

# Terragraph Installation Guide

March 8, 2017  
Version 0.3

# Warnings

**WARNING: Shock Hazard. May result in serious injury or death.** Turn off circuit power at circuit breaker or disconnect power at source receptacle before installing unit.

**WARNING:** Only trained and qualified personnel should be allowed to install, replace, or service this equipment.

**WARNING:** Installation of this equipment must comply with local and national electrical and building codes.

**WARNING: Fall Hazard.** When working at height, observe safe practices and use a suitably-attached safety harness.

**WARNING:** Installing the DC power with reversed polarity may result in completely and permanently destroying the Terragraph primary radio.

# Compliance

This device complies with Part 15 rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for Class A digital devices, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. To minimize interference a Ferrite bead (Manufacture: Steward, Part number: 25A2029) needs to be installed on the input DC power cable.

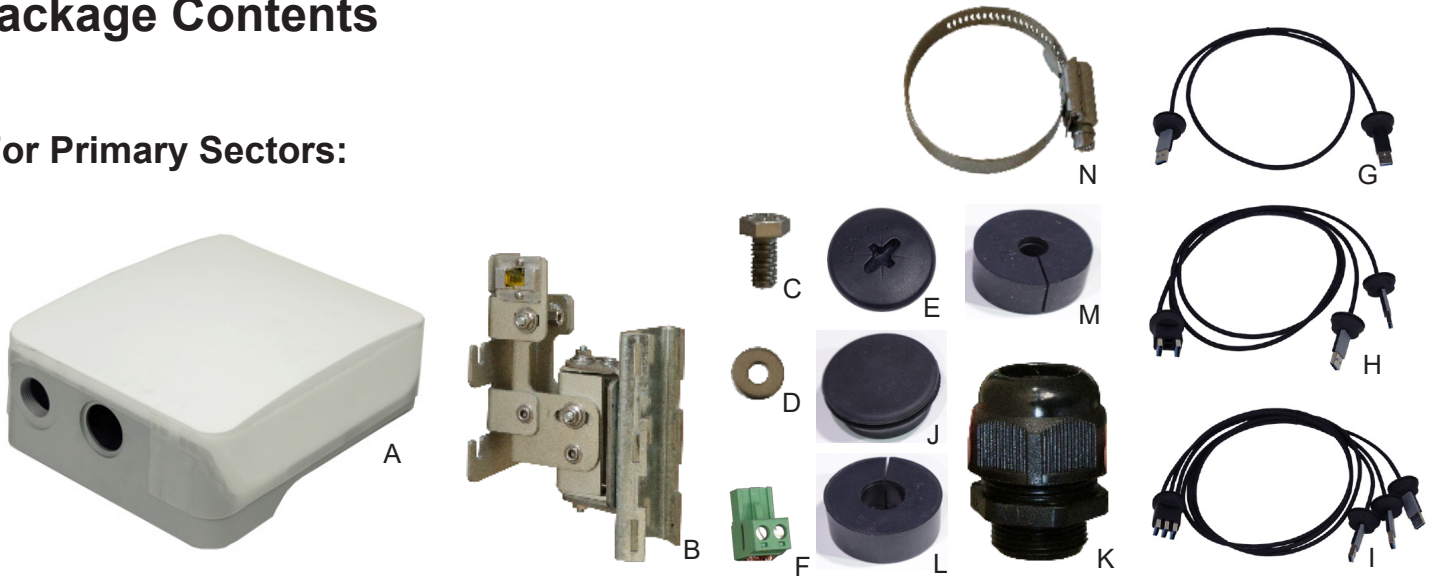
This device contains transmitter module FCC ID: 2AK7S-FBC1701

RF Exposure: This device has been evaluated for RF exposure for Human in reference to ANSI C95.1 (American National Standards Institute) limits. The evaluation was based on ANSI C95.1. At least 37cm of separation distance between this device and the user's body must be maintained at all times.

Any changes or modification to the product not approved by FCL Tech could void the user's authority to operate this device.

