MI.NET MULTI-NETWORK COLLECTOR

Installation and Operation Manual

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MI.NET MULTI-NETWORK COLLECTOR
Installation and Operation Manual

CONTENTS

OVERVIEW

The Mi.Net Multi-Network Collector is an unattended data collector and gateway device. It is intended for indoor or outdoor use in advanced metering infrastructure (AMI) monitoring and control applications.

The complete Multi-Network Collector system consists of a base unit and an amplifier -tower top amplifier / antenna unit (Figure 1).

In typical applications, the collector automatically gathers relevant data from smart metering devices located within the range of its wireless AMI network interface, for billing or analysis purposes. It transfers this data back to remotely located servers by means of a cellular or wired Internet connection. The collector also enables devices on its local AMI network to be remotely controlled or reconfigured through the Internet.

The collector is intended for applications where the antenna unit is installed a significant distance from the base unit, such as on a tower or pole. A tower top amplifier is included with all collector systems to compensate for signal loss over the connecting cable.

MI.NET MULTI-NETWORK COLLECTOR SYSTEM DESCRIPTION

The collector system delivers the maximum transmitter output power allowable by law. The collector enhances AMI network range by enabling installation of the AMI network antenna a considerable distance from the base unit, and at a significant height above ground level.

Increasing the AMI antenna installation height above ground significantly increases the system's operating range. However, it is often desirable to locate the collector base unit close to ground level for easier access to power and serviceability.

The collector system employs a remotely installed amplifier to compensate for losses over the length of the cable. This amplifier restores transmitter power at the antenna to maximum allowable levels. To achieve optimal system performance, this amplifier is fitted immediately below the antenna.

The remote amplifier is powered by the base unit through the coax cable connection between the two units. The fixed collector system incorporates a standard 8dBi antenna. A smaller antenna with 6dBi gain is also available if more suitable for site conditions.

The remote amplifier unit includes an integral bandpass filter, which attenuates strong out-of-band signals that might otherwise impair AMI network reception. This allows the remote amplifier and AMI network antenna to be installed in relatively close proximity (less than 500 meters) to strong sources of potential interference, such as a cellular base station system. Connection to the remote amplifier is made by connecting the coaxial connector to the lightning arrestor connector as shown in Figure 1.

Collector base units are housed in an IP-54 rugged polycarbonate enclosure. Power dissipation ranges from 30 watts (typical) to 100 watts (maximum). The 100W case occurs only when a collector's internal batteries are being recharged following a power interruption.

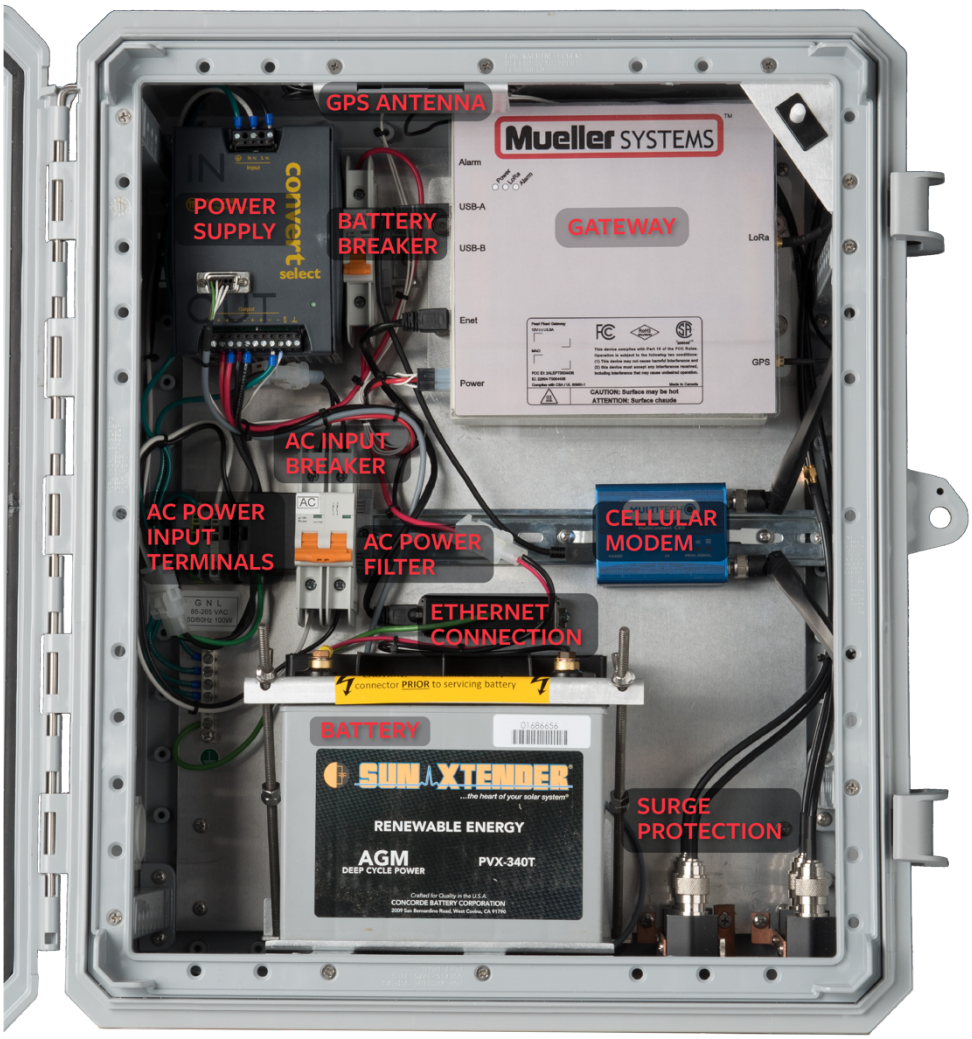
All antenna, network, and power connections to the collector base unit are made at the bottom of the enclosure.

Figure 1: Collector Base Unit and TTU remote antenna assembly – antenna not pictured

BASE UNIT MODULES

The base unit contains 10 modules within its cabinet (see Figure 2). Many of these modules may be replaced in the event of failure or damage. See Appendix IV for information concerning maintenance and replacement of these modules.

NOTE: Your equipment may vary slightly from photographs in this document.



1. Power Supply
2. Backup Battery
3. AC Circuit Breaker
4. Battery Circuit Breaker
5. Gateway Assembly
6. Cellular Modem
7. Ethernet Jack (RS-45)
8. Antenna Surge Protectors
9. Power Surge Arrestor
10. Power Terminals

Figure 2: Mi.Net Multi-Network Collector modules

MODULE DESCRIPTIONS

1. **Power Supply** - Converts the electrical main's power to +12v (13v - 14v nominal) required to operate the collector electronics. The power supply also charges the 12v backup battery and maintains a float charge to ensure the battery is fully charged in the event of a power outage.
2. **Backup Battery** – Is used to run the collector in the event of a power outage. The battery is a 12v, lead-acid type and can operate the collector up to 20 hours under normal conditions. Run-time will be less in colder conditions or if the battery is at the end of its life span (approximately 4 years). For optimum results, the battery should be replaced every 4 years or sooner.
3. **AC Circuit Breaker** – A 15Amp circuit breaker is included to protect against over-current faults on the AC power mains. Used with the Battery Breaker, it may also be used to switch off the power to the collector electronics. Switch off both breakers to ensure power is removed from the collector electronics.
4. **DC Circuit Breaker** – A 15Amp circuit breaker is included to protect against over-current faults on the battery power supply. Used with the AC Circuit Breaker -it may also be used to switch off the power to the collector electronics. **Switch off both breakers to ensure power is removed from the collector electronics.**
5. **Gateway Assembly** – Performs many functions within the collector. Its functions include:
    - Receiving and sending messages to the population of installed nodes
    - Processing and aggregating data from nodes to be sent to the host server
    - Monitoring functional health of the collector modules
    - Providing status indicators
6. **Cellular Modem** - Transfers data between the gateway and the server / host system via the cellular / internet network.
7. **Ethernet Jack** - Provides an Ethernet link to transfer the gateway data to / from the server / host system (in place of the cellular modem).
8. **Antenna Surge Protectors** - Included to protect the collector from nearby lighting strikes.
9. **Power Surge Arrestor** - Included to protect the collector from nearby lighting strikes.
10. **Power Terminals** - Provided to allow connection of the collector to the AC main's power source.

BEFORE YOU BEGIN

You must **contact Mueller Systems Network Operations Center (NOC) at least a day in advance of installation** to ensure a technician will be available to send appropriate test messages over the network once the unit is installed.

After you have installed the unit you will work with the Mueller Systems NOC group to perform the steps described in the Post-installation Items section under Connection Procedure.

SAFETY CONSIDERATIONS

The MNC is powered by 110 - 240VAC power. This voltage can be hazardous. All external power source connections must be performed by appropriate professionals, who are properly licensed to work within the local jurisdiction.

Collector outdoor installation should only be attempted when weather conditions permit this task to be completed safely.

INSTALLATION AND OPERATION

Carefully remove the collector base unit from its custom shipping container. Afterwards, open the enclosure and carefully remove the packing materials from the interior. We recommend you retain these materials in the event the unit should need to be returned for service or upgrade.

All antenna, network, and power connections to the collector base unit are made at the bottom of the enclosure (Figure 3). Most installations will require only a power and RF antenna connection.

Installations that require a hardwired Ethernet connection will need to install a separate conduit and Cat5e Ethernet cable that enters the collector cabinet at the labeled entrance on the bottom of the enclosure. Connection of the Ethernet RJ45 connector is made inside the cabinet at the labeled connector jack (Figure 4).

Installation of a typical collector system consists of 3 major elements:

1. Mounting the base unit enclosure and remote amplifier assembly
2. Connecting the antenna, Ethernet (if required) and ground wires and cables
3. Connecting power to the collector

These processes will be described in the following sections.

Figure 3: Collector Base Unit physical connections

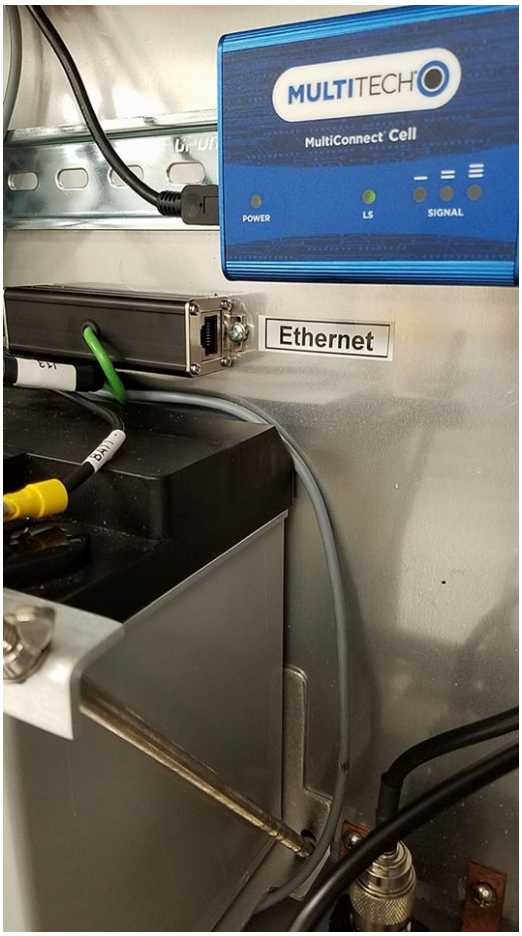


Figure 4: Ethernet Port

BASE UNIT MOUNTING OPTIONS

CAUTION

Ensure mounting is performed by trained personnel and complies with all local building codes and safety rules.

