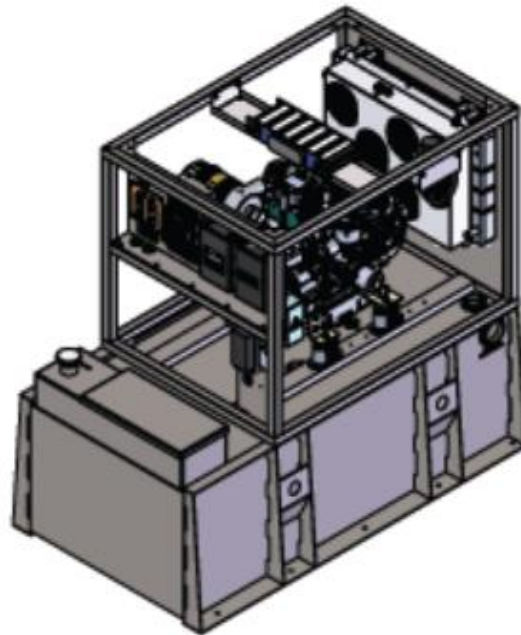




# **360Amps DIESEL BACKUP DC GENERATOR in Open Frame F020DYA360TEB**

## **Installation Method of Procedure**



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# PREFACE

Please use this document for safe installation of the DC generator set manufactured by Polar Power Inc.

Specifications of the components used to build this generator set may be different for each unit depending on customer requirements at the time of installation and the revision history of each generator set. Please refer to the service manuals from the original equipment manufacturers (OEM) for each component used inside this generator set. The customer is responsible for maintaining the generator set according to the periodic inspection and adjustment schedule as well as maintaining functional levels of fluid consumables such as the coolant, lube oil, and fuel.

The specifications and components used in this generator set may be subject to change without notice. If the contents in this method of procedure (MOP) are modified by Polar Power, customers who have registered their products will be notified with an update.

## **SAFETY PRECAUTIONS FOR TRAINED PERSONNEL AND NOMENCLATURE PER ISO/EN 7010**

### **SERVICE AREA**



### **WARNING**

- Sufficient Ventilation  
Inhalation of exhaust fumes and dust particles may be hazardous to your health.
- Safety Equipment  
Fire extinguisher(s), first aid kits and an eye wash / shower station should be close at hand (or easily accessible) in case of an emergency.

## (2) WORK – WEAR (GARMENTS)



### WARNING

- Safe Work Clothing

Appropriate safety wear (gloves, special shoes/boots, eye and ear protection, head gear, harnesses, clothing, etc.) should be used / worn to match the task at hand. Avoid wearing watches, jewelry, rings, unbuttoned cuffs, ties or loose fitting clothes around moving / rotating machinery. A serious accident may occur if clothing or jewelry is caught in moving/rotating machinery or completes an electrical circuit. The Supercapacitor used in the generator set can deliver a jolt of energy in excess of 3000 amps at 50 volts which will instantaneously vaporize metal jewelry.



## (3) TOOLS



### WARNING

- Appropriate Lifting / Holding

When lifting a generator set, use only a lifting device (crane, backhoe etc.) with sufficient lifting capacity. Do not overload the device. Use only a chain, cable, or lifting strap as an attaching device. Do not use rope, serious injury may result. To hold or support a generator set, secure it to a cart designed to carry its weight. Do not overload this device, serious injury may result. Never run the generator set without it being properly secured, serious injury may result.

- Appropriate Tools

Always use tools that are designed for the task at hand. Incorrect usage of tools may result in damage to the generator set and/or serious personal injury.

## (4) GENUINE PARTS AND MATERIALS



### CAUTION

- Genuine Parts

Always use genuine Polar Power Inc. recommended parts and goods. Damage to the generator set, shortened service life, and/or personal injury may result from failure to do so.

## (5) FASTENER TORQUE



### WARNING

- Torque Specifications on Fasteners

Always follow the torque values and procedures as designated in the service manual OR referenced to in this installation MOP. Incorrect torque values, procedures, and/or tools may cause damage to the generator set, and/or cause personal injury.

## (6) ELECTRICAL



### WARNING

- Short Circuits

Always press the generator **E-STOP** button before working on the electrical system or the generator itself. In addition, open the customer's generator breaker located in the DC Plant or in the external disconnect box. This will remove any voltage present at the generator and prevent the generator from starting automatically. An accidental "short circuit" or "reverse polarity" may cause damage, fire, and/or personal injury. Note that opening the breakers will put the generator in manual mode. Use controller display panel to put it back in automatic mode when it is safe to do so.



- Charging Batteries

Our systems incorporate different battery technologies, please confirm the type of battery chemistry before proceeding to work on any battery. Charging wet celled batteries produces hydrogen gas. Hydrogen gas is extremely explosive. Keep sparks, open flame and any other form of ignition away. Explosion may occur causing severe personal injury. Keep Lithium Batteries dry and stored away from all sources of water vapor, moisture, or condensation.

- Battery Electrolyte

Batteries contain different types of electrolytes please review the MSDS sheets before handling any type of electrolyte that may have leaked from the battery cell. Do NOT allow it to come in contact with clothing, skin, and/or eyes, severe burns will result.

## (7) WASTE MANAGEMENT



### WARNING

- Observe the following instructions with regard to hazardous waste disposal. Negligence of these regulations will have a serious impact on the environment.
1. Waste fluids such as lube oil, fuel, and coolant shall be carefully put into separate sealed containers and disposed of properly.
  2. Do NOT dispose of waste materials irresponsibly by dumping them into the sewer, overland, or into natural waterways.
  3. Waste materials such as oil, fuel, coolant, solvents, filter elements and batteries, must be disposed of properly according to local ordinances. Consult the local authorities or reclamation facility.



## (8) FURTHER PRECAUTIONS



### WARNING

- Fueling / Refueling  
Keep sparks, open flames or any other forms of ignition (match, cigarette, etc.) away when fueling/refueling the unit.

#### **FIRE AND/OR AN EXPLOSION MAY RESULT!!!**



- Hot Surfaces  
Do NOT touch the top of the generator set (or any of its components) while it is running or shortly after shutting it down. Scalding / serious burns may result. Allow the generator set to cool down before attempting to approach it.

- Rotating Parts  
Be careful around moving/rotating parts. Loose clothing, jewelry, ties, or tools may become entangled causing damage to the engine and/or cause severe personal injury.



- Preventing burns from scalding
1. Never open the radiator filler cap shortly after shutting the engine down. Steam and hot water will spurt out and seriously burn you. Allow the engine to cool down before attempting to open the filler cap.
  2. Some radiator caps have a pressure release, after the engine is cool down carefully lift the release tab, keeping in mind that hot steam or water can spray from the lift tab.
  3. Securely tighten the filler cap after checking the radiator fluid level.
  4. Do NOT touch or remove the heat shield located on the left side of the engine compartment. Surfaces are extremely hot!

# CODES AND STANDARDS

The following list of Codes and Standards applies to the installation and operation of the generator sets. This list is for reference only, and not intended to be inclusive of all applicable codes and standards. Codes and recommendations are subject to change and may vary by location over time.

Code	Description
NFPA70 ( NEC)	National Electric Code
NFPA110	Generators used by AT&T Mobility are classified as an optional standby source of power as defined in Article 702 of the NEC.
EPA Emissions	EPA Emissions Compliance. Supplier's unit spec sheet shall indicate current EPA tier rating of unit.
NFPA – 37	Standard for Stationary Combustion Engines
NFPA – 54	National Fuel Gas Code (Natural Gas)
NFPA – 58	LP Gas Code
Current NEC	Compliance to the current National Electrical Code (NEC) (NFPA 70).
U.L. 2200	Stationary Engine Generator Assemblies
ICC IBC 2018	International Building Code

# GENERATOR MAIN COMPONENTS

Yanmar 3TNV88 Engine



Supra controller



Over-Fill Prevention Valve



Load Breaker



H - 57"

W - 37"

L - 64"

Electrical tie on





# DC GENERATOR SET MODEL NUMBERS

Enclosure	Output	Diesel	Dry Weight (lbs.)	Dimensions (in.)
88-25-0200	360A	F020DYA360TEB	1610	37" x 64" x 57"

## SPECIFICATIONS

### DC Alternator

Type	Permanent magnets, NdFeB
Weight (lb/kg)	46.5/21
Regulation type	Variable speed engine
Stator	3 phase / 32 poles
Overcurrent protection (A)	450
Disconnect means	Circuit Breaker
Voltage range (VDC)	44 to 60
Alternator exhaust flow (cfm/cmm)	130 to 180 / 3.68 to 5.1
MTBF (hr)	100,000+

### Enclosure

Model	88-25-0200
Type	
Materials	Powder coated aluminum
Door hardware	
Mounting	

---

## Environmental

Operating temperature (°C/°F)	-40 to 51.7 / -40 to 125 (with enclosure)
Operating humidity %	100
Cold start aids	Optional

## Engine specification 20KW Diesel

Engine model	Yanmar 3TNV88-BDSA
Cylinders	3 in-line
Displacement (L)	1.642
Bore (in/mm)	3.4/88
Stroke (in/mm)	3.5/90
Intake air system	Naturally aspirated
Engine HP	36.8 at 3000RPM
Emission compliance	EPA and CARB certified
Variable RPM	2300 to 3000

