the original screws, GEOKON recommends that all 4 screws are replaced.
6	Alkaline: S-BAT-111 Lithium: BAT-202 Rechargeable: BAT-207	Alkaline: Includes **two** D-Cell Batteries Lithium: Includes **one** D-Cell Battery (Two batteries are required for operation) Rechargeable: Battery Pack
7	Non-Rechargeable: S-8800-3 Rechargeable: S-PCB-0292	Battery Holder PCBA
8	S-8900-2A	GeoNet PCBA
9	8903 Models: ELC-826 All Other Models: ELC-819	Antenna
10	8800-NA Models: ELC-1022 All other Models: ELC-804	Antenna Bulkhead/Cable

TABLE 26: *Single-Channel (01C) and Addressable (ADR) Models Components Parts List*

G.2 FOUR-CHANNEL (04C) MODELS

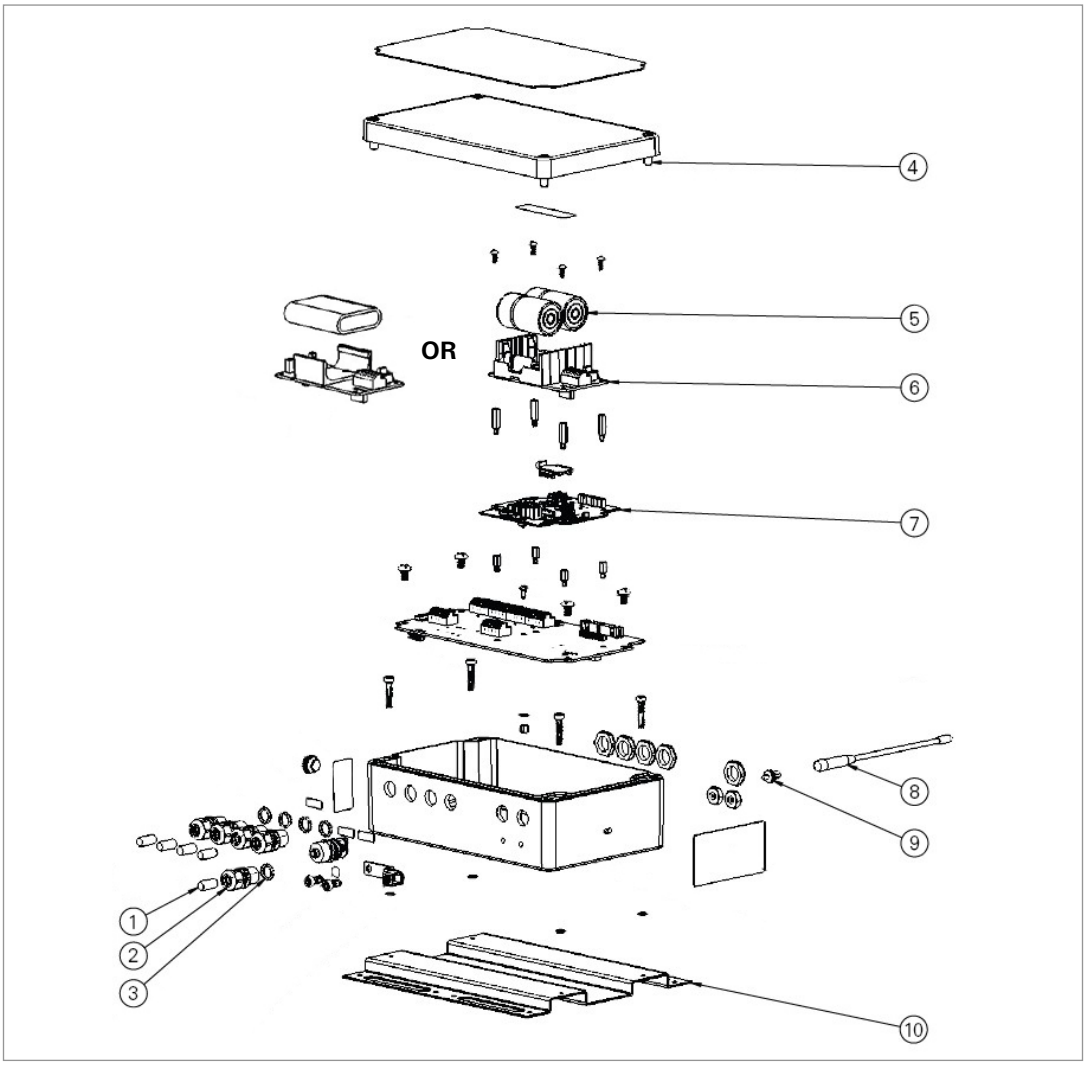


FIGURE 41: *Four-Channel (04C) Models*

Item No.	Part Number	Description
1	CON-A342	Dowel Pin
2	CON-A331	Cable Fitting
3	SEAL-09	Seal Ring for CON-A331
4	HRD-A2006	M6 x 25 mm Allen Head Screw. When any replacements are required from the original screws, GEOKON recommends that all 4 screws are replaced.
5	Alkaline: S-BAT-111 Lithium: BAT-202 Rechargeable: BAT-207	Alkaline: Includes **two** D-Cell Batteries Lithium: Includes **one** D-Cell Battery (Two batteries are required for operation) Rechargeable: Battery Pack
6	Non-Rechargeable: S-8800-3 Rechargeable: S-PCB-0292	Battery Holder PCBA
7	S-8900-2A	GeoNet PCBA
8	8903 Models: ELC-826 All other Models: ELC-819	Antenna
9	8800-NA Models: ELC-1022 All other Models: ELC-804	Antenna Bulkhead/Cable
10	C8800-6	Mounting Bracket

