ALPHAGEN

Power

Technical Manual

CE-3x2 5K-T 48Vdc Telecom Generator
PN-6x-T 7.5kW 48Vdc Telecom Generator

Effective: May 2008

Alpha Technologies

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Technical Manual

042-288-B0-001, Rev. A

Effective Date: May 2008

member of The Group™

NOTE:

Photographs contained in this manual are for illustrative purposes only. These photographs may not match your installation.

NOTE:

Operator is cautioned to review the drawings and illustrations contained in this manual before proceeding. If there are questions regarding the safe operation of this powering system, please contact Alpha Technologies or your nearest Alpha representative.

NOTE:

Alpha shall not be held liable for any damage or injury involving its enclosures, power supplies, generators, batteries, or other hardware if used or operated in any manner or subject to any condition not consistent with its intended purpose, or is installed or operated in an unapproved manner, or improperly maintained.

Contacting Alpha Technologies: *www.alpha.com*

or

For general product information and customer service (7 AM to 5 PM, Pacific Time), call

1-800-863-3930,

For complete technical support, call

1-800-863-3364

7 AM to 5 PM, Pacific Time or 24/7 emergency support

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Safety Notes

Review the drawings and illustrations contained in this manual before proceeding. If there are any questions regarding the safe installation or operation of the system, contact Alpha Technologies or the nearest Alpha representative. Save this document for future reference.

To reduce the risk of injury or death, and to ensure the continued safe operation of this product, the following symbols have been placed throughout this manual. Where these symbols appear, use extra care and attention.

ATTENTION:

The use of ATTENTION indicates specific regulatory/code requirements that may affect the placement of equipment and installation procedures.

NOTE:

A NOTE provides additional information to help complete a specific task or procedure.

CAUTION!

The use of CAUTION indicates safety information intended to PREVENT DAMAGE to material or equipment.

WARNING!

A WARNING presents safety information to PREVENT INJURY OR DEATH to the technician or user.

General Safety Precautions

To avoid injury:

- This enclosure and its associated hardware must be serviced only by authorized personnel.
- Enclosure must remain locked at all times, except when authorized service personnel are present.
- Remove all conductive jewelry or personal equipment prior to servicing equipment, parts, connectors, wiring, or batteries.
- Read and follow all installation, equipment grounding, usage, and service instructions included in this manual.
- Use proper lifting techniques whenever handling enclosure, equipment, parts, or batteries.
- Batteries contain dangerous voltages, currents and corrosive material. Battery installation, maintenance, service and replacement must be performed by authorized personnel only.
- Never use uninsulated tools or other conductive materials when installing, maintaining, servicing or replacing batteries.
- Use special caution when connecting or adjusting battery cabling. An improperly connected battery cable, or unconnected battery cable, can result in arcing, fire, or possible explosion.
- A battery that shows signs of cracking, leaking or swelling must be replaced by authorized personnel immediately using a battery of identical type and rating.
- Avoid any contact with gelled or liquid emissions from a valve-regulated lead-acid (VRLA) battery. Emissions contain dilute sulfuric acid that is harmful to the skin and eyes. Emissions are electrolytic, and are electrically conductive and are corrosive. Follow the Chemical Hazards notes if contact occurs.
- Do not smoke or introduce sparks in the vicinity of the batteries or natural gas/propane connections.
- Under certain overcharging conditions, lead-acid batteries can vent a mixture of hydrogen gas that is explosive. Proper venting of the enclosure is required.
- Follow the battery manufacturer’s approved transportation and storage instructions.

To avoid damage:

- Prior to installation, verify that the AC input voltage to the enclosure and its equipment match with respect to voltage and frequency.
- Prior to installation, verify that the output voltage from the enclosure or its equipment match the voltage requirements of the connected equipment (load).
- Prior to installation, verify that the enclosure’s utility service panel is equipped with a properly rated circuit breaker for use with the equipment inside. Refer to manufacturer’s recommendations.
- Review and upgrade utility service panel circuit breaker requirements whenever the equipment within the enclosure is changed.
- Prior to installation, contact local utilities, local building maintenance departments, and cable/piping locator services to ensure that installation does not interfere with existing utility or building cables/piping.
- Do not exceed the output rating of equipment. Verify load requirements prior and during connection process.
- Prior to handling the batteries, touch a grounded metal object to dissipate any static charge that may have developed in your body.

Battery Safety Notes

WARNING!

Lead-acid batteries contain dangerous voltages, currents, and corrosive material. Battery installation, maintenance, service, and replacement must only be performed by authorized personnel.

Chemical Hazards

Any gelled or liquid emissions from a valve-regulated lead-acid (VRLA) battery contain dilute sulfuric acid, which is harmful to the skin and eyes. Emissions are electrolytic, and are electrically conductive and corrosive.

To avoid injury:

- Servicing and connection of batteries shall be performed by, or under the direct supervision of, personnel knowledgeable of batteries and the required safety precautions.
- Always wear eye protection, rubber gloves, and a protective vest when working near batteries. Remove all metallic objects from hands and neck.
- Batteries produce explosive gases. Keep all open flames and sparks away from batteries.
- Use tools with insulated handles. Do not rest any tools on top of batteries.
- Batteries contain or emit chemicals known to the State of California to cause cancer and birth defects, or other reproductive harm. Battery post terminals and related accessories contain lead and lead compounds. Wash hands after handling (California Proposition 65).
- Wear protective clothing (insulated gloves, eye protection, etc.) when installing, maintaining, servicing, or replacing batteries.
- If any battery emission contacts the skin, wash immediately and thoroughly with water. Follow your company's approved chemical exposure procedures.
- Neutralize any spilled battery emission with the special solution contained in an approved spill kit or with a solution of one pound Bicarbonate of soda to one gallon of water. Report chemical spill using your company's spill reporting structure and seek medical attention if necessary.
- Always replace batteries with those of an identical type and rating. Never install old or untested batteries.
- Do not charge batteries in a sealed container. Each individual battery should have at least 0.5 inches of space between it and all surrounding surfaces to allow for convection cooling.
- All battery compartments must have adequate ventilation to prevent an accumulation of potentially dangerous gas.
- Prior to handling the batteries, touch a grounded metal object to dissipate any static charge that may have developed on your body.
- Never use uninsulated tools or other conductive materials when installing, maintaining, servicing, or replacing batteries.
- Use special caution when connecting or adjusting battery cabling. An improperly connected battery cable or an unconnected battery cable can make contact with an unintended surface and can result in arcing, fire, or possible explosion.
- A battery showing signs of cracking, leaking, or swelling should be replaced immediately by Authorized Personnel using a battery of identical type and rating.

Battery Maintenance Guidelines

The battery maintenance instructions listed below are for reference only. Battery manufacturer's instructions for transportation, installation, storage, or maintenance take precedence over these instructions.

- To prevent damage, inspect batteries every 3 months for:

  Signs of battery cracking, leaking or swelling. The battery should be replaced immediately by authorized personnel using a battery of the identical type and rating.

  Signs of battery cable damage. Battery cables should be replaced immediately by authorized personnel using replacement parts specified by vendor.

  Loose battery connection hardware*.* Refer to battery manufacturer's documentation for the correct torque and connection hardware for the application.
- Apply battery manufacturer's specified antioxidant compound on all exposed connections.
- Verify battery terminals and/or exposed connection hardware is not within 2 inches of a conductive surface. Reposition batteries as necessary to maintain adequate clearance.
- Clean up any electrolyte (battery emission) in accordance with all federal, state, and local regulations or codes.
- Proper venting of the enclosure is recommended. Follow the Battery Manufacturer's approved transportation and storage instructions.
- Always replace batteries with those of an identical type and rating. Never install old or untested batteries.
- Do not charge batteries in a sealed container. Each individual battery should have at least 0.5 inches of space between it and all surrounding surfaces to allow for convection cooling.
- All battery compartments must have adequate ventilation to prevent an accumulation of potentially dangerous gas.

Recycling and Disposal Instructions

Spent or damaged batteries are considered environmentally unsafe. Always recycle used batteries or dispose of the batteries in accordance with all federal, state and local regulations.

Electrical Safety

- Lethal voltages are present within the power supply and electrical boxes. Never assume that an electrical connection or conductor is not energized. Check the circuit with a volt meter with respect to the grounded portion of the enclosure (both AC and DC) prior to any installation or removal procedure.
- Always use the buddy system when working under hazardous conditions.
- A licensed electrician is required to install permanently wired equipment.
- Input voltages can range up to 240Vac. Ensure that utility power is disabled before beginning installation or removal.
- Ensure no liquids or wet clothes contact internal components.
- Hazardous electrically live parts inside this unit are energized from batteries even when the AC input power is disconnected.

Gas Safety

- Do not smoke or use any source of flame around gas lines. Propane and natural gas are extremely flammable, and explosive at high concentrations. Large releases can create a flammable vapor cloud.
- In high concentrations gas is an asphyxiant that displaces oxygen from the breathing atmosphere.
- Contact with liquid may cause skin and eye burns.

Auxiliary Power Unit (APU) Notes

- While the engine is stopping, a small amount of unburned fuel may be present. Fans are used to expel these fumes from the enclosure, but fumes may be detected outside the enclosure for a short period of time after engine shutdown. This is a normal condition and does not present a hazard.
- Most utilities add a chemical agent to the gas which produces a strong odor so leaks can be detected before they reach a dangerous or explosive level. It may be possible to detect this gas additive odor even though the gas hazard sensor does not issue an alarm. The gas sensor will issue an alarm when the detected levels of gas reaches 10% to 20% of the Lower Explosive Limit (LEL). The gas hazard sensor has a 10 minute delay for periods of purging and power up. During the purge phase, the Green alarm light will flash. When the purge phase is completed, the light will glow steadily. In the event the detector has been disconnected from power for more than 24 hours, it may require a period of more than 10 minutes to complete its purge phase. In that event, push the reset button to disable the alarm for repeated purge cycles. The reset button may be used to disable the alarm for 10 minutes at any time.
- If gas fumes are detected before running the engine, or more than 10 minutes after running the engine, check the system for leaks and correct as necessary.

1.0 System Overview

AlphaGen Telecom curb-side generator systems power outside plant communication networks. Every AlphaGen system incorporates industry leading power technology, including natural gas or propane fueling, exclusive audible noise baffling, remote status monitoring features, and a durable, weather resistant enclosure construction.

This document describes the installation, operation, and maintenance of the CE-3x2 5K-T and PN-6x-T 7.5kW Telecom generators.

Features:

- Cost effective extended runtime solution for outdoor powering applications
- Quiet operation, small size, and low profile provides for easier installation in populated areas
- Eliminates large quantities of batteries otherwise required for extended runtime
- Telecom-grade 48Vdc output
- Built-in safeguards to protect the system, operator, and public
- Safe unattended operation designed to UL2200, NFPA 37, 54, 58 & 70 standards