## Power adjustment for conditions

Temperature Deration	1% derate for every 5.6 0C (10 0F) above 25 0C (77 0F)
Altitude Deration	3% derate for every 300 m (1000 ft) above 91 m (300 ft)

## Diesel Fuel System

Type	Diesel
Fuel Pump Type	Electrical
Injector Type	Mechanical
Fuel Filtering	Paper Element

## Fuel Tank

UL Rated Capacity (gal/L)	125/473
Run Time (hrs) (calculated dependent on gen load)	68 to 229
Tank Alarms + Visual Gauge	Yes
OPV (overfill prevention valve)	Yes
Catch Basin (gal/L)	5/19
Listings	UL 142 (double wall)

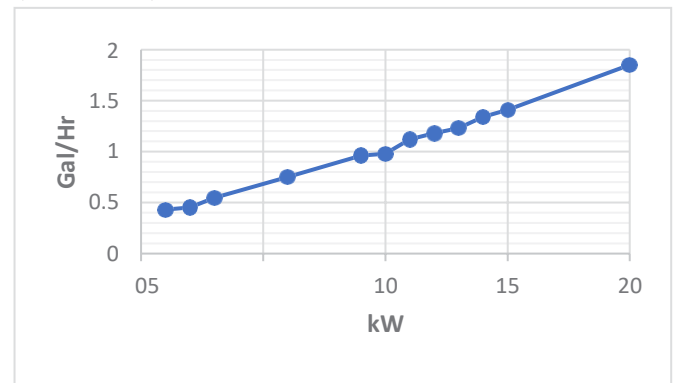
## Fuel Tank Reserve Time

**[\*Note: Calculated Values]**

Output (kW)	Reserve Time (hrs)
4	347
6	245
9	162
10	144
15	123
20	68

## Fuel Consumption Rate

(calculated)



## Engine Cooling

System coolant capacity (gal/L)	2.2/8.3
---------------------------------	---------

## Engine Cooling System

Type	Pressurized Aluminum Radiator
Water Pump	Belt-driven, Pre-lubed, self-sealing
Fan Type	Electric Fans
Airflow CFM	1300
Fan Mode	Pusher
Temperature Sensor	Yes

## Charger

Model	00-10-0015
Input Voltage (VDC)	37 to 62
Output Voltage (VDC)	14 to 14.4
Recharge time from 0 VDC (min)	10
Recharge time from 8 VDC (min)	2
Weight (lb/kg)	2.2/1

## Starter Supercapacitor

Model	20-16-0001
Storage Rating (Ah)	500
Voltage (VDC)	13-14.4
Weight (lb/kg)	12.1/5.5
Operating Temperature (°C/°F)	-40 to 65 / -40 to 149
Service Life (year)	10 to 15

## Engine lubrication system

Oil Filter Type	Full flow spin-on canister
Oil Capacity (L) (Full)	6.7
Oil Pressure Switch (Standard)	Yes
Oil Pressure Transducer	Optional

# PRE-INSTALLATION

Installing a generator set is an undertaking that requires detailed planning. Before moving the generator set to the installation site, it is recommended that the customer and their contractor(s) read this installation MOP and verify the following:

- The accessibility from the service road to the installation site.
- A solid flat level floor/grate capable of supporting the operation of a 600 to 2000 lb generator set .
- Availability of a forklift of sufficient capacity and dexterity for operation over unimproved ground at the site or a mobile crane for transfer of the generator set off the transport vehicle to the slab or shelter.
- Customer supplied switchgear (circuit breakers and disconnects) as required by code.
- Customer supplied plumbing for Propane or Natural Gas with connections provided by local Gas Company.
- Sufficient space around the generator set for ingress and egress of installation and maintenance crews.
- Installation of a Supercapacitor.
- Polar Power ships generator sets with or without lube oil and coolant in the engine.
- Verify that the model of generator arriving at the site includes or does not include a fuel tank.
- Fuel and lube oil system requirements: fittings and filter type as well as oil/coolant requirements, etc.

Before moving the generator to its permanent site it is recommended that the installer verify the presence of:

- Oil in the engine – before starting the engine, use the dipstick (twice) to check that there is lube oil in the engine.
- Coolant in the radiator – before starting the engine, verify that there is coolant in the coolant reservoir.
- Fuel system requirements: secure all fittings, pressure regulators, fuel flow rates, filter requirements, etc.

<b>SAE viscosity grade motor oil</b>	<b>Temperature conditions</b>
0W-30	Below -25 °C (-13 °F)
5W-30	Below -18 °C (0 °F)
10W-40	Above -18 °C (0 °F)
20W-50	Above -7 °C (20 °F)
SAE 30	Above 5 °C (40 °F)
SAE 40	Above 16 °C (60 °F)

Figure 1

Always choose full synthetic oil for cold climates, very hot climates, or for high number of run hours.

# GENERATOR SET INSTALLATION

The customer and their designated contractor(s) should read this installation MOP as well as manuals for the Supra Controller, engine, and optional telecommunications equipment to familiarize themselves with the safe installation, operation, and maintenance of each subassembly **BEFORE** installing the generator set.

Prior to transporting the generator set to the customer's distribution center, every Polar Power generator set is fully tested and run under load. After the generator set is installed, it is commissioned at the customer site by a Polar Power technician or approved partner prior to acceptance. The goal of the commissioning process is to test and validate the successful integration of the customer's system configuration with Polar Power's software, modems, controls and other optional peripherals specified by the customer. In most configurations the generator requires a -48V DC plant and battery plant to be connected to the output; the power and battery plant provide the power to the Supercapacitor and, depending on the configuration of the generator, may provide power to Supra Model 250 controller.

The Polar Power 20kW Diesel generator comes equipped with a Supercapacitor which takes the place of a standard start battery.

## Transportation and placement



### **DANGER**

- NEVER tip the generator set beyond 15° from vertical on any vertical axis even when supported from an overhead crane. Doing so may result in oil spilling from the dipstick tube on the side of the crankcase or the engine detaching and falling off of the isolation mounts which are designed for vertical compressive loading only.

**IF THE UNIT STARTS TO FALL GET OUT OF THE WAY! IT WILL CRUSH YOU!**

A generator set can be transported over any level solid surface such as concrete or asphalt with a pallet jack. To facilitate transportation over unimproved surfaces such as crushed rock, loose dirt or soft landscaped surfaces, Polar Power suggests using a continuous plywood underlayment.

## Moving the generator set



### WARNING

- Dropping the generator set can cause severe personal injury or death. Keep feet and hands clear when lifting the generator set.
- Keep the generator set upright.



Figure 2

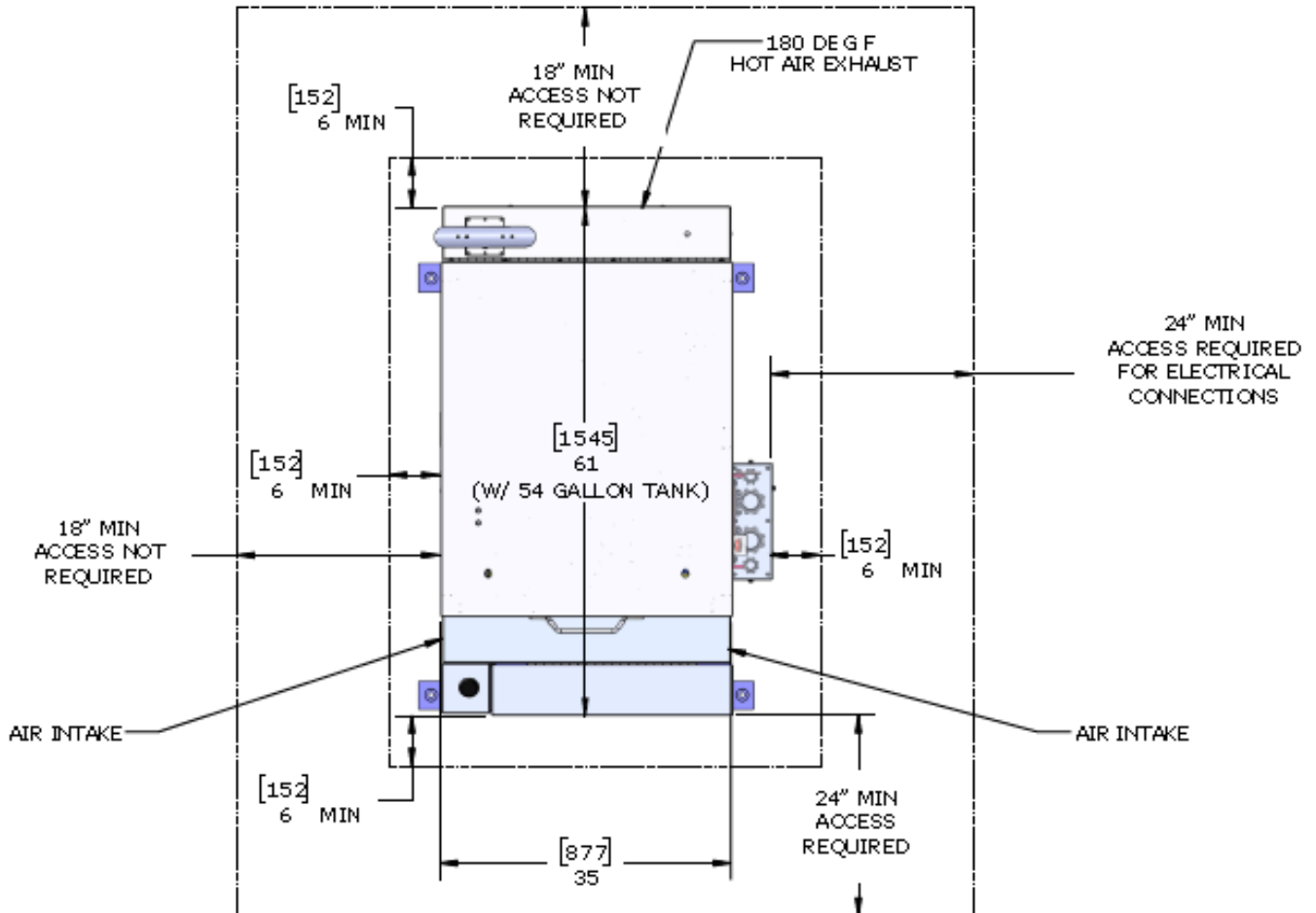
The generator set is heavy and must be handled with care.

