Model 8910 Series

GeoNet Wireless LoRa®

Data Acquisition System

Instruction Manual

GEOKON®

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WARRANTY STATEMENT

GEOKON warrants its products to be free of defects in materials and workmanship, under normal use and service for a period of 13 months from date of purchase. If the unit should malfunction, it must be returned to the factory for evaluation, freight prepaid. Upon examination by GEOKON, if the unit is found to be defective, it will be repaired or replaced at no charge. However, the WARRANTY IS VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion or current, heat, moisture or vibration, improper specification, misapplication, misuse or other operating conditions outside of GEOKON's control. Components that wear or are damaged by misuse are not warranted. This includes fuses and batteries.

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1. INTRODUCTION

The Model 8910 GeoNet Wireless Data Acquisition system utilizes LoRa® radio technology and consists of a gateway and wireless data loggers that transmit data collected from the connected sensors. The GEOKON gateway controls the network and is the aggregator of all the data from the loggers in the system.

The loggers can also operate using LoRaWAN protocol for use with LoRaWAN third-party gateways. The LoRaWAN deployment is typically done in an enterprise application and requires Geokon to provide custom applications depending on the client specified architecture and IT security settings.

The GEOKON gateway transfers 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 loggers, change settings, configure sensor channels, and view current logger status.

OpenAPI Portal

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 and RS-485 (using MODBUS protocol) instruments. Sensor cables are connected through cable glands. For multi-sensor instruments such as load cells and thermistor strings, a multichannel logger with a single cable gland entry is used.

Software Resources

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

Model 8960 Digital Vibrating Wire Interfaces can be connected to GeoNet Multi-Channel, Addressable, and Digital High Power Loggers to expand the capacity of the logger when used to connect to vibrating wire sensors (See Section 4.9).

Rechargeable versions of the loggers, equipped with lithium ion (or in the case of a DHP logger, sealed lead acid) batteries, are also available.

FEATURES:

- Automated data connection to servers
- Automated calculation of engineering units via Web API integration with the GEOKON database
- Up to 8 channels (4 auto configurable)
- Rugged, IP 68 rated to 1.5 m (5 feet) die-cast aluminum enclosure with pressure compensation vent to prevent condensation buildup in humid climates.
- USB-C connector for firmware updates, diagnostics, and more

1.1 8910 MODEL LIST

	Model Number	Description	Network	Sensor Cable Entry
Gateway	8910-GTW-LTE	Cellular Gateway	Cellular, LTE	Not Applicable
	8910-GTW-LTM		Cellular, LTM	
	8910-GTW-SAT*	Satellite Gateway	Satellite	
Logger	8910-01C-CBL	Single Channel Vibrating Wire Logger	Star Topology to the Gateway	Cable Gland
	8910-01C-CBL-R	Single Channel Vibrating Wire Logger, Rechargeable		
	8910-08C-CBL	Eight-Channel Vibrating Wire Logger		
	8910-08C-CBL-R	Eight-Channel Vibrating Wire Logger, Rechargeable		
	8910-ADR-CBL	Addressable Logger, RS-485		
	8910-ADR-CBL-R	Addressable Logger, RS-485, Rechargeable		
	8910-ANA-CBL*	Four-Channel Analog Logger		
	8910-ANA-CBL-R*	Four-Channel Analog Logger, Rechargeable		
	8910-DHP-CBL	Digital High Power Logger, RS-485, Rechargeable		
	8910-TLT-NAP	Tilt Logger		Not Applicable
	8910-TLT-NAP-R	Tilt Logger, Rechargeable		

TABLE 1: *List of Model 8910 LoRa Loggers*

Note: *Currently unavailable for purchase - coming soon!

1.2 INCLUDED ACCESSORIES

GeoNet Product Line	Part Number	Description	Quantity
Gateways	ELC-824	Antenna	2
Rechargeable (-R or DHP) Loggers	ELC-1051	Antenna	1
All other Loggers (Non-Rechargeable)	ELC-1051	Antenna	1
	BAT-202 (Pre-installed inside the logger)	Lithium D-Cell Batteries	2

TABLE 2: *List of Included Accessories by GeoNet Product Line*

1.3 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.
Other	8900-SOL-10W-USB	10 Watt solar panel.
	KIT-GEONET-C-T20, including: COM-169 TLS-112 TLS-641	**Accessory Kit, including:** USB 2.0 A Male to C Male Cable 3/32" Flat Head Screwdriver T20 Torx Key

TABLE 3: *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 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.The gateway transfers collected data to the GEOKON Cloud data storage platform via a cellular network. (GeoNet Cellular Gateways are compatible with all major LTM or LTE-CAT1 networks except Verizon.) Gateways must be connected to a solar panel or other external power supply.

OpenAPI Portal

Users can activate and deactivate the data transmission online via the GEOKON API Portal at api.geokon.com.

FIGURE 1: *Gateway*

2.2 WIRELESS LOGGERS

Wireless loggers collect data from external and internal sensors and transmit it to the gateway. Each logger contains internal sensors for battery, temperature, signal strength, etc. External sensor cables are connected through cable glands. Loggers are equipped with either D-cell batteries or a rechargeable lithium ion (or in the case of a DHP logger, sealed lead acid) batteries. Rechargeable loggers must be connected to a solar panel or other external power supply.

2.2.1 SINGLE-CHANNEL VIBRATING WIRE LOGGER

Single-channel vibrating wire loggers will read one GEOKON vibrating wire gauge and integral thermistor.

FIGURE 2: *Single-Channel Logger*

2.2.2 EIGHT-CHANNEL VIBRATING WIRE LOGGER

Eight-channel vibrating wire loggers will read up to eight GEOKON vibrating wire gauges and integral thermistors.

FIGURE 3: *Eight-Channel Logger*

An eight-channel 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 G for load cell wiring tables*

TABLE 4: *Eight-Channel Logger Gauge/Load Limits*

2.2.3 ADDRESSABLE (RS-485) LOGGER

Addressable loggers are compatible with GEOKON Digital Addressable MEMS products and are capable of reading up to 90 GEOKON MEMS sensors.

FIGURE 4: *Addressable Logger*

2.2.4 DIGITAL HIGH POWER (RS-485) LOGGER

Digital High Power (DHP) loggers are compatible with GEOKON Digital Addressable MEMS products. Loggers are capable of reading up to 250 GEOKON MEMS sensors or 500 GEOKON 6140 Sensors. They are also capable of reading non-GEOKON sensors that utilize RS-485 MODBUS communication protocol. DHP loggers are equipped with a rechargeable battery and must be connected to a solar panel or other external power supply.

FIGURE 5: *Digital High Power Logger*

2.2.5 TILT LOGGER

Tilt 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).

Tilt loggers have two serial numbers, one for the tilt logger and one for the internal tiltmeter.

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

FIGURE 6: *Tilt Logger*

3. NETWORK TOPOLOGY

The Model 8910 GeoNet Wireless Data Acquisition utilizes LoRa radio technology. The system topology takes the form of a star network. All loggers communicate directly with the gateway.

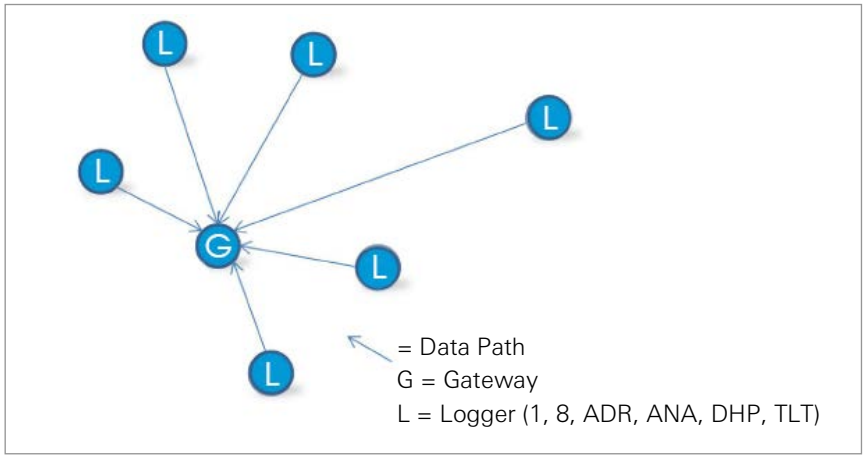

FIGURE 7: *Star Network Topology*

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

The 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.

Fresnel zone must be at least 60% obstruction-free to ensure optimal wireless communication. The Figure 8 illustrates the 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.

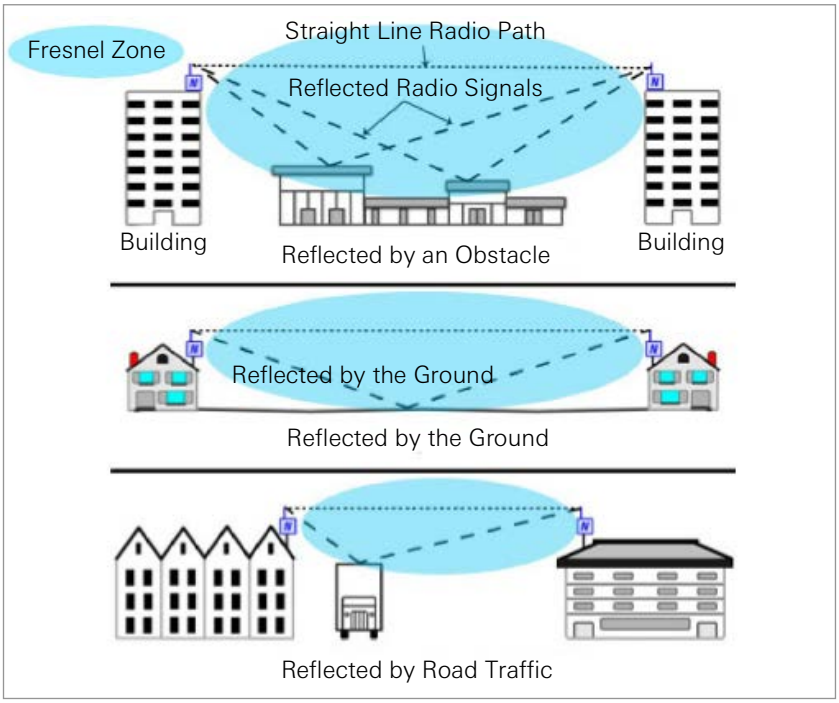

FIGURE 8: *Fresnel Zone*

4. INSTALLATION

4.1 STATUS BUTTON & LED STATUS INDICATORS

All GeoNet devices have red and green LED indicators to display their status. When pressed, the status button triggers the appropriate LED indicators to briefly illuminate.