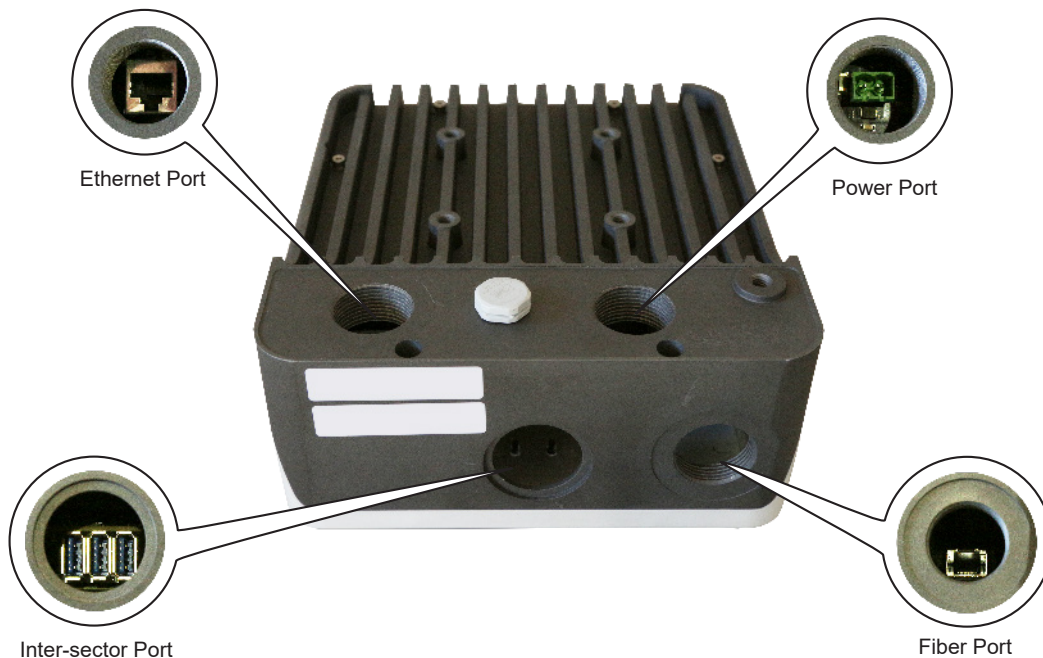
# Package Contents

## For Primary Sectors:



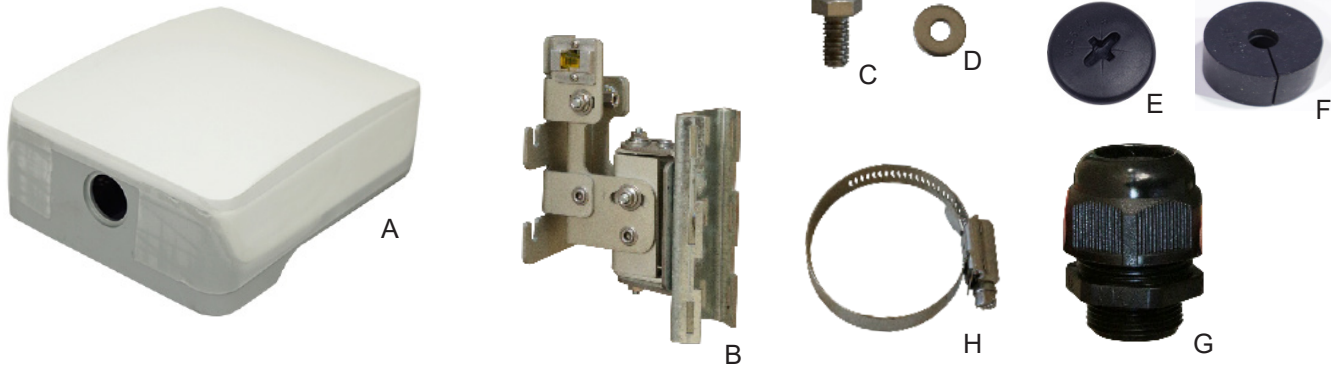
Key	Part Description	Part Number	Quantity
A	Terragraph primary sector	BLY-236-000005	1
B	Terragraph mounting bracket	BLY-213-000013	1
C	Stainless steel M6x1, 12mm mounting bolts	BLY-213-000027	5
D	Stainless steel washers	BLY-213-000041	5
E	M25 dome cap	BLY-207-000251	2
F	Power connector terminal block	BLY-244-000067	1
G	1x1 USB inter-sector cable	BLY-207-000238	1
H	1x2 USB inter-sector cable	BLY-207-000237	1
I	1x3 USB inter-sector cable	BLY-207-000236	1
J	Intersector Port Plug	BLY-213-000039	1
K	M25 Cable Gland	BLY-207-000250	3
L	Power Cable Gland Grommet	BLY-207-000253	1
M	Ethernet/Fiber Cable Gland Grommet	BLY-207-000252	2
N	Stainless steel Band Clamp	BLY-213-000048	2