The collector base unit installation typically involves mounting the base unit onto a wall, utility pole, or similar object, and may involve connecting the power to live power lines. Only trained personnel who are properly licensed to work within the local jurisdiction should perform these installations.

The base unit should be located in an area that complies with the collector temperature range, -40 to +60°C (-40 to +140°F). A shaded area is recommended. Install the unit in a climate controlled area if these ranges are expected to be exceeded.

The mounting options listed in Table I presume that the collector base unit is attached to the mounting plate furnished with the unit (see Figure 5). The collector is shipped attached to its mounting plate. Remove the collector from the back plate prior to installing the mounting plate.

Redundant mounting slots and holes permit one common plate design to provide a variety of mounting options. The use of these mounting holes and slots allows attachment of the mounting plate to infrastructure using U-bolts, lag bolts (LB in Figure 5) or steel bands. See Figure 5. Use stainless steel mounting hardware for all installations.

After successfully installing the mounting plate, the collector may be fitted onto the mounting plate by setting the enclosure on to the lower lip of the plate, then securing the enclosure with the eight 1/4x20x1" bolts furnished with the unit.

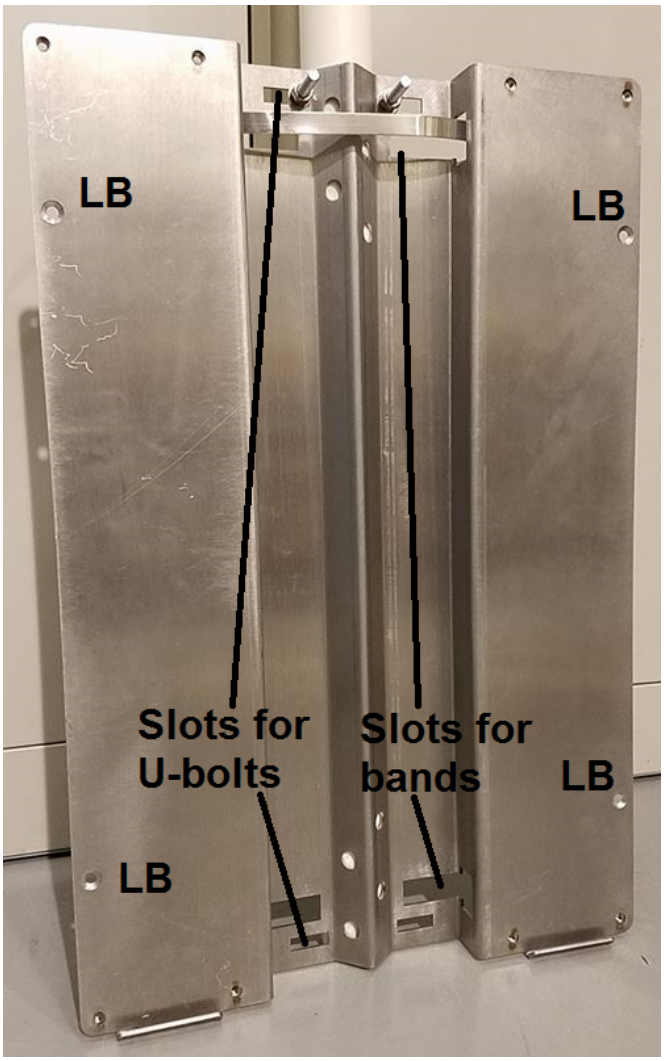


Figure 5: Collector Mounting Plate

TABLE I: COLLECTOR MOUNTING OPTIONS

MOUNTING STRUCTURE	HARDWARE	SPECIFICATIONS
Utility Pole	5/16 x 2-1/2 tapped Climatek coated screw or equivalent	4 required
Metal Pole <= 2-1/2"	U-Bolt (x2)	Torque to 12 lb-ft
Metal Pole > 2-1/2"	Band-it system	See Appendix I: Mounting unit with Band-It
Building Wall	Minimum 3" Lag Bolts (x4)	>75 lb. load rating

The minimum clamping load strength for all mounting options should exceed 75 pounds.

2-1/2" METAL PIPE MOUNTING:

2-1/2" U-bolts should be fitted through the appropriate holes in the upper and lower mounting plates. All four nuts should be snugged with equal thread engagement on each leg of the U-bolt. The nuts should then be evenly torqued to 12 lb-ft. Take care not to over-tighten one side of the U-Bolts.

UTILITY / WOOD POLE MOUNTING:

Pick a safe pole location where the power cord can reach the input power source. Install the collector enclosure to the utility (or other wooden) pole by utilizing the screws and the pre-drilled mounting plates located at the top and bottom of the collector enclosure. Keep the box vertical / plumb as much as possible.

BAND-IT MOUNTING:

Band-It Mounting is used for pole mounting when the pole diameter exceeds 2-1/2". It is the most complex of the mounting methods and is described in detail in Appendix I: Mounting unit with Band-It.

FLAT BUILDING MOUNTING

Attach the collector to flat surfaces (like building walls) using 3" or longer lag bolts (LB in Figure 5) through the predrilled holes of the mounting plates. The bolts should be initially tightened down to where the head is flush with the mounting surface of the bracket. The bolt should then be tightened 1/8 extra turn.

BATTERY INSTALLATION

CAUTION

NOTE: Solar installations do not include the backup battery.

Once the collector has been securely mounted, the battery may be installed. While referring to figure 2 and 7, perform the following steps to install the battery:

1. Remove battery from shipping container
2. Locate and remove battery cable from accessory bag.
3. Attach red battery cable to positive (+) battery terminal and attach the black battery cable to the negative battery terminal (-).
4. Loosen wing nut screws on battery bracket
5. Place battery bracket in lower position to allow battery insertion
6. Carefully place battery into battery holder pan
7. Very carefully position the battery bracket onto the front corner of the battery. BE VERY CAREFUL –DO NOT ALLOW THE METAL BRACKET TO TOUCH THE BATTERY TERMINALS! Refer to Figure 2 and 7.
8. Tighten the wing nuts until snug
9. Connect the battery cable connector

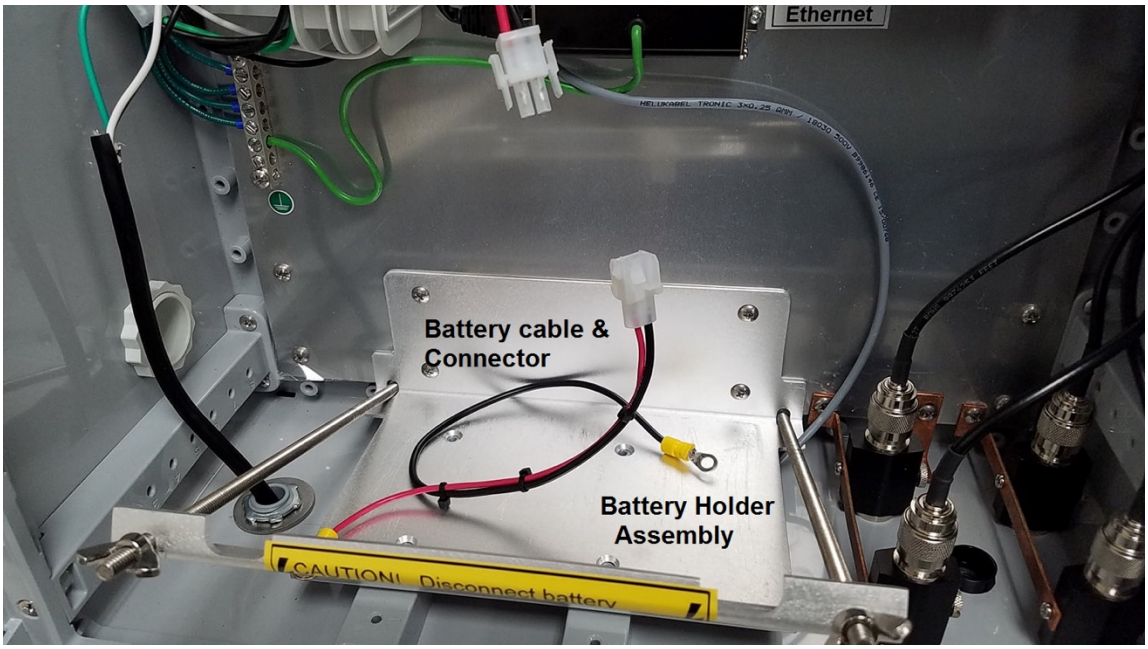


Figure 7: Battery Holder and Cable Assembly

IMPORTANT: To prevent corrosion on the battery terminals, add battery protectant such as Permatex 80370.

REMOTE AMPLIFIER INSTALLATION

The collector base unit includes internal GPS and cellular antennas and a connection for the external remote amplifier / antenna assembly (labeled "RF" in Figure 3). The remote amplifier / antenna assembly should ideally be mounted at an elevated location to achieve superior range.

Note: The antennas must be oriented vertically for proper operation, with the cellular modem antenna pointed upward.

Use up to 250 feet of type LMR-400 or equivalent cable to connect the two units. Greater lengths may be possible, if required, by using higher performance cable. The matrix below lists supported maximum coaxial cable lengths based on type.

COAXIAL CABLE TYPE	DB LOSS PER 100'	MAX LENGTH ALLOWED, FEET
LMR-240	7.6	131.6
RG-6	6	166.7
RG-11	5.4	185.2
RF-9914	4.9	204.1
RF-9913	4.2	238.1
LMR400	3.9	256.4
LMR600	2.5	400.0
LDF4-50	2.17	460.8
RMR-900	1.7	588.2
LDF4.5-50	1.6	625.0
LMR-1200	1.27	787.4
AVA5-50	1.12	892.9

Consult Mueller Systems engineering for additional details.

The standard 8dBi antenna assembly includes a bracket that may be mounted to a pole, tower or solid surface using the same mounting techniques as the collector base unit. See Base Unit Mounting Options. The optional 6dBi antenna shall be mounted on the amplifier bracket as shown on the following page.

Note: All coaxial connections should be protected from weather effects by following the wrapping procedure shown in Appendix II.

If replacing collector antenna equipment, please reorder the original equipment. If modifying the antenna configuration of your collector **you must use an antenna tested and explicitly approved by Mueller Systems**, or all warranties will be voided.

You can reach Mueller Customer Care Monday – Thursday, 8AM – 7PM EST, or Friday 8AM –5PM at (800) 323-8584 (in USA) or at (704) 278-2221.