Table 5 shows the meaning of the various LED indications.

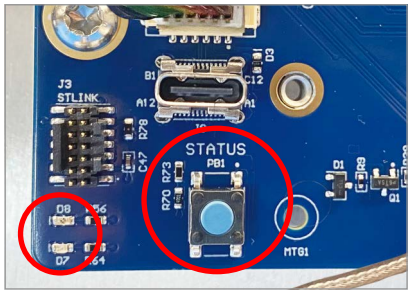

FIGURE 9: *LED Location (Left) and Status Button (Right)*

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

TABLE 5: *LED Indicator Meaning*

When the status button is pressed on the gateway, the LEDs briefly display the network status. 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.

When the status button is pressed on a logger, the LEDs briefly display the radio signal status. The logger will indicate the status of the radio signal after each radio transmission for a period of 10 minutes. If a 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 Logger	Press and hold until both LEDs illuminate (approximately 10 seconds)	✓ Reset the device
Gateway	Press and release	✓ Take a reading and send existing data immediately ✓ Display device status
Logger	Press and release	✓ Display the current status ✓ Indicate signal strength every radio cycle for 10 minutes

TABLE 6: *Status Button Functions*

4.2 INSTALLATION OVERVIEW

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. Open the covers
2. Install the antennas
3. Power the gateway
4. Verify network connectivity
5. Register and configure the gateway
6. Seal the gateway
7. Expanding logger capacity (optional)
8. Mount the devices
9. Connect an earth ground
10. Connect the sensors
11. Power and configure the loggers
12. Seal the loggers

4.3 OPEN THE COVERS

Open the covers of all devices in the network by wedging open the latch on the right-hand side. (If needed, use a flathead screwdriver for leverage.) Unscrew the two Torx screws beneath the latch with the provided Torx key. Open the cover.

Important! Ensure that no dirt, water, or other contaminants enter the enclosure.

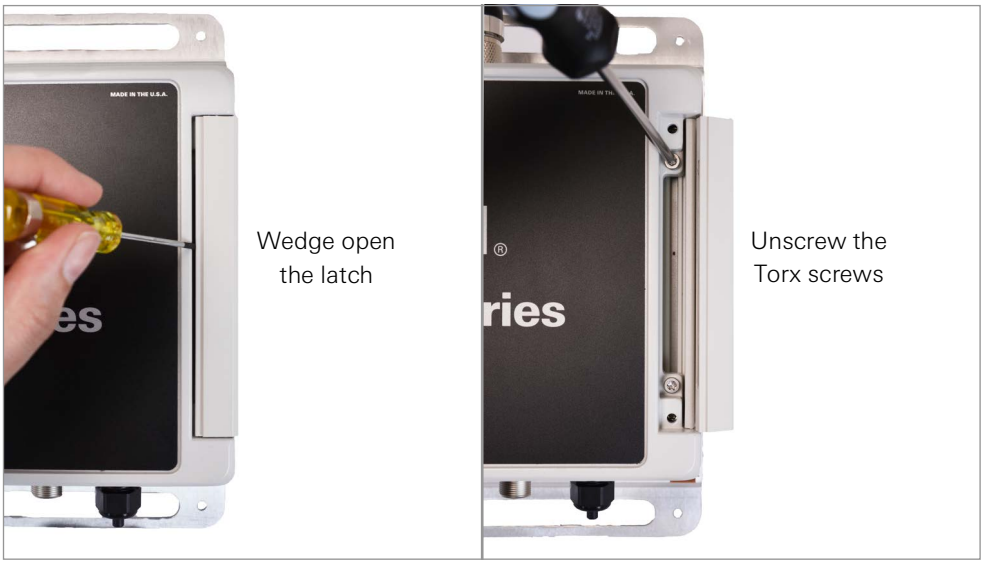

FIGURE 10: *Open the Cover*

4.4 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 gateway antennae must be flush with the enclosure to prevent water entry.

4.5 POWER THE GATEWAY

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

Connect the gateway to an external power source with the provided USB-C connector, or connect to a solar panel (See Appendix B for solar panel installation).

Move the battery switch (Figure 11) to the ON position. (The battery switch is located on the battery board inside the enclosure.) The green battery LED will flash twice, indicating the unit has power.

Green LED	Blue LED	Charge State
Off	Off	No Power
On	On	Bulk
Off	On	Absorption
On	Off	Float (Fully Charged)

TABLE 7: *Battery Board LED Indicator Meaning*

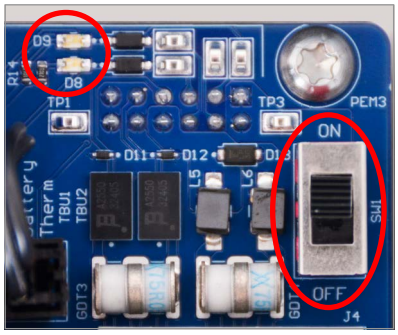

FIGURE 11: *Gateway Battery LED Location (Left) and Switch (Right)*

4.6 VERIFY NETWORK CONNECTIVITY

Gateways will set the network time automatically when they connect to the network.* (Cellular gateways will normally connect to the network within approximately five minutes.)

Verify the network connection has been made by pressing the status button. The status 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.

4.7 REGISTER AND CONFIGURE THE GATEWAY

OpenAPI Portal

Register the gateway by entering the Serial Number in the GEOKON API portal: api.geokon.com. Select the option to activate network service.

Configuring the gateway is optional and only required if the factory settings (see below) need to be modified. A gateway can be configured either through the Network using the GEOKON API portal, or through manual connection using the Logger Config software.

GEONET 8910 GATEWAY AND LOGGER FACTORY SETTINGS:

- **Mode -** Star (for operation with GeoNet Gateways sending data to the Geokon Cloud)
- **Region -** US915 (see LoRa Alliance reference for application frequency settings for your region) https://lora-alliance.org/wp-content/uploads/2020/11/rp_2-1.0.1.pdf.
- **Channel -** Gateways are set sequentially on channels 1-4 (channels 1-4 allow for nodes to automatically configure using the seek setting). Channels 5-8 are user selectable and gateways and loggers need to be manually set.
- **Seek -** Default on for loggers. Allows the logger to connect to the closet gateway set to an auto-configurable channel (ie. Ch 1-4).

LoRa Alliance

For most applications the gateways should be deployed on auto-configured channels (1-4), and loggers should be deployed in "seek" mode. This allows for a rapid network deployment and allows for load balancing of the network traffic across the radio frequency band. In some cases where it is desired to have specific loggers to connect to specific gateways, or if there are multiple API user accounts with gateways in the same range of the radios, user selectable channels may be desired. Multiple gateways can be set on the same channel and the loggers will still load balance between gateways.

Note: For LoRaWAN applications additional gateway/network settings are required from the network administrator.

4.7.1 CONFIGURE THE GATEWAY VIA THE API PORTAL (OVER THE NETWORK)

Use the GEOKON API portal to configure the GeoNet Gateway if required.

Select the appropriate gateway settings from the dropdown menus under the ISM Config section. Select **Update ISM Config**.

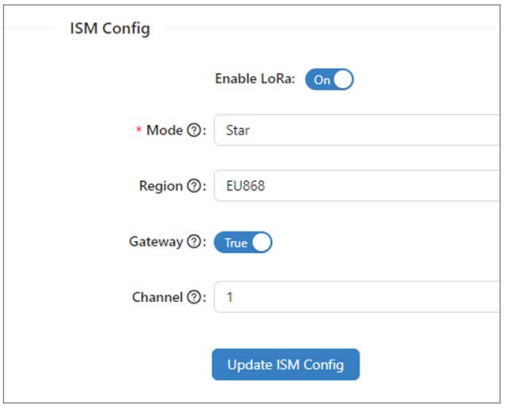

FIGURE 12: *Configuring Using the API Portal*

4.7.2 CONFIGURE THE GATEWAY VIA LOGGER CONFIG SOFTWARE (MANUAL CONNECTION)

Connect the gateway to a laptop with the provided USB-C connector.

Download and launch a VCP driver, this will allow the gateway/logger to be recognized through the USB port on a computer:

VCP Driver

https://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers?tab=downloads

Download and Launch the Logger Config Program:

Logger Config

https://geokoninstallers.blob.core.windows.net/loggerconfigrelease/Publish.html

Select **Read Settings** and select the appropriate gateway settings from the dropdown menus. Select **Apply Above Settings** (Figure 13).

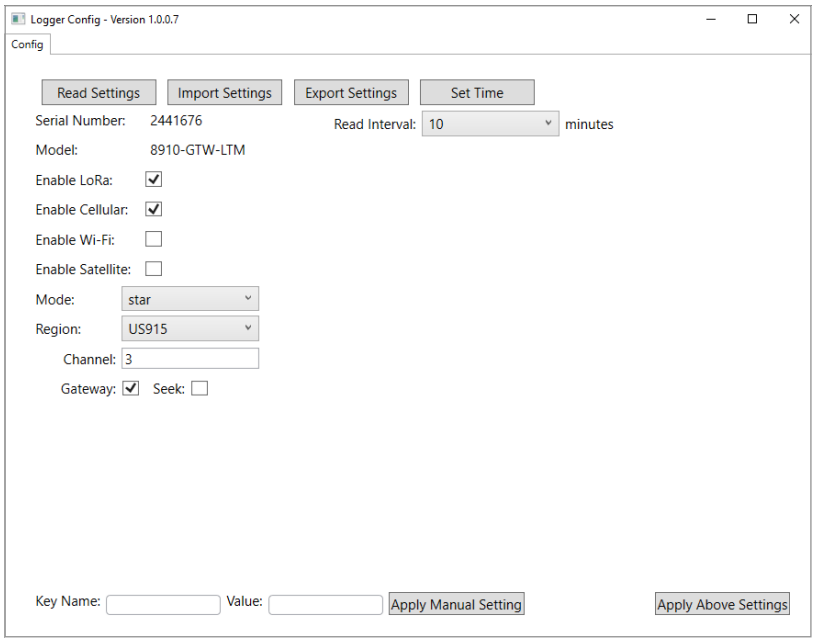

FIGURE 13: *Configuring Using Logger Config*

4.8 SEAL THE GATEWAY

1. Make sure the cover gasket and the mating ridge on the enclosure are clean.
2. Close the cover and tighten the two Torx screws.
3. Push the latch firmly closed onto the cover.
4. Record the serial number of the gateway. (The serial numbers are used for identification purposes in the API portal and Agent software.)