## Primary Sector Ports



# Package Contents

For Secondary Sectors:



Key	Part Description	Part Number	Quantity
A	Terragraph secondary sector	BLY-236-000003	1
B	Terragraph mounting bracket	BLY-213-000013	1
C	Stainless steel M6x1, 12mm mounting bolts	BLY-213-000027	5
D	Stainless steel washers	BLY-213-000041	5
E	M25 dome cap	BLY-207-000251	2
F	Ethernet/Fiber Cable Gland Grommet	BLY-207-000252	1
G	M25 Cable Gland	BLY-207-000250	1
H	Stainless Steel Band Clamp	BLY-213-000048	2

## Secondary Sector Ports



## Materials Required (customer supplied)

- 6-10AWG grounding wire and lugs appropriate to local codes, *Recommended lug: Burndy YAZ8CTC14*
- 48 Volt or 54 Volt DC power supply capable of supplying 2.5A, *Recommended power supply: Mean Well HEP-185-48*
- Terminal Ground Bar with at least 6 terminals which support 6-10AWG grounding wire and can be secured to Primary radio with M6 bolt, *Recommended ground bar: Schneider PK9GTACP*
- Ferrite Bead for electromagnetic interference filtering (EMI), *Recommended ferrite bead: Steward 25A2029*
- Electrical wire conforming to local codes
- Any additional electrical materials necessary to conform to local codes
- Outdoor rate Cat5e or Cat6a J-45 Ethernet cable conforming to local codes
- Outdoor rated 2-strand multi-mode or single mode armored fiber patch cord with LC connector to match SFP module
- UV rated plastic cable ties or stainless steel cable ties for securing cables
- SFP or SPF+ Module. See table below:

SFP Type	Speed	Range	Wavelength
Multi Mode SFP	1Gbps	Upto 300M	1310, 1550nm
Single Mod SFP	1Gbps	Upto 10KM	850nm
Singe Mode SFP+	10Gbps	Upto 300M	1310, 1550nm
Multi Mode SFP+	10Gbps	Upto 10KM	850nm

## Tools Required (customer supplied)

### **Required**

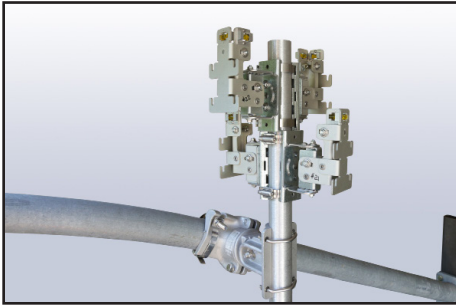
- Terragraph technician kit/aiming tool
- 10mm combination or socket wrench
- Electricians wire cutter/stripper
- Needle nose pliers
- Channellock for removal of cable glands
- 8mm nutdriver or cordless drill with 8mm socket (for band clamps)
- Crimping tool for RJ-45 connector
- Crimping tool for grounding lugs
- Flat blade screw driver

### **Recommended**

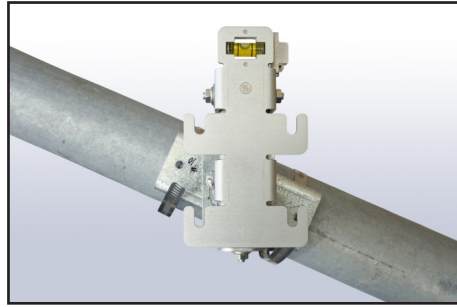
- Personal Safety Protection (Safety glasses, Hard Hat, Work Gloves, Safety harness)
- Flashlight
- Digital multimeter
- RJ-45 tester with POE tester
- Fiber tester
- Level for plumbing mounting pipe

# Installation Steps

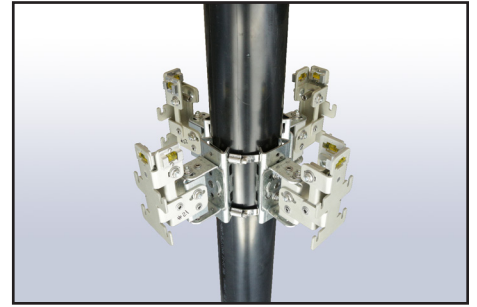
## Terragraph Brackets Mounting Locations



Installation on pipe on luminaire arm.