EXTERNAL CELLULAR AND GPS ANTENNAS

The collector base unit includes built-in antennas for the GPS and cellular modem. An external antenna system (Mueller part number MS-FRU-MNC-AN3 is available for installations that require the use of external antennas for these functions (Figure 8). This antenna module accommodates both the GPS and cell modem and is connected to connectors located on the base of the collector unit (see Figure 8). Contact Mueller Systems if this type of antenna system will be required.

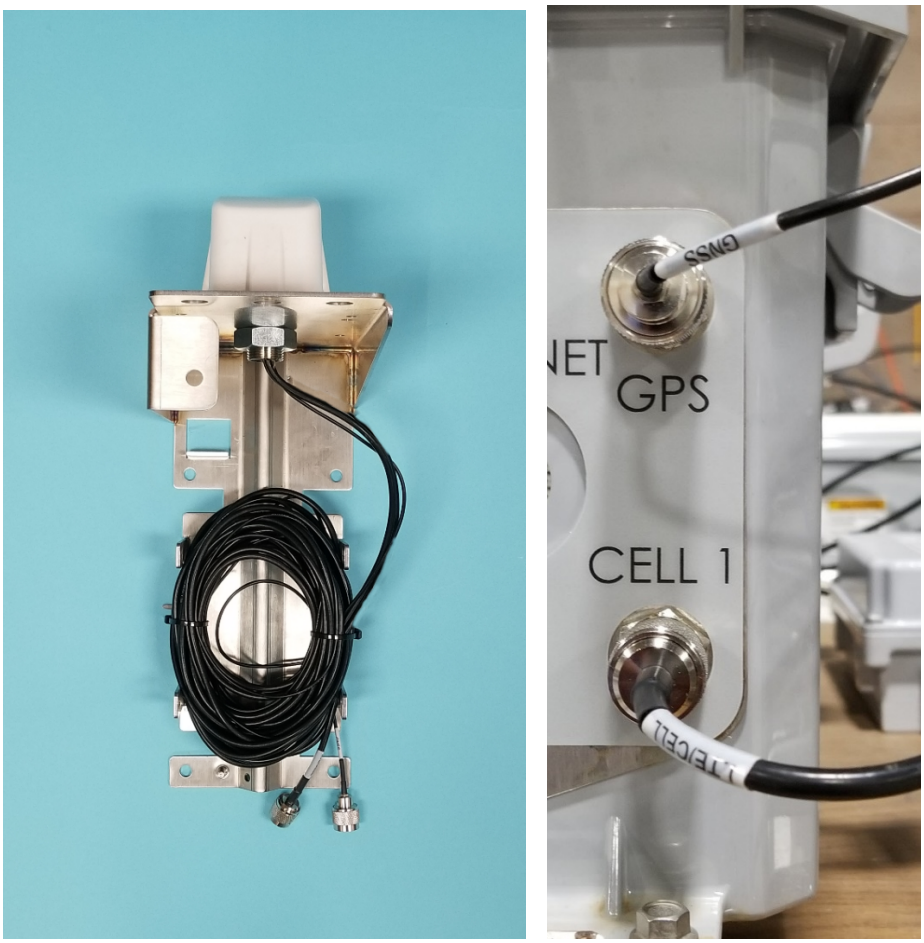


Figure 8: Remote external GPS / Cellular Antenna and connections at bottom of collector

Figure 9: Collector Base Unit and TTU remote antenna assembly – antenna not pictured

LIGHTNING PROTECTION AND GROUNDING

To provide adequate levels of surge protection during an electrical storm, implement proper grounding techniques during installation. See Appendix III: Lightning Protection Recommendations for additional information and installation requirements in lightning-prone locations.

The base unit's lightning arrestor includes a dedicated grounding point (labeled GND in Figure 3). The lightning arrestor ground **must** be connected to earth ground through a very low impedance connection, such as wire braid or large gauge copper wire according to local electrical code. The remote amplifier provides a dedicated grounding screw which must be utilized.

POWER CONNECTIONS

CAUTION

The collector base unit requires a 100 - 240 VAC, 150-watt power source. The collector power source must be supplied by a reliable source with an appropriate disconnect switch that meets local and NEC requirements. A conduit entry is located on the bottom of the collector enclosure and should be used for power wiring to the collector. **Note**: Use ABB LTGUS02G-C, 1/2" Liquid-Tight conduit or equivalent. **Note: conduit, power and ground wiring should only be installed by qualified personnel per applicable OSHA, NEC, local codes and laws.**

SOLAR INSTALLATIONS

Solar arrays should be installed to provide AC power. Power connections are the same as an AC installation.
See Appendix IV: Solar Installation.

AC INSTALLATIONS

Ensure AC power has been disconnected and all collector circuit breakers are in the off (down) position. Install the Line (L) Neutral (N) and Ground (G) in the indicated terminal blocks using the method shown in the Connection Procedure section below.

CONNECTION PROCEDURE

If your AC input wire is a stranded wire you will need to prepare the wires for installation by crimping a ferrule on the end of each of the three wires (line, neutral, and ground). The length of the ferrule shall be 12 mm and the barrel size shall be based on the wire gauge. Refer to the manufacture terminal and crimper instructions for the procedure to crimp the ferrule.

Insert the wires by forcefully inserting a 1/8”-wide, slotted screw driver into the port located above the wire entry hole. This action unlocks the wire port allowing insertion of the wire into its connection port (approx. 3/4” depth). Remove the screwdriver to lock the wire into its terminal (Figure 10). Always test each wire connection by pulling on the selected wire (Figure 11).

NOTE: use 1/8" or smaller screwdriver blade –wider blades will not activate the wire release mechanism.

Figure 10: Power Connections

Figure 11: Pull Test

ATTACH FERRITE FILTER

Snap the ferrite filter included in the accessory kit around the black and white wires leading to the L and N terminals. Note the green ground wire does not need to be enclosed by the filter. Open the filter by pulling on the two snaps as needed.

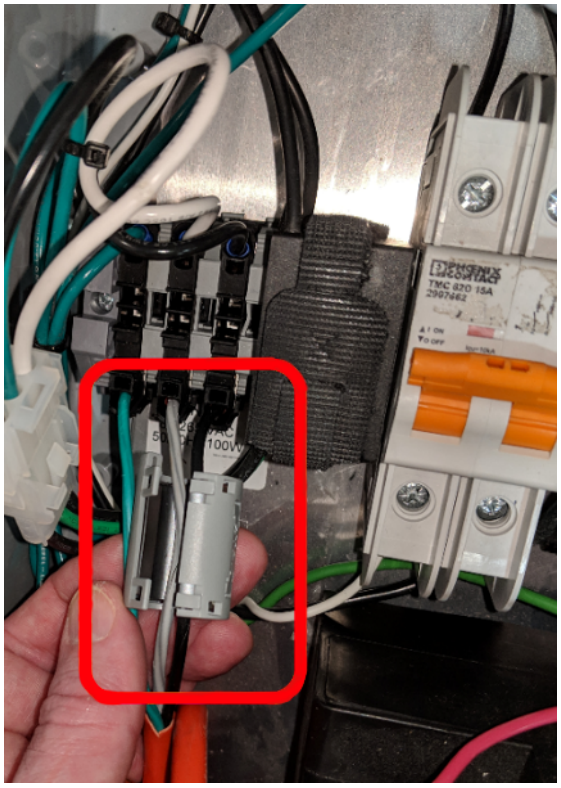


Figure 12: Enclosing L and N wires in ferrite filter

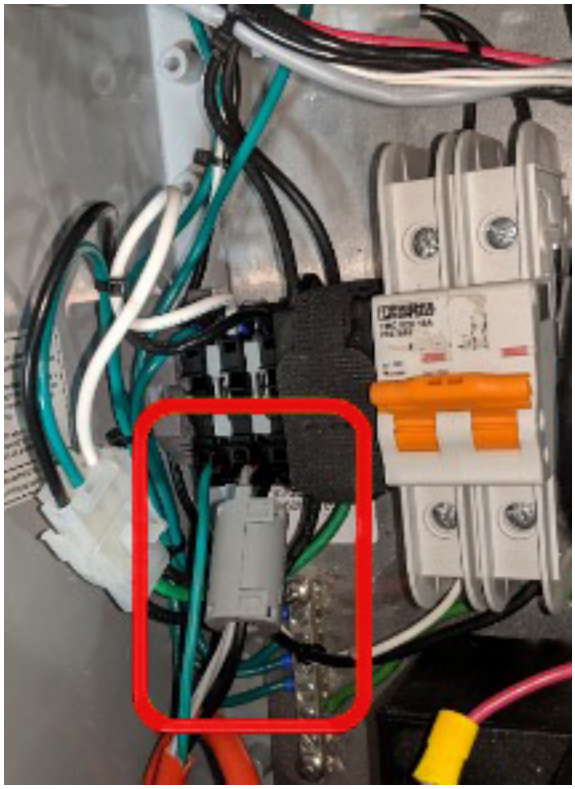


Figure 13: Ferrite filter enclosed around wires

INSTALLATION CHECKLIST

The installer must perform the following steps.

PRE-INSTALLATION COLLECTOR ITEMS

- ☐ PM / INSTALLER to schedule collector install with Tier 2 at least a day in advance for availability: **(800) 323-8584**
- ☐ NOC analyst will review Prop Study to come up with range test locations for PM/Installer
- ☐ NOC analyst to provide locations to PM / Installer for range testing
- ☐ PM / Installer will need DCXR (preferably) or Mi.Node to drive around to Range Test locations for Range Testing

POST-INSTALLATION ITEMS

- ☐ PM / Installer to contact Tier 2 after collector is powered up
- ☐ NOC analyst to verify power levels on collector (message 3.15.1)
- ☐ NOC analyst will verify communication and GPS fix (msg. 3.14.1 Get GPS Status, GPS Fix must be 3)
- ☐ PM / Installer to drive to each Range Test location and call NOC analyst to begin testing
- ☐ NOC analyst to verify signal strength at set locations (msg. 3.1.10 Get Received Signal Strength, RSSI > 40)

Range Test	Results	Notes
Location 1:		
Location 2:		
Location 3:		
Location 4:		
Location 5:		

- ☐ Once completed, NOC analyst will store in Salesforce for record keeping.

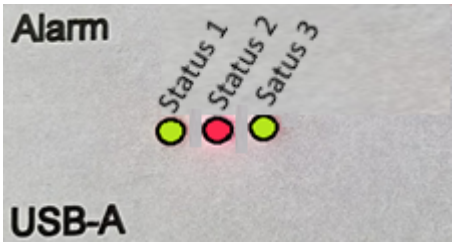
All configuration and control of installed collector units is accomplished remotely, using cellular modem (or Ethernet) based network links.

OPERATION

Once the base unit, battery and antenna / amplifier systems have been installed and all connections to power, Ethernet (optional), ground and antenna have been added, power may be applied by switching on the AC and Battery* circuit breakers to the UP position.

LED STATUSES

After switching on the breakers, the green LED on the power module illuminates. Additionally, three LEDs are provided on the gateway module to indicate status of the various modules in the collector - see Table 2.