4.9 EXPANDING LOGGER CAPACITY (OPTIONAL)

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Model 8960 Digital Vibrating Wire interfaces can be connected to GeoNet Multi-Channel, Addressable, and Digital High Power Loggers to expand the capacity of the logger. Multiple VW interfaces can be daisy-chained together to bus the data to a single logger. The bus limit is 32 units or 64 Channels.

Refer to the Model 8960 Instruction Manual for information on how to connect a 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 logger has been powered on.

4.10 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 information.)

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

Examples of incorrect mounting configurations are shown in the following figures. Figures are for reference use only.

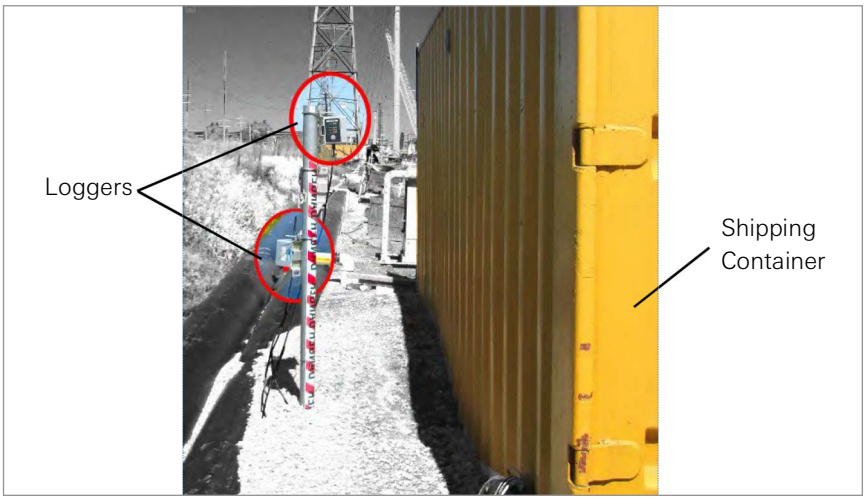

FIGURE 14: *Installing Near a Large or Metallic Object*

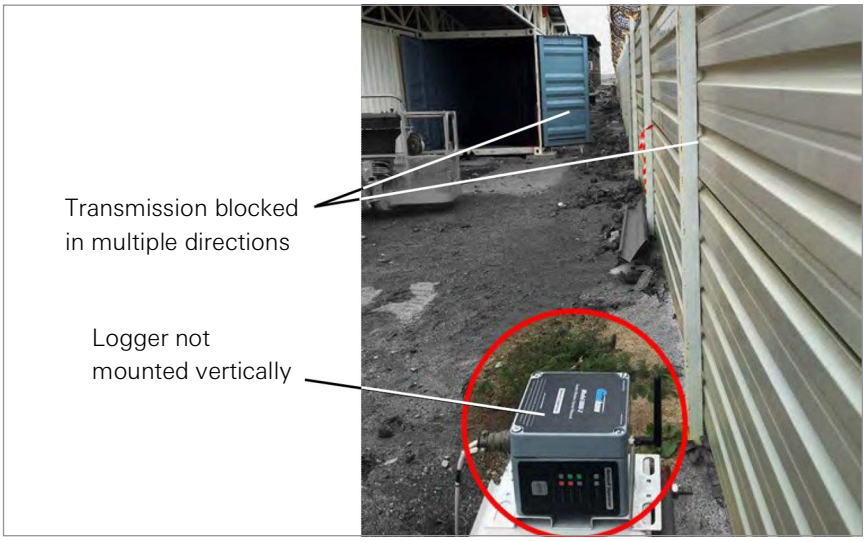

FIGURE 15: *Installing Close to Buildings or Fences/Walls, and/or Horizontally*

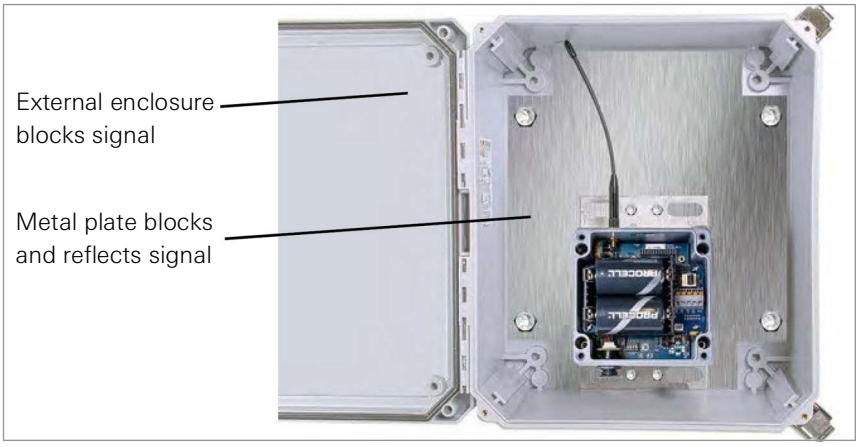

FIGURE 16: *Mounting onto a Metal Plate and/or Inside an Enclosure*

4.11 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.

4.12 CONNECT THE SENSORS

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

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

To connect a sensor:

1. Loosen the nut on the cable fitting and remove the black 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 Table 8 and 9, and in Figure 17.

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 Logger		
Position	**Color**	**Description**
VW+	RED	Vibrating Wire+
VW-	BLACK	Vibrating Wire-
TH+	WHITE	Thermistor+
TH-	GREEN	Thermistor-
SHD	BARE	Analog Ground (Shield)

TABLE 8: *Vibrating Wire Logger Wiring*

Addressable and DHP (RS-485) 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 9: *Addressable and DHP (RS-485) Logger Wiring*

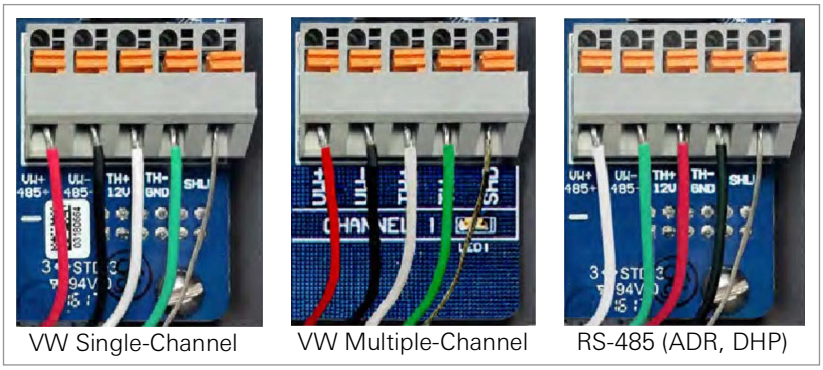

FIGURE 17: *Terminal Connections*

4.13 POWER AND CONFIGURE THE LOGGERS

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

If using D-cell batteries, align the positive (**+**) side of the batteries with the **+** indicator in the battery holder. Push the batteries straight down into the holder.

If equipped with a rechargeable sealed lead-acid battery, connect the logger to an external power source with the provided USB-C connector, or connect to a solar panel (See Appendix B for solar panel installation).

Move the battery switch (Figure 18) into the ON position. (The battery switch is located on the battery board inside the enclosure.) The green battery LED will flash twice, indicating the unit has power.

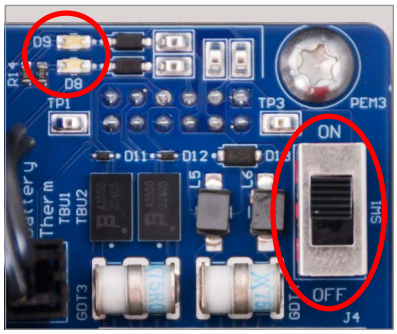

FIGURE 18: *Logger Battery Switch*

The logger will join the network approximately 30 seconds after power up, as indicated by the status LED(s) on the logger flashing in unison with the gateway.

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

If communication cannot be established 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.

To configure the loggers, if required, refer to Section 4.7.1 or Section 4.7.2.

4.14 SEAL THE LOGGERS

1. Record the serial number of the loggers and the attached sensors. For multiple-channel 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.
3. Close the cover and tighten the two Torx screws.
4. Push the latch firmly closed onto the cover.

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

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 it is properly aligned inside the lid, the screws that hold the lid in place are properly tightened, and the latch is closed.

Always mount the devices so that the cable entries are on the bottom. Ensure the cable gland fittings are securely tightened and that the black plastic dowels provided are used to plug cable entries which are not in use.

Despite these precautions, the 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 REPLACING BATTERIES

Replace D cell batteries when their measured voltage drops below 3.0 - 2.9 VDC.

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

Replace the batteries as follows:

1. Open the logger cover. Make sure that no dirt, water, or other contaminants are allowed to enter the enclosure.
2. Set the battery select switch to the OFF position.
3. Remove the existing batteries.
4. 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.
5. Move the battery select switch to the ON position. The green status LED inside the enclosure will flash twice, indicating the unit has power. Once the logger reconnects to the network, the green LED will blink every 10 seconds in unison with the LED inside the gateway.