TABLE 27: *Four-Channel (04C) Models Components Parts List*

G.3 EIGHT-CHANNEL (08C) MODELS

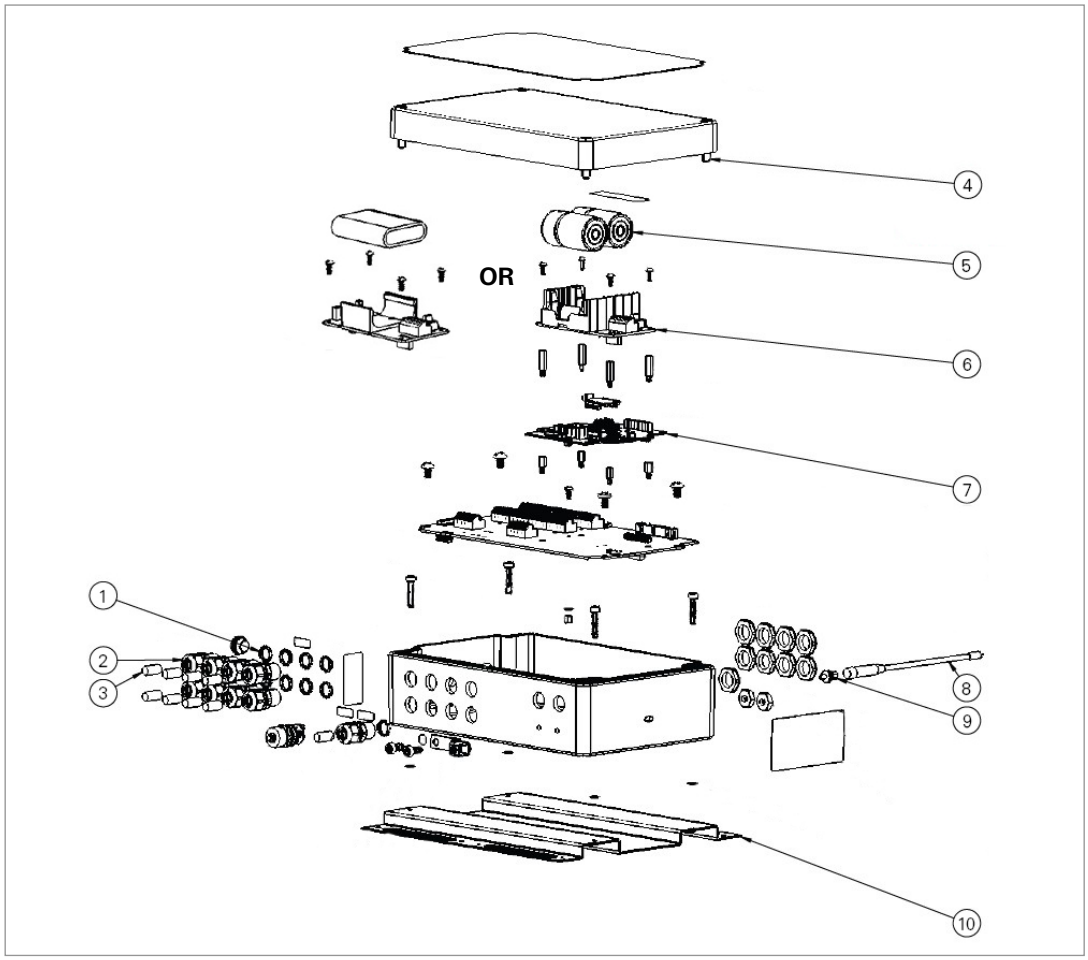


FIGURE 42: *Eight-Channel (08C) Models*

Item No.	Part Number	Description
1	SEAL-09	Seal Ring for CON-A331
2	CON-A331	Cable Fitting
3	CON-A342	Dowel Pin
4	HRD-A2009	M6 x 35 mm Allen Head Screw. When any replacements are required from the original screws, GEOKON recommends that all 4 screws are replaced.
5	Alkaline: S-BAT-111 Lithium: BAT-202 Rechargeable: BAT-207	Alkaline: Includes **two** D-Cell Batteries Lithium: Includes **one** D-Cell Battery (Two batteries are required for operation) Rechargeable: Battery Pack
6	Non-Rechargeable: S-8800-3 Rechargeable: S-PCB-0292	Battery Holder PCBA
7	S-8900-2A	GeoNet PCBA
8	8903 Models: ELC-826 All Other Models: ELC-819	Antenna
9	8800-NA Models: ELC-1022 All other Models: ELC-804	Antenna Bulkhead/Cable
10	C8900-1	Mounting Bracket

TABLE 28: *Eight-Channel (08C) Models Components Parts List*

G.4 TILT (TLT) MODELS

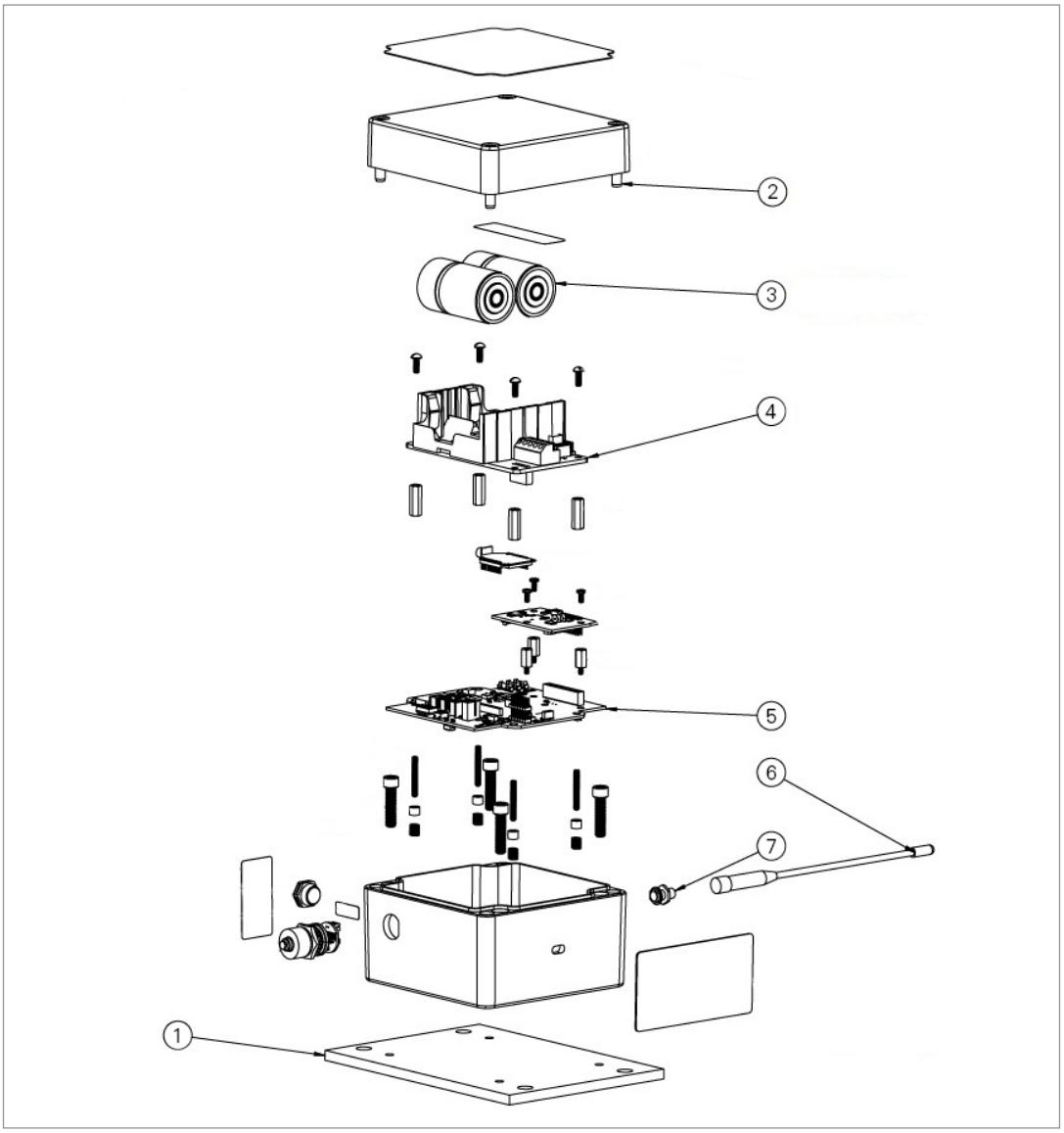


FIGURE 43: *Tilt (TLT) Models*

Item No.	Part Number	Description
1	A8101-3	Mounting Bracket
2	HRD-A2009	M6 x 35 mm Allen Head Screw. When any replacements are required from the original screws, GEOKON recommends that all 4 screws are replaced.
3	Alkaline: S-BAT-111 Lithium: BAT-202	Alkaline: Includes **two** D-Cell Batteries Lithium: Includes **one** D-Cell Battery (Two batteries are required for operation)
4	S-8800-3	Battery Holder PCBA
5	S-8900-2A	GeoNet PCBA
6	8903 Models: ELC-826 All Other Models: ELC-819	Antenna
7	8800-NA Models: ELC-1022 All other Models: ELC-804	Antenna Bulkhead/Cable