When strapping down the generator set to be transported, pass the straps through the generator anchor hole windows. **Do not throw straps over the top of the generator as this will cause the top to deform. Use a spreader bar can prevent straps from damaging the top of the enclosure.**

When assigning a location for the generator, ensure that there is sufficient clearance on all sides and above the generator to allow for service and maintenance. Generator ventilation sound and exhaust should also be considered when selecting a location. See Figure 3 for spacing guidance. See Page 38-39 for Ventilation, Exhaust Considerations.

# Generator set footprint (top view)

24-3





## Generator bolt-down

The Polar 20kW horizontal generator has four 5/8" bolt down hole positions at the corner base of the fuel tank. See Figures 4. All four positions should be utilized. If mounting the generator to a concrete slab, use only IBC-certified anchors. Anchor suppliers have information on which anchors are appropriate for your application and which are IBC-certified.

Consult with the A&E of record for information on which anchors are appropriate for your installation. If the generator is to be mounted on a platform or structural rails, consult with the A&E of record as to how to secure the generator to the base.

For slab on grade installation:

1. Move generator into its permanent location.
2. Mark the concrete at each of the four bolt down hole positions at each corner of the fuel tank.
3. Move generator to expose all four marked hole positions.
4. Drill concrete at each marked hole to the proper depth for the anchor to be used (see anchor manufacturer's installation manual). Ensure hole is drilled straight so anchor bolt sits flush to gen base.
5. Set anchors in place.
6. Move generator back into its permanent position so that the anchor holes are clearly visible and accessible at each position.
7. Install the bolts and washers into each anchor hole and torque to anchor manufacturer's recommendations.
8. Add torque marks to each anchor nut, lock washer, flat washer and anchor base.
9. Bolt-down complete.

## Diesel Fuel and Tank Vent Connection

The Polar diesel generator with 125 gallon fuel belly fuel tank comes fully connected. No additional fuel line connections are required.

The generator also comes installed with a fuel tank vent pipe and vent cap. No further installation is required.

## Oil and Coolant

Polar generators are normally shipped with oil and coolant already added. The installer should inspect the generator to ensure coolant or oil is not visible in the generator compartment. The presence of oil and/or coolant in the generator compartment may indicate that the generator was mishandled (tilted excessively, or damaged during shipping).

## Check for loose electrical connections

As soon as the generator set is in place and secured, check all internal crimped and bolted connections that may have loosened due to the vibrations encountered during shipping. Loose connections which carry heavy currents will generate excessive heat if they are not secure prior to startup. Check that all lug nuts, bolts, and electrical connections are tightened and torqued to the correct values as specified in their respective shop/service manuals.

Loose electrical connections can be the cause of faulty signals, system failure, and/or **fire**.

## Proper cable connections

CORRECT INSTALLATION OF CABLES

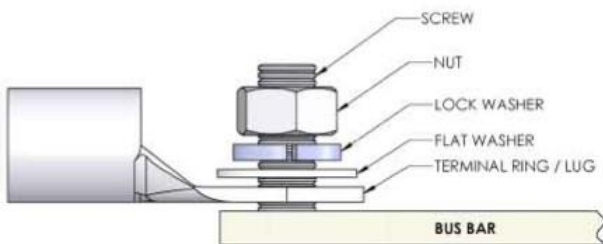


Figure 5

INCORRECT INSTALLATION  
USE NO WASHER UNDER LUG

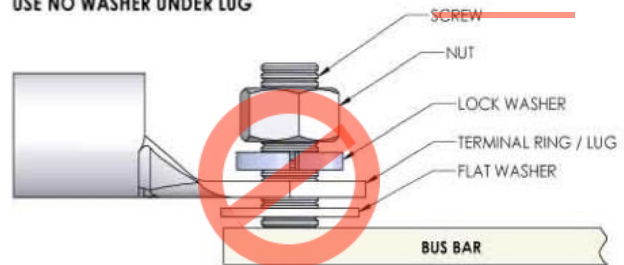


Figure 6

A proper cable connection means that the copper lug must be in direct contact with the copper bus bar, regardless of any plating present. **Do not place any nuts or washers between the lug and the bus bar.** Significant heat will be generated if the lug is not properly torqued down to the bus bar (periodically check the torque on all terminal connections).



### WARNING

Improper cable connections will cause system failure or degradation, and is possibly a hazard.

# WIRING SCHEMATICS

## General schematic for backup applications

Figures 7 and 8 schematics show how the DC Generator can be connected/installed for a Backup Application. Next figure shows the three primary DC connections (labeled as Conduits).

DC Generator installation requires only four conduits:

- Conduit 1 & 2: 2ea 2" EMT or Liquidtight Conduits for DC Power cables (connected to DC Load Center)
- Conduit 3 1" EMT or Liquidtight Conduit for Ground connection
- Conduit 4: 1" EMT or Liquidtight Conduit for Alarm and Comm connections