APPENDIX A. TROUBLESHOOTING

Technical Support

For troubleshooting help, please visit geokon.com/Technical-Support.

APPENDIX B. SOLAR PANEL KIT

The GEOKON Solar Panel Kit enables you to power a gateway, digital high power, or rechargeable logger in an area that has no access to mains / domestic power.

FIGURE 19: *Solar Panel 8900-SOL-10W-USB*

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 20: *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. Turn on the gateway/logger and connect the power cable.

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.

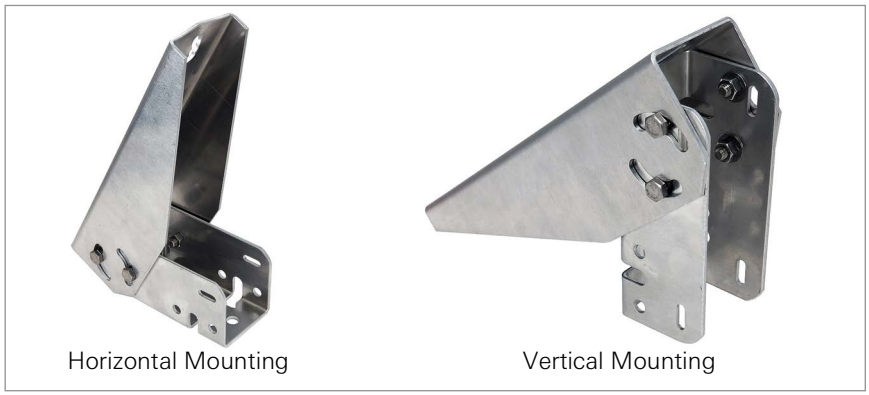

FIGURE 21: *Mounting Options*

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.

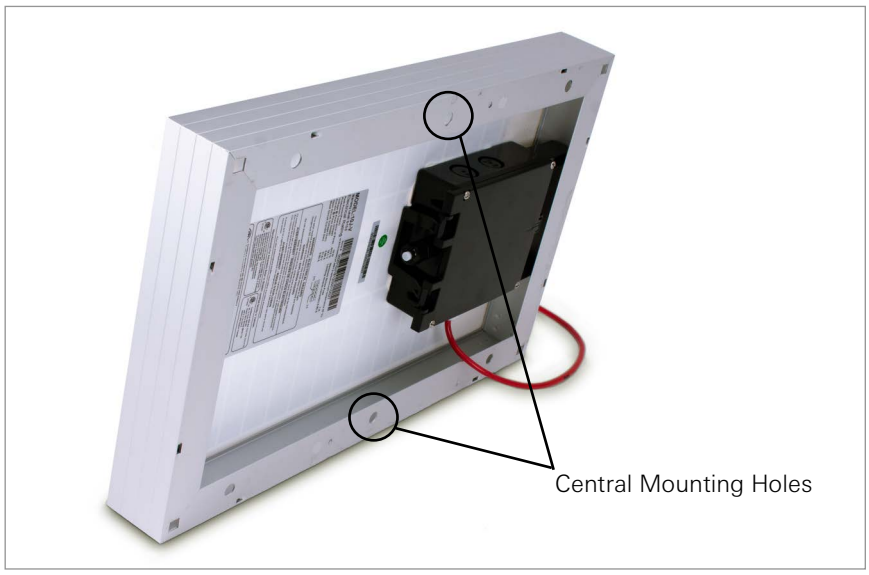

FIGURE 22: *Centrally Located Mounting Holes*

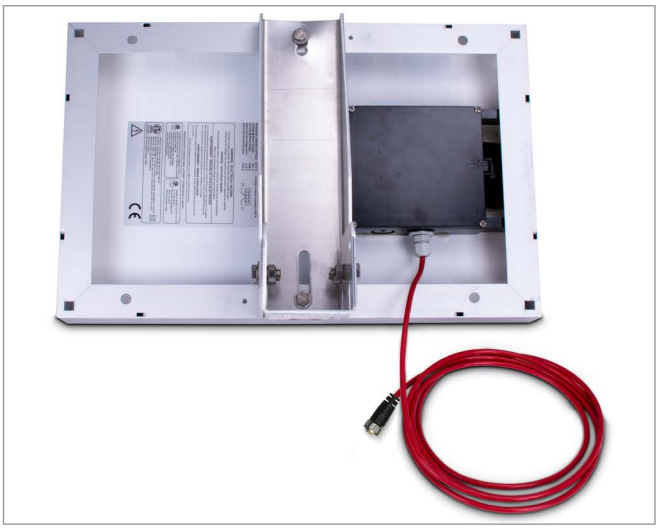

FIGURE 23: *Mounting Brackets Fastened Centrally*

B.5 CONNECT THE POWER CABLE

B.5.1 BATTERY SWITCH

Before connecting the power cable, be sure you have set the battery switch to the ON position.

B.5.2 MAKING THE CONNECTION

Remove the plastic cap from the cable connector, then attach it to the USB-C plug on the logger.

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

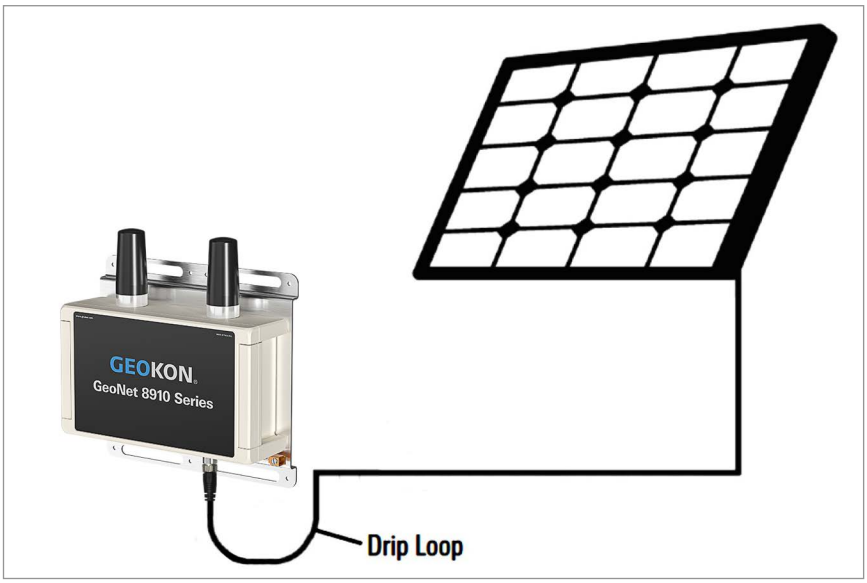

FIGURE 24: *Solar Panel with Model 8910 Gateway*

APPENDIX C. SPECIFICATIONS

C.1 NETWORK SPECIFICATIONS

Topology	Star
Radio Technology	LoRa / LoRaWAN
Radio Frequency, ISM Band	868-928 MHz (user selectable masking by region)
Channels	8 (4 auto configurable)
Range[1]	Up to 20 km in rural open areas with line of site Up to 5 km in urban areas.

TABLE 10: *Network Specifications*

Note:

[1] Outdoor, clear line-of-Sight. Depends on operating frequency.

C.2 GENERAL SPECIFICATIONS

Power Supply	GTW and DHP models: Internal sealed lead acid (SLA) battery pack, 4V, 10 Ah / 5-24V external All other models: 2x D cell, lithium, / 5-24V external
Operating Temperature	-40° C to +85° C (range varies by power source) (TLT model max of +65° C)
Temperature Accuracy	±0.5° C
Direct Connection Type	USB
Enclosure Material	Die-cast aluminum, IP 68 rated to 1.5 m (5 feet)
Enclosure Dimensions	See Appendix D

TABLE 11: *Gateway Specifications*

C.3 VIBRATING WIRE LOGGER SPECIFICATIONS

Trueness	0.082 Hz
Frequency Precision	±0.146 Hz (99% CI)
Frequency Resolution	±0.002 Hz
Enclosure VW Frequency Range	400-6500 Hz

TABLE 12: *Vibrating Wire Logger Specifications*

C.4 DIGITAL LOGGER (ADDRESSABLE AND DIGITAL HIGH POWER) SPECIFICATIONS

MEMS Sensor Limits	Non-rechargeable ADR: 32 sensors Rechargeable ADR: 64 sensors (90 sensors, with the sensor string powered via external 12 V power supply) DHP: 250 MEMS or 500 Model 6140 MEMS Sensors
Communication Protocol	RS-485 Modbus

TABLE 13: *Digital Logger (Addressable and Digital High Power) Specifications*

C.5 TILT 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

TABLE 14: *Tilt 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. UNIT DIMENSIONS