- Status 1 LED indicates power related issues.
- Status 2 LED indicates proper backhaul and GPS operation.
- Status 3 LED indicates cable and antenna fault issues.

After an 80-second boot up period, if all modules are functioning properly and the collector was configured correctly, all three LEDs will be Green. If any fault LEDs are indicated, diagnose and correct the resulting issue according to the specific LED indication. Consult the maintenance and trouble-shooting guide in Appendix VI: Maintenance for additional troubleshooting information.

Note 1: At initial startup, the collector may require up to 15 minutes to achieve GPS lock (Status 2 will be off during this time and will turn Green after GPS lock is achieved).

***For solar powered installations, the battery breaker should remain in the OFF position.**

TABLE 2 LED ALARM DEFINITIONS

Status 1:
Green – No fault
Yellow – Temperature Fault
Red – Power Supply Fault
Note: The PSU includes an 'AC power good' indicator
Status 2:
Green – No Fault
Yellow – GPS Antenna Fault (No GPS lock)
Red – Backhaul Fault (No Connectivity, Ethernet or Cellular)
Status 3:
Green – No Fault
Yellow – Amplifier Fault (Remote); specific to the alarm the remote amplifier is sending down
Red – Gateway antenna Fault (local) Note: This is the cable to the remote amplifier

SET UP AND CONFIGURATION

All configuration and control of installed collector units is accomplished remotely, using cellular modem (or Ethernet) based network links. No additional set up or configuration should be required.

APPENDIX I: MOUNTING UNIT WITH BAND-IT

BAND-IT®'s banding technique described herein will be utilized to mount collector units, Solar Enclosures, Solar collectors and UPS enclosures. The collector mounting procedure is described here in detail because it is probably the most difficult as it involves two pole mounting brackets versus one for the other cases. This method of pole mounting collector is suitable for metal mast & streetlight mounting. Mounting to wooden utility poles should continue to use stainless steel screws or McMaster-Carr Mounting kits.

Mueller Systems has no formal affiliation with IDEX Corporation or BAND-IT. The information is being included here to assist in the installation of Mueller hardware, in the event that the installer chooses to utilize the IDEX BAND-IT system.

When mounting equipment to a pole with stainless steel banding, BAND-IT® always recommends double wrapping for safety and support. The weight of the mounted object must always be taken into consideration. For an average mounting box weight of 25 lbs. and under (which the amplifier falls into), 1/2" wide band is recommended (double wrapped). For the collector (40 lbs – 65 lbs), 3/4" wide band is recommended (double wrapped).

Figure A1-1: BAND-IT® banding materials

Equipment Required:

1. A roll of .5" x .003 stainless steel band (C204B9, Band-It). Cut two lengths ~= 2 x pole circumference + 9"
2. 5" buckles (C25499, Band-It). Two required
3. Single bolt flange less brackets (D02189, Band-It)
4. Collector or collector enclosure with mounting brackets attached

Tools Required (Figure A1-2):

- Tape measure
- Black marker
- Metal Snips
- ROBO-Grip
- Vise Grip
- Hammer
- Screwdriver (non-Phillips)
- 0.5" ratchet
- BAND-IT® C00169 Hand Tool

Figure A1-2: Tools Required

Procedure:

1. Cut two lengths of banding material. Length is 2X the pole circumference plus ~ 9".
2. Bend a 0.6" piece of the banding material back on itself. This keeps the buckle from sliding off of that end. Perform this to both pieces of banding material, then add buckle & brackets as shown in figure A1-3. Note that the left hand side of each band has its end bent 180 degrees to keep the buckles from sliding off.
3. Wrap a piece of rope / tape / acloth around the pole below where the bands are going (optional). This prevents the bands from sliding down the pole!

Figure A1-3: Band Preparation

4. Wrap the top band around the pole & thru the buckle. Tighten the band (vise grips may be helpful here).
5. Wrap around the pole again, thru the bracket (may use fingers or screwdriver to get band out of bracket) and the buckle
6. Using the vise grip, grab & tighten the band & then bend it back ~ 100 degrees so it will not further loosen. At this point, the band is double wrapped, but movable.
7. Repeat for bottom band.
8. Both bands are now loosely attached to the pole.
9. Attach the collector to the brackets utilizing two bolts (the BAND-IT brackets are threaded to hold the bolts). This is shown in Figure A1-6 & A1-7 below.

Adjust the collector to its final location, then tighten the bands with the C00169 hand tool. The band may be held with the vice grips as the tool is attached (to keep it from loosening too much).

Figure A1-4: Buckle & Bent Band

Figure A1-7: Enclosure attached to the loose bands

Figure A1-8: C00169 tool attached to top band

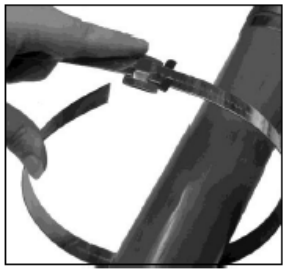
1. Tighten both bands, making sure the outer wrap stays over the inner wrap. Use the black marker to put markings on the banding material (i.e. |||||| like marks every ~ .25") where it is to be drawn through the buckle. This allows you to see the band tightening.
2. Tighten the double band until it has almost stopped tightening (as shown by the |||||| markings).
3. Use the ROBO-GRIP to bend the buckle ears together a little. This assures that the hammer can be utilized to properly fold the ears down over the band after the C00169 tool is removed.
4. Loosen the C00169 tool as described in the C00169 Operating Instructions, step 5. The vise grips may be utilized to keep the double band from slipping as/when the banding tool is removed.
5. Holding the banding tight, use the hammer to bend the holding ears down. Then, fold the banding material back over the top of the buckle & hammer it down. Leave 1" of banding material folded back over the buckle & remove the rest.

The following pages are reproduced with permission from the Operating Manual for the C00169 Hand Tool from IDEX Corporation.

Operating Instructions

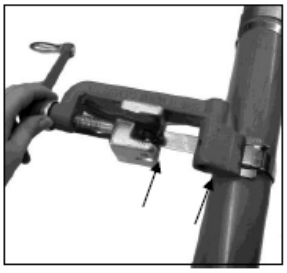
BAND-IT®

C00169 Hand Tool

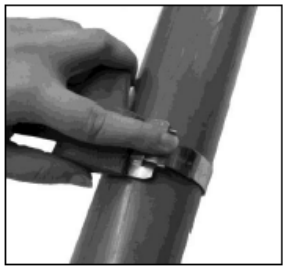


1. Band may be used from bulk roll as this *completely eliminates waste of band*. Slide buckle on band as shown, bringing end of band around object to be clamped and again through buckle. *NOTE: The tension screw thread should be lubricated regularly.*

2. Continue band around object once more and again through buckle. *Double banding develops a great deal more radial compression than single banding.* Bend end of band under buckle.

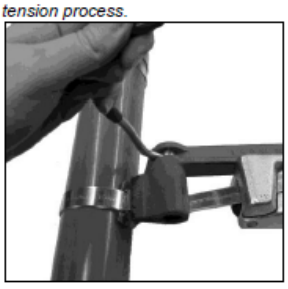


3. Place band in opening of tool nose and gripper block. Move into slot as far as possible, to avoid buckle sliding into tool nose. Tighten band clamp by turning the tension handle clockwise while holding band gripper tight against band. *NOTE: The spring load of the band gripper is not intended to secure and prevent band from slipping during tension process.*

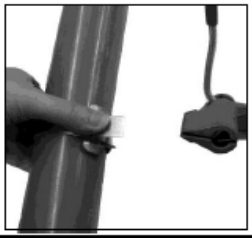


4. Place finger on BAND-IT Band at buckle bridge while tensioning with tool handle. When you feel BAND-IT Band stop moving through buckle as you are turning handle, *maximum pressure is being exerted by the BAND-IT Band* around object being clamped. *Stop turning handle.*

5. *Roll tool over buckle, backing off with tension handle throughout entire rolling operation.* Failure to back off with tension handle through-out entire course of roll-over may result in breaking of band. There is no loss of tension as band released is used up in the bend.



6. Pull cutting handle to cut the band.



7. Remove tool, holding stub of band down with thumb.

8. Hammer down buckle ears to hold band stub in place to complete BAND-IT clamp.

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Cleaning and Accessories

BAND-IT®

C00169 Hand Tool

Gripper Cleaning Instructions:

1. Remove gripper. Align gripper pin hole with notch in tool frame. Using a punch and hammer, punch pin out of slide block.

2. Using a wire brush, clean all foreign matter from teeth.

3. Replace pin. Gripper spring must be seated in tension screw hole. Align gripper hole with slide block hole, insert pin in hole and hammer pin in place.

Scru-Lokt Buckles:

1. The BAND-IT Scru-Lokt clamp, using the Scru-Lokt buckle, is applied in exactly the same way as the BAND-IT clamp except that the tool is not rolled over.

2. After tension is applied, insert set screw in Scru-Lokt buckle and tighten. To permit taking up Scru-Lokt clamp, or to re-use, a 3 inch (7.5 cm) stub should be left so that tool will be able to re-grip band later.

3. Where stub of band is left for Scru-Lokt clamp, it may be folded under as shown.

Tool Accessories:

JR Adapters: The JR adapters (J00169 and J05069 heavy duty) are used with the BAND-IT C00169 tool when BAND-IT JR. preformed clamps are used.

C04388 Close Quarter Tension Nut: In cramped quarters, use instead of tool tension handle.

NOTE: See general catalog or web site for instructions and ordering information.

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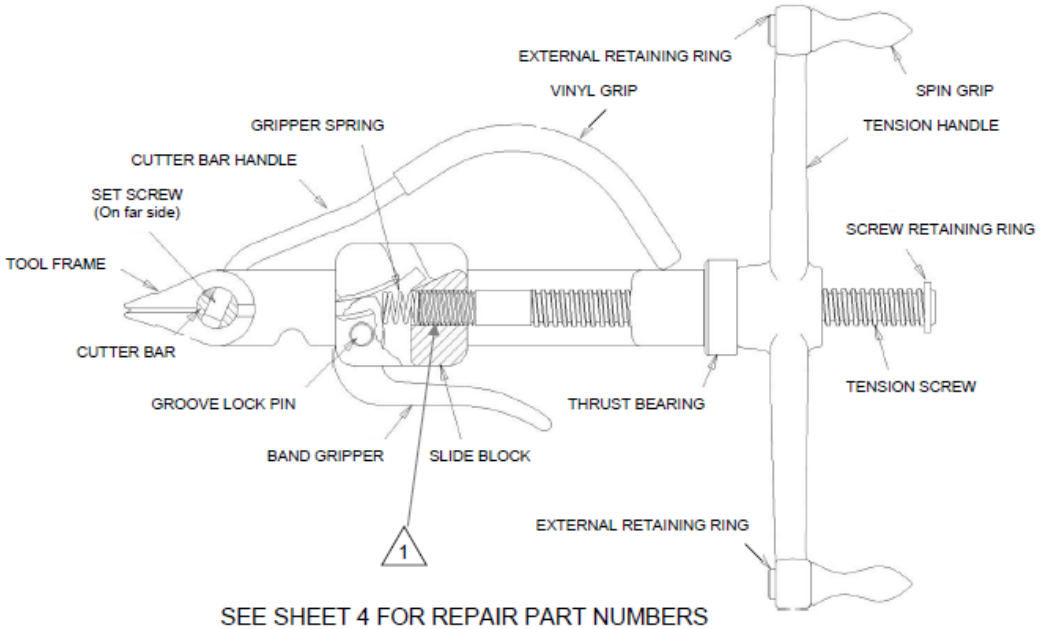
Tool Assembly Parts List

BAND-IT®

C00169 Hand Tool



SEE SHEET 4 FOR REPAIR PART NUMBERS

1. To assist in removing threaded parts, apply heat (softens locking compound).

2. When connecting the tension screw to the slide block, clean threads (male and female) of foreign matter, then apply two drops of medium strength locking compound (Loctite 242 or equiv.) onto male threads and connect parts together. Apply .03 oz. of food-grade white lubricant or equiv. to tension screw thread.