TABLE 29: *Tilt (TLT) Models Components Parts List*

G.5 NETWORK GATEWAY (LTM AND WIFI) MODELS

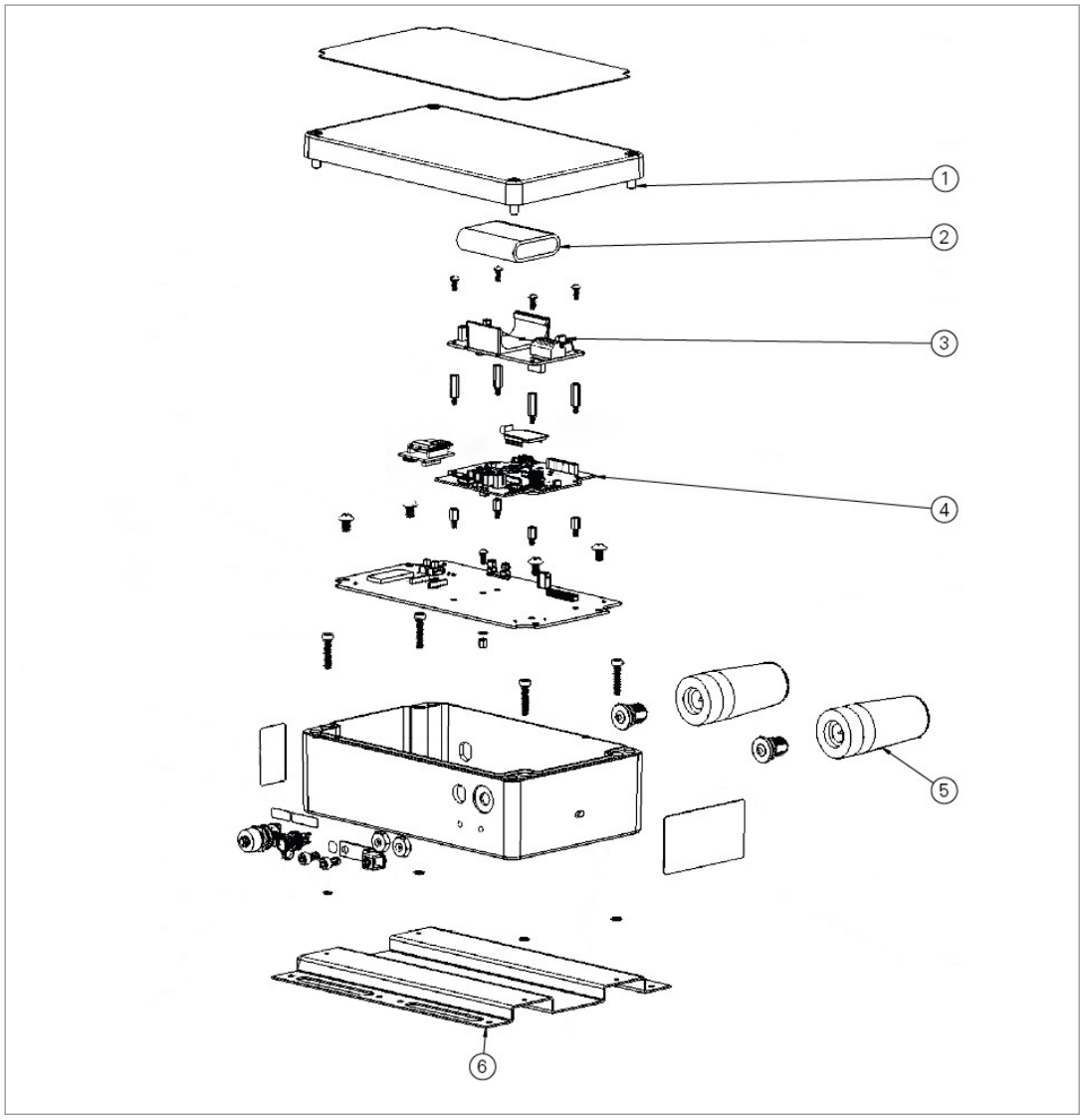


FIGURE 44: *Network Gateway (LTM and WIFI) Models*

Item No.	Part Number	Description
1	HRD-A2006	M6 x 25 mm Allen Head Screw. When any replacements are required from the original screws, GEOKON recommends that all 4 screws are replaced.
2	BAT-207	Battery Pack
3	S-PCB-0292	Battery Holder PCBA
4	S-8900-NET	GeoNet PCBA
5	ELC-824	Antenna
6	C8800-6	Mounting Bracket