Fig. 1-1, PN-6x-T 7.5kW Telecom Generator

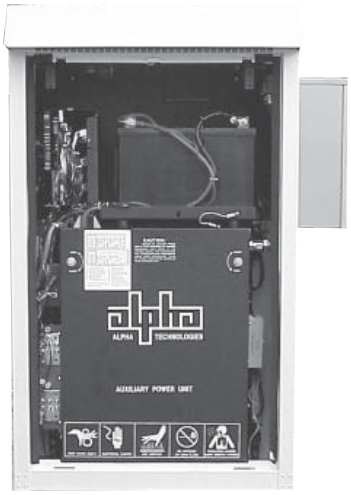


Fig. 1-2, CE-3x2 5K-T Telecom Generator

1.1 PN-6x-T System Diagram

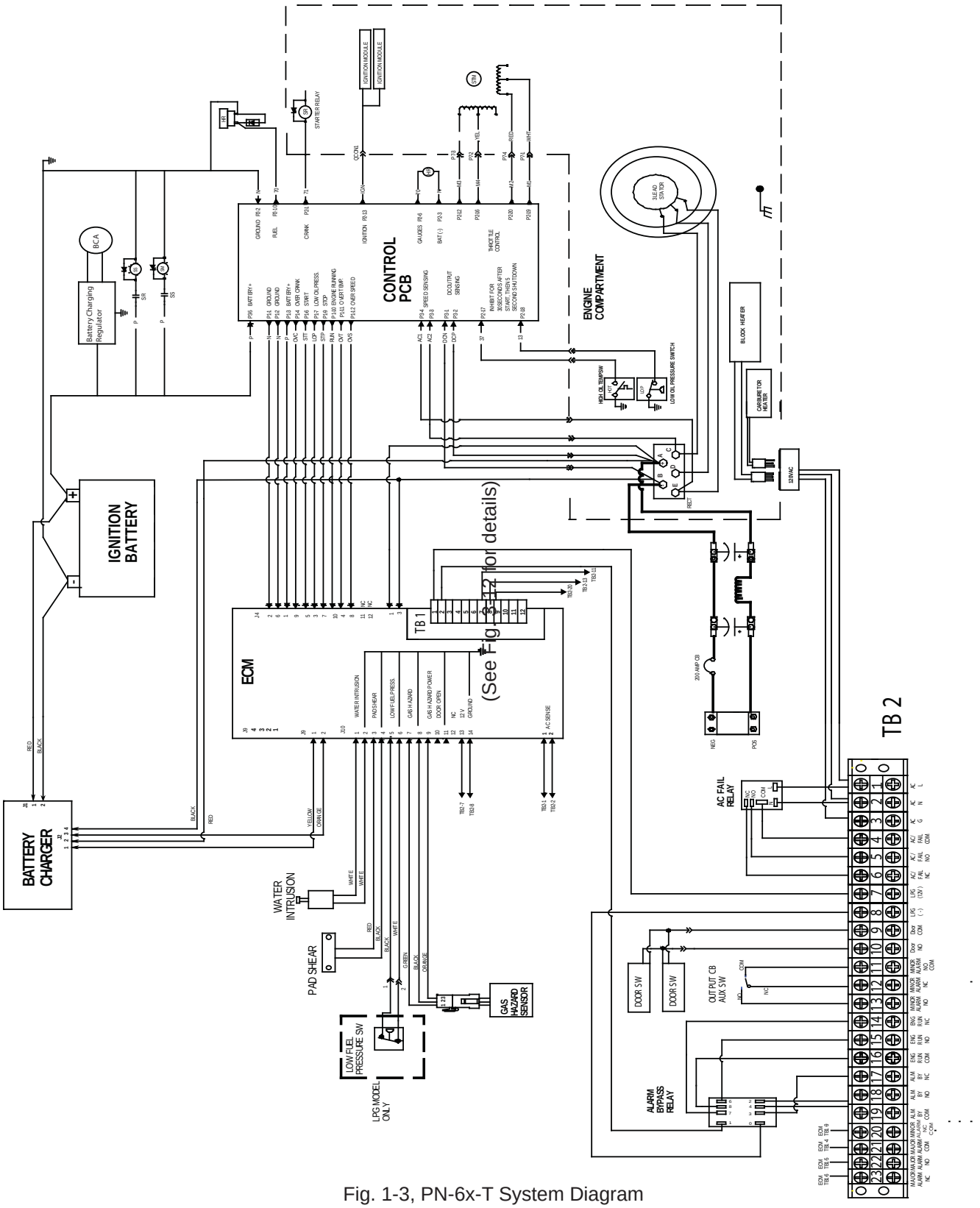


Fig. 1-3, PN-6x-T System Diagram

1.2 CE3x2 5kW System Diagram

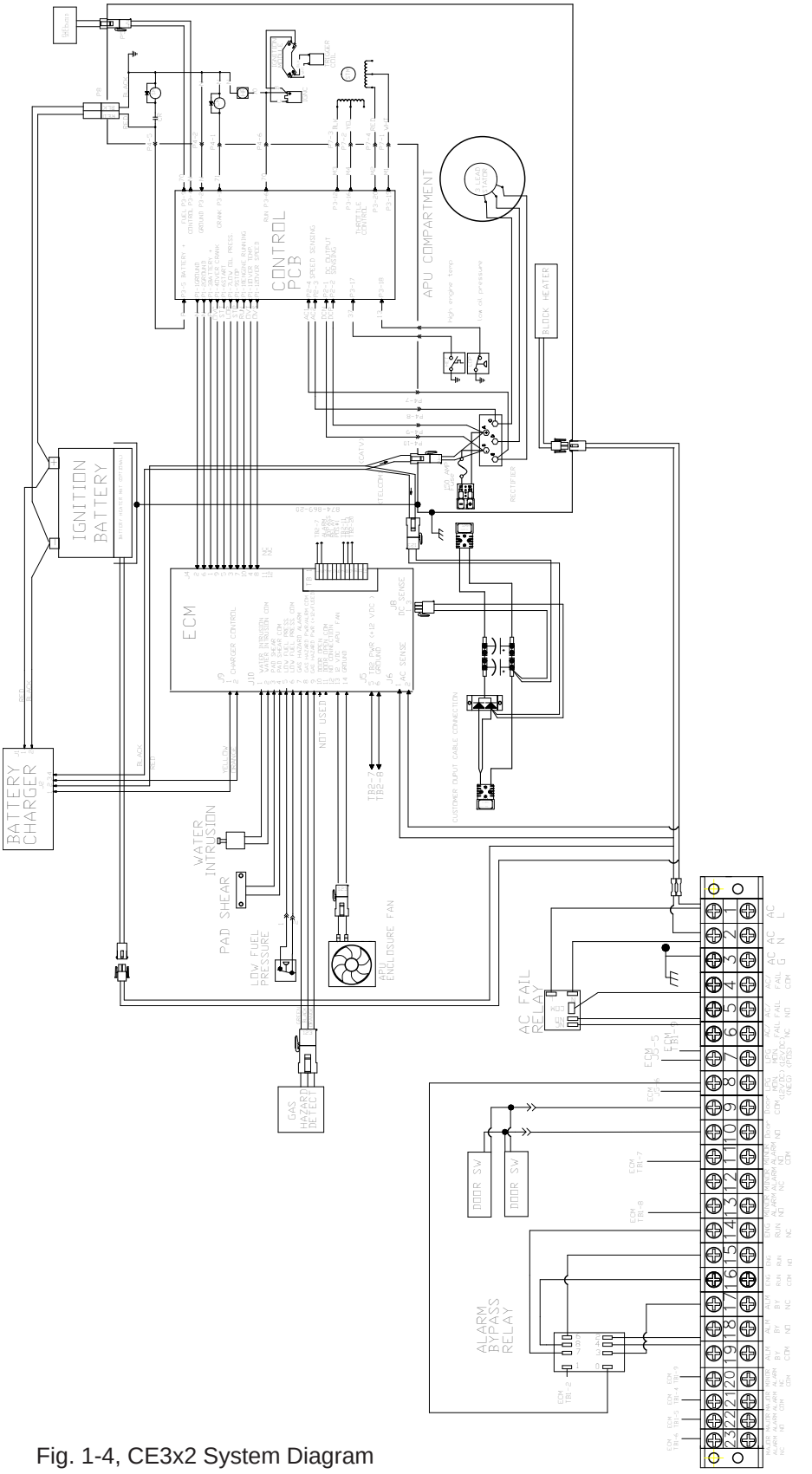


Fig. 1-4, CE3x2 System Diagram

1.3 Natural Gas System Block Diagram

CAUTION!

Do not include the generator system as part of a local gas piping system test. Damage to the generator pre-regulator may result. The generator system is pressure tested in accordance with NFPA standards prior to shipment.

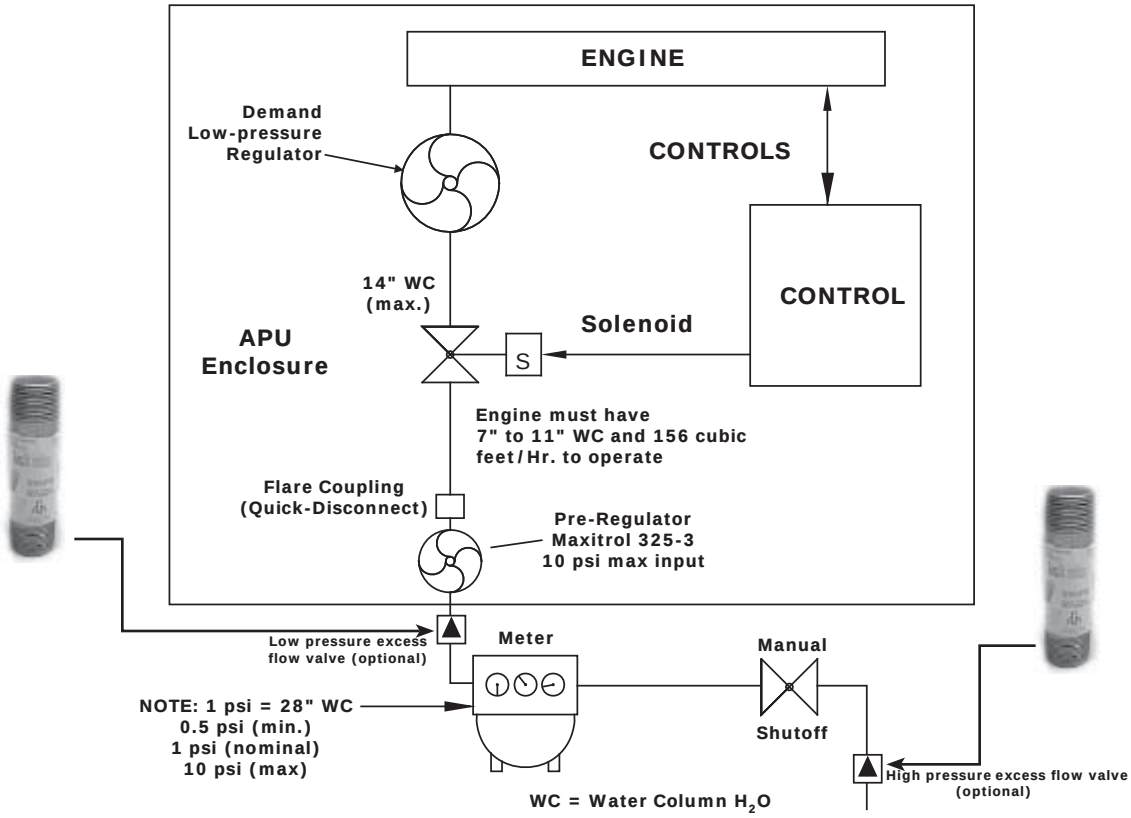


Fig. 1-5, Arrangement of Metered, Nominal Pressure (1-2psi) Natural Gas System

NOTE:

For added safety, a low pressure and high pressure excess flow valve may be installed.

ATTENTION:

Federal DOT Regulation 49 CFR Part 192.383, Excess Flow Valve Customer Notification, requires gas utilities to either voluntarily install Excess Flow Valves (EFVs) on all new home service lines or to notify builders about EFVs' benefits and availability. EFVs are installed on gas service lines during pre-construction site work, and automatically activate when a gas line is ruptured. Excess flow valves should never be used as in-line regulators. They cannot perform this function and may damage equipment.

Fig. 1-6, Excess Flow Valve
(above ground ¾" x 4" NPT nipple)
Alpha P/N 042-146-10

1.4 Liquid Propane System Block Diagram

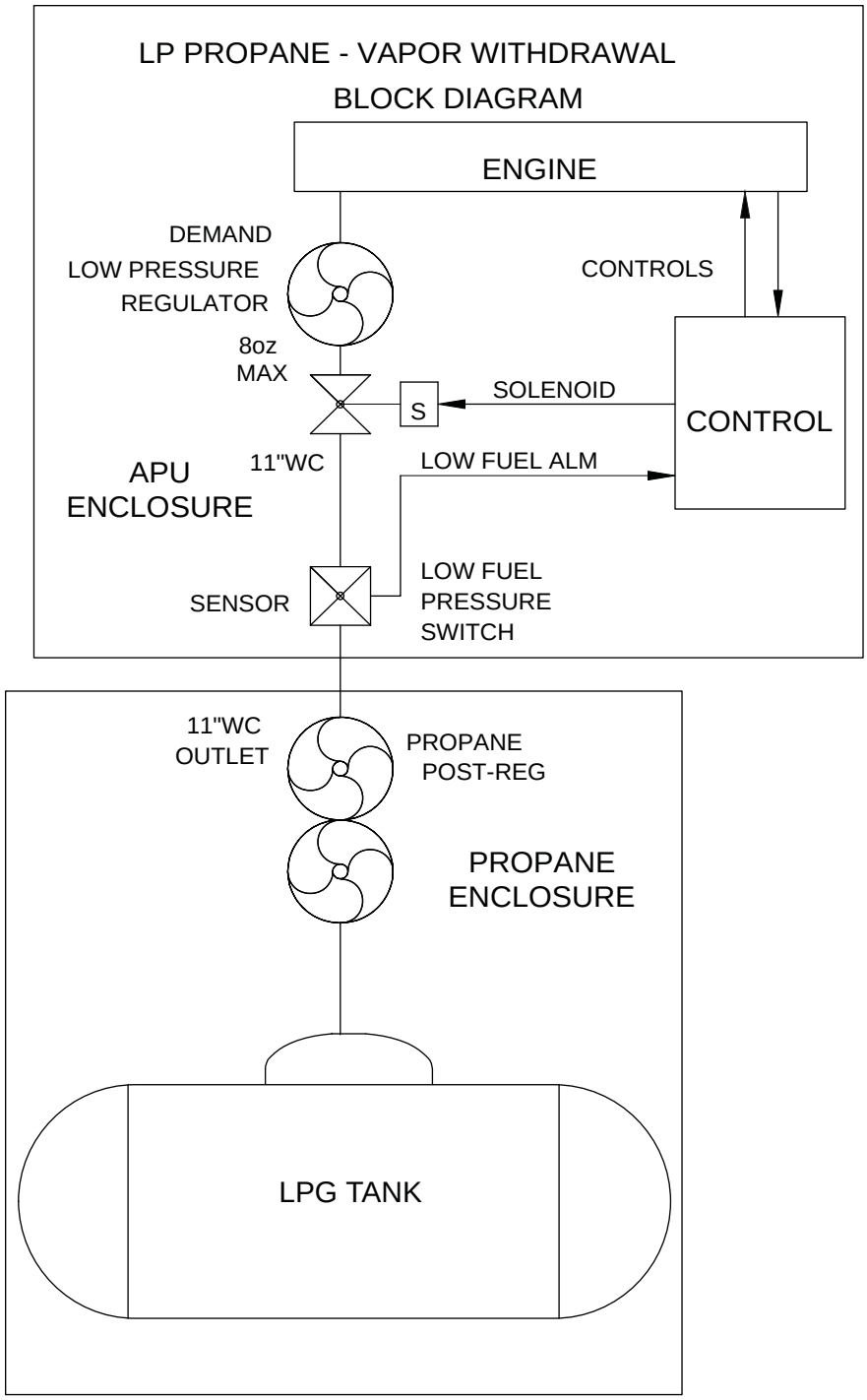


Fig. 1-7, LP Propane Vapor Withdrawal Block Diagram

1.5 Specifications

Model	CE-3x2 5.0kW	PN-6x-T 7.5kW
DC Output Voltage:	-51.5 to -52V @ no load	-51.5 to -52V @ no load
DC Output Load Regulation:	0.5V	0.5V
Output Current:	52V @96A max.	52V @ 144A max.