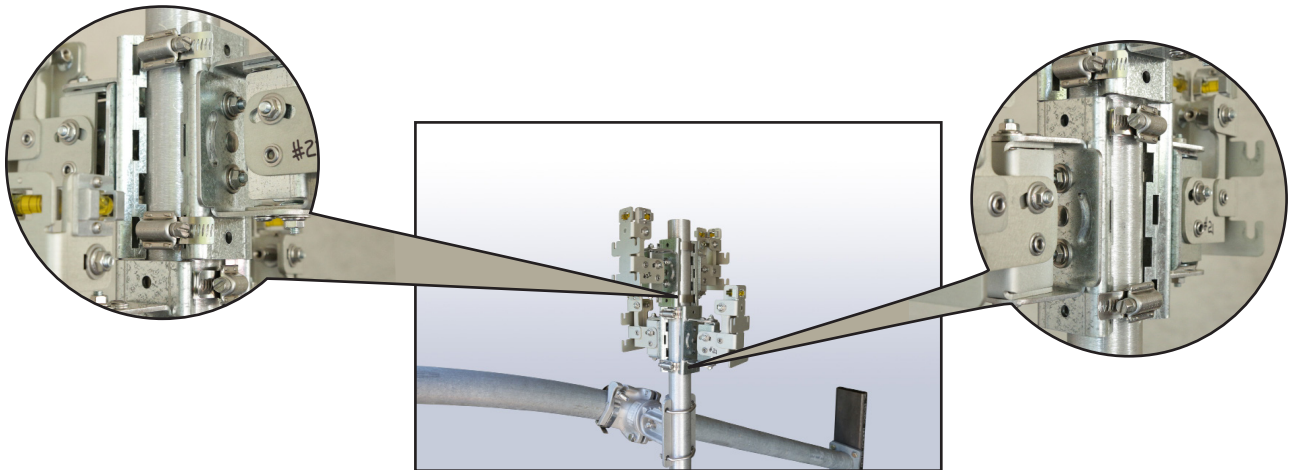


Installation directly on signal arm.



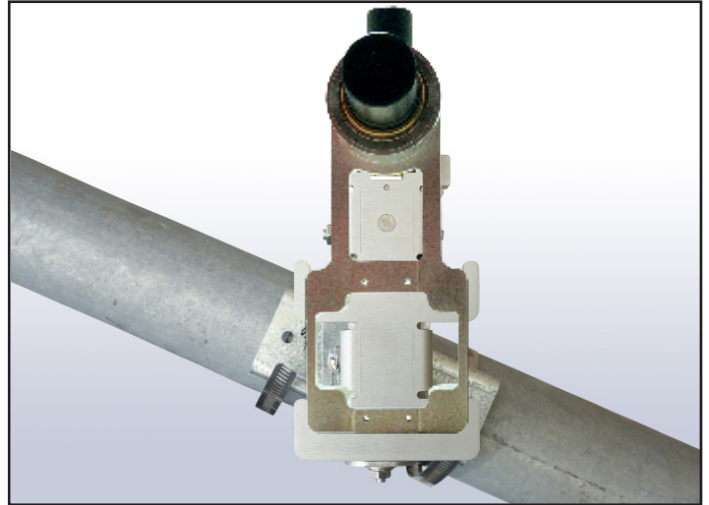
Installation directly on shaft.

Mounting location should be a pole or pipe at least 45mm (1.75") outside diameter. The pipe may be vertical  $\pm 5^\circ$  or horizontal  $\pm 30^\circ$ .