D.1 GATEWAY (GTW) MODELS

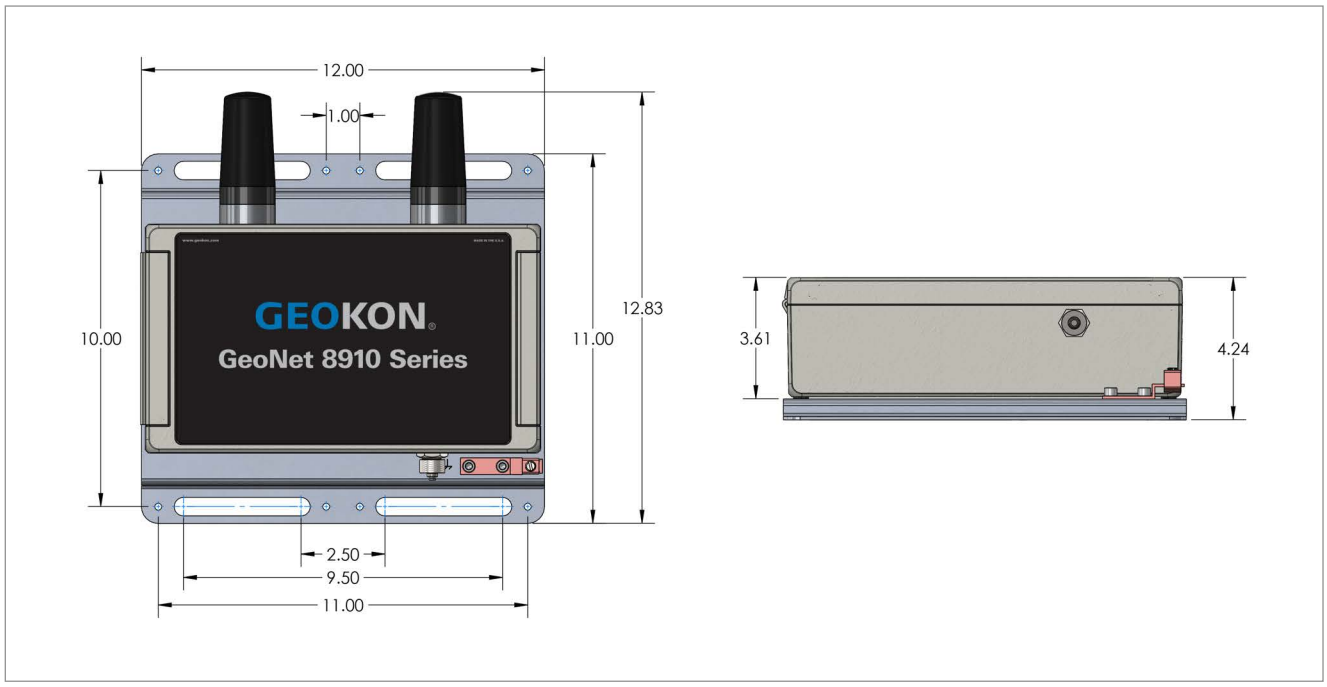

FIGURE 25: *Gateway (GTW) Models*

D.2 SINGLE-CHANNEL (01C) AND ADDRESSABLE (ADR) MODELS

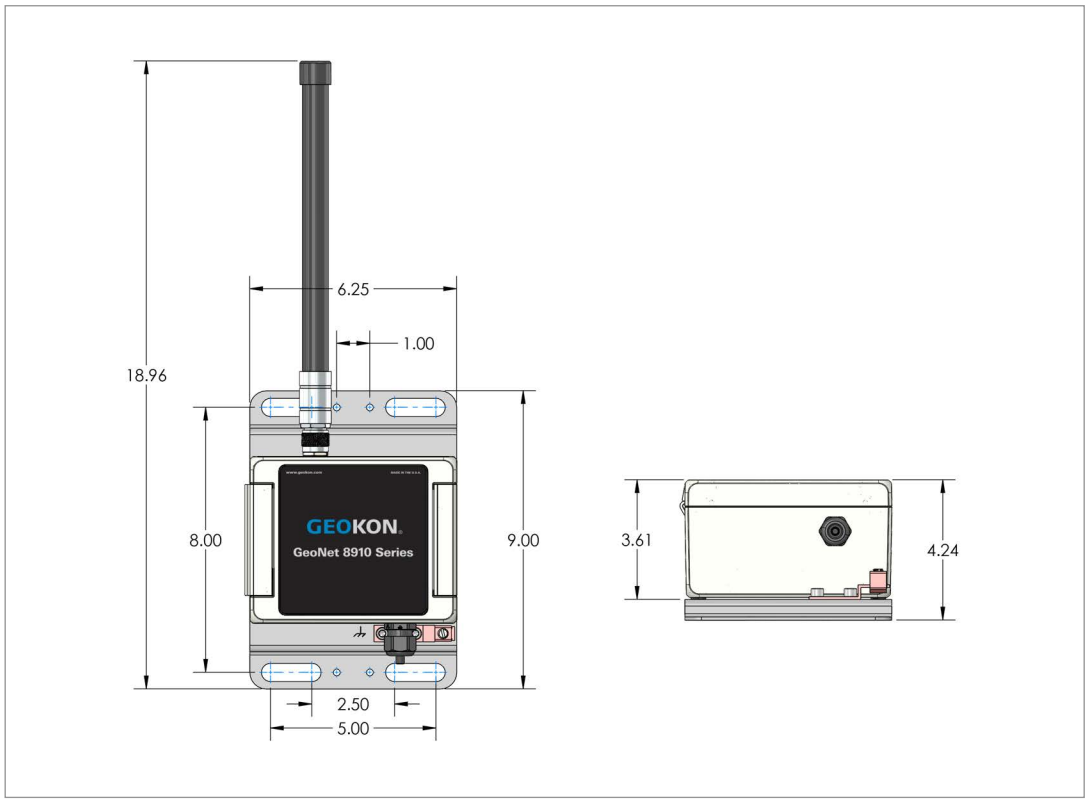

FIGURE 26: *Single-Channel (01C) and Addressable (ADR) Models*

D.3 EIGHT-CHANNEL (08C) AND DIGITAL HIGH POWER (DHP) MODELS

FIGURE 27: *Eight-Channel (08C) and Digital High Power (DHP) Models*

D.4 TILT (TLT) MODELS

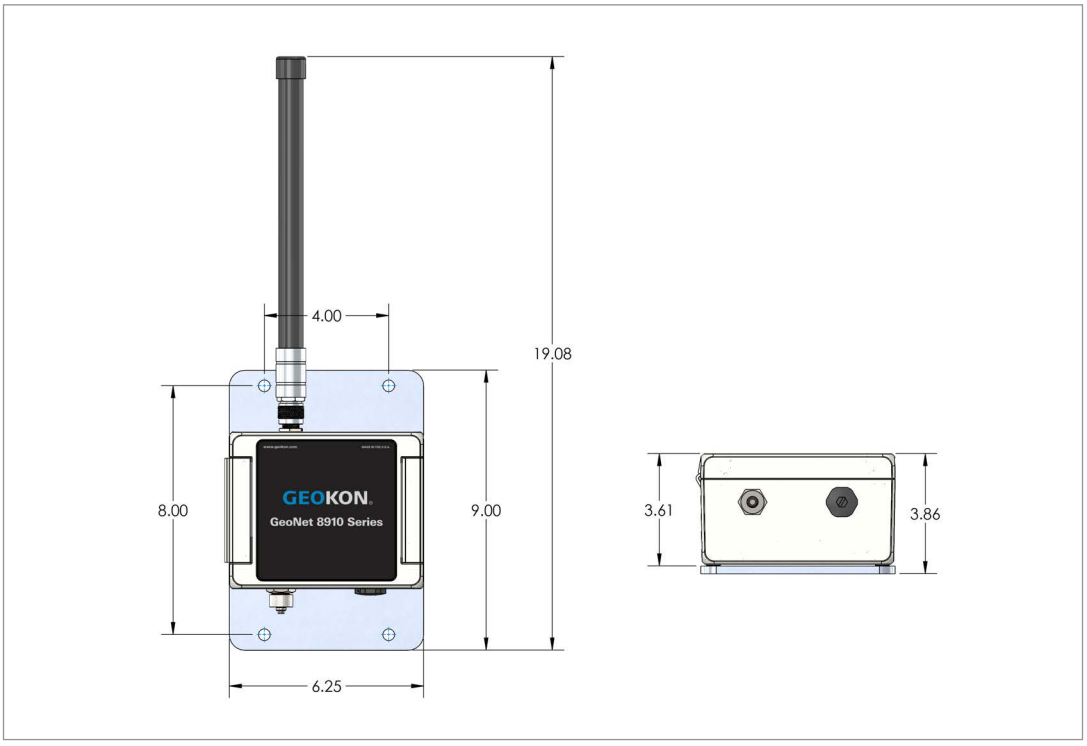

FIGURE 28: *Tilt (TLT) Models*

APPENDIX E. MOUNTING BRACKET DIMENSIONS

E.1 GATEWAY (GTW), EIGHT-CHANNEL (08C), AND DIGITAL HIGH POWER (DHP) MODELS

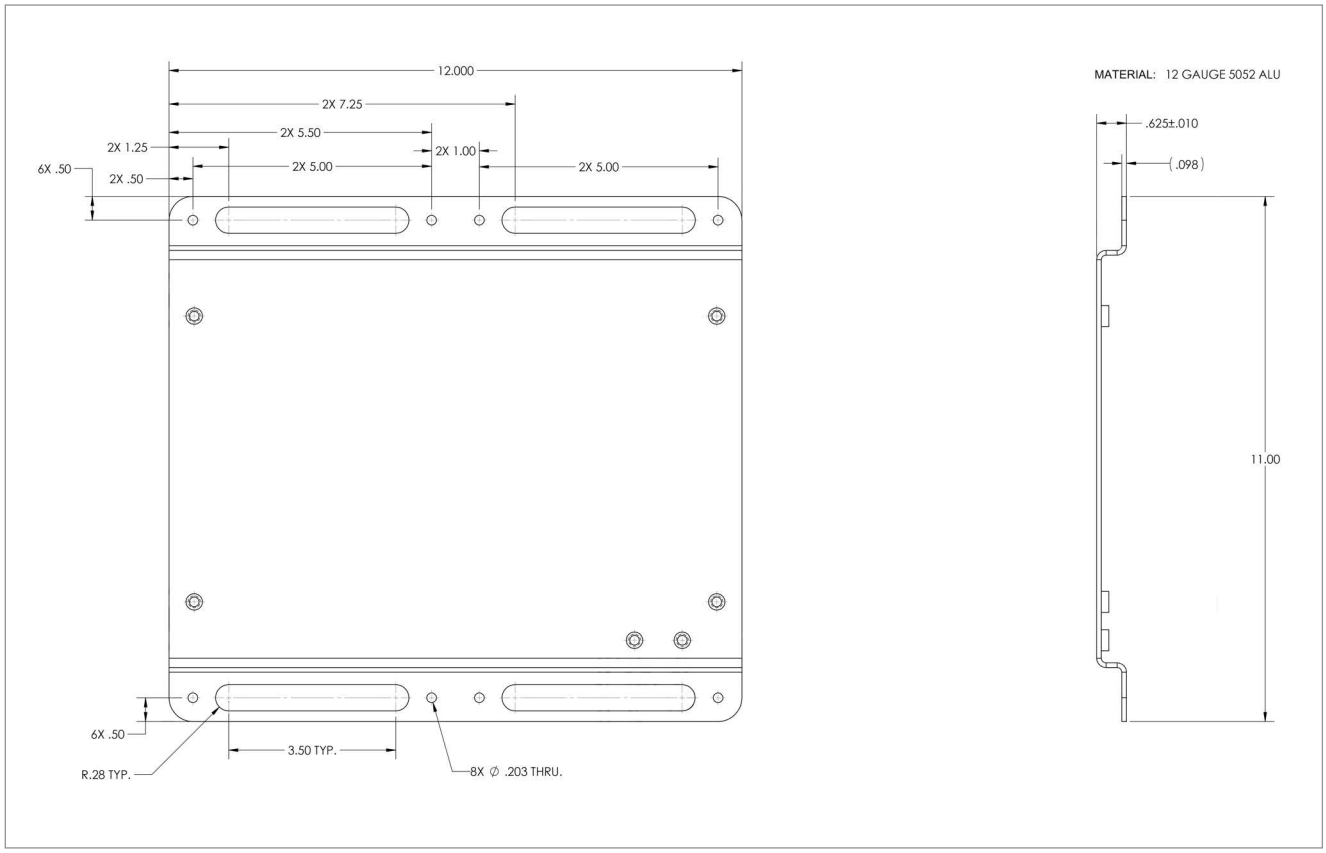

FIGURE 29: *Gateway (GTW), Eight-Channel (08C), and Digital High Power (DHP) Models*