3. When connecting the set screw to the cutter bar, clean threads (male and female) of foreign matter, then apply one drop of medium strength locking compound (Loctite 242 or equiv.) onto male thread and connect parts together.

4. Kit # C00689 contains the Tension Handle Assembly and the Tension Screw. Both parts should be changed as a set to reduce accelerated wear. Review note 2.

5. Kit # C01899 contains the Band Gripper, Gripper Spring and Groove Lock Pin. Replace all parts as a new set to maximize tool performance. Periodic cleaning of band gripper teeth will improve tool performance.

6. Kit # C02499 contains the Slide Block, Groove Lock Pin, Band Gripper, Gripper Spring, and Tension Screw. Periodic cleaning of band gripper teeth will improve tool performance. Review note 2.

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Parts List and Warranty

BAND-IT®

C00169 Hand Tool

C00169 REPAIR PARTS AVAILABLE FOR PURCHASE	
PART #	DESCRIPTION
C02499	SLIDE BLOCK ASSEMBLY INCLUDES: SLIDE BLOCK, PIN, BAND GRIPPER, SPRING, TENSION SCREW.
C06799	KIT, SLIDE BLOCK ASSEMBLY INCLUDES: GRIPPER, SLIDE BLOCK, TENSION SCREW, PIN AND GRIPPER SPRING
C05887	KIT, CUTTER BAR ASSEMBLY INCLUDES: CUTTER BAR HANDLE, VINYL GRIP, SET SCREW, AND CUTTER BAR
C00689	KIT, TENSION HANDLE, BEARING AND SCREW

Refer to website for warranty information: http://www.band-it-idex.com/warranty.html

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APPENDIX II: WEATHERPROOFING CONNECTIONS

If mounting the collector outdoors or anywhere moisture may be present, weatherproof the connections for the AMI network antenna and cellular modem antenna.

To protect signal integrity and general functionality, weatherproofing should be applied to connections subject to water or moisture. After a connection has been made and tested to verify that it is functioning correctly, use multiple layers to seal it.

Recommended layers: an initial layer of UL-approved electrical tape, another layer of butyl mastic tape, and finally a layer of vinyl tape, see figure A2-1.

At each connection, begin by wrapping electrical tape to cover the connector and a portion of the cable. Stretch the tape a little as you wind it around the cable and the connector. As you wrap the tape, cover about half of the previous wrap. Keep the wraps neat and as smooth as possible.

The second step is to wrap a second layer of butyl mastic tape over the electrical tape, but wrap it at a 90-degree angle to the first layer. This is a putty-like layer and should be manually squeezed/compressed onto the initial layer to form a tight bonded assembly.

The last step is to wrap a layer of vinyl tape covering the first two layers.

Any connections subjected to water or humidity should be waterproofed.

NOTE: When weatherproofing the remote fiberglass antenna, ensure it is mounted upright, and take care NOT to cover the weep holes that allow moisture to escape from the base of the antenna. Covering the holes will cause the unit to fill with water, and eventually short out the antenna element.

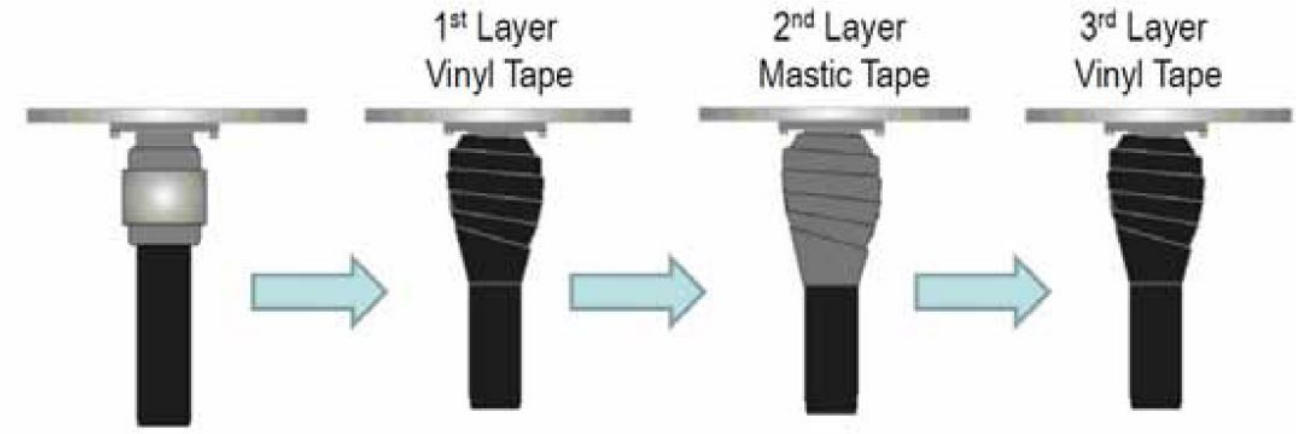

Figure A2-1: Weatherproof connector sealing

APPENDIX III: LIGHTNING PROTECTION RECOMMENDATIONS

To provide adequate levels of surge protection during an electrical storm, proper grounding techniques must be employed. These precautions involve surge protection on cables and proper system grounding. See the following sections for additional instructions.

SURGE PROTECTION

Surge protectors are included in the collector and antenna / amplifier assemblies. In high lightning areas an additional surge protector should be added to the AC service box that supplies power to the collector. This installation should be conducted by certified, professional personnel.

GROUNDING

Proper lightning protection generally involves ensuring the energy of nearby lightning strikes that couple onto AC, signal, or antenna cables can be safely diverted to the ground system. It is also very important that all grounds be tied to the same point, ideally near the AC service box. If these grounds are not tied together, dangerous voltages between different grounds may develop during a nearby lightning event. These voltages can cause surges that can damage electronic equipment. The Grounding system shown below in figure A3-1 shows a grounding system that follows generally accepted best practices. Note that all grounds are tied together near the AC service junction box.

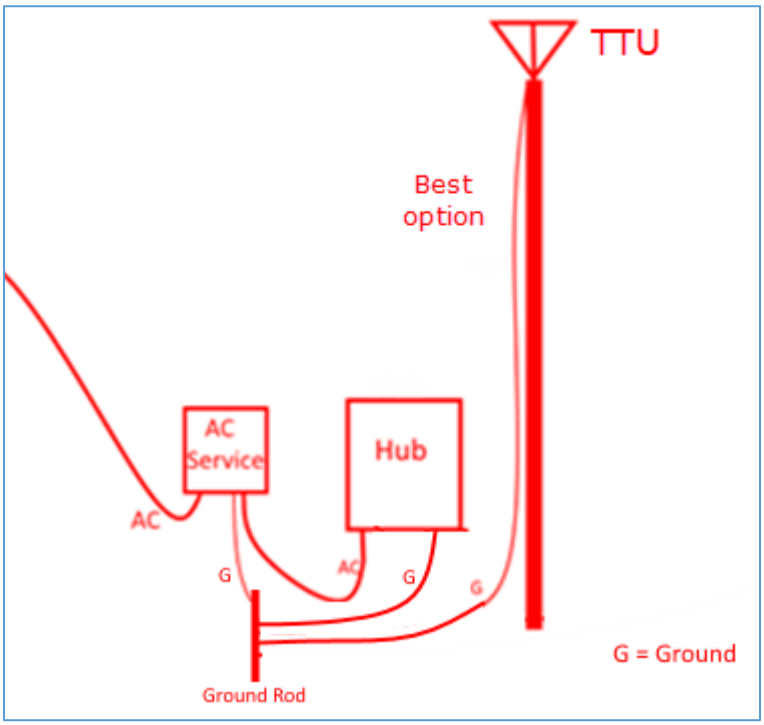

Figure A3-1: Grounding

GROUND CONNECTIONS:

Best practices recommend all ground wires should be #6 AWG size wire, or larger. Grounding rods should be least 6 feet long, copper clad or galvanized steel, approved for grounding applications and driven into good conducting soil. All grounds should be connected together with a solid bus bar similar to those shown in figure A3-4 and A3-5. See Figure A3-2 for the location of the collector ground connection. A dedicated ground lug is supplied on the tower top unit to facilitate its grounding as shown in Figure A3-3. The collector grounding system should be installed by certified, professional personnel and comply with applicable NEC and local codes and laws.

The MNC and TTU ground nuts should be torqued to 20 in-lbs.

Figure A3-2: Ground connection on MNC

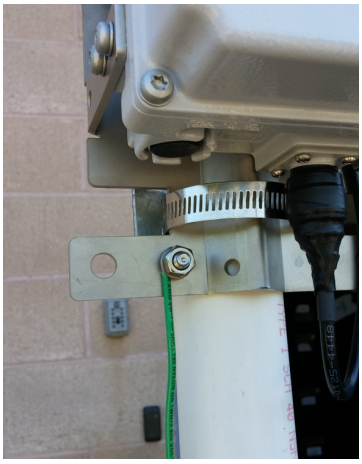

Figure A3-3: Ground connection on TTU

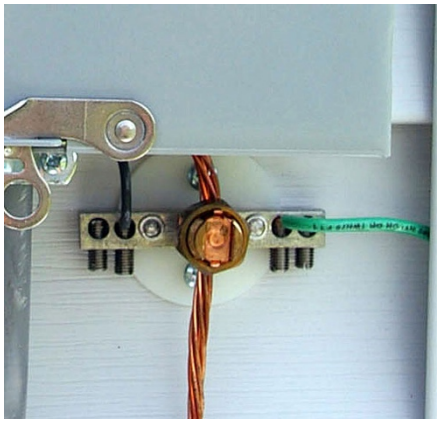

Figure A3-4: Ground Block, Burndy BDT1

Figure A3-5 Ground Block, Arlington Industries GBB5250

Figure A3-6 Ground Rod

APPENDIX IV: SOLAR INSTALLATION

This document describes only the necessary modifications for using the MNC with a solar-based power source.

Consult the manufacturer's instructions for assembly, wiring, and grounding the solar array.