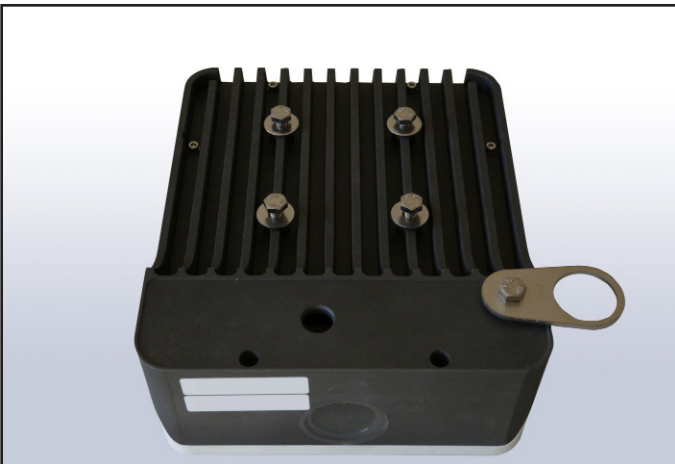
1. Install brackets for all the Terragraph sectors at this location. Supplied band clamps support a pole diameter between 45mm-63.5mm (1.75"-2.5"). *Note that band clamps can be interleaved as shown for a compact installation.*
2. If mounting on a short length of pipe, you may install the brackets to the pipe first, then mount the pipe at the target location for convenience.
3. Horizontally center each of the brackets using the built-in bubble levels.

## Using the Aiming Tool



1. Place the Terragraph aiming tool on each of the brackets.
2. Adjust the azimuth, then the elevation, until the target location on the opposite side of the link appears in the center of the crosshairs of the aiming tool.
3. Remove the tool and carefully store the aiming tool in its case when finished.

## Mounting the Terragraph Sectors



1. Mount the Terragraph sectors according to the site plan. We recommend that you install the primary sector at the position which has the most convenient access to the back and bottom of the unit.
2. Tighten the four nuts securely to the mounting bracket but do not over-tighten.
3. If specified in the site plan, use the tethering loop (built into on the fins on the back of the unit) to secure each sector with a safety cable or wire.

## Installing the Inter-sector Cable



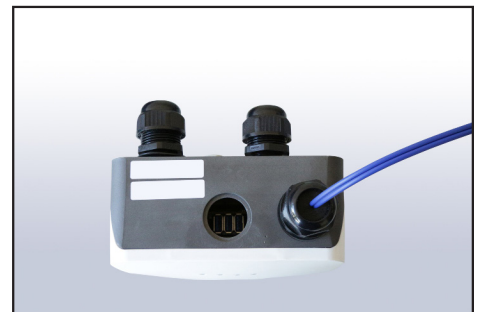
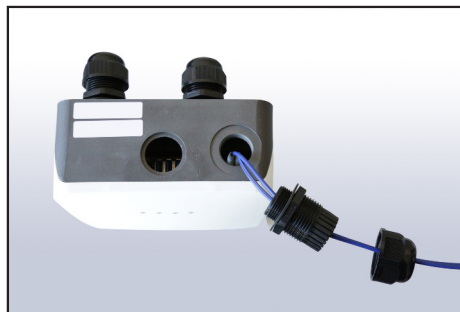
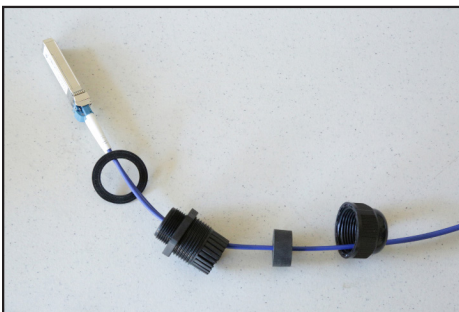
### Installation of Inter-sector Cable

1. Select the inter-sector cable for the number of sectors you will install to the primary.
2. Remove the label covering the inter-sector opening.
3. Plug the the inter-sector cable into the USB connectors. Primary units will use the larger end of the inter-sector cable for locations using the 1x2 and 1x3 inter-sector cables.
4. Slide the grommet toward the USB connectors until it fits over the inter-sector opening and then push the rubber grommet into opening in the Terragraph radio. The intersector cable has a groove which needs to fit into the lip of the inter-sector opening. It is recommended to use a flat blade screw driver to gently push the inter-sector cable's groove into the lip of the inter-sector opening.
5. Repeat steps 2-4 to install the other end of the inter-sector cable to the secondary sectors.
6. If there are no secondary sectors, secure the inter-sector opening with the inter-sector grommet.