Noise		
Voiceband:	<54dBrnc	<54dBrnc
Wideband:	<100mVrms in any 3kHz bandwidth from 10k to 20mHz	<100mVrms in any 3kHz bandwidth from 10k to 20mHz
Broadband:	<250mVp-p from 20 to 100mHz	<250mVp-p from 20 to 100mHz
Engine:	398cc, air-cooled, single OHV 10.5hp (using natural gas fuel)	624cc, air-cooled, twin OHV 13.1hp (using natural gas fuel)
RPM (Variable Speed):	2800 to 3600RPM	2100 to 3450RPM

Acoustic Noise		
dBA 10' @ 100% rated load:	68.5 avg.	70.3 avg.
dBA 20' @ 100% rated load:	62.5 avg.	64.3 avg.
dBA 10' @ 70% rated load:	66.9 avg.	66.4 avg.
dBA 20' @ 70% rated load:	60.9 avg.	60.4 avg.

System Size:	CE-3x	PN-6x
Height (in/cm):	44/111.8	36/99.1
Width (in/cm):	26/66	39.25/99.7
Depth (in/cm):	24/61	24/61
Weight (lb/kg):	395/179.2	338/153.3

Fuel Consumption		
Natural Gas: 1000BTU/ft^3	80ft^3/hr	156ft^3/hr
Propane Gas: 2520 BTU/ft^3	1.1gal/hr	1.48gal/hr
	40ft^3/hr	54ft^3/hr
	4.62lb/hr	6.24lb/hr
Gas Inlet Pressure:	0.5 to 2 PSI Inlet pressure *(Please contact Alpha Technologies for low pressure)*	0.5 to 2 PSI Inlet pressure *(Please contact Alpha Technologies for low pressure)*
Ignition Charger Voltage:	13.5Vdc	13.5Vdc
Ignition Charger Current:	6A max.	6A max
Remote Interface Length:	50ft. max Distance depends upon proper installation, de-rating, and wire gauge. *Please contact Alpha Technologies for remote interface length usage.*	25ft. max Distance depends upon proper installation, de-rating, and wire gauge. *Please contact Alpha Technologies for remote interface length usage.*
Agency Compliance:	UL2200, NFPA 37/54/58 and 70, CSA 22.2, FCC Class A	UL2200, NFPA 37/54/58 and 70, CSA 22.2, FCC Class A

Common to All Models		
Fuel System, Controls & Monitoring:	The controls and fuel system meet applicable sections of NFPA 37, 54, and 58 for automatic unattended operation of remotely located generators. Full system control and status monitoring included	
Sensors:	Gas hazard, pad shear, water intrusion & tamper	
Safety shutdowns:	Low oil pressure Water intrusion Pad shear Gas hazard (propane or Natural Gas)	Over speed Over crank Over temp Low fuel pressure shutdown (Propane only)

Optional Features	
Optional Integrated Propane Storage: ***(5kW APU only)***	For locations where gas is not available, Alpha offers the CE-G propane enclosure for use with the 5kW APU system. Contact local propane supplier for proper tank sizing. Fully CSA & NFPA compliant, and designed for curbside applications.

1.5 Specifications, continued

Engine Specifications, PN-6x-T 7.5kW	
Manufacturer:	Kohler
Make/model:	CH20
Cycle:	4
Compression Ratio:	8:5:1
Displacement, cu. in. (cc):	38 (624)
Rated Horsepower: (using natural gas fuel)	13.1
Engine Speed (rpm):	2100-3450
Bore, in. (mm):	3.08 (77)
Stroke, in. (mm):	2.64 (67)
Valve Train:	Overhead valve
Valve Material: Intake Exhaust	Steel Stellite® face
Number of Cylinders:	2
Cylinder Block Material:	Aluminum with cast iron liners
Cylinder Head Material:	Aluminum
Cylinder Head Tightening Torque, ft. lb (Nm):	30 (41)
Piston Rings:	2 compression, 1 oil
Crankshaft Material:	Heat treated, ductile iron casting
Bearings: Number Type	2 Replaceable sleeve
Governor:	Electronic
Starter Motor:	Electric, 12Vdc, solenoid shift
Lubrication System:	Full pressure
Oil Capacity: (with filter and cooler), qt. (L)	2 (1.9)
Oil Filter Tightening Torque	1/2 turn
Oil Pressure, psi (kPa):	25-35 (172-241)
Low Oil Pressure, psi (kPa):	3.5±1.5 (24.1±13.8)
Fuel Type:	Natural gas or propane
Fuel Pressure, kPA (in. water):	7-11 (1.7-2.7)
Battery Voltage:	12Vdc
Battery Ground:	Negative
Battery Recommendation (min.):	585 CCA @ 0ºF (-18ºC)
Spark Plug Type: (Kohler P/N 24 132 02-S)	(Champion RC12YC)
Spark Plug Gap, in. (mm):	0.030 (0.75)
Spark Plug Tightening Torque, ft. lb (Nm):	18-22 (24.4-29.8)
Ignition System:	Capacitive discharge
Cooling System:	Air cooled
High Engine Temperature, ºF (ºC):	305 (152)
Exhaust System:	USFS approved spark arrestor

48Vdc Generator Set Specification	
Manufacturer:	Kohler
Dimensions (in/mm):	21.5"L x 20"W x 21.8"H 546 x 508 x 554
Weight (lb/kg):	190/86
Rated* kW:	7.5
Rated Voltage: (after rectifier)	52 ± 0.5Vdc @ no load
Rated Amps:	144 @ 52Vdc
Stator Resistance: (ohms)	0.024
Stator Type:	3-phase, 3-lead, ungrounded
Excitation Method:	Permanent magnet, brushless
Coupling Type:	Direct-to-Engine
Insulation (stator):	Class 180, epoxy varnish, vacuum-impregnated
Winding Material:	Copper
* Derate approximately 4% per 1000 ft (300m) over 500 ft (153m) above sea level. Derate 1% for each 10ºF (5.5ºC) increase in temperature above 77ºF (25ºC).	

1.5 Specifications, continued

Engine Specifications, CE-3x2 5K-T	
Manufacturer:	Kohler
Make/model:	CV14
Cycle:	4
Compression Ratio:	8:5:1
Displacement, cu. in. (cc):	24.3 (398)
Rated Horsepower: (using natural gas fuel)	10.5
Engine Speed (rpm):	2800-3600
Bore, in. (mm):	3.43 (87)
Stroke, in. (mm):	2.64 (67)
Valve Train:	Overhead valve
Valve Material: Intake Exhaust	 Steel Stellite® face
Number of Cylinders:	1
Cylinder Block Material:	Aluminum with cast iron liners
Cylinder Head Material:	Aluminum
Piston Rings: number/type:	2 compression, 1 oil
Crankshaft Material:	Heat treated, ductile iron casting
Bearings: Number Type	 2 Replaceable sleeve
Governor:	Electronic
Starter Motor:	Electric, solenoid shift
Lubrication System:	Full pressure
Oil Capacity: (with filter and cooler), qt. (L)	 2.1 (2.0)
Oil Type: summer/winter:	Synthetic 5W-30
Oil Pressure, psi (kPa):	25-35 (172-241)
Low Oil Pressure, psi (kPa):	2-5 (13.8-34.5)
Fuel Type:	Natural gas or propane
Fuel Pressure, kPA (in. water):	7-11 (1.7-2.7)
Battery Voltage:	12Vdc
Battery Ground:	Negative
Battery Recommendation (min.):	425 CCA @ 0ºF (-18ºC)
Spark Plug Type:	Kohler P/N 24 132 03
Spark Plug Gap, in. (mm):	0.75 (0.030)
Spark Plug Tightening Torque, ft. lb (Nm):	18-22 (24.4-29.8)
Ignition System:	Battery/Coil
Cooling System:	Integrated air cooled
High Engine Temperature, ºF (ºC):	305 (152)

48Vdc Generator Set Specification	
Manufacturer:	Kohler
Dimensions (in/mm):	24"L x 26"W x 44"H 546 x 508 x 554
Weight (lb/kg):	395/179
Rated* kW:	5kW
Rated Voltage: (after rectifier)	52 ± 0.5Vdc @ no load
Rated Amps:	96 @ 52Vdc
Stator Resistance: (ohms):	0.024
Stator Type:	3-phase, 3-lead, ungrounded
Excitation Method:	Permanent magnet, brushless
Coupling Type:	Direct-to-Engine
Insulation (stator):	Class 155, epoxy varnish, vacuum-impregnated
Winding Material:	Copper
* Derate approximately 4% per 1000 ft (300m) over 500 ft (153m) above sea level. Derate 1% for each 10ºF (5.5ºC) increase in temperature above 77ºF (25ºC).	

2.0 Site Preparation

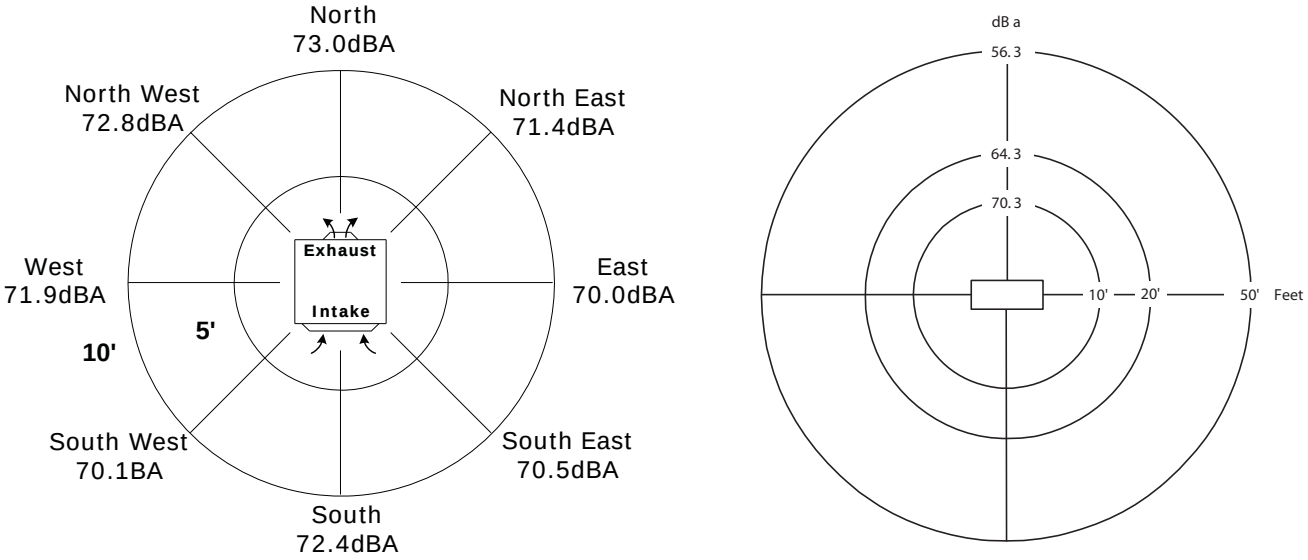
2.1 Site Considerations

- Where possible, select a site away from houses, and above the 100-year flood plain.
- Place in a shaded location to minimize the effects of solar loading.
- Avoid locating the enclosure where it obstructs or inhibits visibility.
- Locate the enclosure away from sprinkler systems, or other sources of forced water.
- Locate the enclosure out of the prevailing wind to minimize the buildup of snow or wind-borne dust.
- Determine if soil conditions are suitable for the appropriate grounding system.
- Verify utility power cabling is terminated at the site.
- Ensure maintenance access and exhaust clearance.
- Locate the enclosure to allow for 36" of clearance around all enclosure door and exhaust openings.

2.2 Acoustics

Nuisance noise is of concern to nearby residents. Nuisance noise is a directional noise which can cause discomfort during engine-generator operation to nearby residential occupants (audible levels may vary due to absorption and reflection caused by the immediate surroundings).

Audible impact on neighborhoods is mitigated by recent advances in mufflers, flame resistant sound materials, intake air sound attenuators, along with improved cabinet airflow dynamics. The figures below show the measured audible levels from CE-3x2 5KW and PN-6x-T 7.5kW generators at full load. Note the symmetry of these emissions. Deployment decisions must include noise consideration to minimize nuisance noise.



CE-3x2 PN-6x-T

Fig. 2-1, Generator Sound Levels at 100% Load

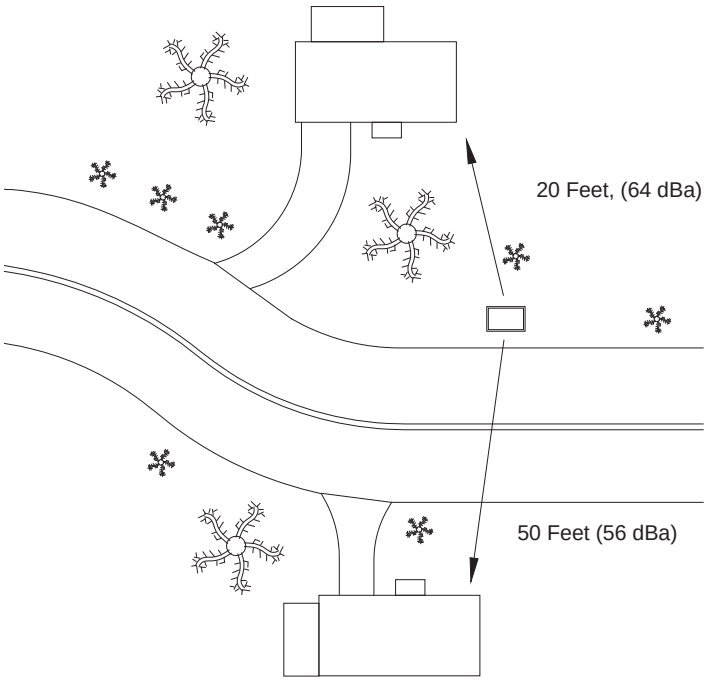


Fig. 2-2, Acoustical Measurements in Relation to Placement Near Residences
(generator sound levels at full load)

2.3 Enclosure Impact Protection

The National Fire Protection Agency (NFPA) requires that equipment using natural gas or liquid propane be protected, based on good engineering practices, in areas where vehicle traffic is normally expected at that location. The required protection is based on the anticipated speed of the vehicles operated in that area. The NFPA does not provide specific guidelines for when protection is needed or the nature of the protection. However, the intent is to provide sufficient protection for the equipment should contact occur by a vehicle operating in the area at a reasonably expected speed.