E.2 SINGLE-CHANNEL (01C) AND ADDRESSABLE (ADR) MODELS

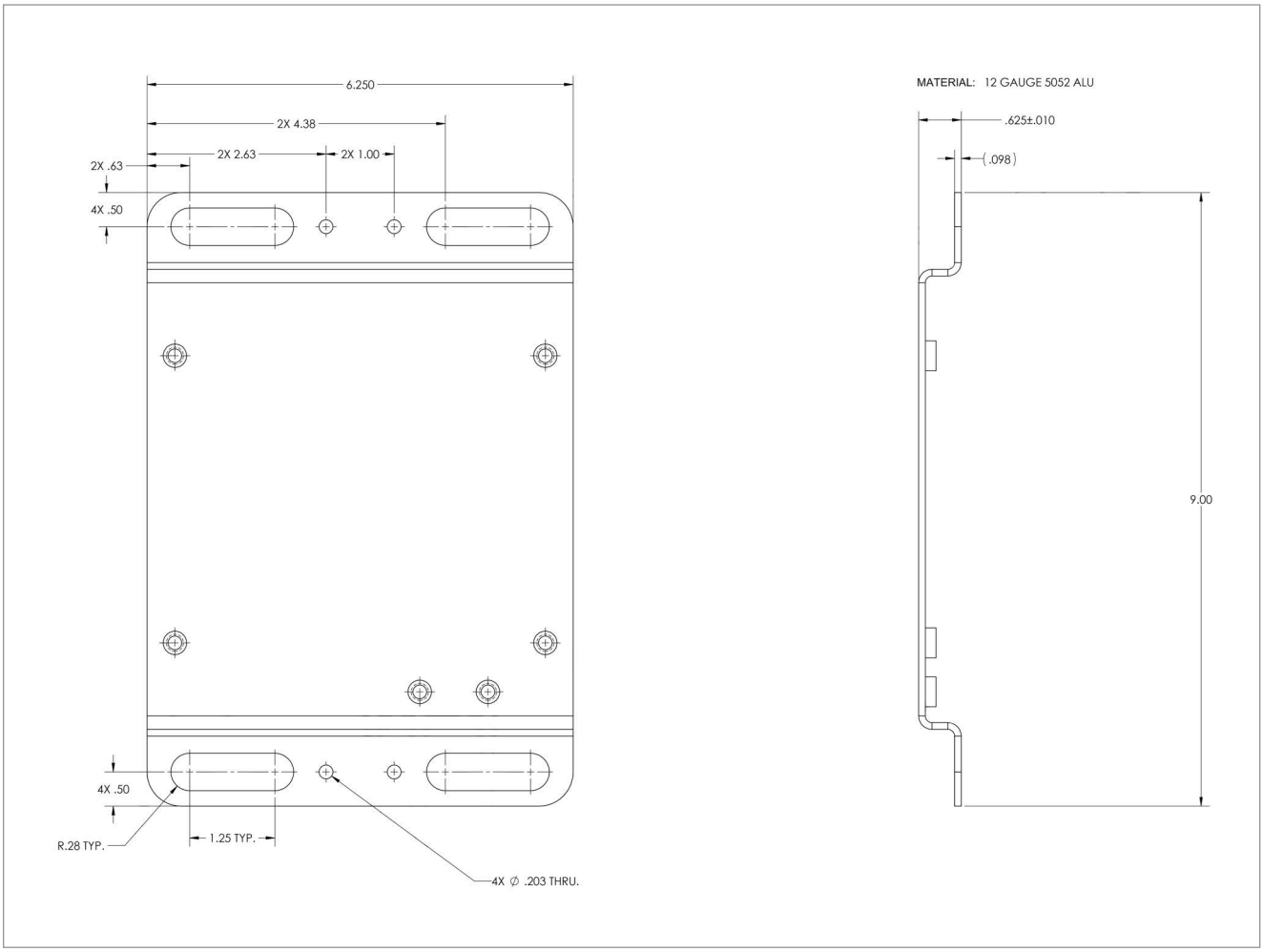

FIGURE 30: *Single-Channel (01C) and Addressable (ADR) Models*

E.3 TILT (TLT) MODELS

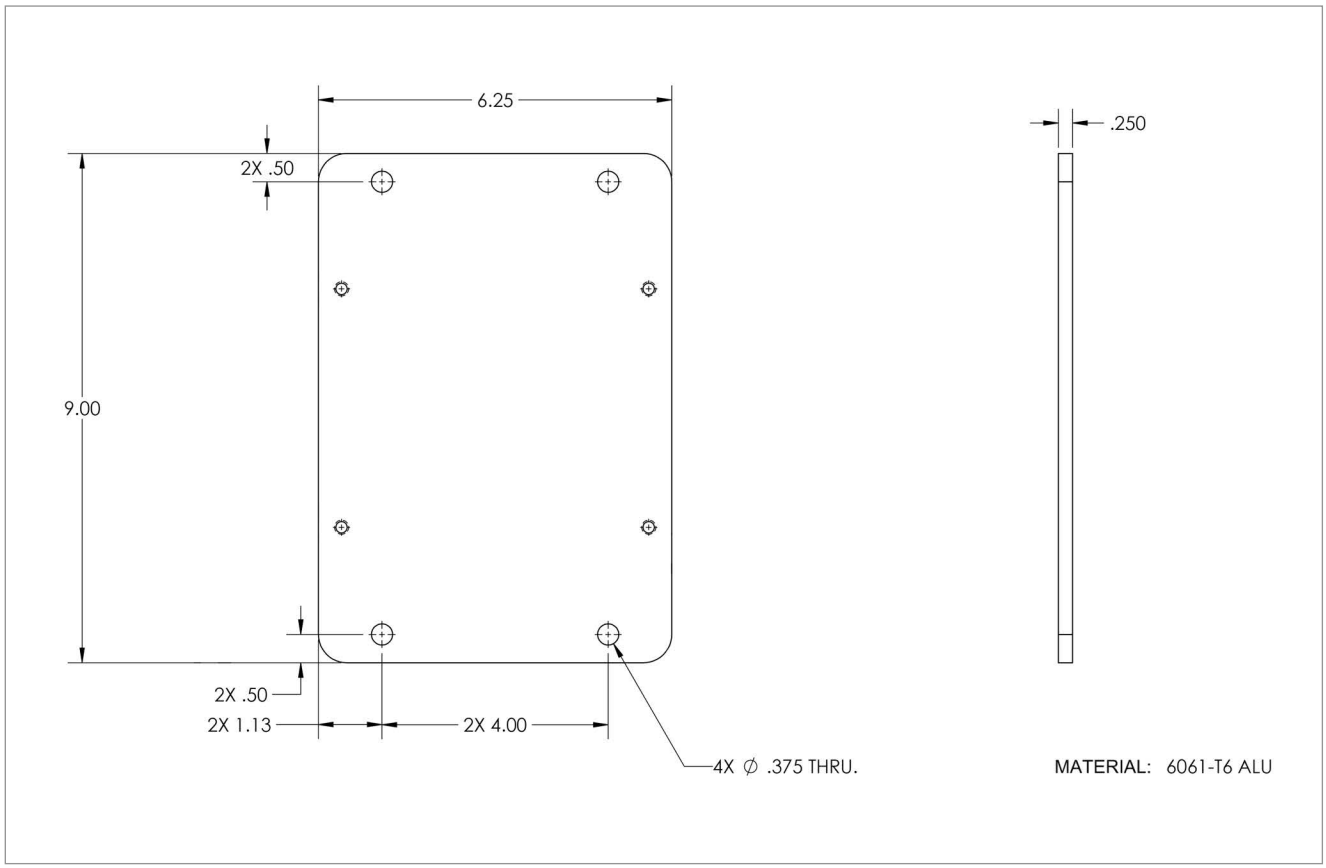

FIGURE 31: *Tilt (TLT) Models*

APPENDIX F. COMPONENTS (TYPICAL REPLACEMENT PARTS)