### Removal of Inter-sector Cable

1. Push one side of the grommet into the inter-sector hole using a flat blade screw driver.
2. Rotate the grommet so it can be rotated sideways.
3. With a pair of needle nose pliers pull the grommet outside of the inter-sector hole and disconnect the inter-sector connector from the USB connectors.

## Installing Fiber

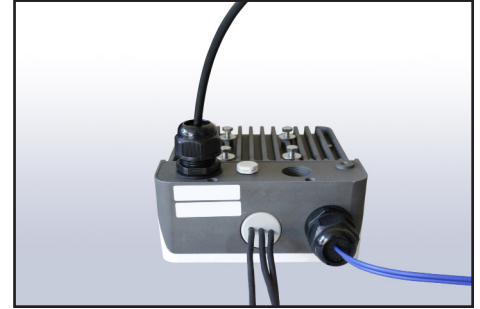
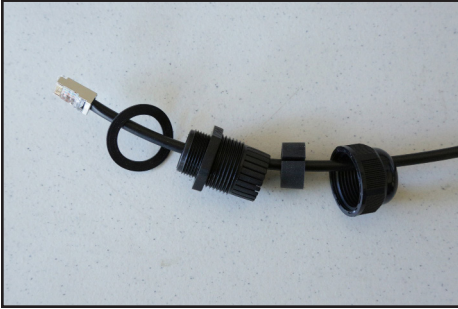


1. If fiber will be installed at this location, plug the SFP+ module into the fiber patch cord connector and place all the parts of the cable gland over this fiber cable.  
*Recommendations:*
  - All fiber used outside should be armored or protected in conduit.
  - Test the fiber to the switch or transceiver before the install.
2. Remove the protective label from the SFP opening of the primary sector.
3. Push the SFP+ module up into the SFP+ cage until connected and well seated.
4. Screw the cable gland into the thread of the primary sector and tighten hand-tight.
5. Turn an additional 1/4 turn using a large open-ended or adjustable wrench.
6. Assemble the rest of the cable gland and tighten hand-tight.
7. If no fiber will be installed, remove the label and replace with an M25 dome cap.

**CAUTION:** Make sure that you form a 80mm - 130mm (3"-5") drip loop in each cable that slopes downwards into any cable gland or building penetration. This will prevent water from running along the cable and entering the enclosure or building where the cable terminates.



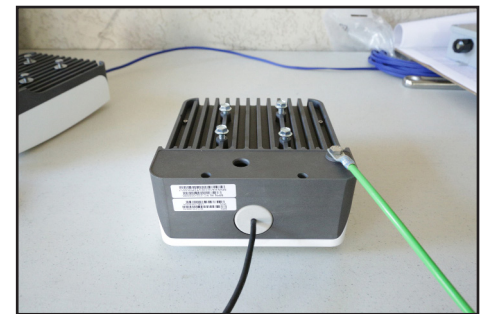
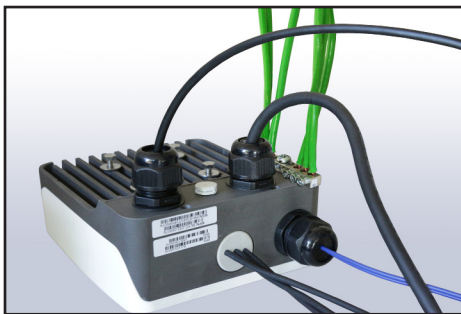
## Installing Ethernet Access Device



1. If an Ethernet access device will be installed at this location, mount the device according to the manufacturer's instructions.
2. Route the Ethernet cable from the access device to the Terragraph radio appropriately.
3. Pass the Ethernet cable through the cable gland and crimp the RJ-45 connector if necessary.
4. Test the cable.
5. Remove the protective label from the Ethernet opening on the primary sector.
6. Insert the cable into the cable gland and plug in the RJ-45 connector.
7. Screw the cable gland into the thread of the primary sector and tighten hand-tight.
8. Assemble the rest of the cable gland and tighten hand-tight.  
*Ensure the rubber grommet for the cable gland is oriented in the correct direction (rubber grommet is labeled with either inside or outside).*
9. If no Ethernet will be installed, remove the protective label and replace with an M25 dome cap.