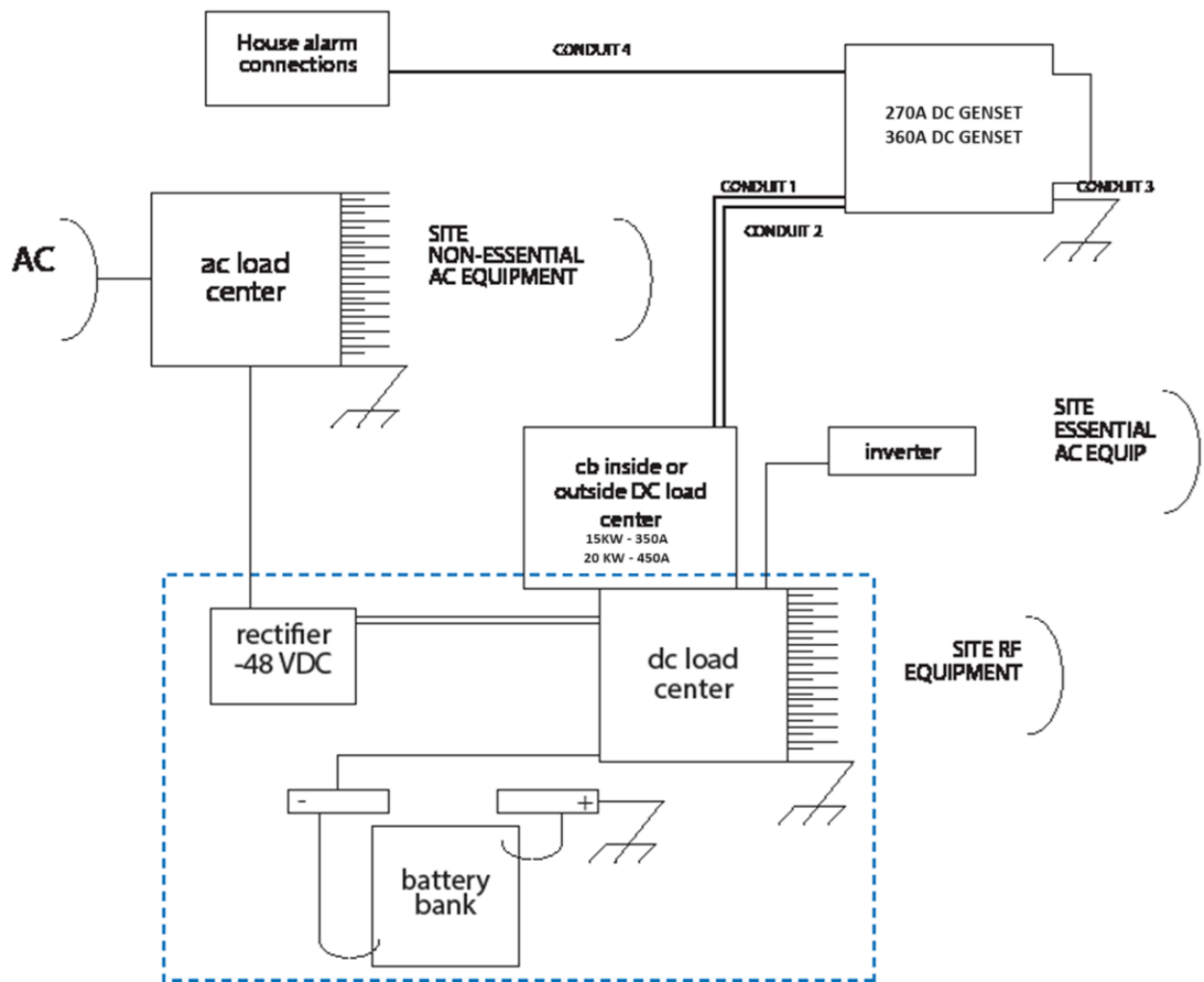
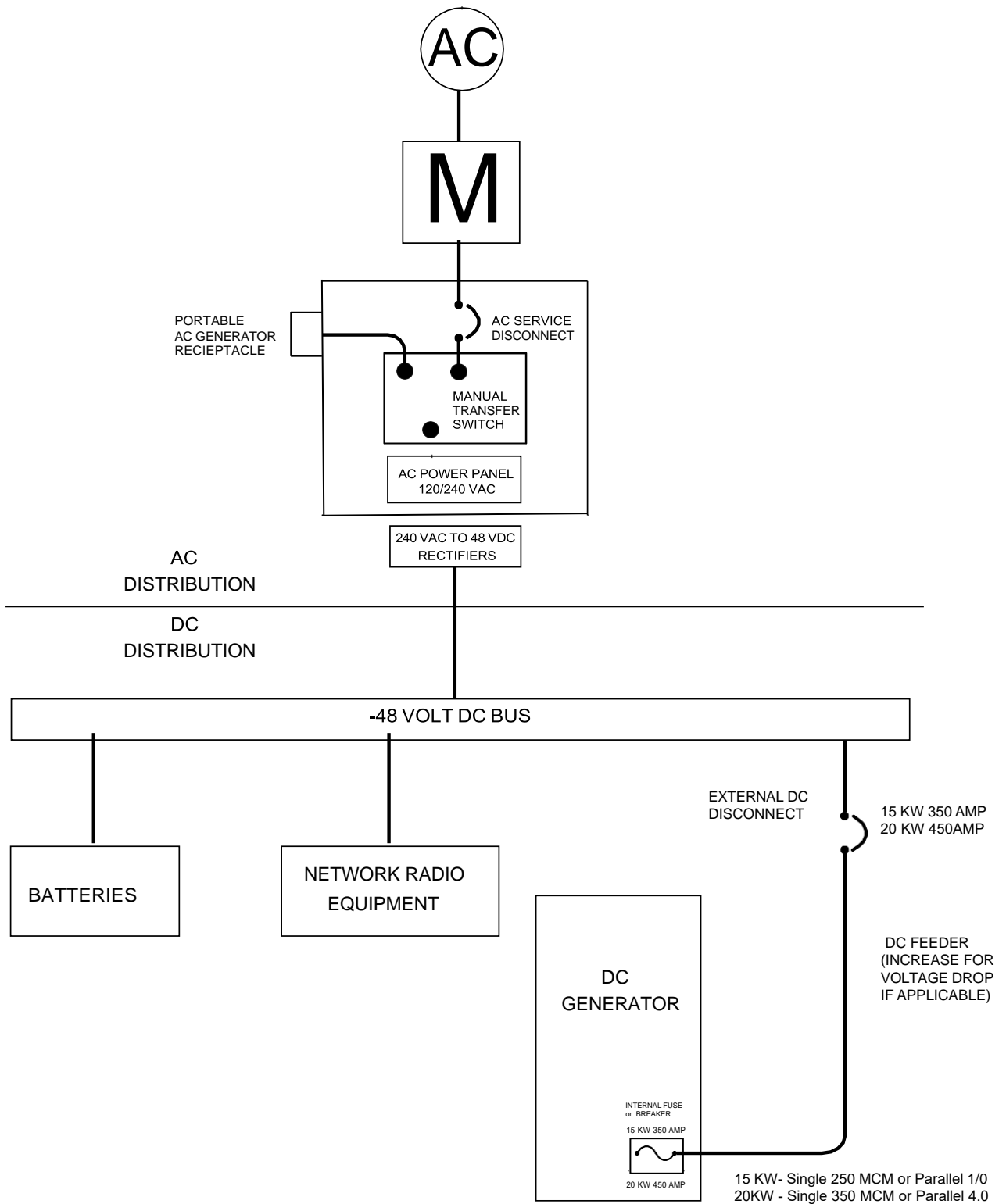


Figure 7

# Detailed schematic for backup applications



15 KW DC GENERATOR: NOMINAL 270 AMPS @ -51.5 VOLTS  
 20 KW DC GENERATOR NOMINAL 360 AMPS@ -51.5 VOLTS

Figure 8

# ELECTRICAL CONDUIT AND CABLE CONNECTIONS

## Main Power, Ground, Alarm/Comm Conduit Connections

### NOTE:

Power cable sizing and associated conduit sizing are impacted by breaker size, cable type, cable length, allowable voltage drop, NEC temperature scale used and available space at the cable terminations. While Polar Power does provide suggestions here for conduit and power cable, the Installation contractor must consult with the Customer to determine if their engineering practices or standards require some other conduit and cable type/size/quantity.

The conduit type and size suggested here for power assumes:

1. Using parallel 4/0 RHW-2 cables (4ea total cables, 2ea negative, 2ea positive (return)).
  - a. Use of 4/0 based on max ampacity of cable using 90 degree C scale (Ampacity: 260A)
2. No more than 2ea 4/0 RHW-2 cables in each 2" conduit
2. Short run of 4/0 cable from generator to Customer's DC Plant (< 40').
3. Minimum number of bends. (large number of bends make cable pulling more difficult and might require upsizing of conduit or the addition of pull boxes along the conduit run)
4. 450A breaker at Generator and at DC Plant. (AT&T has approved using a 400A breaker at the DC Plant).

### Main Power Conduit Connections (conduits # 1&2)

The Power Termination box on the Polar 20kW generator contains 2ea holes cut into the base plate that support up to 2" conduit. See Figure 14. Whether conduits are to be run above or below ground, they will have to route to the underside of this Power Termination box in order to gain access to the cable terminations. It is suggested that 2ea 2" EMT or Liquidtight conduits be installed to each carry one pair of 4/0 power cables. Using two conduits for power will help reduce heat build up and make cable installation easier. Route the other end of the conduits to the customer's cabinet. See Figure 7.

### Ground Conduit Connection (conduit # 3)

The Power Termination box on the Polar 20kW generator contains 2ea 1 1/8" holes cut into the base plate. See Figure 14. Whether conduits are to be run above or below ground, they will have to route to the underside of this Power Termination box in order to gain access to the generator ground bar. Install one 1" EMT or Liquidtight conduit from the Power Disconnect box to the #2 solid tinned ground wire rising up from the ground ring or to the MGB. See Figure 7.

### Alarm, Comm Conduit Connections (conduit # 4)

The Power Termination box on the Polar 20kW generator contains 2ea 1 1/8" holes cut into the base plate to support up to 1" conduit. See Figure 14. Whether conduits are to be run above or below ground, they will have to route to the underside of this Power Termination box in order to gain access to the generator interior. Install one 1" EMT or Liquidtight conduits from the Power Termination box to the side or rear knockouts of the Customer's cabinet that houses the alarm punch down block. See Figure 7.

## DC cable type and sizing (2 V drop)

Ampacity per the NEC at 52 VDC (minimum normal operating voltage):

Generator size	Current output regulation (Max FLA)	kW at stop Voltage point (51.5 VDC)	100% continuous FLA per NEC 215.2 Exception #1	Generator output fuse	DC plant input breaker	<b>MINIMUM feeder conductors</b> Evaluate to determine if an increase for voltage drop is required when in excess of 100 feet (RHW/RHH 90°C) GR-347 CORE (NEC 310) AMPACITY 1/0 = 170 A 2/0 = 195 A 3/0 = 225 A 4/0 = 230 A 250 MCM = 290 A 350 MCM = 350 A 500 MCM = 430 A  Paralleled 1/0 is the smallest size that can be paralleled per NEC	<b>Frame ground</b> Evaluate per NSTD33 to determine if an increase is warranted if in excess of 150 feet
15 kW	270A	14.4 kW	270A	350A	350A Or 400A	Single 250 MCM or Paralleled 1/0	#2 RHH/RHW (green)
20 kW	360A	18.5 kW	360A	450A	400A	Single 500 MCM or Paralleled 4/0	

Figure 10

1. Listed feeder conductors are MINIMUMS. Larger conductors are permitted if the associated lugs / terminals will accept them. Verify sizes on runs in excess of 100 feet to address voltage drop

## Exhaust Installation

The generator is shipped with a separate exhaust muffler. It should be installed after the genset placement.

## Circuit Breakers / fuses

Fuses and circuit breakers must be carefully sized to prevent damage to the generator and to all electrical components connected to the circuit. A fuse / circuit breaker too large in current trip point provides limited protection and too small the trip point can actually cause more damage.