TABLE 30: *Network Gateway (LTM and WIFI) Models Components Parts List*

G.6 LOCAL GATEWAY (SUP) MODELS

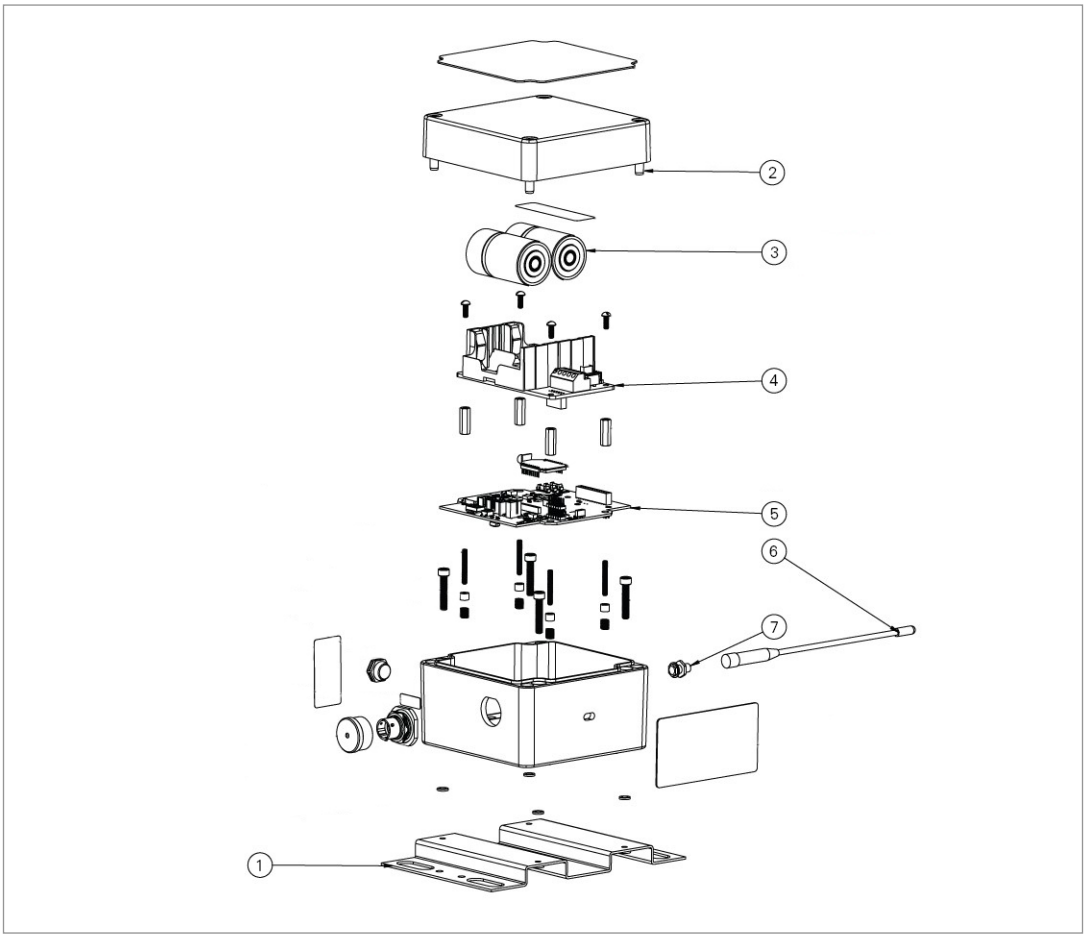


FIGURE 45: *Local Gateway (SUP) Models*

Item No.	Part Number	Description
1	C8800-1	Mounting Bracket
2	HRD-A2009	M6 x 35 mm Allen Head Screw. When any replacements are required from the original screws, GEOKON recommends that all 4 screws are replaced.
3	Alkaline: S-BAT-111 Lithium: BAT-202	Alkaline: Includes **two** D-Cell Batteries Lithium: Includes **one** D-Cell Battery (Two batteries are required for operation)
4	S-8800-3	Battery Holder PCBA
5	S-8900-2A	GeoNet PCBA
6	8800-WW Models: ELC-803 8903 Models: ELC-826 All Other Models: ELC-819	Antenna
7	8800-NA-SUP-232 Models: ELC-1022 All other Models: ELC-804	Antenna Bulkhead/Cable

TABLE 31: *Local Gateway (SUP) Models Components Parts List*

APPENDIX H. FIRMWARE UPGRADE

Warning! Performing a firmware update on a data logger will reset the data logger memory. **Retrieve all data from the data logger prior to performing a firmware update.**

H.1 PC CONNECTION

H.1.1 RS-232 GATEWAYS

1. Connect the COM-108 (RS-232 cable) to the 10-pin connector on the gateway.
2. Connect the 8001-7 (USB to RS-232 adapter) to the COM-108.
3. Connect the 8001-7 to the PC.

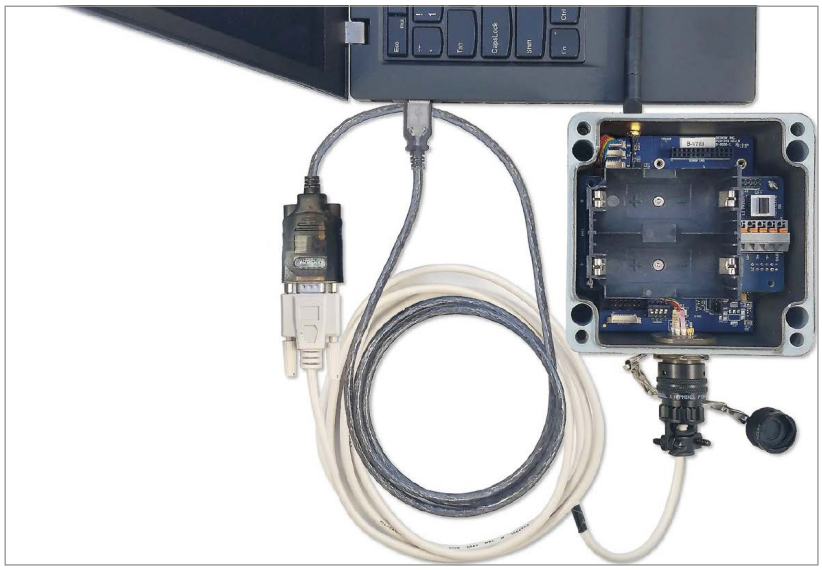


FIGURE 46: *RS-232 Cable Connection*

H.1.2 ALL OTHER DATA LOGGERS AND GATEWAYS

1. Connect the COM-169 (USB 2.0 A Male to C Male Cable) to the USB-C connector on the bottom of enclosure and the USB port on the computer.

Note: Older Models may use a COM-166 (Mini USB to STD A Cable).



FIGURE 47: *USB Cable Connection (COM-166 Pictured)*

H.2 UPGRADE PROCEDURE

1. Download the "GeoNet Firmware Update Package" from geokon.com/Software.
2. Right click on the download file and choose "Extract All...".

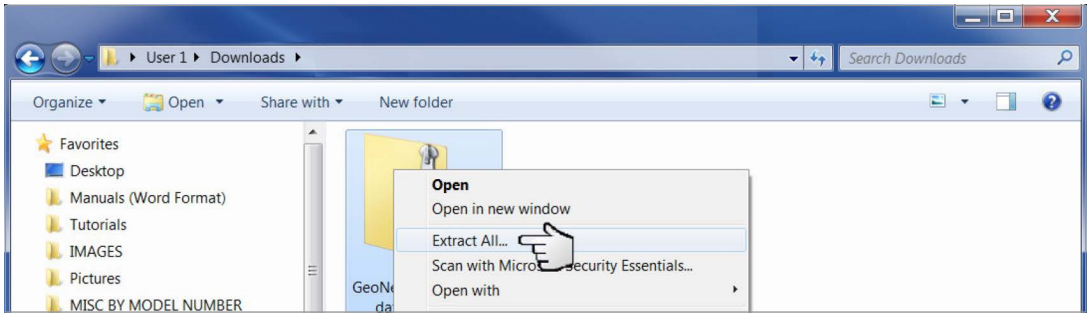


FIGURE 48: *Extract File*

3. When prompted click "Extract All".
4. Select a destination for the files and then click "Extract".

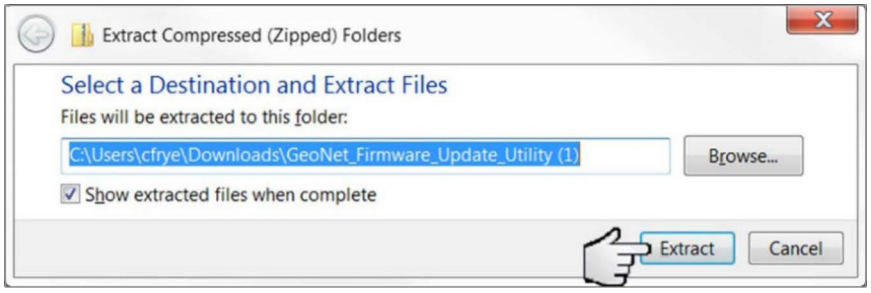


FIGURE 49: *Select Destination, then Click Extract*

5. Open "GeoNetUpdateUtility.exe" file. (If a security warning appears, click "Run").

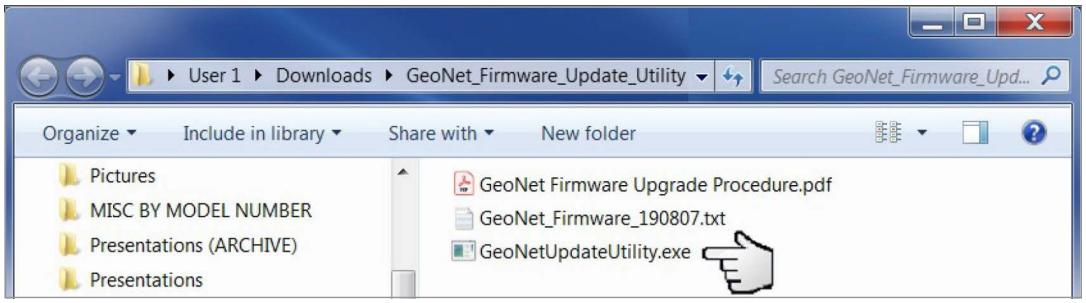


FIGURE 50: *Open the GeoNet Update Utility Application*

6. Click "Select File".



FIGURE 51: *Click on "Select File"*

7. Double click on the .txt firmware file. (Firmware files are named in the following format: "GeoNet_Firmware_YYMMDD.txt", where YY is the last two digits of the year, MM is the month, and DD is the day of the month.)