Alpha Technologies, Inc. cannot anticipate all the ways a vehicle may potentially threaten an installed generator system, or the specific type of protection that is appropriate for a particular location. The determination of the threat to the equipment and the means of protection are the responsibility of the end user of the equipment and the authority having local jurisdiction. The following installation drawings are general recommendations and are not intended to be specific guidelines for protecting the equipment. The numbers of bollard posts (or other protection devices) depend upon equipment locations, site surveys, and traffic patterns as shown below in a typical installation.

Generator Protection, Vehicular Areas

Several variations of installation are possible. The diagrams provide information on the different configurations and site installations. The collocated natural gas meter shown below may require two to four bollard posts depending on location, site surveys, and traffic patterns. Typical bollard post construction may change based on local codes regarding pipe material, concrete, or stanchion design.

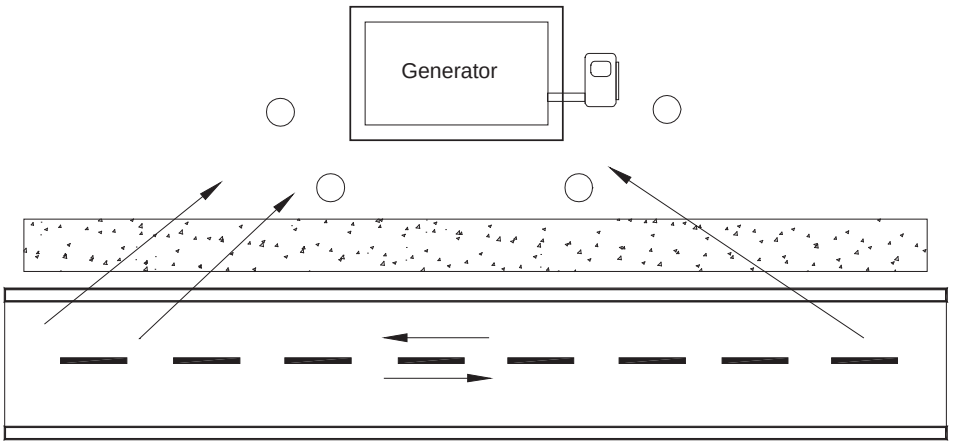


Fig. 2-3, Vehicular Area Impact Protection for Collocated Natural Gas Meter

2.0 Site Preparation, continued

2.3 Enclosure Impact Protection, continued

Generator Protection, Vehicular Areas, continued

The remote located natural gas meter shown below may require two to four bollard posts depending on location, site survey, and traffic pattern. This is a typical installation design with gas meters supported by dual risers and located near the cabinet.

ATTENTION:

Install enclosure protection in compliance with local codes.

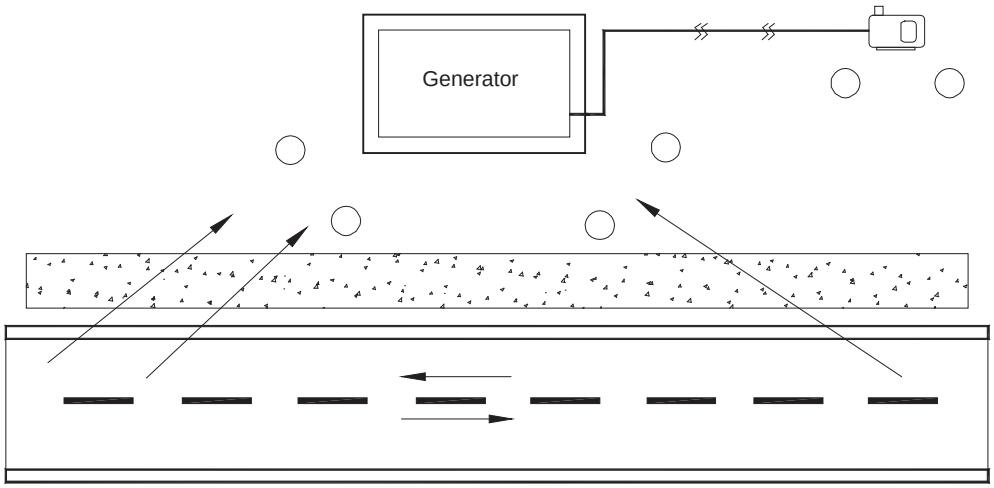


Fig. 2-4, Vehicular Area Impact Protection for Remote Natural Gas Meter

2.4 Natural Gas Meter Configurations

The gas utility company should have the meter installed prior to generator arrival. Meter configurations must comply with local codes. The illustrations provided are for illustrative purposes only.

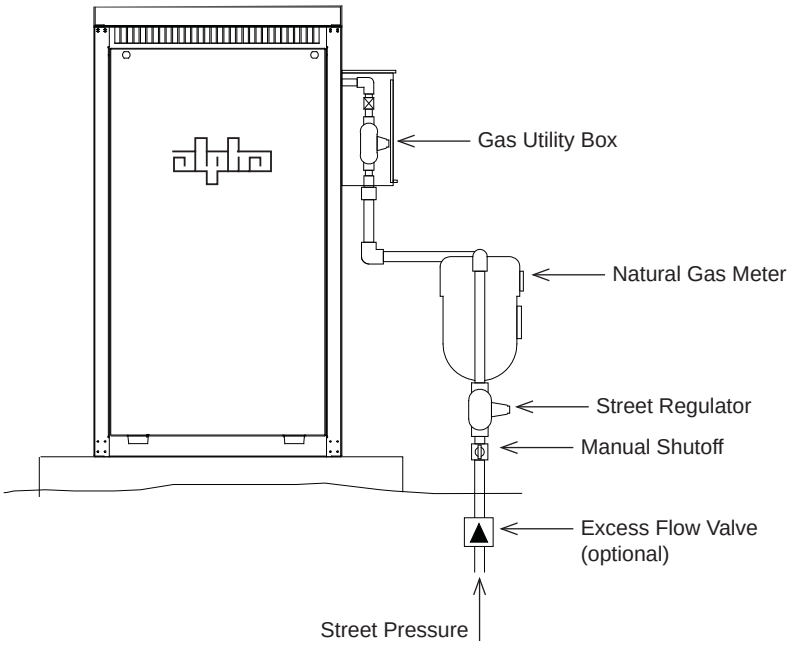


Fig. 2-5, Collocated Natural Gas Meter Setup for CE-3x2 Generator

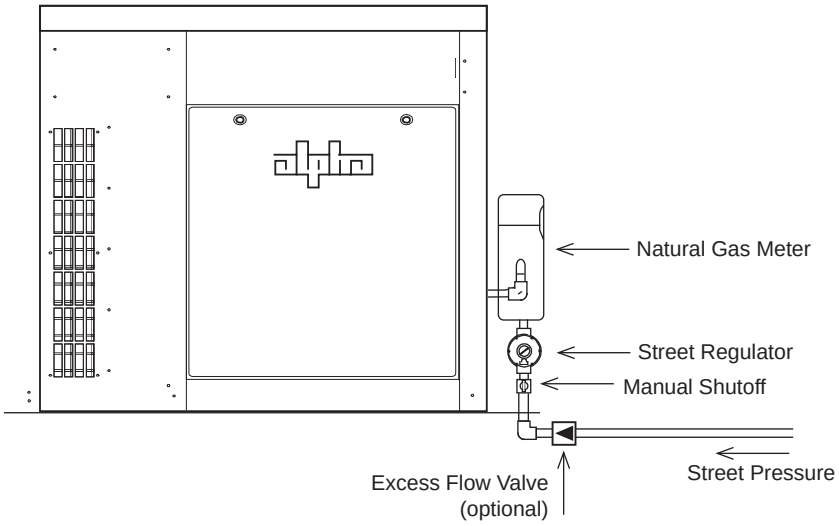


Fig. 2-6, Collocated Natural Gas Meter Setup for PN-6x-T 7.5kW System

2.4 Natural Gas Meter Configurations, continued

The gas utility company should have the meter installed prior to generator arrival. Meter configurations must comply with local codes. Examplesz provided are for illustrative purposes only.

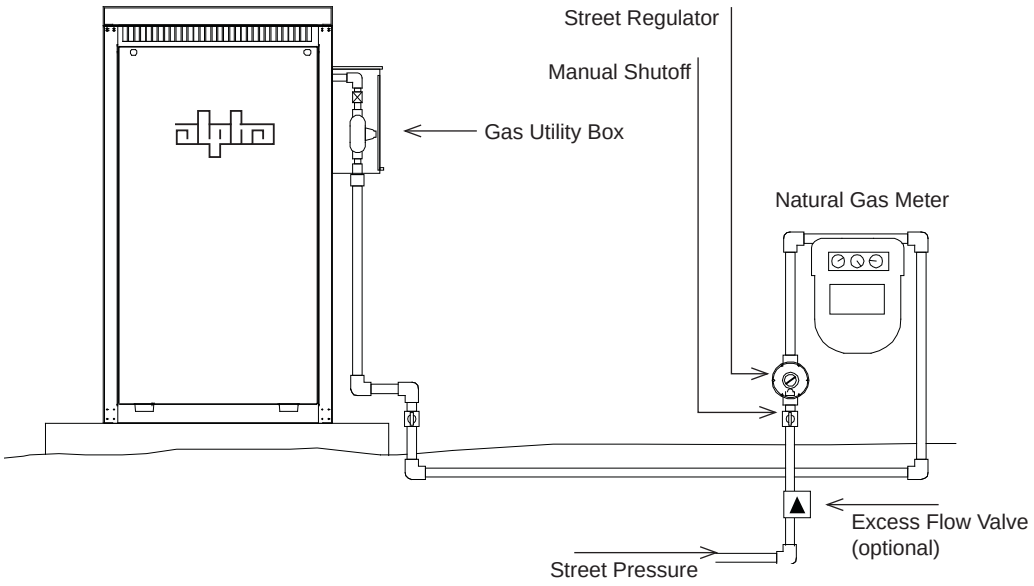


Fig. 2-7, Collocated CE-3x2 5K-T Generator with Remote Natural Gas Meter

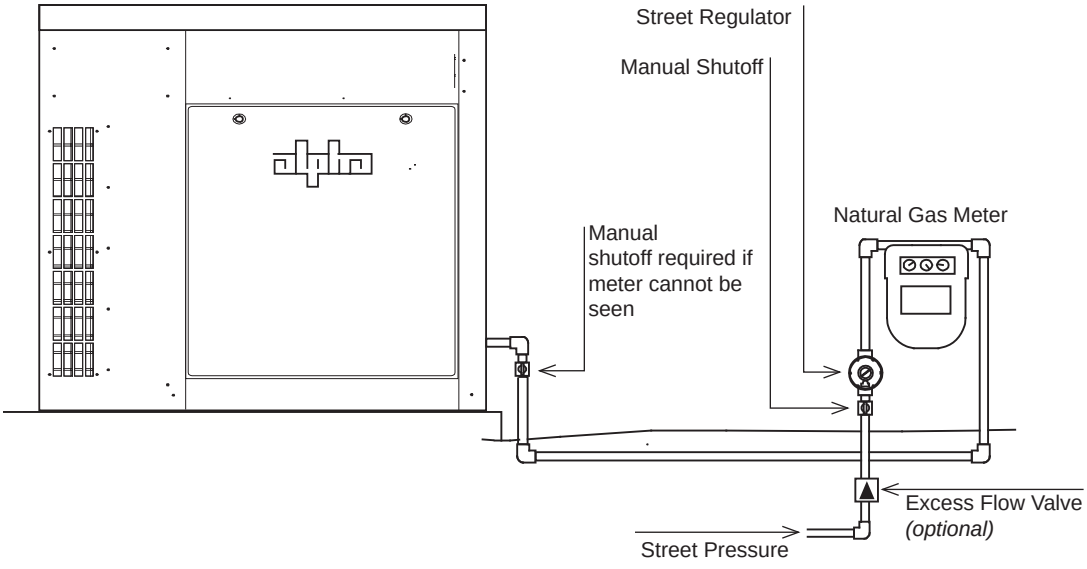


Fig. 2-8, Remote Natural Gas Meter Setup for PN-6x-T 7.5kW Generator

2.5 Liquid Propane Systems

For systems using liquid propane, the end user must provide a suitable LP tank. For collocated propane enclosures, see the CE-G Series Enclosure Installation Manual, Alpha P/N 031-093-C0-001, located at www.alpha.com.