The current limiting device should be at a minimum 25% higher than the rating of, or the current limit set point in, the generator set. This will also affect the cable sizing between the generator set and the load / distribution busbar/power panel. **AT&T has approved the use of a 400A breaker at the DC Plant.**

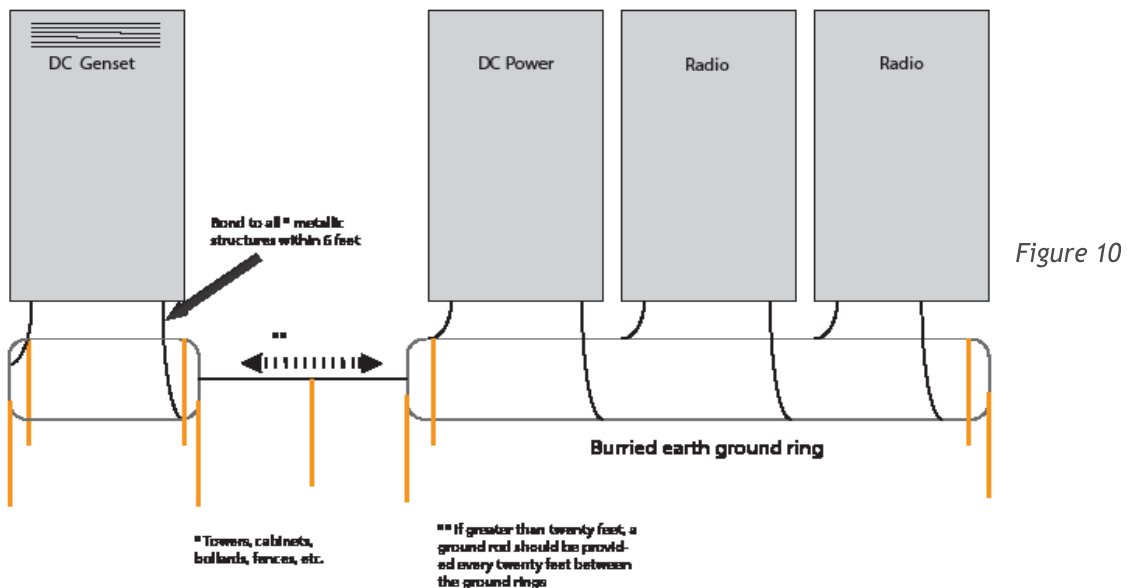
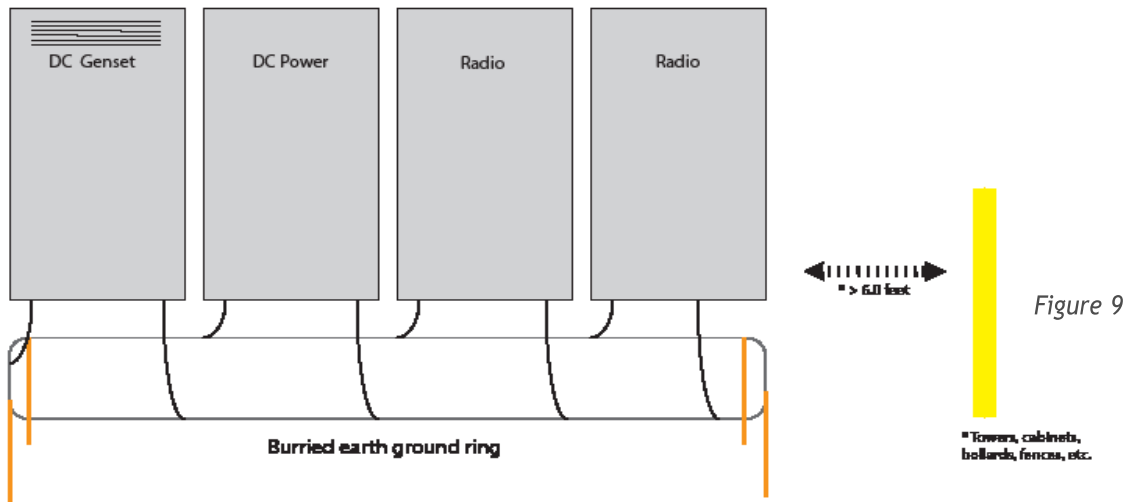
**Precautions should be taken when the DC generator and breakers are under load.** A circuit may suddenly open, creating high-voltage spikes which can damage the generator or anything connected to it. The voltage / current spike (or surge) can travel in both directions of the open circuit (upstream and downstream of the fuse / circuit breaker). There are numerous conditions that will affect the energy behind the voltage spike, including:

1. The length of the wire runs and whether or not the wires are twisted or running parallel. There is more induction in the circuit when the wires are run in parallel as opposed to twisted; the higher the induction the greater the voltage / current spike.
2. The amount of load on the generator or electrical circuit, obviously when a circuit breaker / fuse opens the circuit is under the highest current levels.
3. The amount of over-voltage protection circuit.

# Bonding and grounding

Poor electrical grounds are major reason for generator and electronic equipment failure. Too often the earth grounds for the generator are overlooked or the installation has too much resistance between the generator set and the earth ground.

If the standby DC generator set is fewer than six feet from the cell or hub equipment, see Figure 11 for guidance on bonding and grounding. If greater than 6 feet from the cell or hub equipment, see Figure 12. All bonding and grounding shall use #2 bare, tinned solid copper wires. Terminations shall employ approved connectors and lugs and/or welds. In both cases, if other metallic structures such as tower legs, bollards, fuel tanks, and the like are closer than 6 feet, bonding wires shall be run between them.





## Ground cable connection

Two-hole lugs (3/8" hole, 1" spacing) are used to connect between the ground busbar in the generator's Power Termination box to either the solid #2 tinned copper wire rising up from the buried ground ring, or to the green #2 stranded wire connecting to the site's MGB.

There are three two-hole (3/8" hole, 1" spacing) lug positions for the ground connection.

Figure 11 below shows the location of the ground busbar relative to the Breaker box. Figure 12 shows the ground bar and 3 available ground positions.

1. Route the ground wire coming from the MGB or buried ground ring through the previously installed conduit #3 and into the generator's Power Termination box.
2. If using a bare copper ground wire, install clear heat shrink for the length of the wire exposed inside the Power Termination box to prevent it from coming into direct contact with the Negative bus bar.
3. Using the proper crimp tool and die, crimp a 2 hole lug on the ground cable and land it on the available terminals on the generator's ground bar. Take care to maintain proper soft bend radius.
4. Install washer, lock washer and nut and torque to spec printed on Power Termination box.
5. Label ground wire using fiber tag and include to and from information.

### CAUTION



When power is fully configured, -48V from the DC Power Plant will always be present in the DC disconnect at the main breaker terminal inside the generator engine compartment. For Polar generators manufactured before 1-1-2020, the DC generator may rely on power from the DC plant in order to command the generator into service. All generators rely on the DC Plant to maintain charge on the super-capacitor bank that supplies the engine's starting power.

When working inside the generator compartment, it is necessary to first press the generator's E-STOP button and open the DC Breaker at the Power Plant or at the external Disconnect box (if equipped). This will remove -48V from the generator enclosure. Note that pressing the Estop button and opening the DC disconnect or the breaker in the DC plant will force the generator into manual mode (an out-of-auto alarm will result). Once power is fully restored, it will be necessary to pull out the E-Stop button and use the control panel at the front of the generator to put it back in automatic mode.

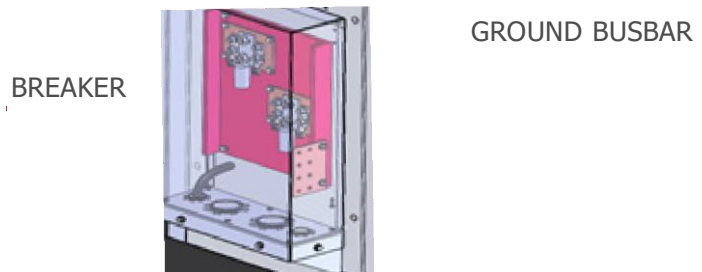


Figure 12



POSITIVE (RETURN) TERM BAR (2 ea positions - accept 2-hole lugs (3/8" holes, 1" spacing)

NEGATIVE TERM BAR (2 ea positions - accept 2-hole lugs (3/8" holes, 1" spacing)

GROUND BUSBAR (3ea positions - accept 2-hole lugs (3/8" holes, 1" spacing when landed horizontally)

ACCESS HOLE FOR ALARM & COMM CABLE

1 1/8" HOLE FOR EARTH GROUND CONDUIT

2" HOLES FOR PWR CONDUIT GROUND BUSBAR

1 1/8" HOLE FOR ALARM AND COMM CONDUIT

## Main Power, Alarm, Comm Cable Installation

Power cable sizing and associated conduit sizing are impacted by breaker size, cable type, length, allowable voltage drop, temperature scale used and available space at the cable terminations. While Polar Power does provide suggestions here for conduit and power cable, the Installation contractor must consult with the Customer to determine if their engineering practices or standards require some other conduit and cable type/size/quantity.

The neg cables at the genset should connect to the breaker in the customer's -48V plant or external disconnect. The Positive (Rtn) cables at the genset should connect to the positive (rtn) bar in the customer's -48V plant or external disconnect..

Ensure that the Generator Main breaker and the DC Plant breaker (or external disconnect, if equipped) are open before pulling power cable into place. Make sure to torque terminal connections to the breaker and power plant manufacturers' specifications. The lug must be in direct contact with the bus bar.

**DO NOT PLACE ANYTHING** between the TERMINAL RING/LUG and the BUS BAR. Neither washers nor grease are good conductors of electricity and should **NOT** be placed between the TERMINAL RING/LUG and the LOCK WASHER. Resistance between the BUS BAR and TERMINAL LUG will create a substantial amount of heat when high current passes through the stacked elements. Using corrosion inhibiting grease (NO-OX-ID) to protect your connections is a good idea. Do not use the grease between the lug and the bus bar. After the lug is properly torqued down to the bus bar, apply the grease in moderation on top of the connection.