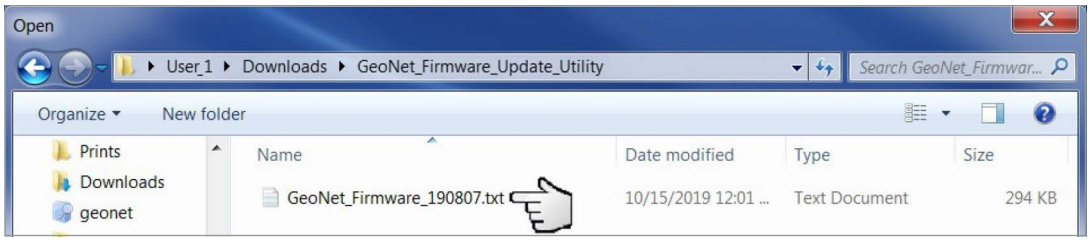


FIGURE 52: *Double Click on Firmware Text File*

8. Using the drop-down box below the "Select File" button, select the correct serial port for the 8001-7 or COM-169 cable. To identify which serial port the unit is connected to, complete the following:
   a. Unplug the 8001-7 or COM-169 cable from the PC.
   b. Go to the "Control Panel" then open "Device Manager".
   c. Click on the triangle to the left of "Ports (COM & LPT)" to expand the list.
   d. Plug the cable back into the computer and the port will appear in the list.

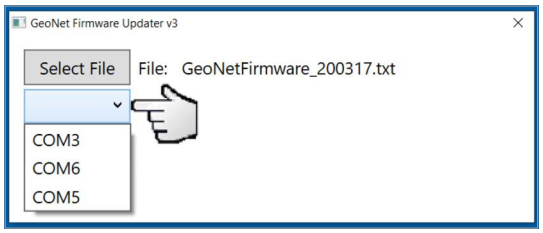


FIGURE 53: *Select COM Port*

9. Click "Program".

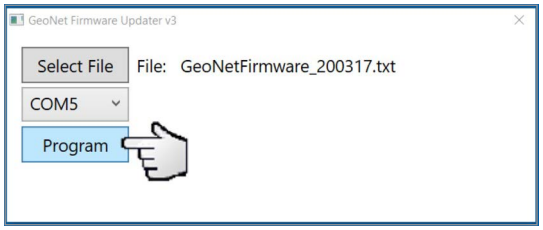


FIGURE 54: *Click on Program*

10. A progress bar will appear. The update process will normally take one to two minutes.
11. Once the update has finished, operation will return to normal.

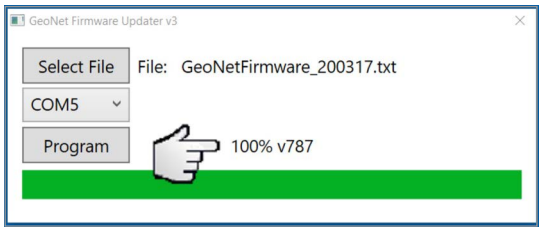


FIGURE 55: *Update Finished*

12. Repeat the above process with all the data loggers in the Network.

The firmware update is now complete.

H.3 FIRMWARE UPGRADE TROUBLESHOOTING

- ☐ For RS-232 gateways, updates should be done using the GEOKON provided 8001-7 USB to RS232 adapter. Other adapters and native serial ports have been unreliable.
- ☐ Make sure the batteries are fresh.

APPENDIX I. FIRMWARE UPGRADE

Warning! Performing a firmware update on a data logger will reset the data logger memory. **Retrieve all data from the data logger prior to performing a firmware update.**

1. Power off the gateway by moving the battery select switch to the "OFF" position, or by disconnecting the external battery. (For units manufactured prior to June 2017, which do not have an OFF position, remove the D cells from the battery holder.)

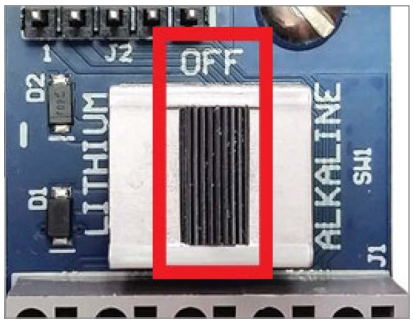


FIGURE 56: *Battery Selector Switch in OFF Position*

2. Ensure that the unit is completely discharged of electrical potential by pressing the status button repeatedly until no LED lights flash.

I.1 PC CONNECTION

I.1.1 RS-232 GATEWAYS

1. Connect the COM-108 (RS-232 cable) to the 10-pin connector on the gateway.
2. Connect the 8001-7 (USB to RS-232 adapter) to the COM-108.
3. Connect the 8001-7 to the PC.

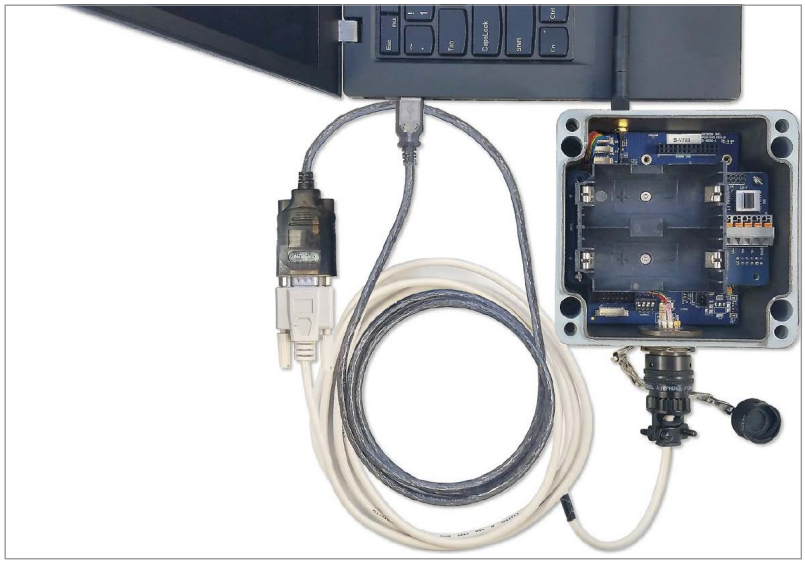


FIGURE 57: *RS-232 Cable Connection*

I.1.2 ALL OTHER DATA LOGGERS AND GATEWAYS

1. Connect the B8800-5 (update cable) to the "RS232" connector on the bottom circuit board as shown.

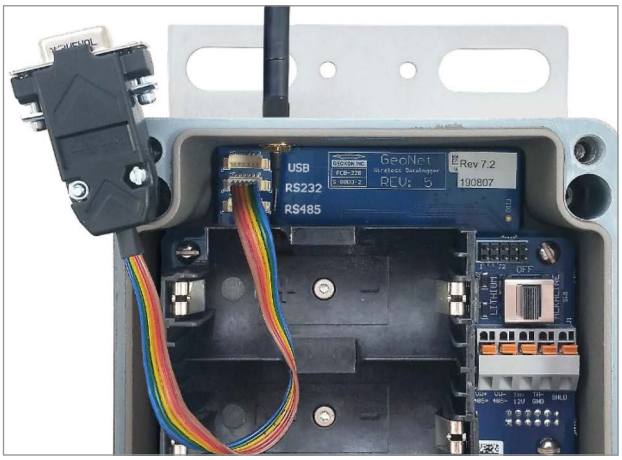


FIGURE 58: *RS-232 Connector Detail*

2. Connect the B8800-5 update cable to the 8001-7 cable (USB to RS-232 adapter).
3. Connect the 8001-7 cable to the computer.