CAUTION

- Disconnect AC power to the unit before you begin.
- Switch the AC breaker (labeled "AC") and the battery breaker (labeled "BATT") to the OFF position.

SOLAR POWER INSTALLATION NOTES:

- Solar array installation should be performed only by qualified, licensed personnel, and conform to all relevant regulations
- The solar array should provide AC power, 90-264V, 50 / 60Hz, 100W
- For any solar installation, ensure the MNC battery has been removed. It should be shipped to you without a battery. Contact Mueller Systems if you have received an MNC with a battery included.

SOLAR BATTERY MONITORING WIRING

The solar array's Remote Sensor Module (RSM) should be connected to the gateway via General Cable E1004S.41.10. Thread the four-wire bundle through a protective sheath attached at the Ethernet hole on the bottom right of the collector.

Once connected, the gateway can forward alarms regarding the solar array voltage to the Mi.Host interface.

SOLAR BATTERY ALARMS

Solar Voltage Warning Alarm

Indicates the solar power system is dropping below 12 volts. The alarm is cleared when voltage surpasses 12 volts.

Solar Voltage Critical Alarm

Indicates voltage on the solar power system is dropping below 11.8 volts. The alarm is cleared when voltage is above 11.8V.

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SOLAR BATTERY SIGNAL WIRING

This section describes wiring connections between the RSM and the MNC to enable battery alarm signal transfer. Ultimately, alarms are displayed in the Mi.Host interface.

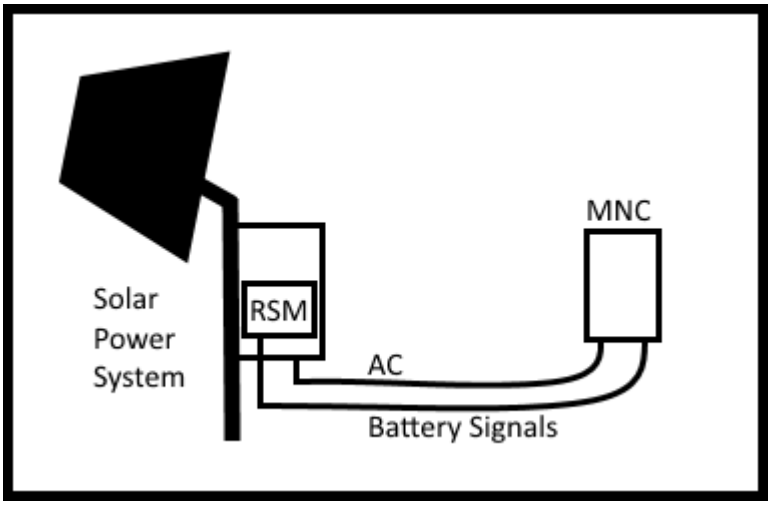

Figure A4-1 Battery signal connection to MNC

Battery signal wiring should be connected from the RSM in the solar power system to the MNC. Connect the RSM signal wires to Terminal block 4 as shown in Figure A4-2 (note, this image is for guidance only; your RSM may have additional wiring).

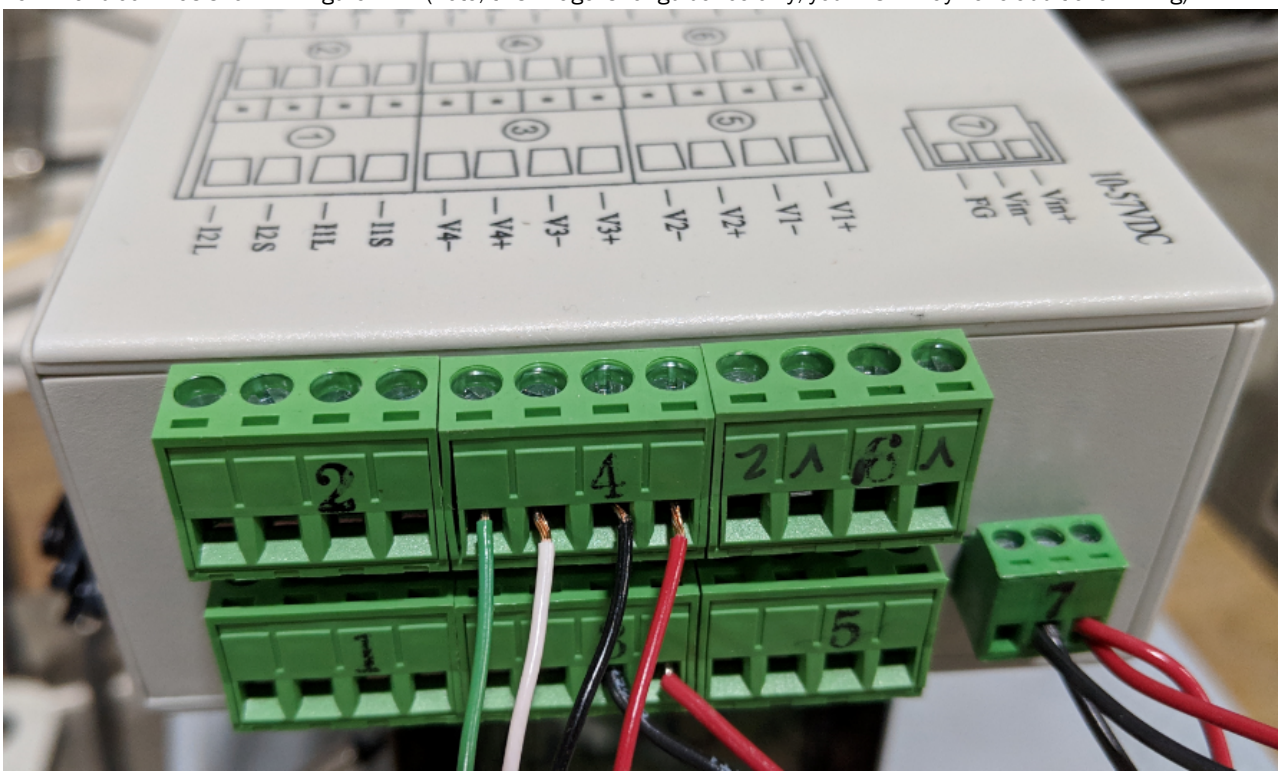

Figure A4-2: RSM Block 4 wiring to MNC

RSM SIGNAL NAME	RSM TERM	WIRE COLOR	MNC TERM	WIRE COLOR* (MNC)
+5V	CH3-COM	Red	1	Red
Alert 1	CH3-NO	Black	2	Black
+5V	CH4-COM	White	3	White
Alert 2	CH4-NO	Green	4	Green

Table A4-3: RSM-to-MNC wiring connections for battery alarms

Using a precision screwdriver or other pointed tool, connect the wires from the RSM to the terminal mounted to the right of the AC breaker. Insert the tool into the terminal hole as shown to open the clamp.

From left to right, attach the red, black, white, and green wires as shown in Figure A4-3.

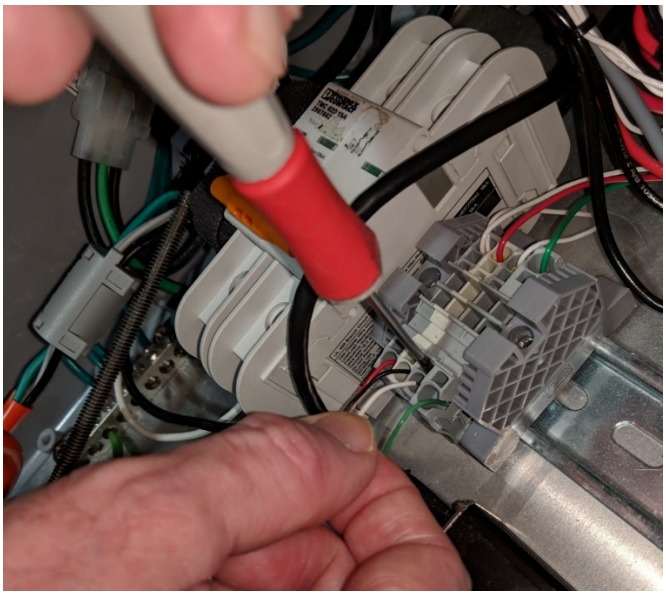

Figure A4-4: Battery signal wiring connections in MNC

APPENDIX: COMPLIANCE INFORMATION

FCC INFORMATION

Appendix Changes or modifications not expressly approved by the Mueller Systems could void the user's authority to operate the equipment.

IMPORTANT NOTE: To comply with FCC RF exposure compliance requirements, the antenna used for this transmitter must be installed to provide a separation distance of at least 34 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio / TV technician for help.

IC INFORMATION

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

This radio transmitter, IC: 9235A- 2ALEPT0004438, has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated.

Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

- Antenna 1: Dipole, 8dBi gain
- Antenna 2: Dipole, 6dBi gain

Cet émetteur radio, IC: 9235A-LMXR, a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous avec le gain maximal admissible indiquée. Types d'antennes ne figurant pas dans cette liste, ayant un gain supérieur au gain maximum indiqué pour ce type, sont strictement interdits pour une utilisation avec cet appareil.

- Antenne 1: dipôle, le gain 8dBi
- Antenne 2: dipôle, le gain 6dBi

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

APPENDIX VI: MAINTENANCE

CAUTION

For troubleshooting that does not involve diagnostics requiring LED indicators, disconnect the power to the unit.

The collector has been designed to allow field replacement of various modules by qualified service personal. Various faults may be detected via the LED, NOC report or diagnostic information provided via USB / laptop (see Table A6-2 and A6-3). Also, a trouble shooting guide has been included to aid identification of a faulty module. Upon successful fault analysis, the modules shown in Table A6-1 may be replaced by qualified personal.

Warning: maintenance or service must be performed only by qualified service personnel.

REPLACEMENT MODULES

Table A6-1

MS PART NUMBER	DESCRIPTION
MS-FRU-MNC-AB	AC Breaker, 15A ,2-pole, 277 VAC, DIN, FRU, Mi.Net Collector
MS-FRU-MNC-AN1	Ant 900 Mhz 6 dBi, FRU, Mi.Net Collector
MS-FRU-MNC-AN2	Ant 900 Mhz 8 dBi, FRU, Mi.Net Collector
MS-FRU-MNC-AN3	Ext GPS / Cel Ant Assy, FRU, Mi.Net Collector
MS-FRU-MNC-BB	Battery Breaker, 15A , 480 VAC, 125 VDC, FRU,Mi.Net Collector
MS-FRU-MNC-BU	Battery, Lead-Acid, 12V, 34 Ahr, FRU, Mi.Net Collector
MS-FRU-MNC-CM-AT1	Modem, Cellular, ATT, Cat M1, USB, FRU, Mi.Net Collector
MS-FRU-MNC-CM-AT3	Modem, Cellular, ATT, Cat 3, USB, FRU, Mi.Net Collector
MS-FRU-MNC-CM-VZ1	Modem, Cellular, Verizon, Cat M1, USB, FRU, Mi.Net Collector
MS-FRU-MNC-FC	Cable for Mi.Net Cavity Filter, 6'
MS-FRU-MNC-FLTR	Mi.Net Cavity Filter, w/o Cable
MS-FRU-MNC-GA	Mounted Gateway Assembly, FRU, Mi.Net Collector
MS-FRU-MNC-PS	PSU, 12V, 100W, FRU, Mi.Net Collector
MS-FRU-MNC-SA	AC Surge Assy, FRU, Mi.Net Collector
MS-FRU-MNC-SP	Ant Surge Protector, FRU, Mi.Net Collector
MS-FRU-MNC-TTU	TTU Amp & Filter, FRU, Mi.Net Collector

GATEWAY LEDS

The Gateway module includes 3 LEDs to indicate the fault status of the Gateway. After an 80-second startup period, the three Gateway LEDs should become green if functioning normally. Use this table in conjunction with the troubleshooting guide to isolate faulty modules.