**CAUTION:** Make sure that you form a 80mm - 130mm (3"-5") drip loop in each cable that slopes downwards into any cable gland or building penetration. This will prevent water from running along the cable and entering the enclosure or building where the cable terminates.

## Grounding the Terragraph Sectors



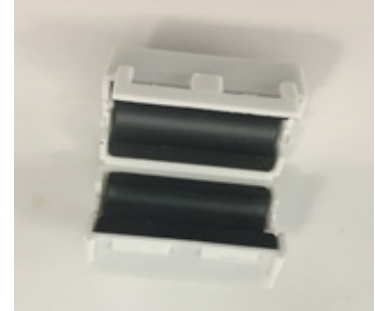
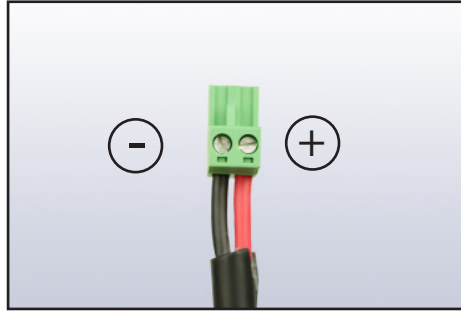
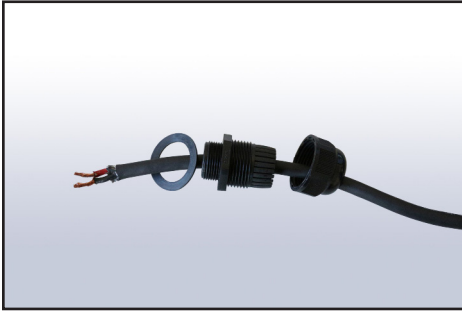
1. Connect each of the sectors (and, if appropriate, the access point) to earth ground according to local codes. There is an M6 bolt on the back of each unit designed for grounding using a lug with a 6.5mm (1/4") inner diameter center hole.

We recommend using a grounding bus bar on the primary sector which can then be used to ground the secondary sectors. This allows the use of just one grounding run to the earth ground.

We recommended to use a grounding wire between 6-10AWG, but local codes should dictate grounding requirements.

**CAUTION:** Be sure that grounding is available and that it meets local and national electrical codes. For additional lightning protection, use lightning rods and lightning arrestors. Make sure that proper lightning surge protection precautions are taken according to local electrical codes.

## Installing the Power Supply



1. Install and secure the power supply according to the site plan and local codes.
2. Place the power cable gland over a length of approved wiring (suitable for use between the power supply and the Terragraph primary sector).
3. Using an approved outdoor/waterproof junction box or connector, connect the DC output of the power supply to the power cable leading to the Terragraph primary.
4. Strip the power cable by 10mm (3/8") and insert into the terminal block according to the polarity in the figure above.
5. Tighten the terminal block screws very firmly and verify that the wire is well secured.
6. Install the Ferrite bead around the outer cable sheathing. Open the bead and place it 5mm (3/16") from the end of the DC power supply outer cable sheathing on the end which contains the terminal block. Once positioned, close the Ferrite bead which will then snap shut.
7. Remove the protective label from the power opening of the primary sector.
8. Insert the power terminal block into its receptacle.
9. Holding the power cord to ensure it remains connected and well seated, screw the cable gland into the thread of the primary sector and tighten by hand.
10. Assemble the rest of the cable gland and tighten hand-tight.  
*Ensure the rubber grommet for the cable gland is oriented in the correct direction (rubber grommet is labeled with either inside or outside).*

**CAUTION:** Make sure that you form a 80mm - 130mm (3"-5") drip loop in each cable that slopes downwards into any cable gland or building penetration. This will prevent water from running along the cable and entering the enclosure or building where the cable terminates.

# Basic Troubleshooting

## **Terragraph primary unresponsive:**

1. Remove the intersector cable grommet which will allow the power LED to be viewed.
2. Check if the power LED is illuminated.
3. Unscrew the power cable gland.
4. Disconnect the power and remove the power connector for the primary sector.
5. Reconnect the power.
6. If power LED is not illuminated, use a digital multimeter in DC voltage mode to verify there is 48V to 54V DC at the Terragraph power terminal block with the correct polarity. If not, correct the problem.
7. Reseat the power connector and reconnect to primary sector.
8. If LED inside unit does not illuminate even with correct power at the power connect, replace the primary sector.