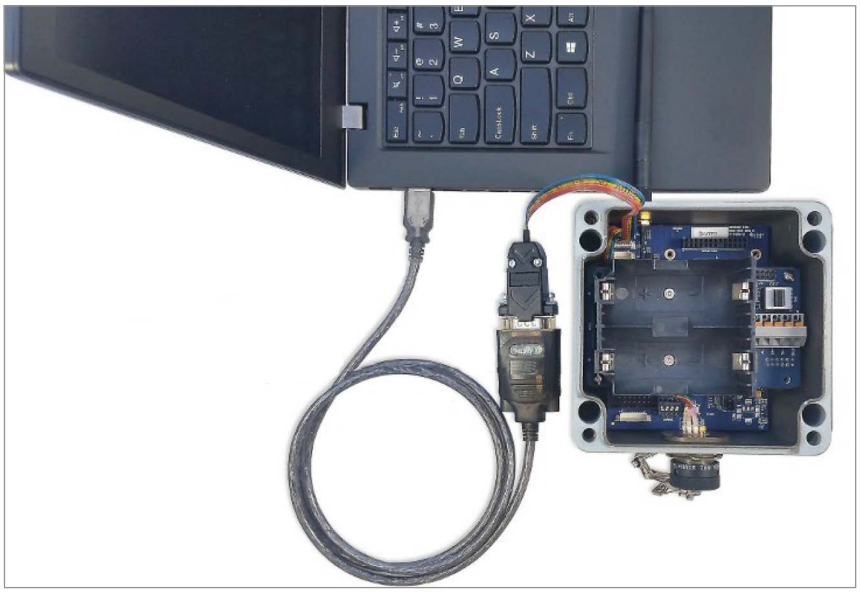


FIGURE 59: *Update Cable Detail*

I.2 UPGRADE PROCEDURE

1. Move all channel dipswitches to the ON position.

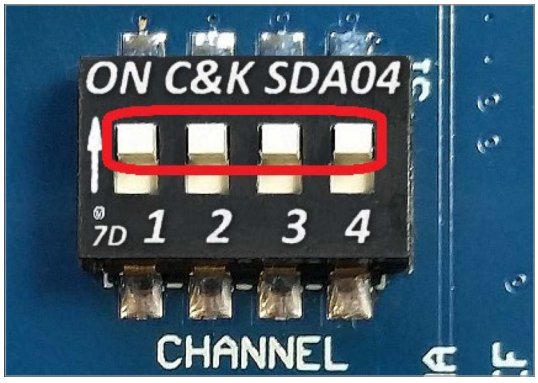


FIGURE 60: *Channel Selector Switch Detail*

2. Move the battery select switch to either the “Alkaline” or “Lithium” position depending on the type of battery being used. Reconnect the external battery if equipped. (For units manufactured prior to June 2017 reinstall the D cell batteries into the unit.)
3. The green LED indicator on the right side of the unit will begin to flash in one-second intervals.
4. Download the “8800 GeoNet Firmware Update Package” from geokon.com/Software.
5. Right click on the download file and choose “Extract All...”.

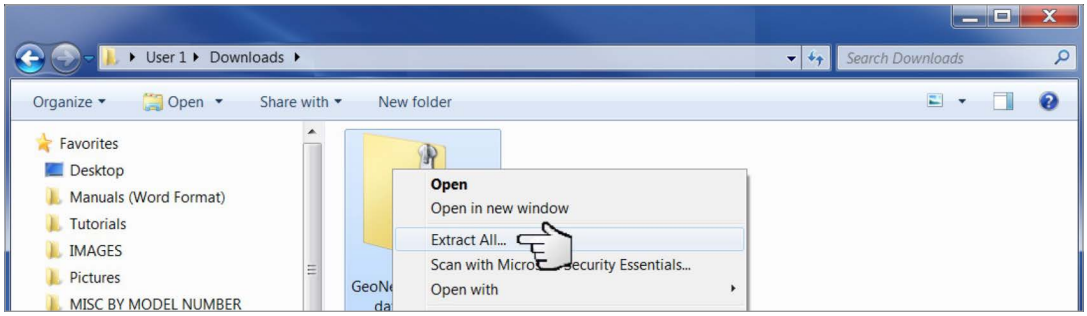


FIGURE 61: *Extract File*

6. When prompted click “Extract All”.
7. Select a destination for the files and then click “Extract”.

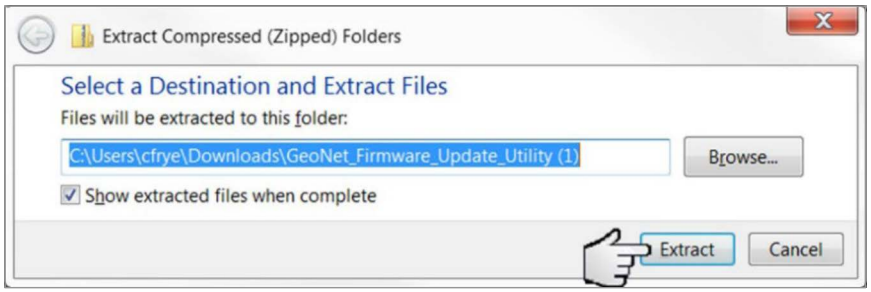


FIGURE 62: *Select Destination, then Click Extract*

8. Open “GeoNetUpdateUtility.exe” file. (If a security warning appears, click “Run”).

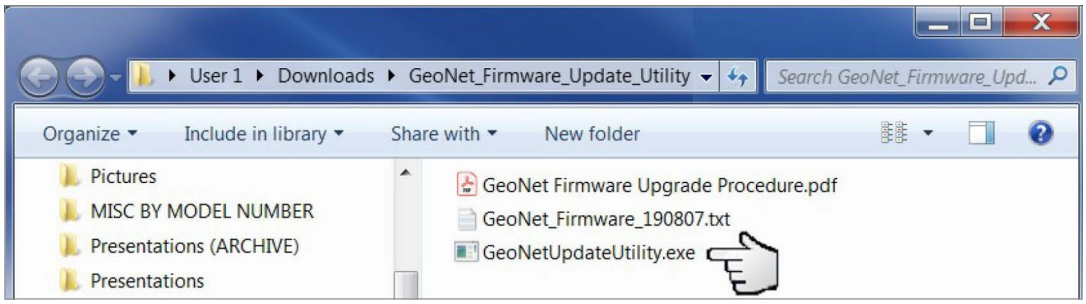


FIGURE 63: *Open the GeoNet Update Utility Application*

9. Click “Select File”.

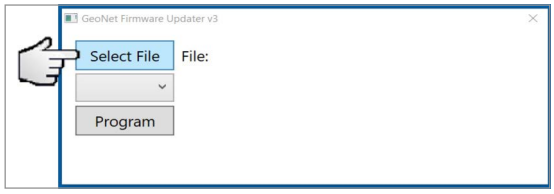


FIGURE 64: *Click on “Select File”*

10. Double click on the .txt firmware file. (Firmware files are named in the following format: "GeoNet_Firmware_YYMMDD.txt", where YY is the last two digits of the year, MM is the month, and DD is the day of the month.)