### WARNING

System failure or fire may result if the nut on the lug is not torqued down properly. A loose connection will result in high resistance which will generate a significant amount of heat at all high current connections.

### CAUTION

**Always assume the power plant is hot.** When working in and around DC power plants and battery plants, always take precaution to protect exposed cable ends. Lugging and landing should always be a two person job. One will hold the cable, one will lug, land and install the hardware. If necessary use rubber insulating mats to cover the exposed bus in the plant until you are ready to land cable on its termination.

## Power Cable Prep and Pull Through Conduits

1. Prep four (4ea) runs of 4/0 power cable by cutting them to appropriate length, taping exposed ends, and temporarily label each end of each cable as follows:

1a: Cable 1: Neg-1   Cable 2: Rtn-1   Cable 3: Neg-2   Cable 4: Rtn-2

1b: Follow Customer cable color coding (if specified) when labeling cable ends.

1c: Ensure cable is long enough to route to the termination point at both ends such that there is sufficient slack to avoid sharp bends and such that cables do not pull on the terminal lug or termination bus bar.

2. Pull two cables through each of the two power cable conduits. Note that in a typical telco low voltage DC environment it is customary that 1ea neg and 1ea positive cable are run together. Installer should consult with the Customer or the jurisdiction on their accepted cable pairing practice.

### Landing Power Cables at Customer's External Disconnect or DC Plant

Note: Breaker must be able to accept 2ea 4/0 lugs. Breaker and return positions may need to have a bus bar added to accommodate these cables. Depending on the orientation of the additional bus bar, an angled lug (45 or 90 degree) and a narrow-tongue lug may be necessary.

1. At the customer's external disconnect or DC Plant cabinet ensure that the generator breaker (assumes breaker is already installed) is in the off (open) position.
2. At the Generator, ensure that the main 450A breaker is in the off (open) position.
3. Locate cable labeled Rtn-1.
  - a. Carefully, temporarily dress the Rtn-1 cable to its termination on the DC plant's generator breaker's return (positive) position. Cable should be dressed in such a way that it will not pull on its termination.
  - b. Mark cable for cutting.
  - c. With one person holding the cable, another installer should cut the cable to length.
  - d. With one person holding the cable, another installer will strip the cable end at the appropriate length for the 4/0 lug.
  - e. Slide clear heat shrug up onto cable and away from cable end.

## Landing Power Cables at Customer's External Disconnect or DC Plant - Continued

- f. Install lug onto exposed cable end ensuring that:
  - i. Lug is rotated on cable end in the orientation that cable was temporarily dressed. This will minimize twisting of cable once installed on its termination.
  - ii. Exposed copper end of cable is fully seated and visible in lug's inspection window.
  - iii. There is no exposed copper at lug opening. (No Shiners). Insulation should but up to lug opening.
- g. With one person holding the cable end, another installer will crimp lug using the proper crimp tool and die for the lug type.
- h. Crimp lug the number of times required by the lug manufacturer. Slide the heat shrink over the lug
  - i. With one person holding cable a few feet from the cable end and safely away from equipment or other cabling, another installer will use heat gun to heat up the heat shrink around the circumference of the lug. Ensure heat shrink fully heated down onto lug and cable insulation (no gaps).
4. Install permanent labeling on cable end just below lug. Use fiber tag with "Rtn-1" on one side and to and from information on the other side. Sew fiber tag onto cable.
  - a. If necessary, slide a temporary insulated boot over lug and cable end in order to pull cable to its termination.
5. One installer should feed the cable from the back of the cabinet toward to the installer in the front of the cabinet.
6. Once installer at front of cabinet has cable end firmly in hand, remove temporary boot from lug.
7. Land Rtn-1 lug onto the DC Plant's generator breaker's RETURN (POSITIVE) bus bar position (DO NOT TERMINATE THIS CABLE TO THE BREAKER).
8. With one installer holding cable in place, another installer adds flat washer, lock washer and nut to both terminals.
9. Tighten the nuts on both terminals to manufacturers specifications.
10. Add torque marks to terminal end, nut, lock washer, washer and base of lug for each terminal.
11. Repeat steps 1-10 for the Rtn-2 cable.
12. When both return cables are fully installed. Repeat steps 1-11 for Neg-1, Neg-2 cables with the following exceptions:
  - a. Neg-1 and Neg-2 cables will land on the breaker's NEGATIVE terminals.
  - b. Ensure breaker bus bar extension, if needed, is installed. Ensure bus bar extension is fully torqued and marked.
  - c. Once each cable is lugged and heat shrunk, add fiber tag with Neg-1 (Neg-2 for second cable) labeled one side of tag and to and from information on the other side of tag.
  - d. Sew fiber tag onto cable end so that it is clearly visible once installed onto its termination.
  - e. Depending on negative and positive cable/bus detail clearances the installer may consider wrapping the negative bus/lugs with customer-approved insulating paper to prevent any contact with the return bus or other grounded surfaces. Use wax string to secure insulating paper in place. If neg terminals are covered in this way, be sure to take photos of the torqued connections before covering them.
13. Once cables are fully terminated, complete sewing of cables within the cabinet and ensure there is sufficient strain relief at the cable termination.
14. Seal all power conduits with intumescent plugs.

# Landing Power Cables at Polar Generator

Install power cable lugs at the generator and land on the Negative and Positive (Return) term bars. **The term bars take 2-hole lugs (3/8" hole, 1" spacing). Lugs should have inspection windows.**

1. Remove tape from Neg-1 cable end.
2. Using an ohm meter, check continuity between this exposed cable end and a known good ground.
  - a. **THIS SHOULD NOT TONE OUT! NO CONTINUITY TO GROUND SHOULD BE PRESENT!**
3. Temporarily dress this cable to its termination on the negative bus and cut the cable at appropriate length.
4. Carefully strip back cable insulation (do not nick copper conductors) such that the conductors will extend all the way to the end of the lug's inspection window and that there is no exposed copper at the lug opening (no shiners!).
5. Slide clear heat shrink over cable end and away from conductors.
6. Use the proper 2-hole lug for the cable type and use the proper crimp tool and die for the lug type. Lug should be rotated on cable so that it easily will rest on its termination without twisting or pulling on the termination. Crimp lug as per manufacturer's recommendation.
7. Pull cable away from equipment and other cables. With one person holding the cable 2+ feet from cable end, another person will slide heat shrink into place and heat it down around lug and cable insulation as per lug manufacturer's recommendation. (no gaps!)
8. Land the Neg-1 cable onto the NEGATIVE terminal bus bar on the Power Termination box. If cable is dressed in properly, lug should stay on its termination even without hardware installed on the studs.
9. Install washer, lock washer and nut on each of the two lug posts and torque to manufacturer's specifications.
10. Torque mark the lug post, nut, lock washer, washer and lug base.
11. Repeat Steps 1-10 for Neg-2 Cable.
12. Remove tape from Rtn-1 Cable end.
13. Using an ohm meter, check the continuity between this exposed cable end and a known good ground.
  - a. **THIS SHOULD TONE OUT! THERE SHOULD BE CONTINUITY TO GROUND!**
14. Once step 12 is confirmed lug and land the cable as per steps 3-11 except these two cables will land on the POSITIVE (also known as "Return") terminal bus bar on the generator's Power Termination box.
15. When Cables are fully installed, seal power cable conduits with intumescent plugs. See Figure 12a.

Figure 12a





# Alarm/Communication Cable Installation

Polar Power recommends using 12pair (with ground wire) 22-24 gauge wire for making alarm connections. As an alternative, Cat5e cable can be used. Cat5e should be used for the Comm connection.

1. Cut one alarm cable and one comm cable sufficiently long so that it can reach between the generator enclosure and customer's cabinet and such that the cable can reach any termination within both enclosures.
2. Temporarily label both ends of the alarm cable with "ALM". Label both ends of the Comm cable "Comm".
3. Pull the alarm cable and Comm cable from the Generator disconnect box to the customer's cabinet via the previously installed 1" conduit. (Figure 7 Conduit # 4)
4. Route the alarm cable and Comm Cable inside the Generator Disconnect box to the 3/4" access hole on the back wall of the box (see Figure 12 for location) and into the generator enclosure. Once inside the enclosure, route the alarm and comm through the factory installed split tube and up to the alarm/control/enet panel. See Figure 13 below.
5. Unscrew the alarm enclosure panel and swing open to expose the alarm terminations.
6. Pull alarm cable through alarm module cable port and terminate alarm pairs to Terminal Positions. The Polar commissioner will land these alarm wires at the generator end.
7. Route other end of alarm cable through 1" conduit into the customer's cabinet and coil at the customer's house alarm block. Do not land alarm wires unless instructed by the customer to do so. Permanently label both ends of the cable with "ALM" and include to and from information.
8. Route the Comm Cat5e cable along the front top panel's left side-mounted ENET module. Crimp an 8 pin modular connector.
9. Route other end of Comm cable through 1" conduit into the customer's cabinet and dress it to assigned Router port. Do not land it. Crimp an 8pin modular connector on the cable end (straight cable connector. Permanently label both cable ends with "Comm" and include to and from information. Seal both ends of the conduit.