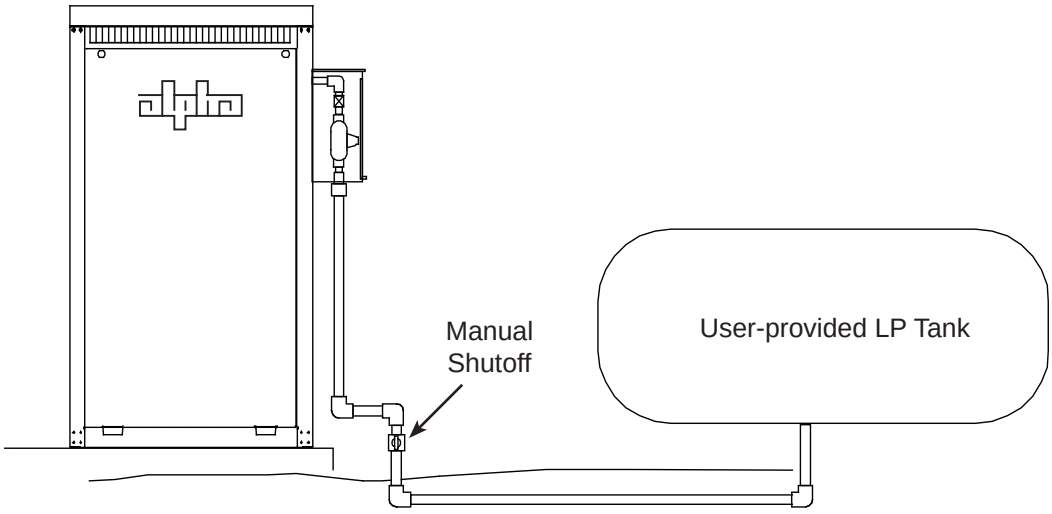


Fig. 2-9, Liquid Propane Setup, CE-3x2 5K-T

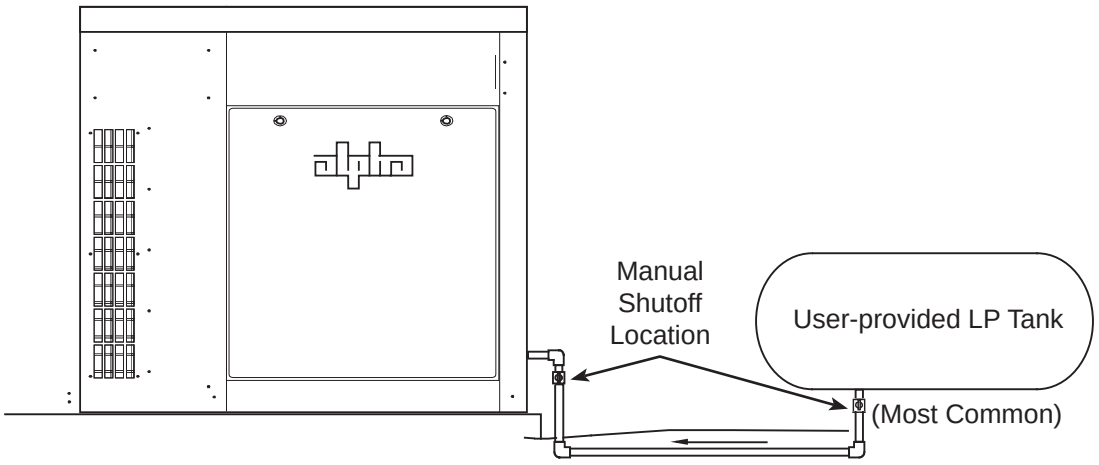


Fig. 2-10, Liquid Propane Setup, PN-6x-T 7.5kW

2.6 Grounding Requirements, CE-3x2 5K-T

The ground rod system is typically used in remote applications where the generator is located away from the power supply enclosure and exposed to lightning strikes, or coincidental surges. The wiring interface between the DC Genset and system carries a *system* ground to ensure common ground between both cabinets and communication devices. The remote APU cabinet ground rod serves only as an alternate discharge path.

NOTE:

Alpha Technologies recommends using the grounding method illustrated below. The grounding method for a particular site will be dependant upon soil type, available space, local codes, NEC (National Electric Code), and other site- specific characteristics.

Alpha Technologies recommends 5 ohms minimum ground resistance between enclosure and ground rods, in accordance with IEEE 1100-1999 Powering and Grounding Electronic Equipment. NEC minimum grounding standard is 25 ohms.

Alpha Technologies assumes no responsibility or liability for failure of the installer to comply with the requirements of all applicable local and national codes. Where allowed, exothermic welding may be used as an alternative to Burndy clamps and connectors.

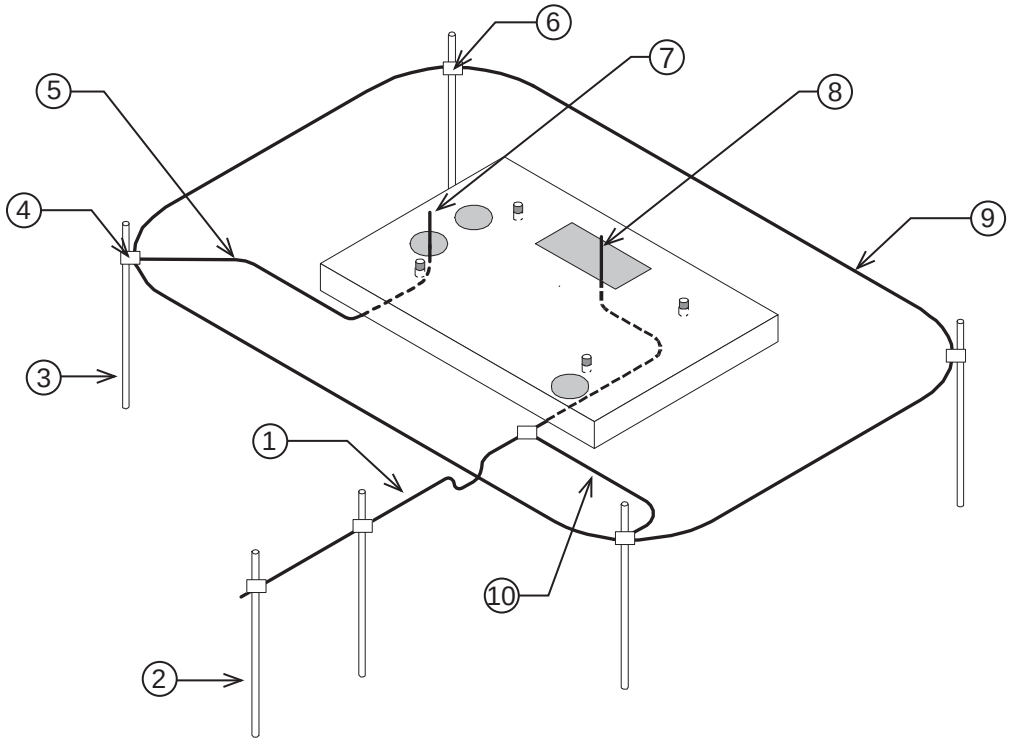
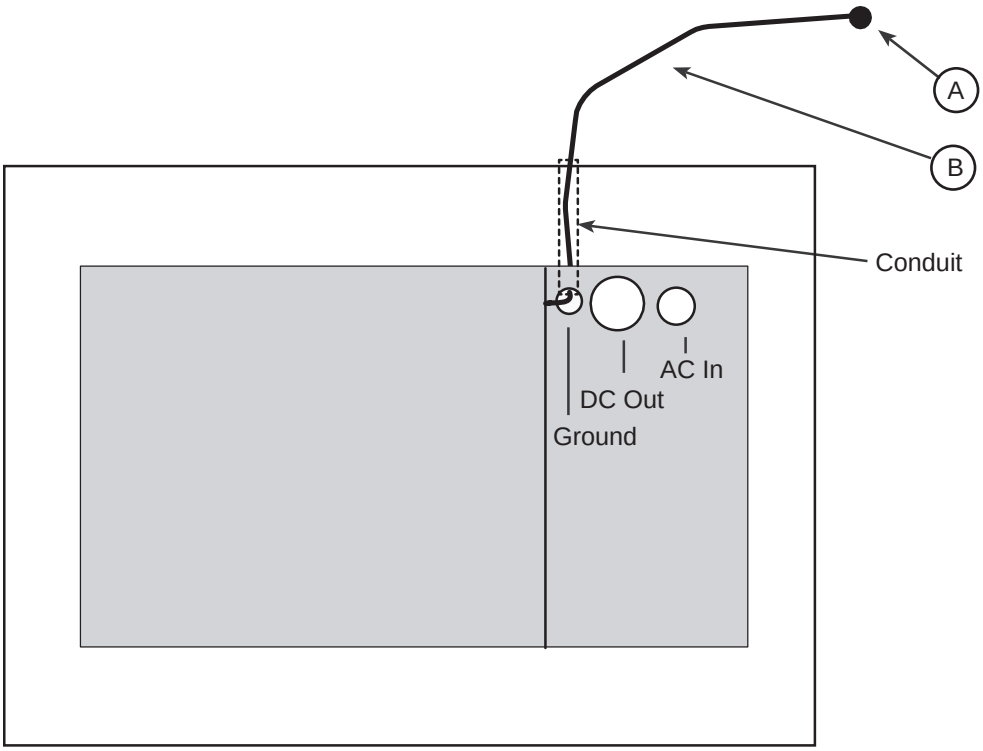


Fig. 2-11, Enclosure Grounding, CE-3x2 5K-T
(for reference only)

1. Service grounding (required). #6AWG Copper wire from service entrance ground bar.
2. Two ground rods, 6' apart
3. Lightning protection (optional). 1/2" x 8' Copper ground rods, 4 places.
4. Burndy YGHP58C2W-3 or equivalent compression ground tap connector
5. #6 bare copper wire from loop to enclosure ground bar
6. Burndy YGHP58C2W-3 or equivalent compression ground tap connector
7. Terminate at ground bar
8. Terminate at ground bar
9. #6 bare copper loop terminated at each ground rod, 30” below grade (min). Corrosion-proof (25 yr. life-span) connections suitable for direct burial MUST be used
10. #2 AWG wire

2.7 Grounding Requirements, PN-6xT 7.5kW

The ground rod system is typically used in remote applications where the generator is located away from the power supply enclosure and exposed to lightning strikes, or coincidental surges. The wiring interface between the DC Genset and system carries a *system* ground to ensure common ground between both cabinets and communication devices. The remote APU cabinet ground rod serves only as an alternate discharge path.



Front of Enclosure

A
- 8 feet long, 1/2 inch diameter copper electrode.
- To aid in serviceability, place the ground electrode outside the concrete pad's perimeter. Consult local utility codes for additional cabinet grounding and utility requirements.

B
- #6AWG bare copper wire exposed 5 feet above grade (min.) for output ground bus bar.
- Clamp #6AWG bare copper wire exposed 5 feet above grade (min.) for output ground bus bar.

Fig. 2-12, Enclosure Grounding, PN-6x-T 7.5kW

3.0 Installation

3.1 Installing the CE-3x2 5K-T or PN-6x-T 7.5kW Pad Template

To ease the installation of the generator enclosure, use the pad mounting template to accurately locate the mounting holes for the generator cabinet mounting hardware. The installation instructions for the two types of generator pad templates are the same, only the dimensions vary.

Site Considerations:

- Where possible, select a site that is above the 100-year flood plain, and away from houses.
- Place in a shaded location to minimize the effects of solar loading.
- Avoid locating the enclosure where it will be an obstruction or inhibit visibility.
- Locate the enclosure away from sprinkler systems or other sources of forced water.
- Locate the enclosure out of the prevailing wind to minimize the buildup of snow or the accumulation of wind-borne dust.
- Determine if soil conditions are suitable for the installation of the required grounding system.
- Verify utility power cabling has been run and terminated at the site.

1 Template frame

2 Threaded fasteners with “hex” spacers (4). Insert mounting bolts into the threaded fasteners to prevent concrete from fouling the threads. Once the pad has cured, attach the enclosure to the threaded fasteners.

3 Sweep compression plate. For the CE-3x2, verify sweep is held in place against the frame by the compression plate. For the PN-6xT, verify the sweep retaining bracket is located properly.

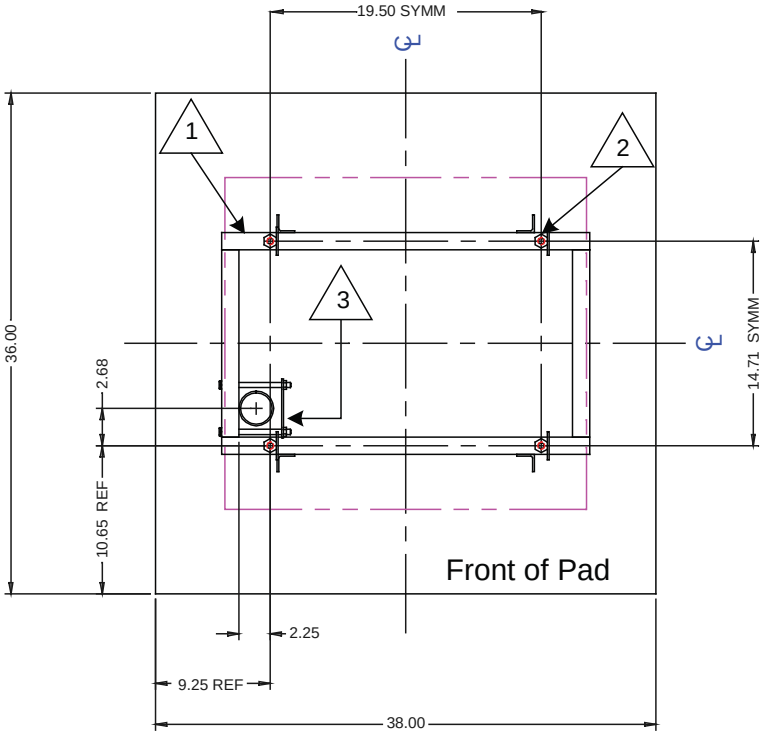


Fig.3-1, Pad Frame Template for CE-3x2 5K-T
(in inches)

3.0 Installation, continued

3.1 Installing the CE-3x2 5K-T or PN-6x-T 7.5kW Pad Template, continued

1. Determine the size of the pad you need. Typically it is best to leave at least 6 inches of space between the outside of the cabinet and the edge of the pad. Occasionally, you might want to extend the pad in one or more directions for ease of access during maintenance.
2. Using the physical placement of the mounting bolts in the pad template, calculate the exact dimensions of the pad, taking into consideration the size of the wooden frame used around its perimeter. Measure the overall pad dimensions from the inside of the wooden frame.
3. Using the dimensions calculated in step 2, excavate the site for the pad.