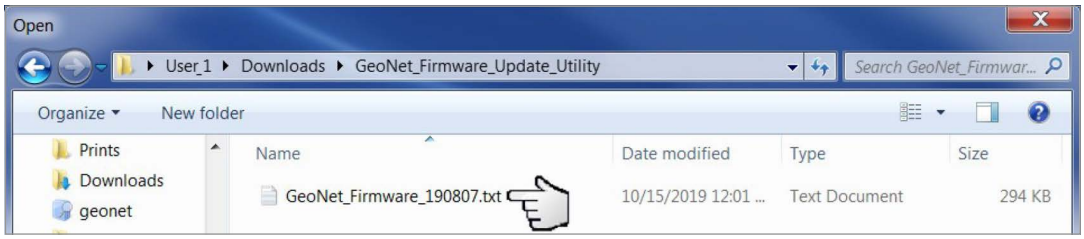


FIGURE 65: *Double Click on Firmware Text File*

11. Using the drop-down box below the "Select File" button, select the correct serial port for the 8001-7 cable. To identify which serial port the unit is connected to, complete the following:
    a. Unplug the 8001-7 cable from the PC.
    b. Go to the "Control Panel" then open "Device Manager".
    c. Click on the triangle to the left of "Ports (COM & LPT)" to expand the list.
    d. Plug the cable back into the computer and the port will appear in the list.

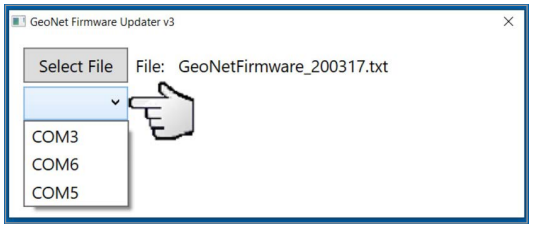


FIGURE 66: *Select COM Port*

12. Click "Program".

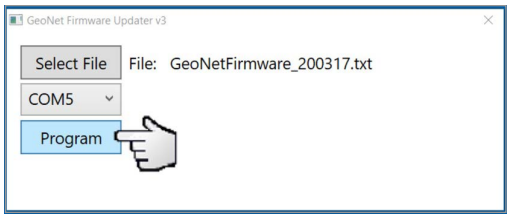


FIGURE 67: *Click on Program*

13. A progress bar will appear. The update process will normally take one to two minutes.
14. Once the update has finished, power off the unit by moving the battery select switch to the "OFF" position, or by disconnecting the external battery. (For units manufactured prior to June 2017, which do not have an OFF position, remove the D cells from the battery holder.)

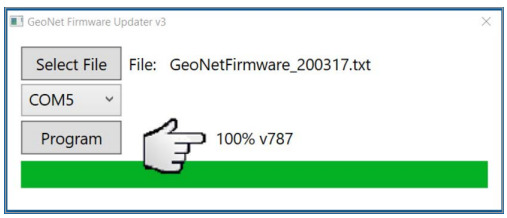


FIGURE 68: *Update Finished*

15. Ensure the unit is completely discharged of electrical potential by pressing the status button repeatedly until no LED lights flash.
16. Return the channel select dip switches to the desired channel setting.
17. Move the battery select switch to either the "Alkaline" or "Lithium" position depending on the type of battery being used. Reconnect the external battery if equipped. (For units manufactured prior to June 2017, reinstall the D cells into the unit.)
18. Repeat the above process with all the data loggers in the Network.

The firmware update is now complete.

I.3 FIRMWARE UPGRADE TROUBLESHOOTING

☐ Make sure the green light is flashing on and off in one second intervals.

☐ The B8800-5 multicolored update ribbon cable must be used on all units except for the RS-232 version Gateway.

☐ Updates should be done using the GEOKON provided 8001-7 USB to RS232 adapter. Other adapters and native serial ports have been unreliable.

☐ Make sure the batteries are fresh.

APPENDIX J. MODEL 8800-7, EXTERNAL 12V BATTERY CONVERSION CABLE

1. Remove the cover by unscrewing the four screws on the enclosure.
2. Turn the unit off and remove the batteries.
3. Remove the four flat head screws holding battery board in place.



FIGURE 69: *Remove Screws*

4. Carefully remove the battery board and set it aside.
5. Drill ½" hole in enclosure in the location shown below. (Do not use excessive force while drilling as it will internally damage the fiberglass box.)

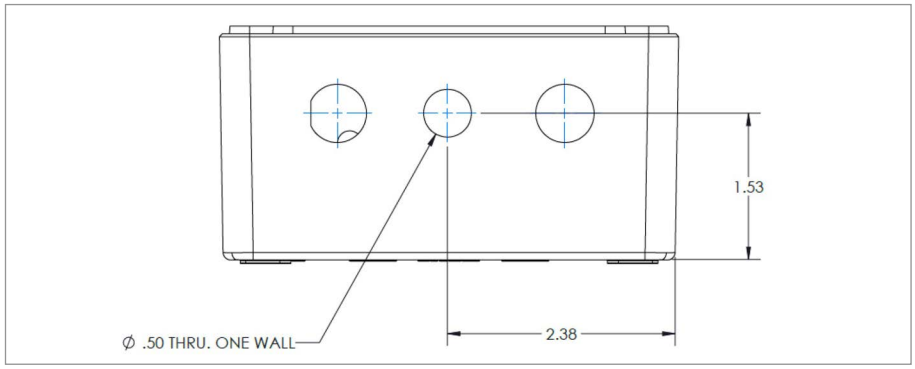


FIGURE 70: *Single-Channel Hole Location*

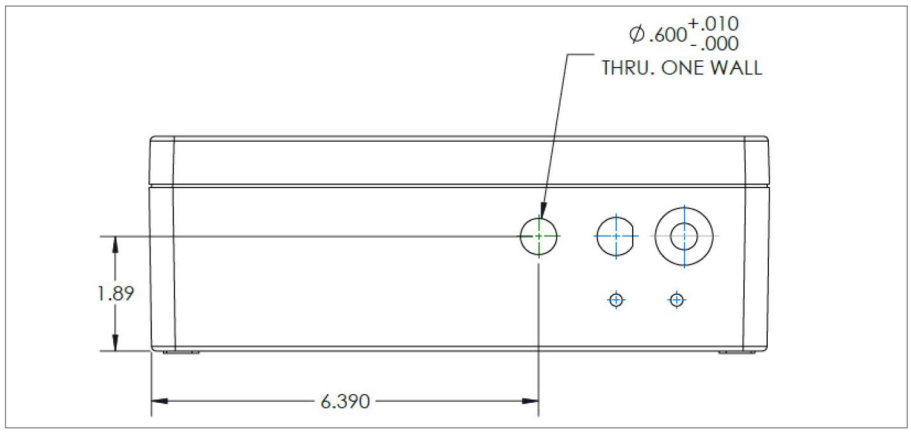


FIGURE 71: *Four-Channel Hole Location*

Note: For Eight-Channel enclosures only one of the cable entries, or the 485 IN/OUT entry, is typically not utilized and can be used for the 8800-7.

6. Remove the nut from the cable gland. Insert the threaded end of the cable gland into the drilled hole.
7. Install the nut on the cable gland and tighten. (The flat side of the nut should face the enclosure.)
8. Locate the black and red twisted leads that terminate in a black 3-pin connector and unplug them from the board. (The location of the connector will vary depending on the board revision. See below.)