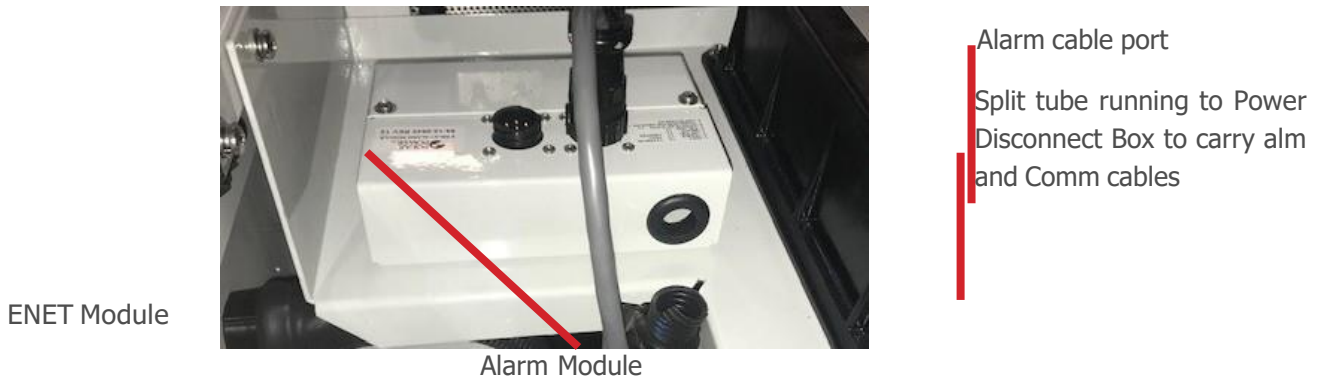


Figure 13

RBS GENERATOR RUNNING = Alarm Point 4, Position 1 &3  
RBS GENERATOR FUEL LOW = Alarm Point 3, Position 1 &3  
RBS GENERATOR MJ = Alarm Point 2, Position 1 &3  
RBS GENERATOR FAIL = Alarm Point 1, Position 1 &3  
RBS GENERATOR FUEL LEAK = Alarm Point 5, Position 1 &3

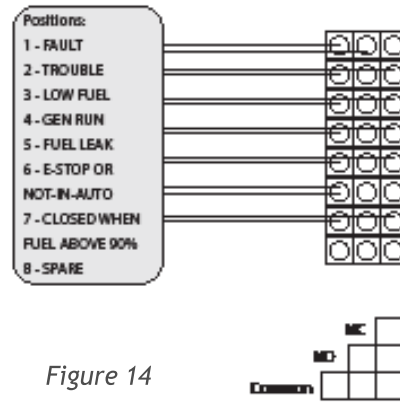


Figure 14

Relay position	Description	Input positions to trigger	Alarm relay power during fault	Terminal position
1	Fault	Overcrank (fail to start)	Off	Level 1, Level 2 (NO)
1	Fault	High engine temperature shutdown	Off	Level 1, Level 2 (NO)
1	Fault	Low oil pressure	Off	Level 1, Level 2 (NO)
1	Fault	Overspeed	Off	Level 1, Level 2 (NO)
1	Fault	Not in auto	Off	Level 1, Level 2 (NO)
1	Fault	E-Stop depressed	Off	Level 1, Level 2 (NO)
2	Trouble	High engine temp. pre alarm temp. above 95%	On	Level 1, Level 3 (NC)
2	Trouble	Low fuel below 15%	On	Level 1, Level 3 (NC)
2	Trouble	Low coolant level controller switch 2	On	Level 1, Level 3 (NC)
2	Trouble	High starting battery voltage (above 15 Volts)	On	Level 1, Level 3 (NC)
2	Trouble	Low starting battery voltage (below 8 Volts)	On	Level 1, Level 3 (NC)
2	Trouble	Fan fail	On	Level 1, Level 3 (NC)
2	Trouble	Air flow restriction	On	Level 1, Level 3 (NC)
3	Low fuel	Fuel level below low fuel level (45%)	On	Level 1, Level 3 (NC)
4	Generator running	Generator running variable	On	Level 1, Level 3 (NC)
5	Fuel leak	Controller switch 1	On	Level 1, Level 3 (NC)
6	E-Stop or not in Auto	E-Stop depressed or not in Auto	On	Level 1, Level 3 (NC)
7	Fuel level over 90%	Fuel level over 90%	On	Level 1, Level 2 (NO)
8				

Figure 15



## Connections to the alarm board

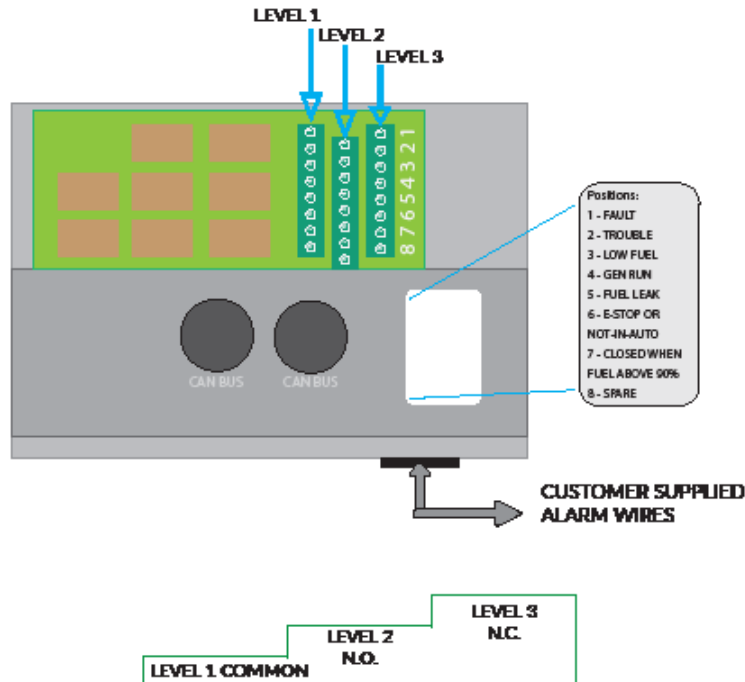


Figure 16

## Finalizing installations

When all installation steps listed above are completed:

1. Do a final check of all connections, labeling, and general installation quality.
2. Remove all trash associated with the installation.
3. Leave generator and DC power plant gen breaker in the off (open position).
4. Enter name, company name, date, time and activities performed in the site's log book.
5. Complete the Polar Power Installation Checklist and take all required photos as detailed in the Polar Installation Photo document.
  - a. If there is any installation discrepancy or damage to the generator please note these on the Installation checklist.
  - b. If there are any abnormal site conditions or safety concerns, notify your AT&T contact.
6. Ensure panel cover is securely in place on generator Power Termination Box. Ensure customer's cabinet is closed and locked. Ensure generator top access door is closed and locked.
7. Place generator lock key in the site's key lock box or key secure location.
8. Submit the completed Installation checklist and Installation Photo documents to Polar Power Technical Support (see bottom of installation checklist document for addresses)
9. Polar Power will review the installation checklist for accuracy and will take any necessary action to ensure any deficiencies noted on the checklist are corrected.
10. Installation is complete once the Installation Checklist is approved by Polar Power.

## INSTALLATION COMPLETE

# Polar Power Software Download

The Polar Power Software required for the Supra Controller can be downloaded from the following website.

The software is a graphical user interface (GUI) that allows the user to observe the Generator and Engine status, such as the Engine Temperature, Alternator Voltage, and Alternator Current along with various other options. The website has instructions on how to download the software and install it into the user's computer or laptop. Verify that the correct firmware is installed and restart your computer or laptop after each installation.

Latest version software can be found on the website.

## polarpowerinc.net

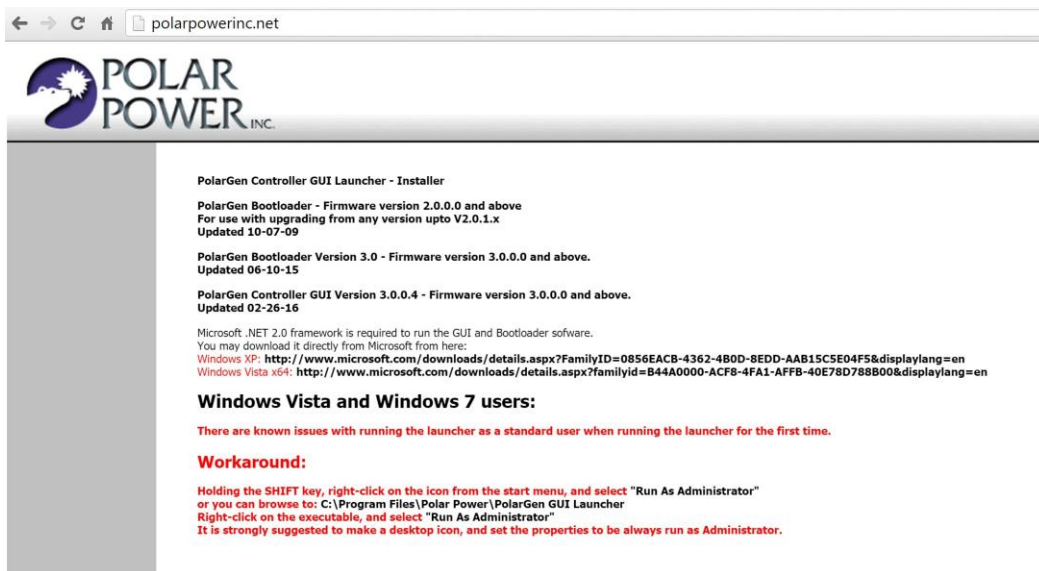


Figure 17

The following are brief instructions on what to download and how to run the Polar Power GUI.