F.1 GATEWAY (GTW) MODELS

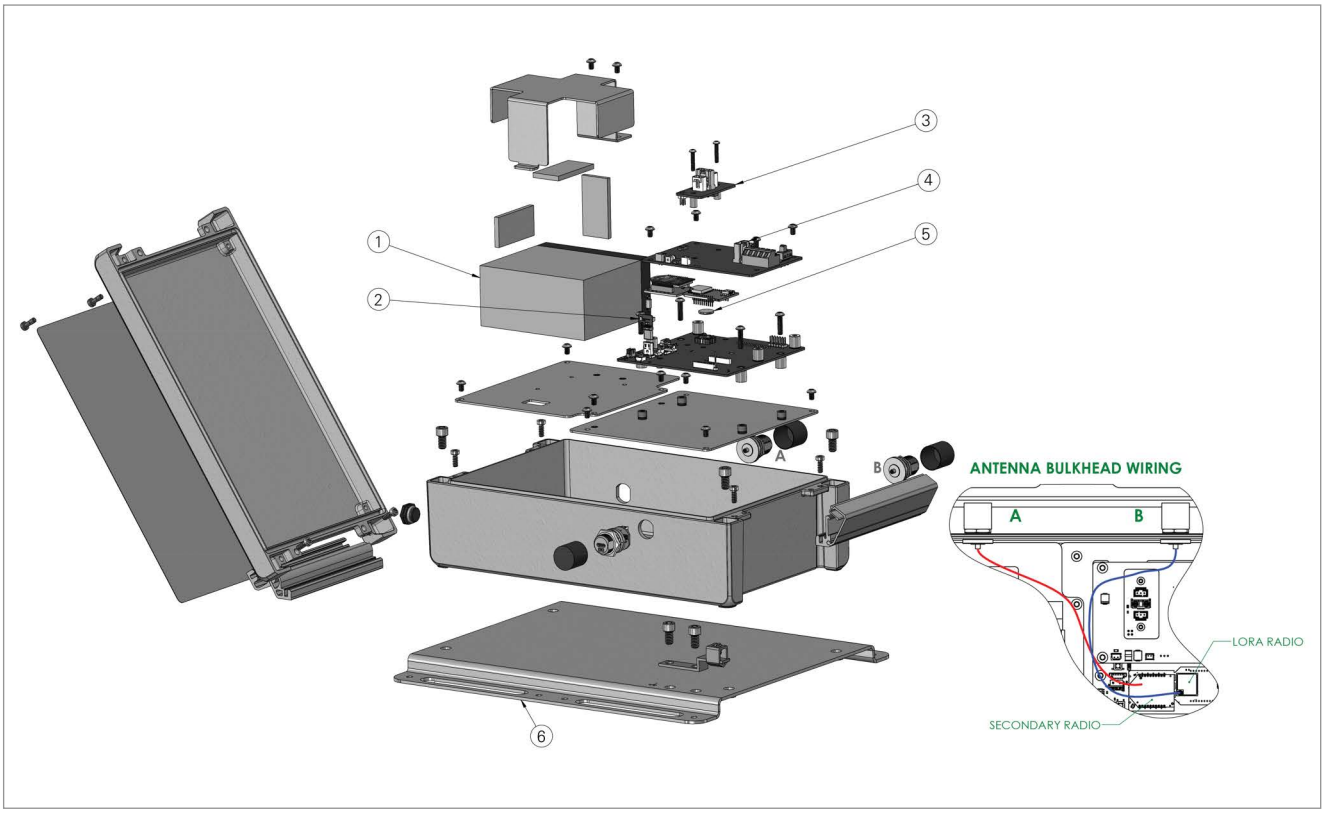

FIGURE 32: *Gateway (GTW) Models*

Item No.	Part Number	Description
1	BAT-209	Sealed Lead Acid Battery
2	S-8910-13	PicoBlade to USB-C Plug OVP
3	S-8910-3-1	LoRa SLA OVP
4	N/A	Fuse, contact GEOKON for more information.
5	BAT-122	Lithium Coin Cell Battery
6	BOX-501-BRACKET	Mounting Bracket
7 (Not pictured, for antenna locations **A** and **B**)	ELC-824	Antenna for both **A** and **B** locations

TABLE 15: *Gateway (GTW) Models Components Parts List*

F.2 SINGLE-CHANNEL (01C) AND ADDRESSABLE (ADR) MODELS

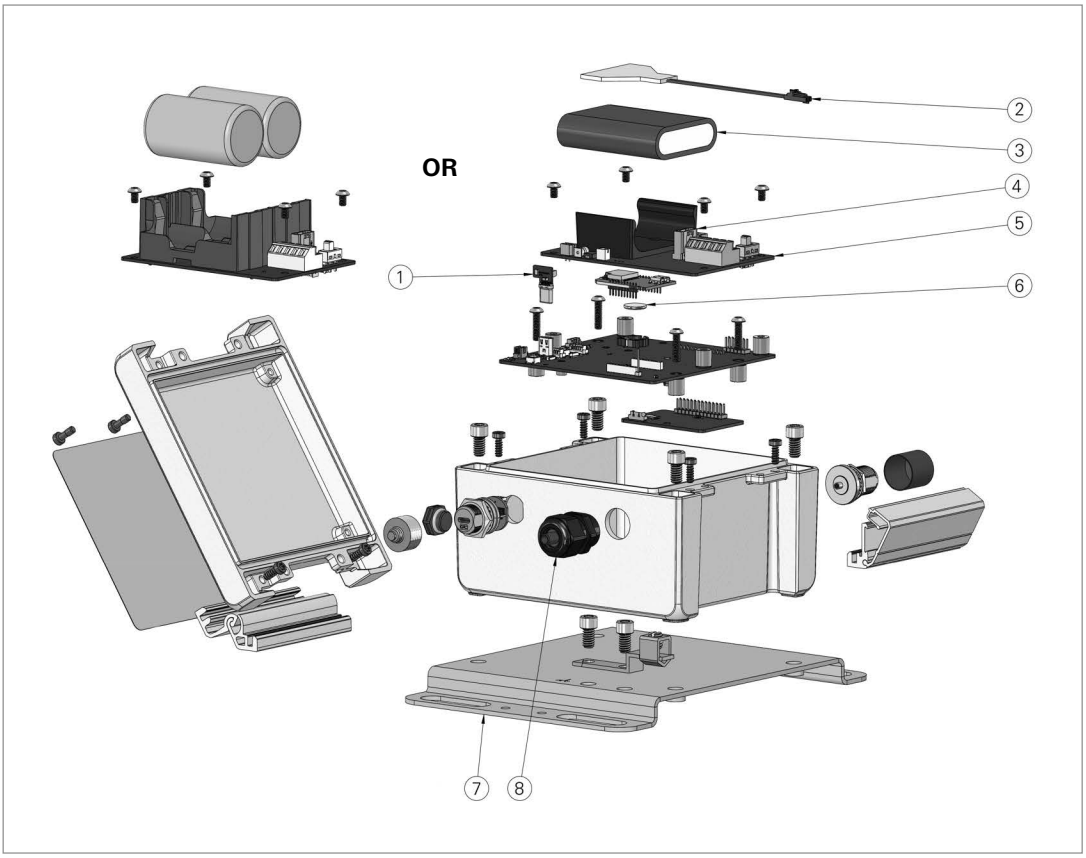

FIGURE 33: *Single-Channel (01C) and Addressable (ADR) Models*

Item No.	Part Number	Description
1 (Rechargeable units only)	S-8910-13	PicoBlade to USB-C Plug OVP
2 (Rechargeable units only)	ELC-1046	Thermistor Assembly
3	Non-Rechargeable: BAT-202 Rechargeable: BAT-207	Non-Rechargeable: Includes **one** Lithium D-Cell Battery Rechargeable: Battery Pack
4	N/A	Fuse, contact GEOKON for more information.
5	Non-Rechargeable: S-8910-4 Rechargeable: S-8910-3-LI	Battery Holder PCBA
6	BAT-122	Lithium Coin Cell Battery
7	BOX-500-BRACKET	Mounting Bracket
8	**CON-A443, including:** CON-A342 CON-A331 SEAL-09	**Assembled Cable Gland, including:** Dowel Pin Cable Fitting Seal Ring
9 (Not Pictured)	ELC-1051	Antenna

TABLE 16: *Single-Channel (01C) and Addressable (ADR) Models Components Parts List*

F.3 EIGHT-CHANNEL (08C) MODELS

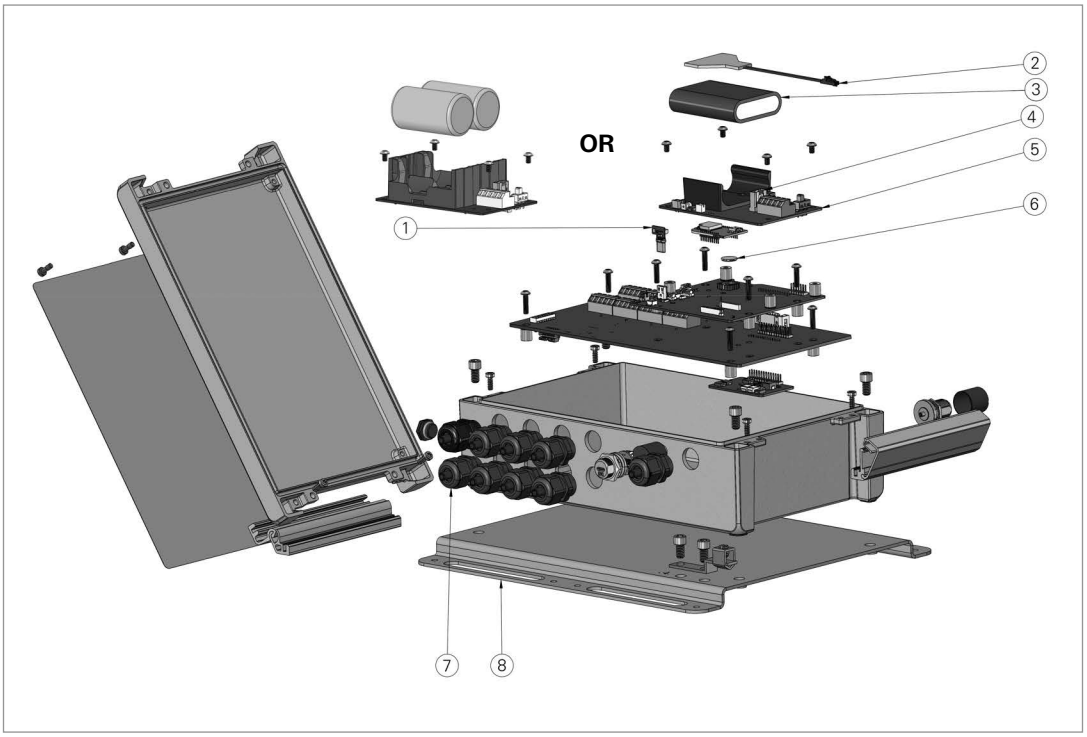

FIGURE 34: *Eight-Channel (08C) Models*

Item No.	Part Number	Description
1 (Rechargeable units only)	S-8910-13	PicoBlade to USB-C Plug OVP
2 (Rechargeable units only)	ELC-1046	Thermistor Assembly
3	Non-Rechargeable: BAT-202 Rechargeable: BAT-207	Non-Rechargeable: Includes **one** Lithium D-Cell Battery Rechargeable: Battery Pack
4	N/A	Fuse, contact GEOKON for more information.
5	Non-Rechargeable: S-8910-4 Rechargeable: S-8910-3-LI	Battery Holder PCBA
6	BAT-122	Lithium Coin Cell Battery
7	**CON-A443, including:** CON-A342 CON-A331 SEAL-09	**Assembled Cable Gland, including:** Dowel Pin Cable Fitting Seal Ring
8	BOX-501-BRACKET	Mounting Bracket
9 (Not Pictured)	ELC-1051	Antenna