## **Terragraph secondary unresponsive:**

1. Remove the intersector cable grommet which will allow the power LED to be viewed. Make sure you keep the intersector cable connected to the USB port.
2. Check if the power LED is illuminated.
3. Disconnect the inter-sector cable.
4. Reconnect the power.
5. If power LED is not illuminated, use a digital multimeter in DC voltage mode to verify there is 48V to 54V DC between pin1 and pin 5 on the intersector cable connecting to the secondary radio.
6. If there is no DC power on the intersector cable check the cable connection at the primary radio. If this doesn't fix the issue try replacing the intersector cable. If problem persists, replace the primary sector.
7. Reseat the power connector and reconnect to primary sector.
8. If LED inside unit does not illuminate even with correct power at the power connect, replace the secondary sector.

## **Fiber connected to Terragraph, but remote switch/router indicates no link integrity:**

1. Verify that the device on the other end of the fiber is powered on and correctly configured.
2. Use a fiber cable tester to verify that receive light power and (if possible) link integrity for the fiber running to the Terragraph radio.
3. Remove the SFP module, plug the fiber cable into a known good SFP module and reseat firmly.
4. If problem persists, replace the primary sector.

## **Ethernet connected to Terragraph, but non-PoE device indicates no link integrity:**

1. Verify that the Ethernet device is powered on and configured.
2. Remove the Ethernet cable from the Terragraph radio and using cable tester verify link integrity between the Ethernet device and a known good laptop.
3. Reconnect Ethernet cable to Terragraph radio.
4. If problem persists, replace the Terragraph radio.

## **Ethernet connected to Terragraph, but PoE powered device does not power up:**

1. Unplug Ethernet cable from the primary sector.
2. Use a PoE tester and a known working Ethernet cable, verify that the Terragraph Ethernet port is providing 48V or 54V DC voltage. If Terragraph primary sector is not supplying correct voltage, replace the primary sector.
1. Reconnect the Ethernet cable to the Terragraph primary sector.
2. Use a cable tester to test POE power at the end of the Ethernet cable connected to the Terragraph primary sector. If needed replace Ethernet cable.
3. Verify the voltage requirements of the POE device
4. If problem persists, try with another PoE powered device.

# Product Specifications

## Physical

Dimensions (Without Bracket): 168.15mm (W) x 202.70mm (H) x 88.62mm (D)

Dimensions (With Bracket): 168.15mm (W) x 227.33mm (H) x 200.66mm (D)

Weight: 3.51KG (With Bracket and Glands)

Environmental conditions: Operating temperature range: -40°C to +50°C

Ingress Protection: IP66

Mounting configurations: Mounting for up to 4 sectors on vertical ( $\pm 5^\circ$ ) pipe or pole or 2 sectors on horizontal ( $\pm 30^\circ$ ) pipe or pole

Bracket freedom of movement: azimuth  $\pm 20^\circ$  and elevation  $\pm 25^\circ$

## Power

Input Power: 48 volts DC to 54 volts DC nominal with reverse polarity protection

PoE Output Power: IEEE 802.3af (15 watts maximum with 48V or 54V power supply) or IEEE 802.3at (25.5 watts maximum with 54V power supply).

Power consumption (without POE): 21 watts for primary sector, 19 watts per secondary sector

## Interfaces

Network ports on primary sector:

Single 1000BASE-T port

Single SFP+ 10Gbps Ethernet module

Three 2.5Gbps Ethernet inter-sector connectors

Network ports on secondary sector:

Single 1000BASE-T port

Single 2.5Gbps Ethernet inter-sector connectors

## Radio

Operating Frequency: 57GHz-64GHz\*

Number of channels: single channel operation out of 3 available\*

Channel Bandwidth: 2.16GHz

EIRP: 43dBm Peak ; 40dBm Average

Modulation: BPSK, QPSK, 16 QAM

Latency: 667 $\mu$ s per node ; max 10ms for system (15 hops)

\*Based on local regulatory standards.

## Certifications

FCC pending.

UL listing pending.

# Support

To obtain technical support for the Terragraph product please email [terragraph-support@xxxx.xxx](mailto:terragraph-support@xxxx.xxx)