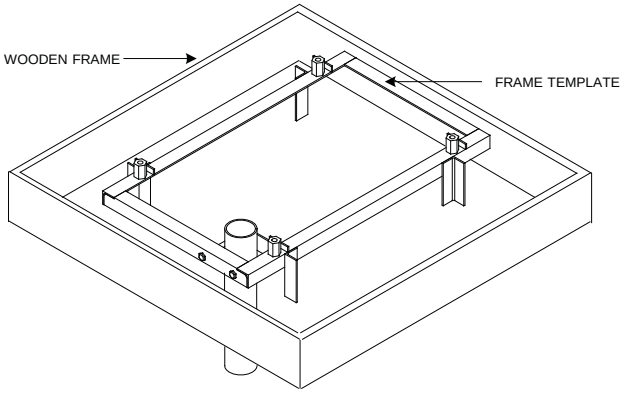


Fig. 3-2, Pad frame and mounting template CE-3x2 5.0 kW

NOTE:

If using a gravel foundation, the hole for the pad must be deep enough to place the gravel before installing the pad template. Check local codes for exact specifications.

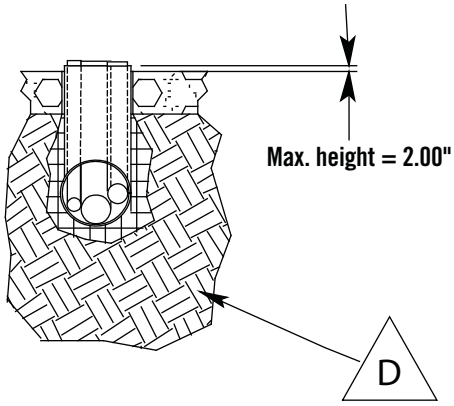
4. Dig the trenches for the sweep conduits. Consult your local codes for the required depth, fill material, and back filling.
5. Install the wooden perimeter frame in pad opening.
6. Verify that the top of the pad is 4 inches above grade to minimize debris buildup around the base of the cabinet.
7. Place the pad template in pad opening and adjust the template so the tops of the four threaded fasteners are level with the top of the wooden frame.
8. Plug the threaded inserts.
9. Pour the concrete, smooth the surface of the pad, and let the concrete cure.
10. Backfill the sweep trench.

A Backfill trenches over conduit.

B Concrete pad.

C Stagger or nest conduits for passage through the three inch pad sweep opening on CE-3x2.

D When pouring the pad the sweeps may extend to a maximum of 4 inches above the finished pad to prevent concrete from filling the sweep openings. After the concrete is set, trim the conduit to a height no more than 2 inches above the surface of the pad.



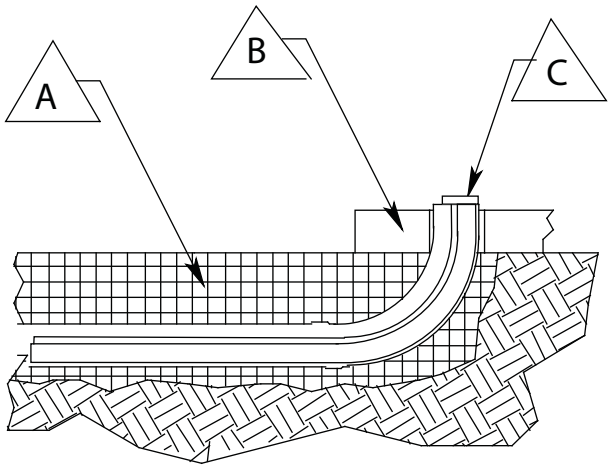


Fig. 3-3, Cross-section of Sweep Trench

3.2 Installation, CE-3x2 5K-T

Prior to installation verify the following:

- All necessary grounding rods and materials are in place.
- Utility power was run to site in accordance with the NESC (National Electric Safety Code).
- Obtained local safety practices for working with high-voltage systems.
- Gas piping, hardware, supports, and other gas carrying components to the pad location conform to NFPA standard and local requirements.

Required Tools and Materials:

- Crane to lift enclosure from shipping pallet and place on pad
- Key(s) to enclosure doors
- Digital voltmeter
- Torque wrench with insulated handle and 7/16" socket
- 7/16” box-end wrench
- NO-OX or other suitable corrosion inhibiting agent (NCP-2)
- Silicone sealant GE RTV123 (or equivalent)
- Phillips screwdriver (for pad shear mounting)
- 5/8" socket for removing pallet mounting bolts
- Hard hats
- Utility knife

WARNING!

To prevent injury or death, do not walk, or allow personnel to walk, beneath the suspended unit. Use steel-toe work shoe protection. Use hard hats at all times during this procedure. Before lifting, verify the transport path is clear of obstructions.

3.2 CE-3x2 5K-T Installation

3.2.1 CE-3x2 5K-T Transportation and Lifting

The generator weighs approximately 395 lbs. A safe means of transporting to the site, and unloading the generator must be arranged. Do not transport, lift, or place the generator on a surface unable to fully support its weight.

The generator is shipped bolted to a pallet. Remove the protective outer wrapping material, and inspect the outside of the generator for shipping damage. Use a forklift to place the unit (still bolted to its pallet) in the back of the transport vehicle for delivery to the installation site. Once on-site, follow the procedure outlined on the following pages to lift the enclosure from the shipping pallet and place it on the concrete pad.

CAUTION!

Do not install the ignition battery until the enclosure is set in place in its permanent location.

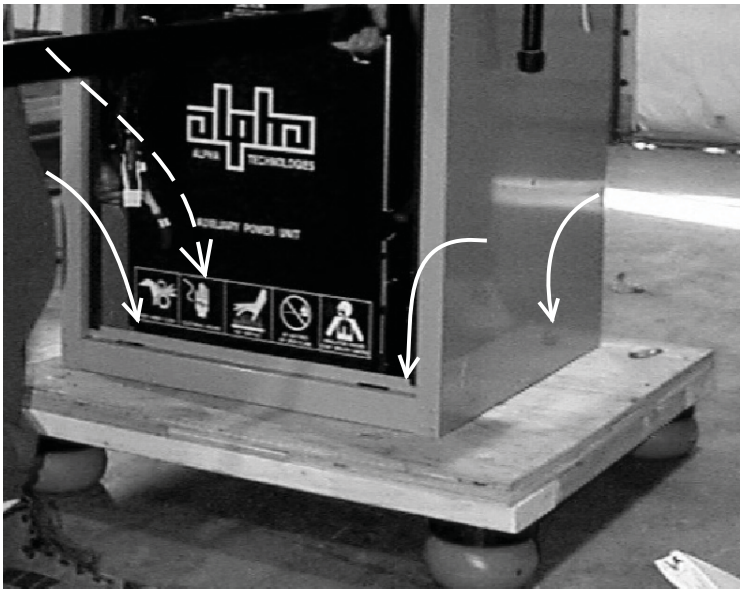
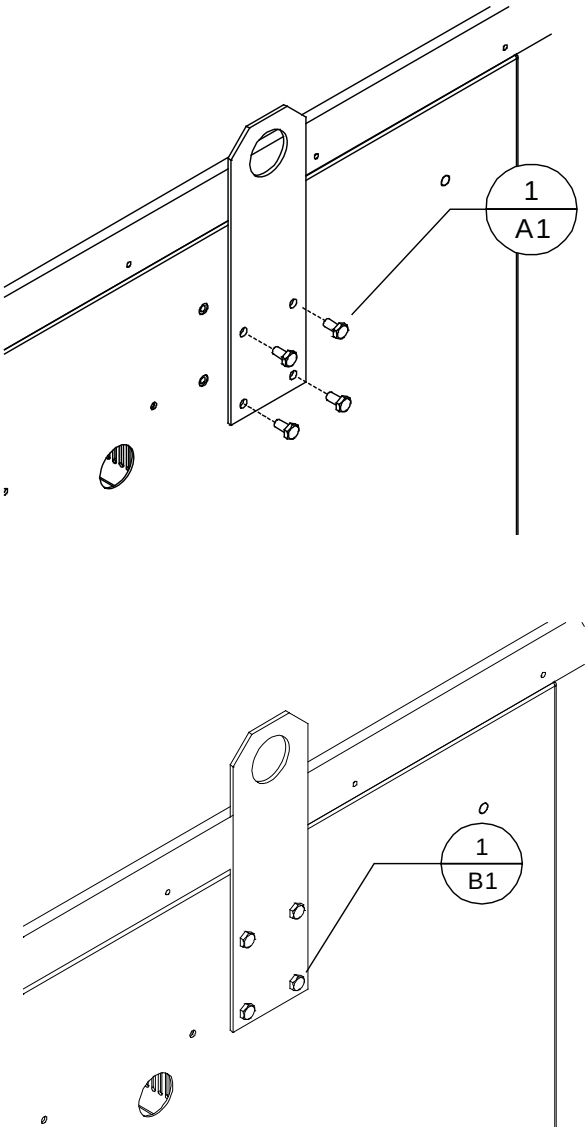


Fig. 3-4, Pad Bolt Location, CE-3x2 5K-T

3.2 CE-3x2 5K-T Installation, continued

3.2.1 CE-3x2 5K-T Transportation and Lifting, continued

The enclosure is lifted via the attached lifting ears. The lifting ears are attached to the cabinet with 1/4-20 x 3/8” stainless steel SAE J429 Grade 8 hex head bolts, torqued 80 to 90 in-lbs.



1/A1 1/4-20 x 3/8” stainless steel SAE J429 Grade 8 hex head bolts. 4 places per ear.

1/B1 Bolts torqued 80 to 90 in-lbs.

Fig. 3-5, Lifting Ear Attachment

3.2.2 Enclosure Installation, CE-3x2 5K-T

1. Lift the enclosure with a lifting appararatus rated in excess of 500 lbs. Configure the lifting arrangement so the distance from the top of the cabinet to the lift ring or hook is at least twice the distance between the lifting ears (Fig. 3-2).

2. Position the enclosure above the concrete pad, and slowly lower it into position over the pad's 3/8" (or 1/2") anchor or J-bolts. Use a 25-year vapor barrier between the concrete and enclosure base to inhibit moisture ingress, and to prevent possible corrosion caused by metal to concrete contact. The vapor barrier material (such as 30 lb. felt, neoprene pond liner, or heavy grade tar paper) should initially extend at least 6" in all directions around the perimeter of the enclosure. After the enclosure is in place, the material should be cut closer to the enclosure, using the appropriate knife or cutting tool.

3. Secure the enclosure using stainless or galvanized flat washers, lock washers, and 3/8" (or 1/2") nuts at each mounting bolt. Torque mounting hardware in accordance with the manufacturer's recommendation.

4. Make a small cutout in the vapor barrier material directly under the pad shear sensor, Apply silicone glue to the concrete pad (in the cutout section) and set the pad shear magnet into the glue (potted side down). Let the glue set 12-24 hours.

CAUTION!

To prevent damage to the enclosure, it must be mounted flush to a completely flat surface. If the concrete pad is uneven or has bumps, cracks or other imperfections, the installer is responsible for correcting these defects prior to installing the enclosure.

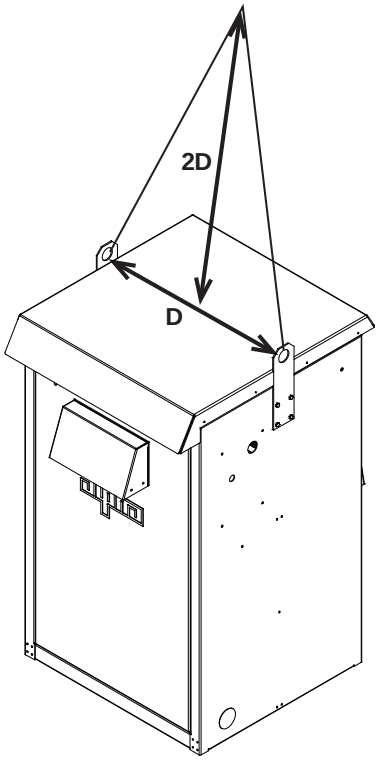


Fig. 3-6, Enclosure with Lifting Ears Installed, CE-3x2 5K-T

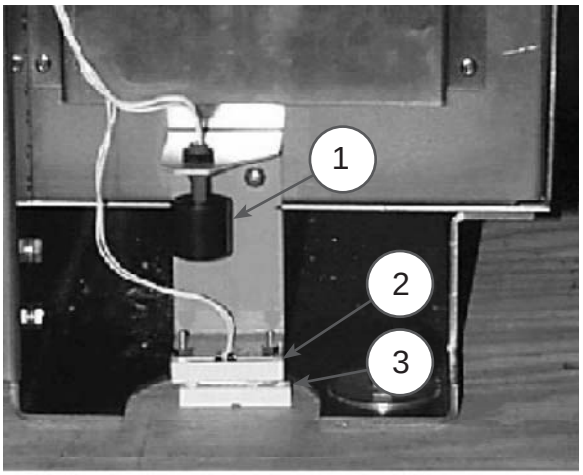


Fig. 3-7, Water Intrusion Alarm (1), Pad Shear Sensor (2), and Pad Shear Magnet (3)

3.3 PN-6x-T 7.5kW Installation

Prior to installation verify the following:

- All necessary grounding rods and materials are in place.
- Utility power run to site in accordance with the NESC (National Electric Safety Code).
- Obtained local safety practices for working with high-voltage systems.
- Gas piping, hardware, supports, and other gas carrying components to the pad location conform to NFPA standard and local requirements.