TABLE 17: *Eight-Channel (08C) Models Components Parts List*

F.4 DIGITAL HIGH POWER (DHP) MODELS

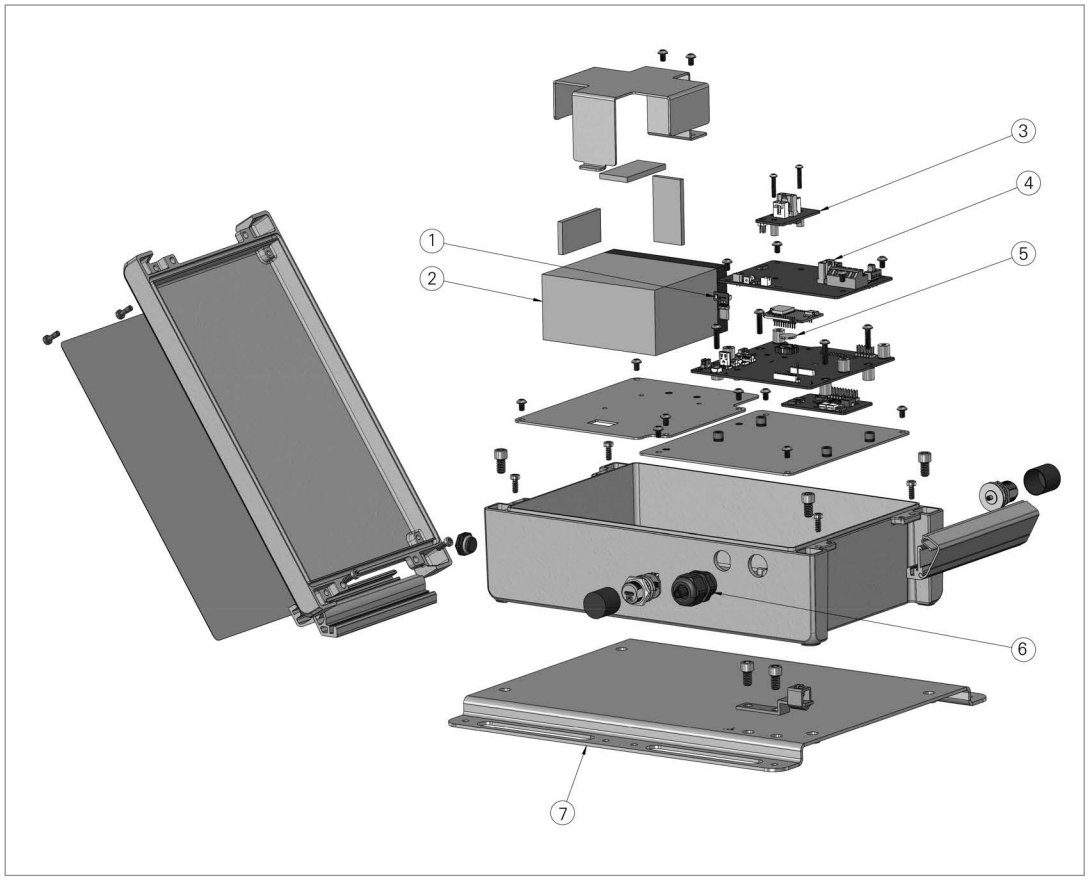

FIGURE 35: *Digital High Power (DHP) Models (Antenna Not Pictured)*

Item No.	Part Number	Description
1	S-8910-13	PicoBlade to USB-C Plug OVP
2	BAT-209	Sealed Lead Acid Battery
3	S-8910-3-1	LoRa SLA OVP
4	N/A	Fuse, contact GEOKON for more information.
5	BAT-122	Lithium Coin Cell Battery
6	**CON-A443, including:** CON-A342 CON-A331 SEAL-09	**Assembled Cable Gland, including:** Dowel Pin Cable Fitting Seal Ring
7	BOX-501-BRACKET	Mounting Bracket
8 (Not Pictured)	ELC-1051	Antenna

TABLE 18: *Digital High Power (DHP) Models Components Parts List*

F.5 TILT (TLT) MODELS

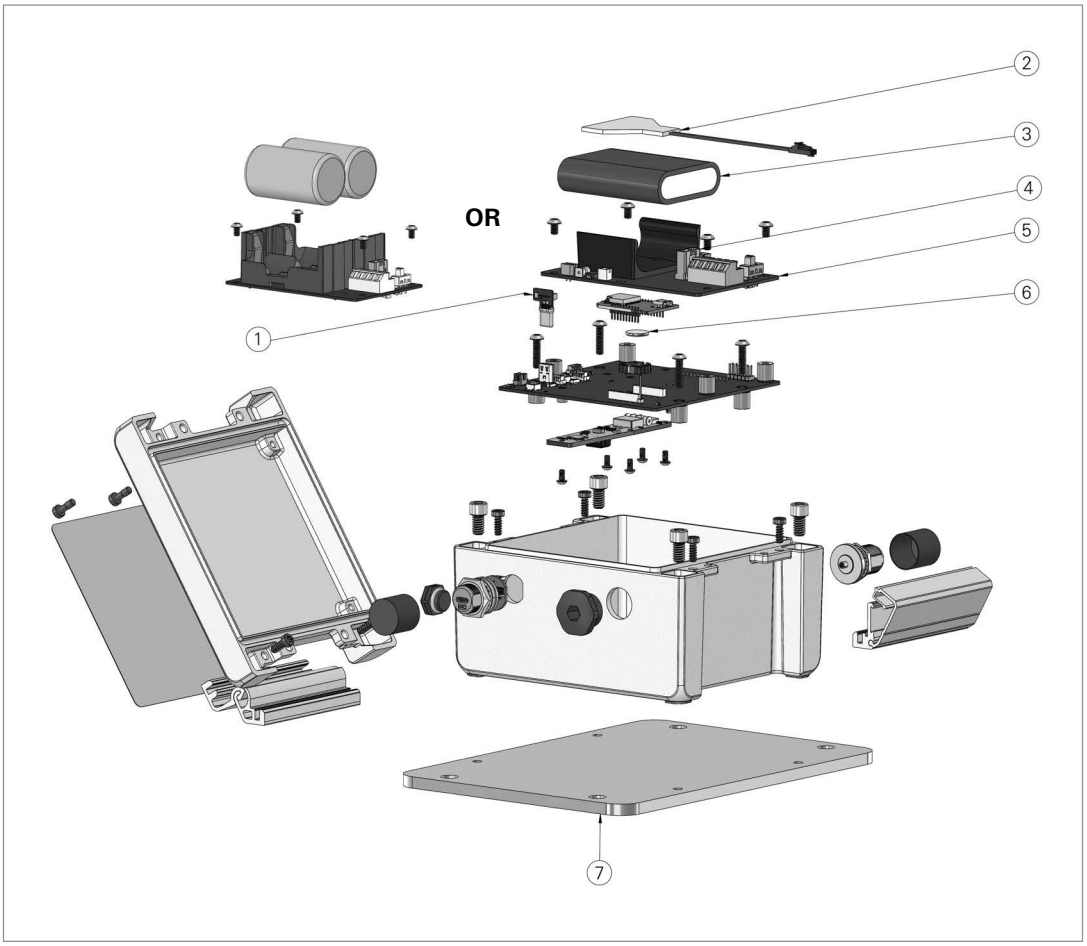

FIGURE 36: *Tilt (TLT) Models*

Item No.	Part Number	Description
1 (Rechargeable units only)	S-8910-13	PicoBlade to USB-C Plug OVP
2 (Rechargeable units only)	ELC-1046	Thermistor Assembly
3	Non-Rechargeable: BAT-202 Rechargeable: BAT-207	Non-Rechargeable: Includes **one** Lithium D-Cell Battery Rechargeable: Battery Pack
4	N/A	Fuse, contact GEOKON for more information.
5	Non-Rechargeable: S-8910-4 Rechargeable: S-8910-3-LI	Battery Holder PCBA
6	BAT-122	Lithium Coin Cell Battery
7	BOX-500-TILTBRACKET	Mounting Bracket
8 (Not pictured)	ELC-1051	Antenna

TABLE 19: *Tilt (TLT) Models Components Parts List*

APPENDIX G. VIBRATING WIRE LOAD CELL WIRING

G.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 20: *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.

G.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 21: *Load Cell Configuration Switch Settings*

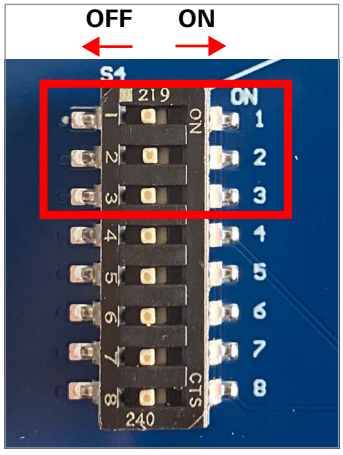

FIGURE 37: *Load Cell Configuration Switch*

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