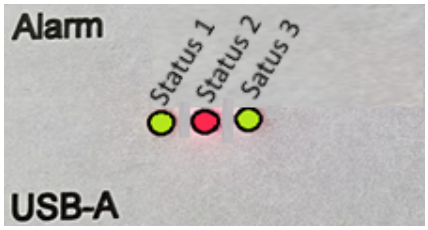

TABLE A6-2 GATEWAY LED ALARM DEFINITIONS

Status 1 LED:
Off – No power
Green – No fault
Yellow – Temperature Fault
Red – Power Supply Fault
Status 2 LED:
Green – No Fault
Yellow – GPS Antenna Fault (No GPS lock)
Red – Backhaul Fault (No Connectivity, Ethernet or Cellular)
Status 3 LED:
Green – No Fault
Yellow – Amplifier Fault (Remote); specific to the alarm the remote amplifier is sending down
Red – Gateway antenna Fault (local) Note: This is the cable to the remote amplifier

The following faults may be provided via the NOC service or when using specialized diagnostic service programs (via USB port).

TABLE A6-3 FAULTS AVAILABLE VIA DIAGNOSTIC USB PORT OR MUELLER NOC

Gateway status
Gateway SWR fault
Antenna SWR fault
AC Fault (no AC –running on battery)
Battery Voltage
Power supply fault -error signal from PSU
Tamper fault -Door
Temperature Fault
Cell modem status (Or Ethernet, if configured)
GPS status

When replacing collector FRUs (Field Replaceable Units), please reorder the original equipment modules from Mueller ONLY or all warranties will be voided.

You can reach Mueller Customer Care Monday – Thursday, 8AM – 7PM EST, or Friday 8AM –5PM at (800) 323-8584 (in USA) or at (704) 278-2221.

TROUBLESHOOTING GUIDE

Caution must be used as hazardous voltage levels exist within the MNC.

SECTION 1, Power Section:

Temporarily turn off the Battery Circuit Breaker (down position, see Figure A6-1)

Power Supply LED and DC Connector locations

Is Green Status 1 LED on gateway illuminated?

Yes-> Go to Section 2

No-> Is Green LED on Power Supply illuminated?

Yes -> Go to Section 1B

No -> Check AC circuit breaker is ON (up position)

Check all AC Mains wires are properly attached to MNC terminals

Wiring OK?

No -> Repair wiring (refer to wiring diagram in Appendix VI)

Yes-> Is AC voltage present at AC terminals? (use AC voltmeter) *

No-> Check all AC wiring entering the Collector

Yes-> Is AC voltage present at top terminals of AC circuit breaker? (use AC voltmeter) *

No-> Replace AC Surge Protection Module, MS-RC-HUB-SA

Yes -> Check for AC voltage at power supply terminals at top of power supply (use AC voltmeter) *

AC present?

No -> Check wiring and/or replace AC Circuit Breaker, MS-RC-HUB-AB

Section 1B:

Yes -> Check for 13 - 15 VDC at power supply DC Connector, on 12V +/- pins

Voltage OK?

Yes -> Temporarily disconnect RF Antenna Cable, see fig 8

Is Green Status 1 LED on gateway now illuminated?

Yes -> Replace Cable connected to RF connector. End of Test

No -> Turn off AC and carefully remove power supply DC connector.

Reapply AC power and check for 13 - 15 VDC at lower power supply connector, on 12V +/- pins

Voltage OK?

Yes -> System wiring is shorted. If able, locate and repair short circuit, else call Mueller Systems for additional service.

No -> Replace power supply module, MS-RC-HUB-PS

*Refer to Figure A6-1 and A7-1

The following procedures should be performed by qualified personnel per applicable OSHA, NEC, local codes, rules and laws.

End of Section 1 of Trouble Shooting Guide

SECTION 2:

Evaluate status LEDs and/or status codes from NOC and refer to the applicable trouble-shooting section as directed in Table A6-4.

Table A6-4
Gateway LED Definitions

	Refer to Section:
Status 1 LED:	
Off = no power	
Green – No fault	
Yellow – Temperature Fault	2.7
Red – Power Supply Fault	1.0
Status 2 LED:	
Green – No Fault	
Yellow – Backhaul (modem or Ethernet) GPS Antenna Fault	2.3, 2.5
Red – GPS Fault (No GPS lock Backhaul (modem or Ethernet)	2.6
Status 3 LED:	
Green – No Fault	
Yellow – amplifier to Ant SWR Fault (Remote)	2.2
Red – Gateway to amplifier SWR or Power Fault	2.1

2.1 Gateway SWR fault:

(Status 3 LED =Red)

Action: Check all RF cable connections from Gateway module to remote amplifier

Problem solved? Yes -> Done

No -> Check/replace Antenna surge protector, MS-RC-HUB-SP

Problem solved? Yes -> Done

No -> Check/replace antenna cable between collector and remote amplifier

Problem solved? Yes -> Done

No -> Replace amplifier, MS-RC-HUB-amplifier

Problem solved? Yes -> Done

No -> Replace Gateway, MS-RC-HUB-GA

Problem Solved? Yes -> Done

No -> Repeat Section 2.1

End Section 2.1

2.2 Antenna SWR fault:

(Status 3 LED = Yellow)

Action: Check all cable connections between remote amplifier and antenna

Problem solved? Yes -> Done

No -> Check/replace surge protector on amplifier

Problem solved? Yes -> Done

No -> Replace amplifier, MS-RC-HUB-amplifier

Problem solved? Yes -> Done

No -> Replace antenna

Problem solved? Yes -> Done

No -> Contact Mueller Systems

End Section 2.2

2.3 Backhaul/Cell modem Error (Or Ethernet, if configured):

(Status 2 LED = Yellow/Red)

Start -> Ensure all gateway and modem (or Ethernet) cables, antennas and connections are correct (Refer to Figure A6-1 and A6-1).

Problem solved? Yes -> Done

No -> Check PWR LED on modem is ON

Yes -> Go to Section 2.4

No -> Check/replace USB cable

Problem solved? Yes -> Done

No -> Replace cell modem, MS-RC-HUB-CM-AT or MS-RC-HUB-CM-VZ

End Section 2.3

Section 2.4:

Check Line Status (LS) LED on modem is Normal (Blinking Green) -indicates modem is properly registered on a network.
Steady Green = NOT registered on a network (FAULT)

LS LED = is Blinking Green/ (Normal)

No -> Contact Mueller Systems to ensure cellular data account is activated.

Problem solved? Yes -> Done

No -> Check if cellular signal is present (use cell phone bars)

Signal present? Yes -> Replace cell modem, MS-RC-HUB-CM-AT or MS-RC-HUB-CM-VZ

No -> Check if cellular signal is present outside the building (if applicable -use cell phone bars)

Signal present? Yes -> Add external cellular antenna, MS-RC-HUB-AN3 (see figure 8)

No -> Check if cellular signal is present from a different cellular provider.

Signal present? Yes -> Replace cell modem with alternative modem, MS-RC-HUB-CM-AT or MS-RC-HUB-CM-VZ

No -> Contact Mueller Systems

End Section 2.3/4

2.5 Backhaul/Ethernet Troubleshooting:

(Status 2 LED = Yellow/Red)

Start -> Ensure all gateway and or Ethernet cables, antennas and connections are correct

Problem solved? Yes -> Done

No -> Check Ethernet Provider is present at source (use PC app)

Ethernet is present? Yes -> Check/replace Ethernet cable

No -> Correct Ethernet provider issue

Problem solved? Yes -> Done

No -> Replace Gateway, MS-RC-HUB-GA

End Section 2.5

2.6 GPS Error:

(Status 3 LED = Red/Off)

Action: Ensure GPS antenna (top of enclosure) and gateway cable/connections are correct

Problem solved? Yes -> Done

No -> Check if GPS signal is present (use cell phone app)

Signal present? Yes -> Replace or reposition the internal GPS Antenna Module

Problem solved? Yes -> Done

No -> Add external GPS/cellular antenna (Mueller p/n MS-RC-HUB-AN3 (see figure 8)

Problem solved? Yes -> Done

No -> Replace gateway

(Status 3 LED = Yellow)

Action: GPS antenna requires replacement. Call Mueller Systems for replacement information.

End Section 2.6

2.7 Miscellaneous Faults:

Gateway Fault:

(Status 1 LED = Red, Status 2 LED = off, Status 3 LED = off)

-Replace gateway (Mueller p/n MS-RC-HUB-GA)

AC Fault (no AC and/or running on battery):

Refer to Section 1

Power Supply Fault:

(Gateway Status 1 LED = Red)

-Replace power supply module (Mueller p/n MS-RC-HUB-PS)

Tamper Fault –Door open (via NOK):

-Close and secure the enclosure door

Temperature Fault:

(Gateway Status 1 LED = Yellow)

-Reduce temperature below 60°C

-Remove unit from direct sun exposure

-Install heat/sun shield, if needed

Battery Fault:

When AC fails, the battery should provide backup power for approximately 20 hours. The battery should be replaced if holdup is found to be appreciably less. Additionally, for maximum reliability, it is recommended the battery be replaced every 4 years.