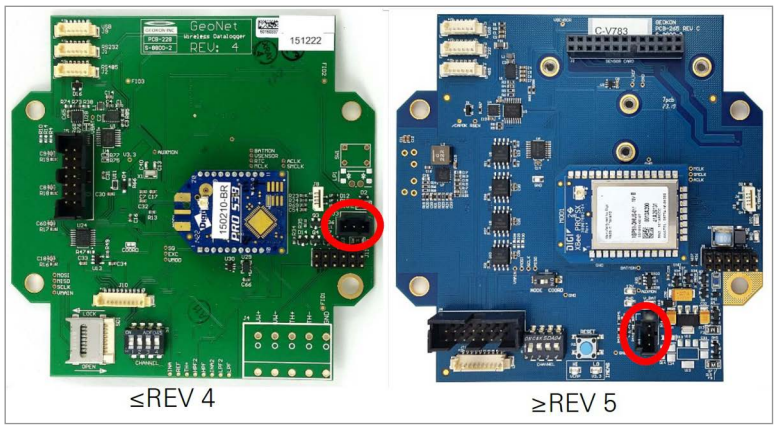


FIGURE 72: *3-Pin Connector Location*

9. Connect the 8800-7 to the same 3-pin connector (labeled J3 on the PCB).
10. Carefully place battery board back onto standoffs, making sure to align the holes in the board with the standoffs as shown below.

Note: There is a header (connector) on the underside of the battery board, which plugs into the board below it. If not lined up properly, the boards will not connect properly, and the unit will not function.

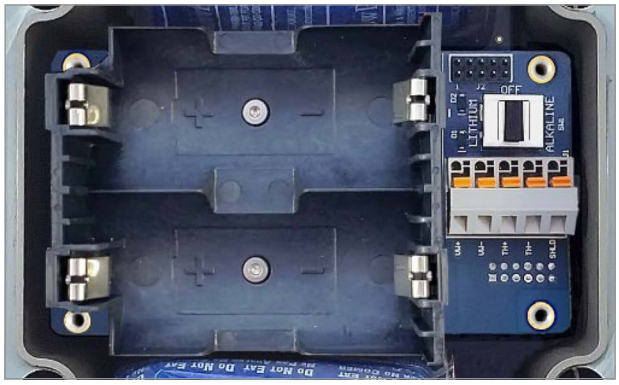


FIGURE 73: *PCB Aligned with Standoffs*

11. Re-install the four screws that hold the battery board in place.
12. Reinstall the D cells batteries and set the battery switch to the correct position. (The D-cell batteries provide a backup power source in case the 12V battery is depleted.)
13. Attach the appropriate connector (spade, ring, terminal, etc.) to the bare leads of 8800-7 so that it can be connected to the 12V battery. (The type of connector required depends on the type of battery being used.)
14. If an 8020-7-1 Solar Panel kit is being used, connect the solar panel directly to the battery terminal posts using the battery clip leads. Refer to Appendix B for solar panel mounting instructions.

APPENDIX K. VIBRATING WIRE LOAD CELL WIRING

K.1 WIRING SINGLE LOAD CELL

8CH Interface[1]	Function	3-Gauge Load Cell Violet Cable	4-Gauge Load Cell Violet Cable	6 Gauge Load Cell Orange Cable
Channel 1 VW+	Gauge #1	Red	Red	Red
Channel 2 VW+	Gauge #2	Red's Black	Red's Black	Red's Black
Channel 3 VW+	Gauge #3	White	White	White
Channel 4 VW+	Gauge #4	NC	White's Black	White's Black
Channel 5 VW+	Gauge #5	NC	NC	Green
Channel 6 VW+	Gauge #6	NC	NC	Green's Black
Channel 1 SHD	Shield	All Shields	All Shields	All Shields
VW- Channels[2]	Common	White's Black[3]	Green	Blue
Channel 1 TH +	Thermistor	Green[3]	Blue	Yellow
Channel 1 TH -	Thermistor	Green's Black	Blue's Black	Yellow's Black

TABLE 32: *Single Load Cell Wiring*

Note:

[1] Where second Load Cell is being included, retain relative channel position count up from channel 5.

[2] Common "VW-" between all channels associated with each VW Load Cell

[3] White's black and Green wires are switched on GEOKON three-gauge VW load cells prior to serial number 3313.

K.2 LOAD CELL CONFIGURATION SWITCH SETTINGS

POS 1	POS 2	POS 3	Configuration
OFF	OFF	OFF	Std. No Load Cell
ON	OFF	OFF	One 3-Gauge Load Cell
OFF	ON	OFF	One 4-Gauge Load Cell
ON	ON	OFF	Two 3-Gauge Load Cells, second starting at channel 5
OFF	OFF	ON	Two 4-Gauge Load Cells, second starting at channel 5
ON	OFF	ON	One 3-Gauge Load Cell & One 4-Gauge Load Cell starting at channel 5
OFF	ON	ON	One 4-Gauge Load Cell & One 3-Gauge Load Cell starting at channel 5
ON	ON	ON	One 6-Gauge Load Cell

TABLE 33: *Load Cell Configuration Switch Settings*

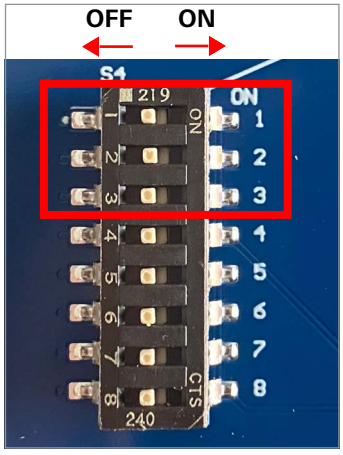


FIGURE 74: *Load Cell Configuration Switch*

APPENDIX L. CERTIFICATIONS

1 Assessment

The following device as further described in section 3 of this report meets applicable criteria specified in the Code of Federal Regulations Title 47 parts 15B and ICES-003 Issue 6, as it has been evaluated against the standards mentioned above under this section.

No deficiencies were ascertained.

Company	Description	Model
Geokon	Low power, wireless, data acquisition network	Geonet 8900

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2019-04-23	Compliance	Cindy Li (Lab Manager)	

Responsible for the Report:

Date	Section	Name	Signature
2019-04-23	Compliance	Chin Ming Lui (Associate EMC Engineer)	

The test results of this test report relate exclusively to the test item specified in Section3. CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
EMC Lab Manager:	Cindy Li
Responsible Project Leader:	Isabel Wang

2.1 Identification of the Client

Applicant's Name:	Geokon
Street Address:	48 Spencer Street
City/Zip Code	Lebanon, NH 03766
Country	USA

2.2 Identification of the Manufacturer

Manufacturer's Name:	Same as Client----------
Manufacturers Address:	----------
City/Zip Code	----------
Country	----------

3 Equipment under Test (EUT)

3.1 EUT Specifications

Marketing name:	Geonet 8900
Power Supply/ Rated Operating Voltage Range:	Low 2.0 VDC, Nominal 3.3 VDC, High 12 VDC
Operating Temperature Range:	Low -40 ºC, High 85 ºC
Radios included in the device:	❖ IEEE 802.15.4 FHSS: • Module name: Digi X-Bee-PRO 900 HP • Model number: XBP9B-DMUT-002 • FCC ID: MCQ-XB900HP • IC ID: 1846A-XB900HP • Main Antenna: ▪ Type: Half-wave dipole ▪ Location: External ▪ Gain: 2.1 dBi
Radios Co-location:	NO
Sample Revision:	☐Prototype Unit; ☐Production Unit; ■Pre-Production
EUT Dimensions [mm]:	122 X 120 X 91
Weight [grams]:	1000
EUT Diameter:	■ < 60 cm ☐ Other _____

GEOKON®

GEOKON
48 Spencer Street
Lebanon, New Hampshire
03766, USA

Phone: +1 (603) 448-1562
Email: teamsales@geokon.com
Website: www.geokon.com

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