Required Tools and Materials:

- Crane to lift enclosure from shipping pallet and place on pad
- Key(s) to enclosure doors
- Digital voltmeter
- Torque wrench with insulated handle and 1/2" socket
- 1/2" box-end wrench
- NO-OX or other suitable corrosion inhibiting agent (NCP-2)
- Silicone sealant GE RTV123 (or equivalent)
- Phillips screwdriver (for pad shear mounting)
- 5/8" socket for removing pallet mounting bolts
- Hard hats
- Utility knife

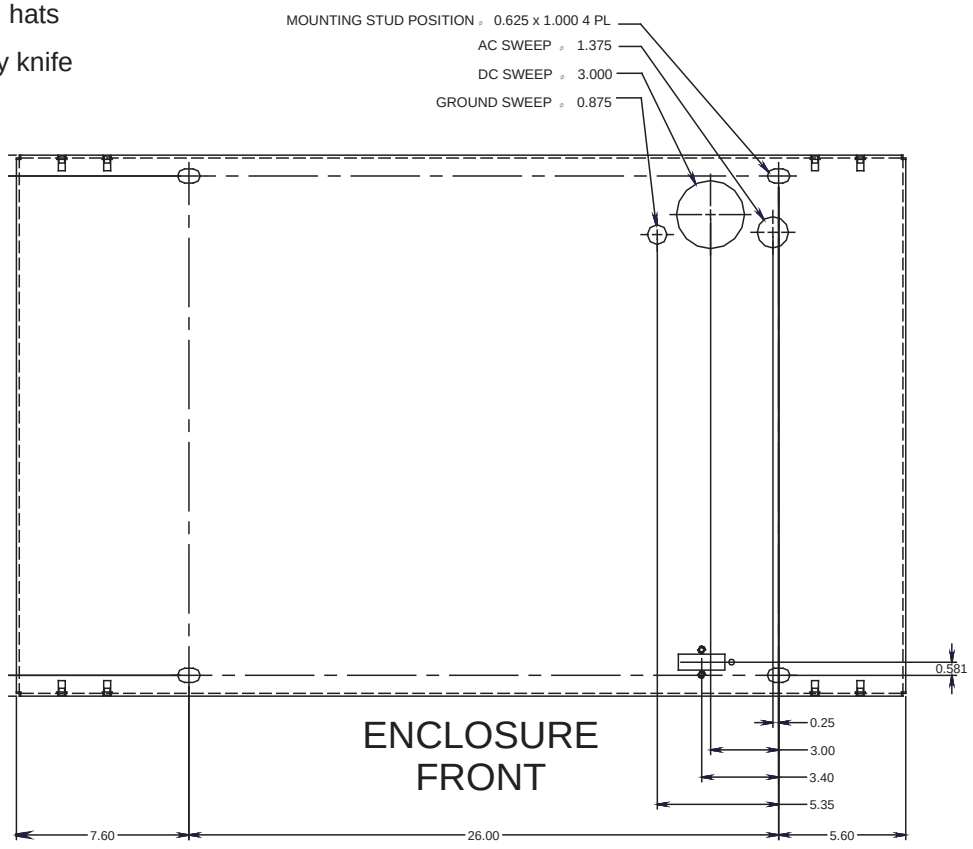


Fig. 3-8, PN-6x-T 7.5kW Sweep Dimensions (in inches)

3.3.1 PN-6x-T 7.5kW Transportation and Lifting,

The enclosure as shipped contains the Auxiliary Power Unit (APU) and weighs approximately 338 lbs. A safe means of transporting to the site, and unloading the enclosure must be considered. Do not transport, lift, or place the unit on any surface unable to fully support its weight.

The system is shipped bolted to a pallet. Once the system arrives, remove the protective outer wrapping material and inspect the outside of the enclosure for shipping damage. Use a forklift to place the unit (still bolted to its pallet) in the back of the transport vehicle for delivery to the installation site. Once on site, attach the lifting plates to the enclosure at the holes indicated below. Remove the front and rear doors and remove the pallet mounting bolts using a 5/8" socket wrench.

CAUTION!

Do not install the ignition battery until the enclosure is placed in its permanent location.

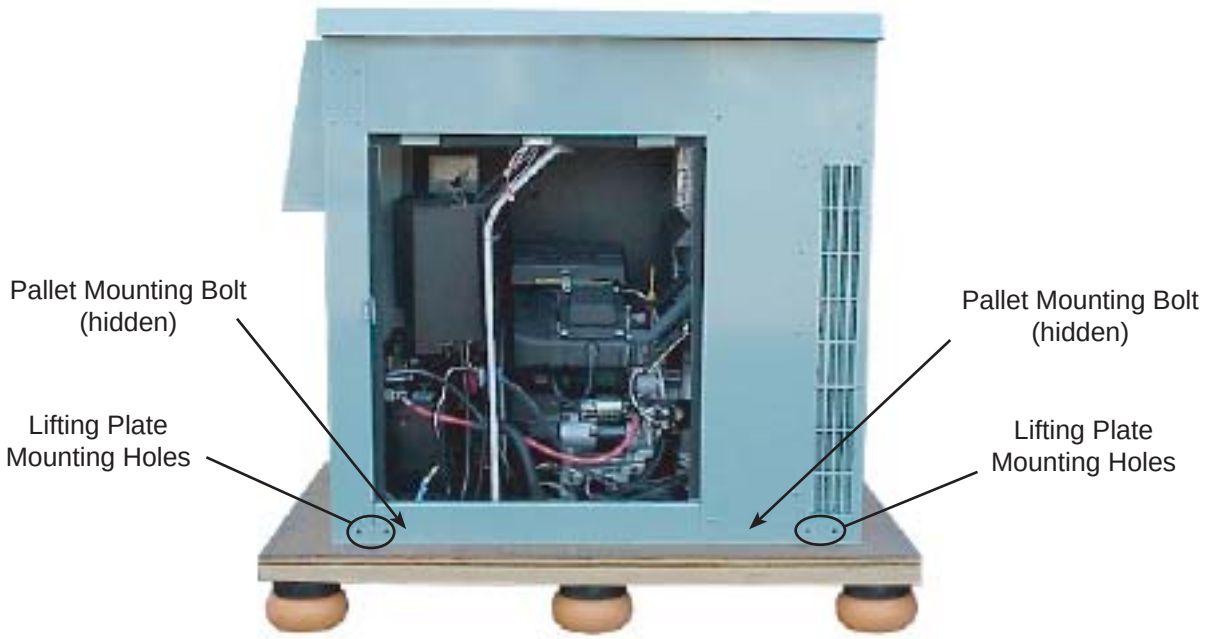


Fig. 3-9, Pallet Bolt Locations, PN-6x-T 7.5kW

The enclosure is lifted via four lifting plates included with the generator. The lifting plates are attached to the cabinet with 1/4-20 x 3/8" stainless steel SAE J429 Grade 8 hex-head bolts, torqued 80 to 90 in-lbs.

WARNING!

To prevent injury or death, do not walk, or allow personnel to walk, beneath the suspended unit. Use steel-toe work shoe protection. Use hard hats at all times during this procedure. Before lifting, verify the transport path is clear of obstructions.

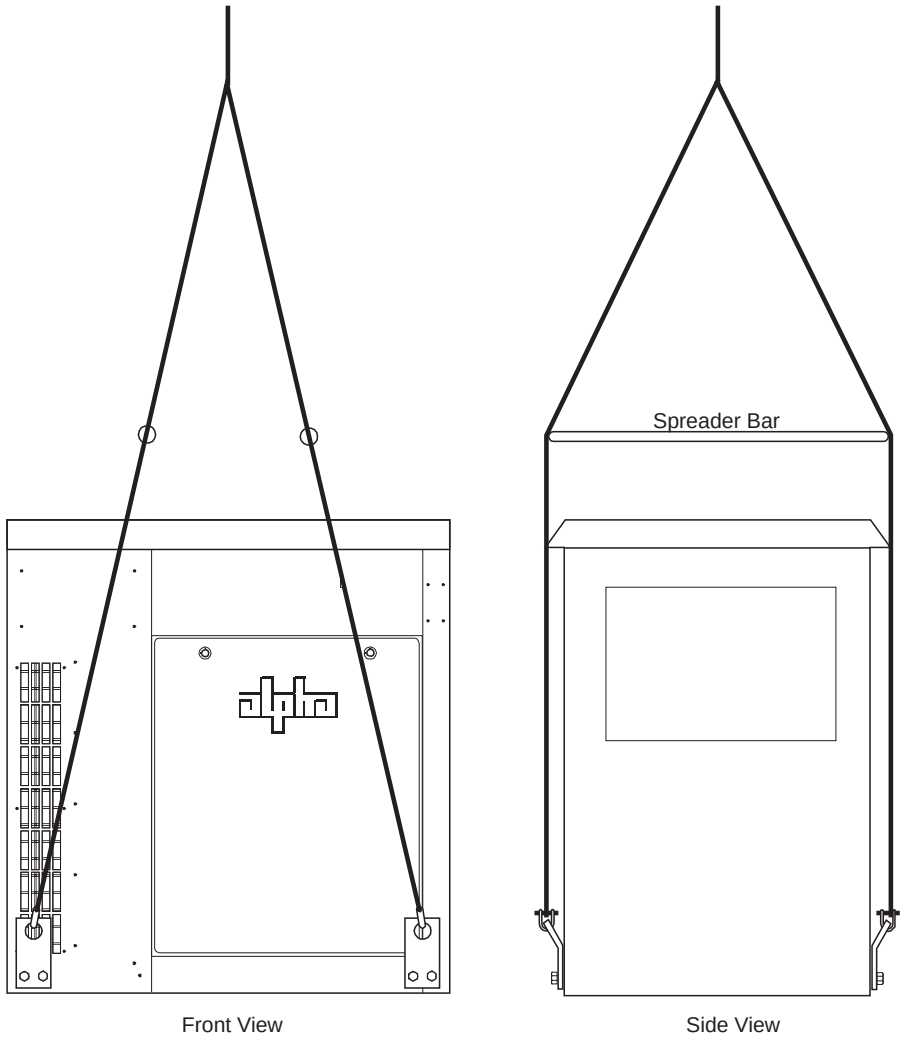


Fig. 3-10, Enclosure with Lifting Ears Installed, PN-6x-T 7.5kW

3.3.2 Enclosure Installation Procedure, PN-6x-T 7.5kW

1. Position the enclosure above the concrete pad and slowly lower it into position over the pad's 3/8" (or 1/2") anchor or J-bolts. A 25+ year vapor barrier MUST be used between the concrete and enclosure base to inhibit moisture ingress, and to prevent possible corrosion caused by metal to concrete contact. The vapor barrier material (such as Alpha P/N 564-721-10) should initially extend at least 1/2" in all directions around the perimeter of the enclosure. After the enclosure is in place, the material should be cut closer to the enclosure, using the appropriate knife or cutting tool.

2. Secure the enclosure using customer-supplied stainless, galvanized (or better), flat washers, lock washers and 3/8" (or 1/2") nuts at each mounting bolt. Torque mounting hardware in accordance with manufacturers' ratings.

3. The pad shear sensor is located in the left hand corner of the enclosure from the rear door. To install, locate the loose magnet (located in a plastic bag included with the enclosure). Remove the two screws holding the sensor in place, and lift out. Using a silicone based glue, glue the loose magnet to the pad in the center of the hole. After the glue has set, install the sensor with the two Phillips screws so it faces the glued down magnet.

   If a pedestal is used, relocate the pad shear sensor to the L-bracket located near the bottom of the pedestal. Glue the pad shear magnet directly below the sensor. Use the extender cable to connect the pad shear sensor wires to the wires located in the generator enclosure (route wires through pad shear sensor hole in the floor of the generator enclosure).

CAUTION!

To prevent damage to the enclosure, it must be mounted flush to a completely flat surface. If the concrete pad is uneven or has bumps, cracks or other imperfections, the installer is responsible for correcting these defects prior to installing the enclosure.

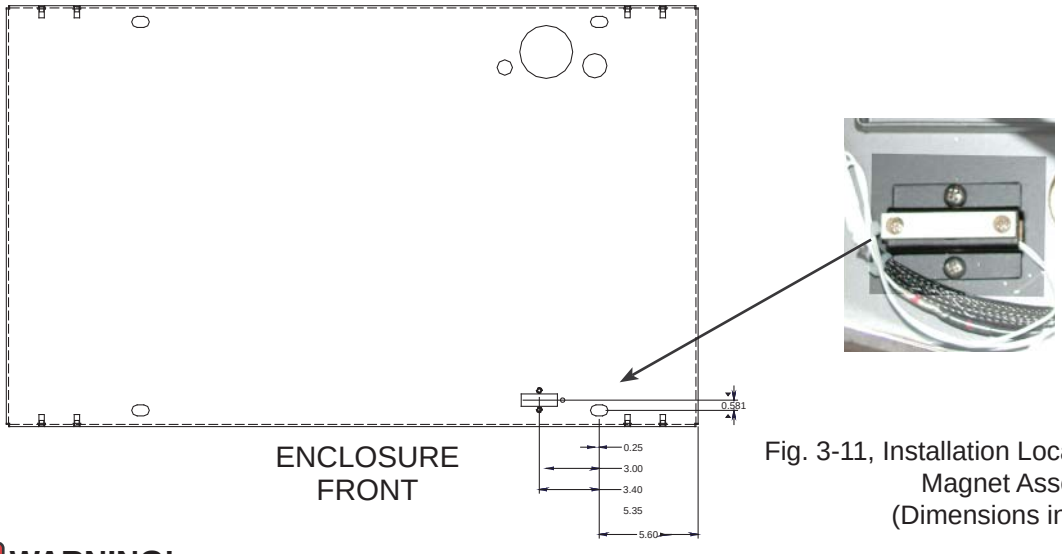


Fig. 3-11, Installation Location of Pad Shear/ Magnet Assembly
(Dimensions in inches)

WARNING!

The pad shear sensor is a safety feature that must be correctly installed before connecting the gas utility. This is a CRITICAL safety feature required to disable the generator in the event of automobile impact, seismic, or other unforeseen catastrophic event.