Improper combination of components:

The multi-network collector **must** be connected only to the TTU and not directly to an antenna assembly, or the previous generation Mi.Hub XR-R remote amplifier. This may prevent the multi-network gateway from starting properly (Green LED1 on gateway is off). **If the multi-network collector is replacing a Mi.Hub XR-R, the Mi.Hub's antenna / filter assembly must be replaced by a TTU.**

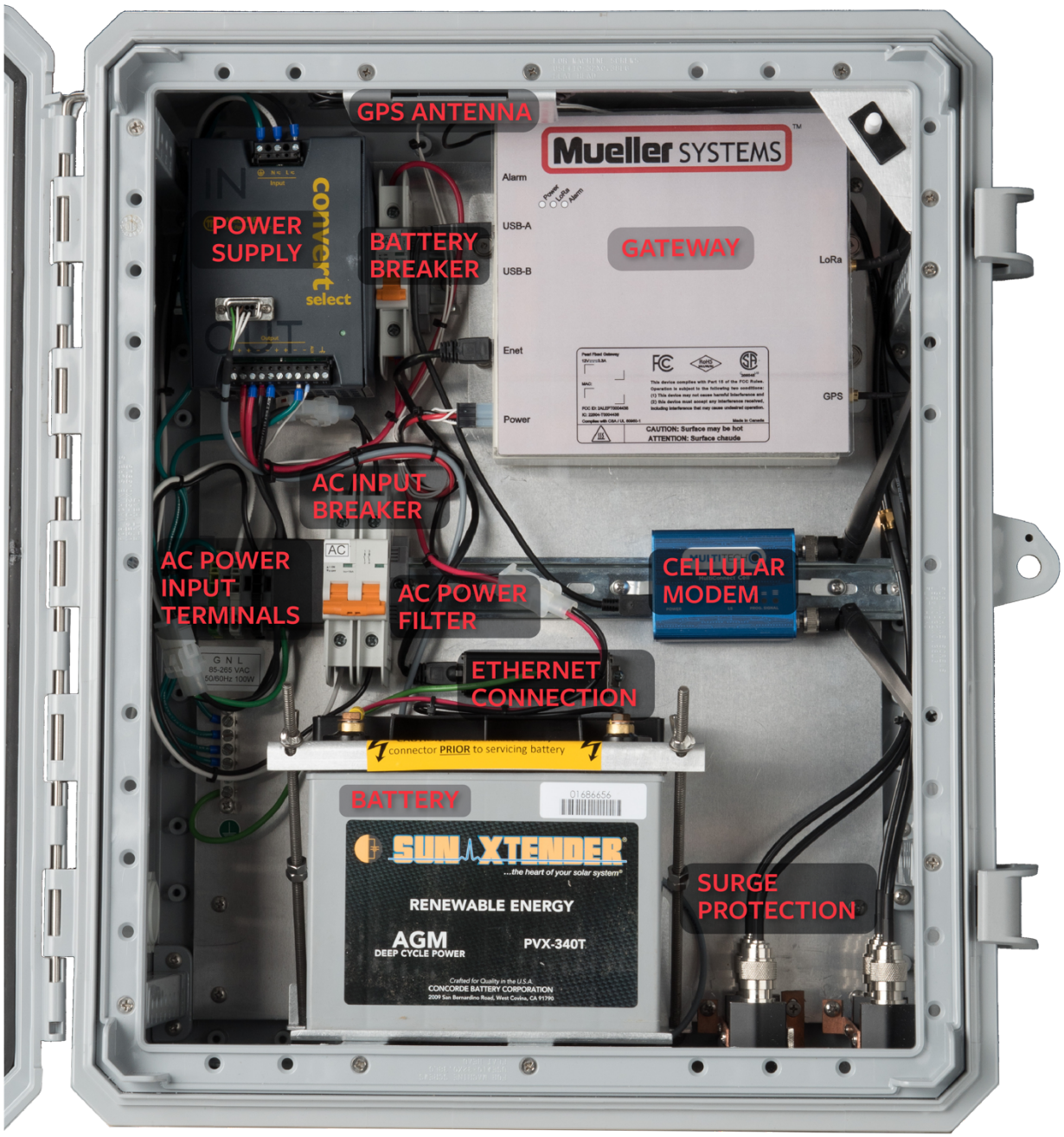

Figure A6-1: Replaceable Modules

APPENDIX VII: WIRING DIAGRAM

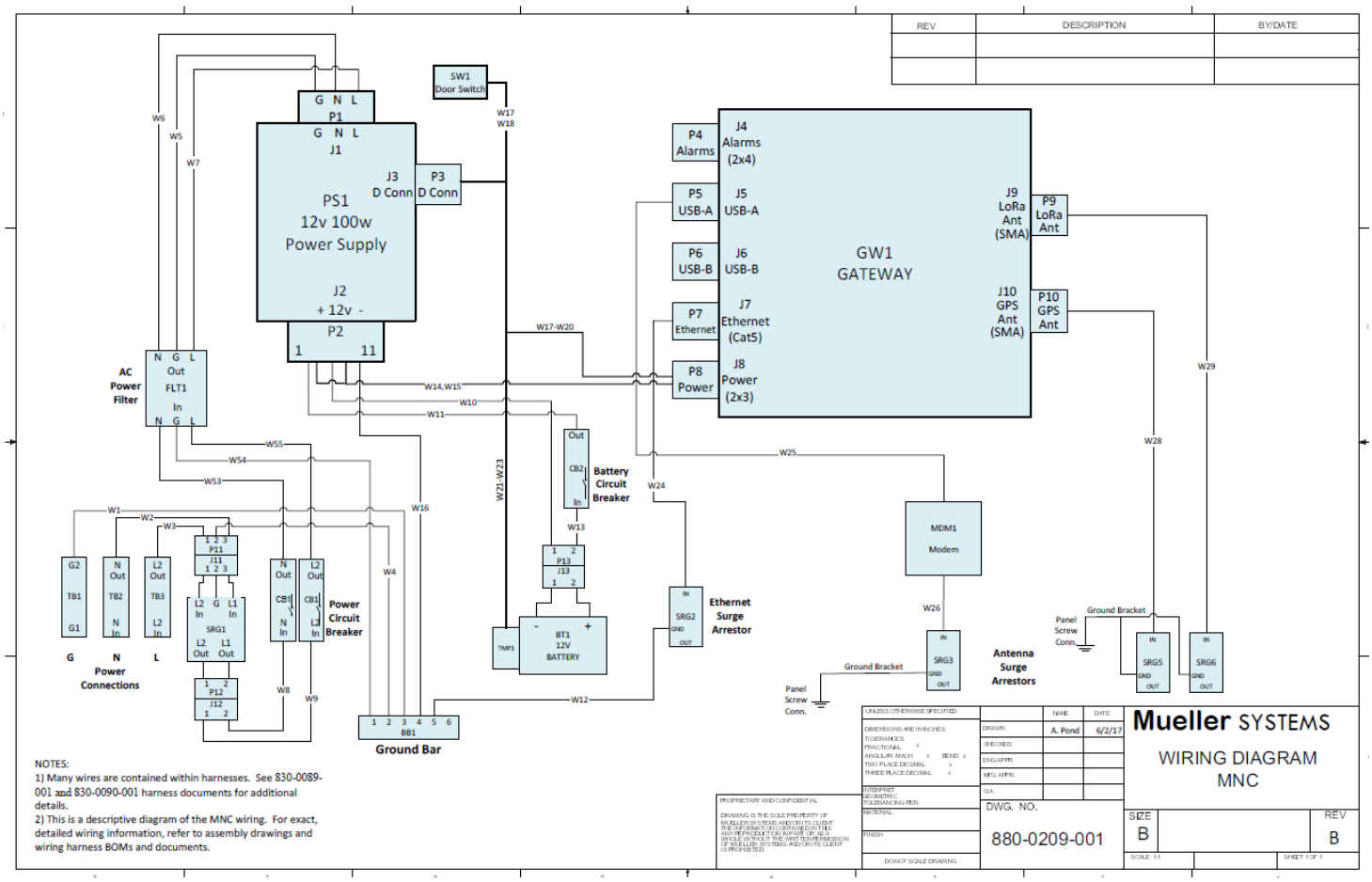

Figure A7-1

APPENDIX VIII: SPECIFICATIONS

BASE UNIT SPECIFICATIONS	NOTES
Gateway Transceiver	ISM, 902-928MHz, LoRa, 0.1 Watt max
Data Backhaul	Cellular (Verizon or ATT) or Ethernet
Operating Supply Voltage	90 - 264 VAC 50 / 60 Hz, 100W
Battery	12VDC, 34Ahrs
Battery Type	Sealed lead-acid, deep-discharge
Battery holdup	Approx. 20Hrs (@ 25°C)
Dimensions	24.0H x 21.00.5W x 9.5D (inches)
Dim. w/ Mount Plate	24.0H x 21.0W x 11.0D
Weight	33 lbs. (excluding battery)
Weight, Battery	23 lbs.
Weight, Mt Plate	8.2 lbs.
Weight, total	64.2 lbs. (includes battery and mounting plate)
Enclosure Rating	IP-54
Enclosure Material	Polycarbonate
Temperature Range	-40 to +60 C
Safety Rating:	UL/CSA 60950-1 / 60950-22
Connections:	
AC Power	Push terminals (22-12 AWG) wires via 1/2" conduit
Terminals	Push terminals -requires small screwdriver
Ethernet	Cat5e with RJ-45 plug via 1/2" conduit
Cable Length	300 feet, max
RF Antenna, ISM	N Connector, Female
Cable Length	6 to 250 feet with LMR400 cable
GPS, Ext Ant (optional)	N Connector, Female
Cell #1, Ext Ant (opt)	N Connector, Female

REMOTE AMPLIFIER SPECS

Power	12 VDC, 6W (supplied via coaxial cable)
Transceiver	ISM, 902 - 928 MHz, 1.0 Watt max
Connector	N Connector, Female
Dimensions	15.0H X 11.0D X 5.75W (inches, excluding antenna)
Weight	13 lbs.
Rating	IP-54
Temperature Range	-40 to +60 C
ANTENNAS:	
6dB ISM Antenna-	
Dimensions	24" (height), diameter: 1.3"
Weight	1.5 lb.
Rating	IP-54
Wind Rating	108 MPH
Temperature Range	-40 to +85 C
Connector	N Type
8dB ISM Antenna-	
Dimensions	63" (height), diameter: 1.5"
Weight	4 lb.
Mast Mounting Range	1.2" to 2.0", diameter
Wind Rating	130 MPH
Temperature Range	-40 to +60 C
Rating	IP-54
Connector	N Type
Other Antennas:	
Cellular, std	Internal, built-in
GPS, std	Internal, built-in, 5V powered
Ext Cellular/GPS (Optional)	Combination Cell / GPS Antenna
Rating:	IP-67
Cable:	17 feet with N connectors
Power:	Requires 5V from Gateway

APPENDIX IX: SAFETY AND PRODUCT LABELS

Explanation of Hazards with Related Labels and Symbols

Service personnel should be trained to recognize unexpected HAZARDS and to react accordingly. Labels below are used on collector Unit products.

Caution, risk of electric shock (located at Shock Hazards)

Label is defined as “Caution, refer to Manual”

Alternating current (see rating / model label)

Direct Current (see rating / model label)

Electric Shock Hazard Warning

ABOUT MUELLER SYSTEMS

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Mueller Systems provides Smart Metering solutions to optimize the delivery and use of water and energy. Municipalities that supply water, electricity or — or any combination of the three services — need innovative ways to increase efficiencies, reduce costs, conserve water and energy, and improve customer service. The Mi.Net® Mueller Infrastructure Network for Utilities from Mueller Systems meets that need.

Mueller Systems develops meters and metering systems that are a Smart Move™ for the most demanding applications including residential, commercial and fire-line meters, advanced metering infrastructure (AMI) / automated meter reading (AMR) systems and related products. We provide utilities with infrastructure technology—including the water industry's first AMI system with 2-way network configuration—that enables them to access the intelligent, actionable data needed to increase efficiencies, reduce costs, conserve water and energy, and improve customer service.

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