Step 1 – Click on the first link “PolarGen Controller GUI Launcher – Installer”

Step 2 – For Windows 8 users, once the executable file has been downloaded and installed the only way to properly run it is to press Shift and Right-click on the mouse and “Run As Administrator”

Few additional instructions

- When Open GUI 3.0.0.4 – run it as Administrator
- After connecting cables from PC to Male connector in the genset:

Make sure you choose: Direct Connections in Communications Page:  
Please set COM 3 in Edit, Preference, Communications.  
Select Connect on Communications Page.

## Connecting Through The Serial RS232

Once the Polar Power GUI is downloaded, connect your computer to the Polar Generator Supra Controller using a 9pin male to USB cable. The Supra Controller contains all generator settings, operational data, exercise settings and trouble logs. Polar Power recommends using a TrendNet TU-S9 cable (See Figure 18). Lesser quality cables cause packet errors and failed controller reports.



Figure 18 Male RS232 serial connector

## Connecting through the Ethernet module

The Ethernet Module (See Figure 19) is powered by the Supra Controller. Remote access from the customer's network can be made here. Note that IP settings need to be made in the Controller. The ENET Module accepts either a Cat6 or Cat5e cable connection. Local connection to the Supra Controller can also be made through the ENET Module.

The Ethernet module allows the user to access the Generator and Engine status.



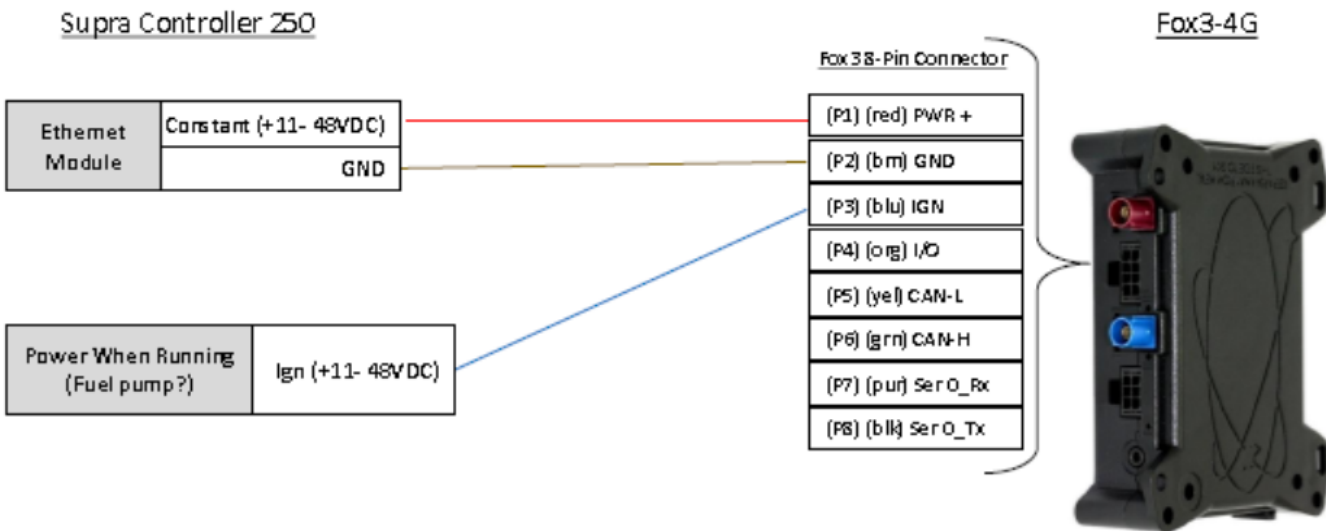
Figure 19

# Connecting through the IoT module

FOX3-4G is a compact, all-in-one cellular telematics gateway combining a rich connectivity choice with our powerful Edge intelligence. This IoT device provides secure real time data monitoring and remote diagnostics via CANBUS, RS232, and Edge compute abilities.



## Power Connection – Polar Power Supra 250 to Fox3-4G



# Remote login information

Polar Power also offers remote connectivity through a cellular router using Virtual Private Network (VPN) software. Below are the instructions on how to install the VPN software and connect to the Polar Power generator set. The following procedure applies only to the cellular router MultiConnect rCell 100 Series.



Figure 23

## VPN Credentials

Go to <https://vpnlab.aeris.net/> and follow the prompt to download and install the VPN software.

Example:

Username: polarpower

Password: R6Yx7C3j

Polar Power Generator Login

Example:

IP: 10.192.147.120

Port: 8071

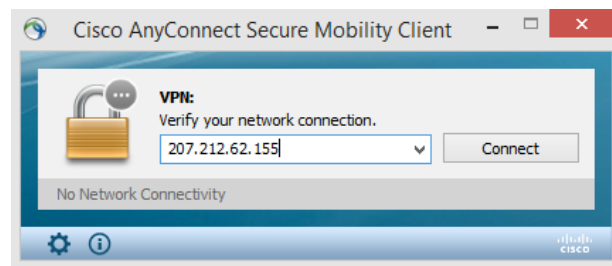


Figure 24

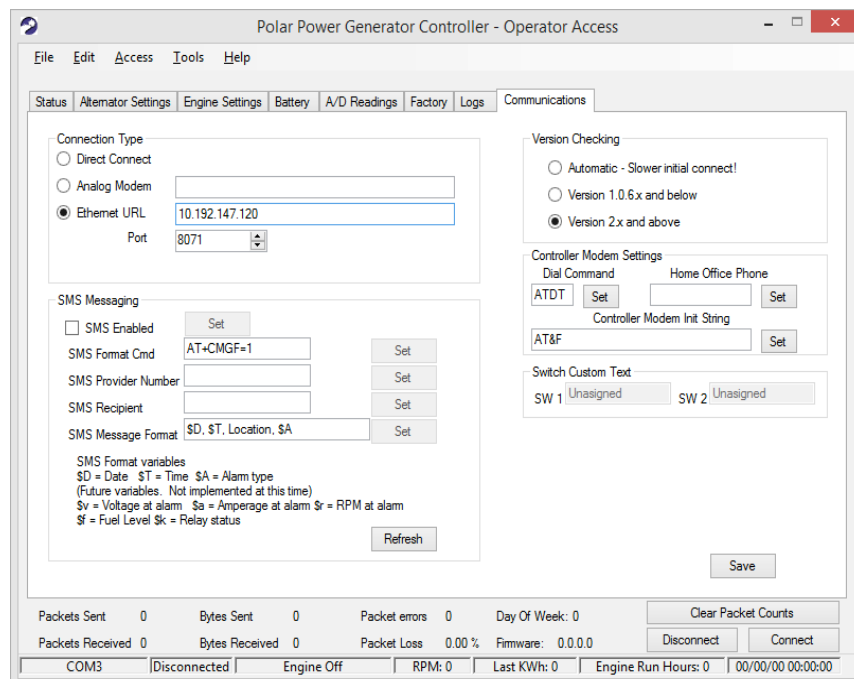


Figure 25

## Ventilation considerations

Although it is important to make sure the generator set is safely and securely positioned and secured to the floor, it is even more important that there is proper unobstructed ventilation (inflow and outflow) of ambient air flowing AROUND and THROUGH the generator. In areas of significant snowfall, installing the generator on a raised pad will prevent snow from clogging the air intake and air exhaust openings.

## Engine Exhaust Considerations

In many locations, the exhaust has to be relocated and moved away from the generator, sometimes at great distances. The installation issues to overcome are:

1. Additional tubing should not increase the back pressure on the engine as measured from the 1 1/2" exhaust pipe outlet by 0.5 psi.
2. Water condensation filling up the muffler and possibly draining into the engine. Water is a byproduct of combustion, the combustion process can produce a lot of water. Water exiting the generator exhaust (or automobile) is quite pronounced when the engine is first started. As the engine and exhaust lines warm-up, it no longer condenses and exits as hot vapor. Many exercise routines don't allow the generator to warm up long enough to remove condensed water. Having long exhaust runs provides a means of cooling the exhaust and condensing water in the exhaust; therefore long exhaust pipe runs should be installed with a slight incline to drain the water at the pipe exit and does allow water to flow back to the generator.
3. Provide a means to prevent people /animals from getting burns or combustible materials coming in contact with the exhaust pipe. The smaller the diameter of the pipe the higher the pipe surface temperature. Larger diameter pipes run cooler because of the lower gas pressure.
4. Exhaust gas is corrosive, the metal used for the pipe should have resistance to corrosion. If black iron pipe or galvanized pipe is used, replacement may be required at some point in time. Provisions should be made for future replacement.

Gas volumes exiting the engine are dependent on electrical load and temperature of the exhaust. As the temperature decreases the volume of gas decreases. Long runs of pipe will have a significant impact on lowering the exhaust temperature, decreasing the volume of exhaust gas. Temperatures exiting the engine are around 1200°F and temperatures exiting the exhaust muffler is around 900°F.

The type of pipe/tube: the radius is in the pipe bends, plumbing fittings all have a significant effect on pressure drop. The most pronounced effect on pressure drop is the use of corrugated / metal hose, this type of hose creates significant turbulence causing high pressure drops. For this reason, this material should be limited to very short lengths (under 4 feet).

Given all the conditions affecting pressure drop you should be conservative in your sizing. In the final outcome, you should measure the pressure drop with a 0 to 5 psi gauge.



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