3.4 Enclosure Grounding, CE-3x2 5K-T

Run the chassis and earth grounding wires through the one-inch opening in the bottom of the generator enclosure. Using a 7/16" nutdriver or socket, secure the ground leads to the grounding stud located on the enclosure wall. See Fig. 3-12 below.

ATTENTION:

It is the responsibilty of the system installer to verify applicable grounding requirements, and to ensure that system grounding complies with all state, local, or regional requirements.

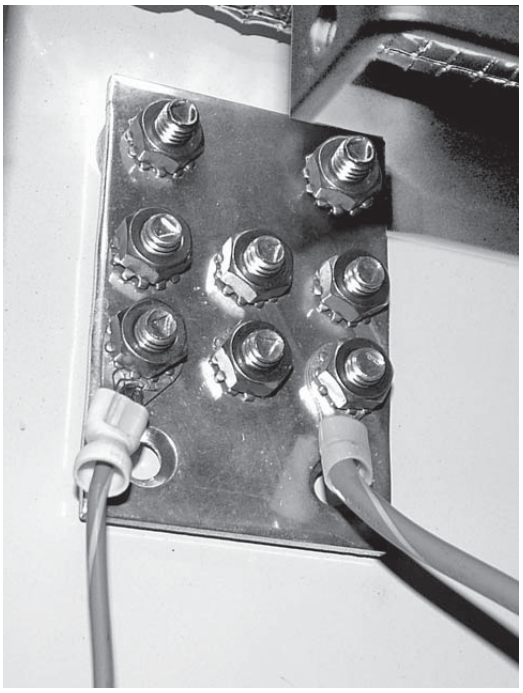


Fig. 3-12, Enclosure Grounding, CE-3x2 5K-T

3.5 Enclosure Grounding, PN-6x-T 7.5kW

Run the chassis and earth grounding wires through the one-inch opening in the bottom of the generator enclosure. Using a 7/16" nutdriver or socket, secure the ground leads to the grounding stud located on the enclosure wall. See Fig. 3-13 below.

ATTENTION:

It is the responsibilty of the system installer to verify applicable grounding requirements, and to ensure that system grounding complies with all state, local, or regional requirements.

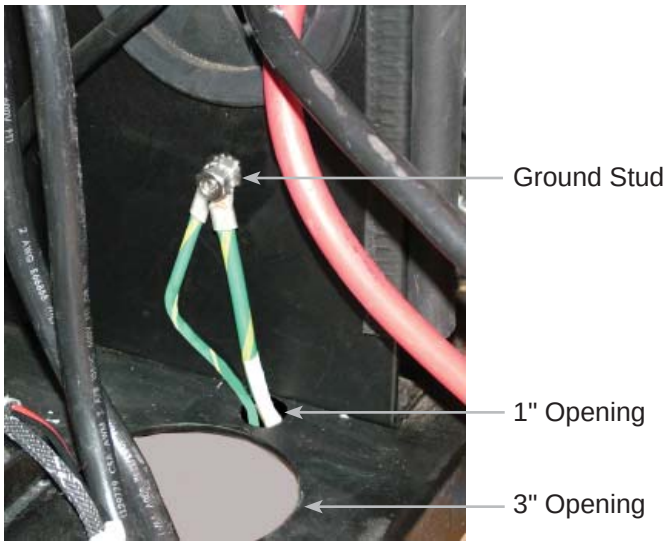


Fig. 3-13, Enclosure Grounding, PN-6x-T 7.5kW

3.6 Natural Gas Utility Fuel Hookup, CE-3x2 5K-T

These general instructions apply to either remote or collocated systems.

- Connection to the utility fuel line is made using a 3/4" shear point union, 1/2" black iron pipe, and the appropriate pipe thread sealant suitable for use with natural gas or propane vapor.
- Use approved pipe thread sealant on all fuel line connections (except flare fittings).
- Thoroughly check the fuel system for vapor leaks. Use an approved leak detector liquid, or a soap-water solution, with the fuel system pressurized to the cabinet with 0.5 to 1.0 pounds of fuel pressure. Do not use test solutions that contain ammonia or chlorine, since they prevent soap from bubbling.
- Check and satisfy all local codes before connecting gas to the fuel system.

WARNING!

Observe all safety precautions when working with fuel lines. The illustrations on this page should be considered for general reference only. Installation should ONLY be done by qualified personnel. Alpha is not liable for gas leaks resulting from improper installation.

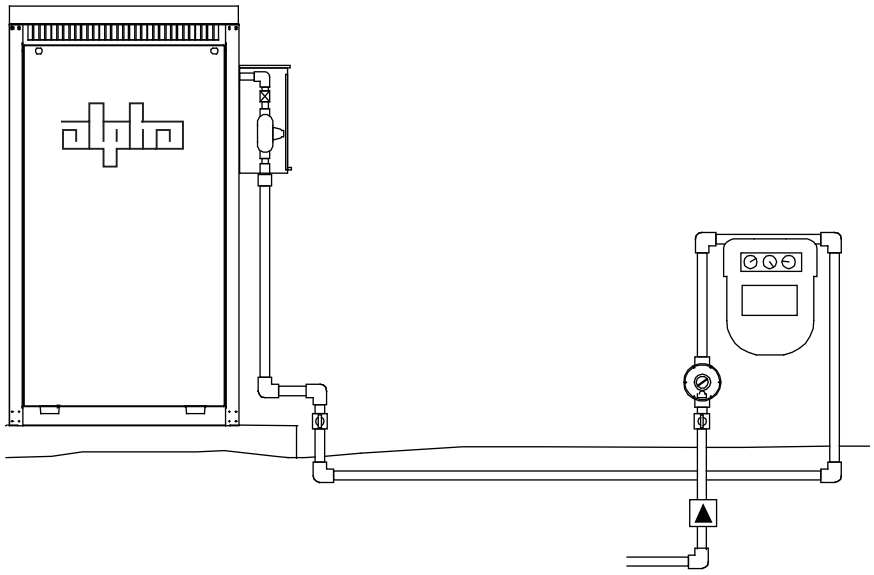


Fig. 3-14, Utility Gas Service Input, CE-3x2 5K-T

3.7 Natural Gas Utility Fuel Hookup, PN-6x-T 7.5kW

These general instructions apply to either remote or collocated systems.

- Connection to the utility fuel line is made using a 3/4" shear point union, 1/2" black iron pipe, and the appropriate pipe thread sealant suitable for use with natural gas or propane vapor.
- Use approved pipe thread sealant on all fuel line connections (except flare fittings).
- Thoroughly check the fuel system for vapor leaks. Use an approved leak detector liquid, or a soap-water solution, with the fuel system pressurized to the cabinet with 0.5 to 1.0 pounds of fuel pressure. Do not use test solutions that contain ammonia or chlorine, since they prevent soap from bubbling.
- Check and satisfy all local codes before connecting gas to the fuel system.

WARNING!

Observe all safety precautions when working with fuel lines. The illustrations on this page should be considered for general reference only. Installation should ONLY be done by qualified personnel. Alpha is not liable for gas leaks resulting from improper installation.

Natural Gas Utility Fuel Connection

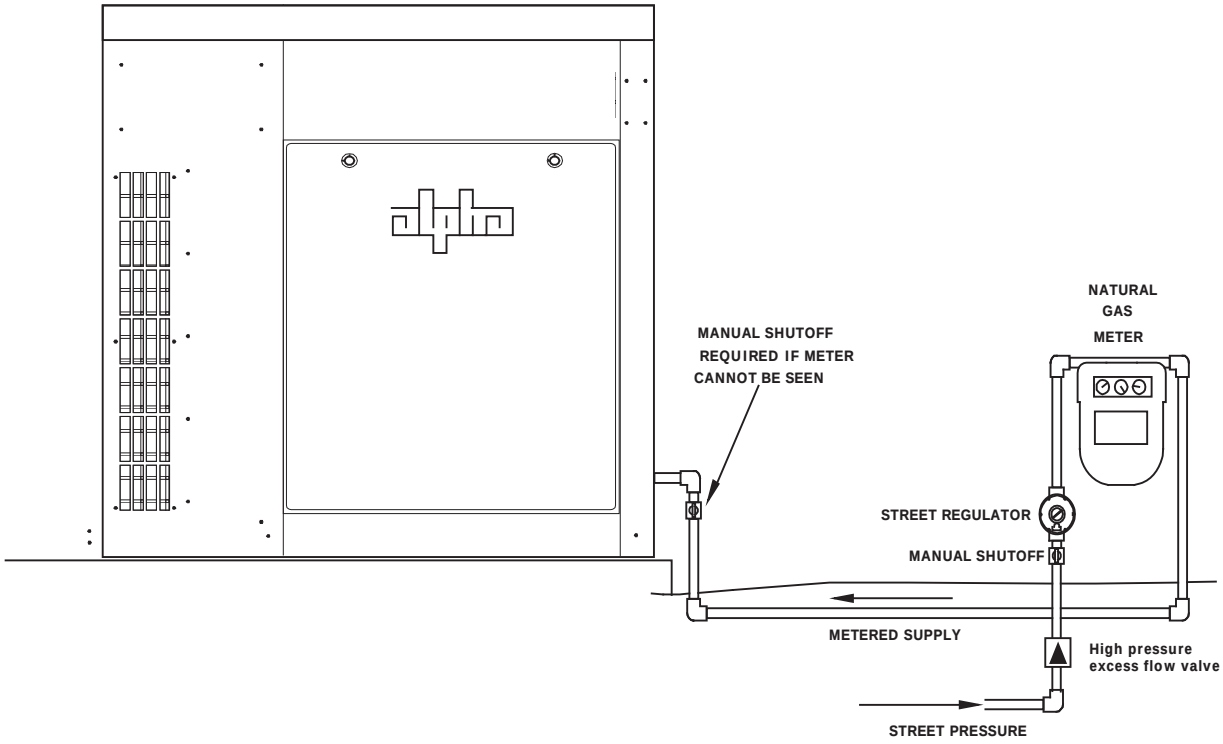


Fig. 3-15, Utility Gas Service Input, PN-6x-T 7.5kW

3.8 Liquid Propane Utility Fuel Hookup, CE-3x2 5K-T

For collocated propane enclosures, see the CE-G Series Enclosure Installation Manual, Alpha P/N 031-093-C0-001, located at www.alpha.com.

- Connection to the LP fuel line is made using a 3/4" shear point union, 1/2" black iron pipe, and the appropriate pipe thread sealant suitable for use with propane vapor.
- Approved pipe thread sealant must be used on all fuel line connections (except flare fittings).
- Thoroughly check the fuel system for vapor leaks. Use an approved leak detector liquid, or a soap-water solution, with the fuel system pressurized to the cabinet with 0.5 to 1.0 pounds of fuel pressure. Do not use test solutions that contain ammonia or chlorine, since they prevent soap from bubbling.
- Check and satisfy all local codes before connecting gas to the fuel system.

WARNING!

Observe all safety precautions when working with fuel lines. The illustrations on this page should be considered for general reference only. Installation should ONLY be done by qualified personnel. Alpha is not liable for gas leaks resulting from improper installation.

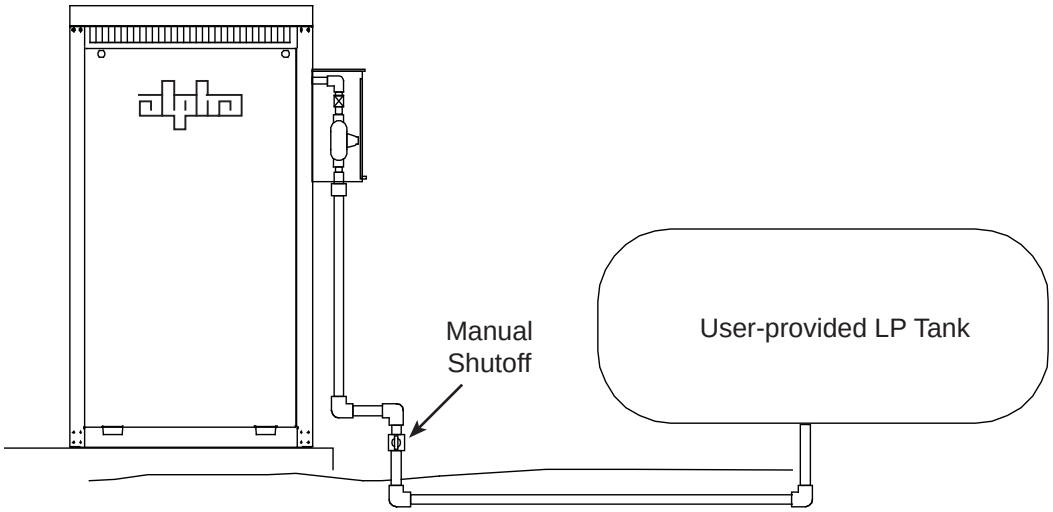


Fig. 3-16, Propane Fuel Hookup, CE-3x2 5K-T

3.9 Liquid Propane Utility Fuel Hookup, PN-6x-T 7.5kW

- Connection to the LP fuel line is made using a 3/4" shear point union, 1/2" black iron pipe, and the appropriate pipe thread sealant suitable for use with propane vapor.
- Approved pipe thread sealant must be used on all fuel line connections (except flare fittings).
- Thoroughly check the fuel system for vapor leaks. Use an approved leak detector liquid, or a soap-water solution, with the fuel system pressurized to the cabinet with 0.5 to 1.0 pounds of fuel pressure. Do not use test solutions that contain ammonia or chlorine, since they prevent soap from bubbling.
- Check and satisfy all local codes before connecting gas to the fuel system.

WARNING!

Observe all safety precautions when working with fuel lines. The illustrations on this page should be considered for general reference only. Installation should ONLY be done by qualified personnel. Alpha is not liable for gas leaks resulting from improper installation.

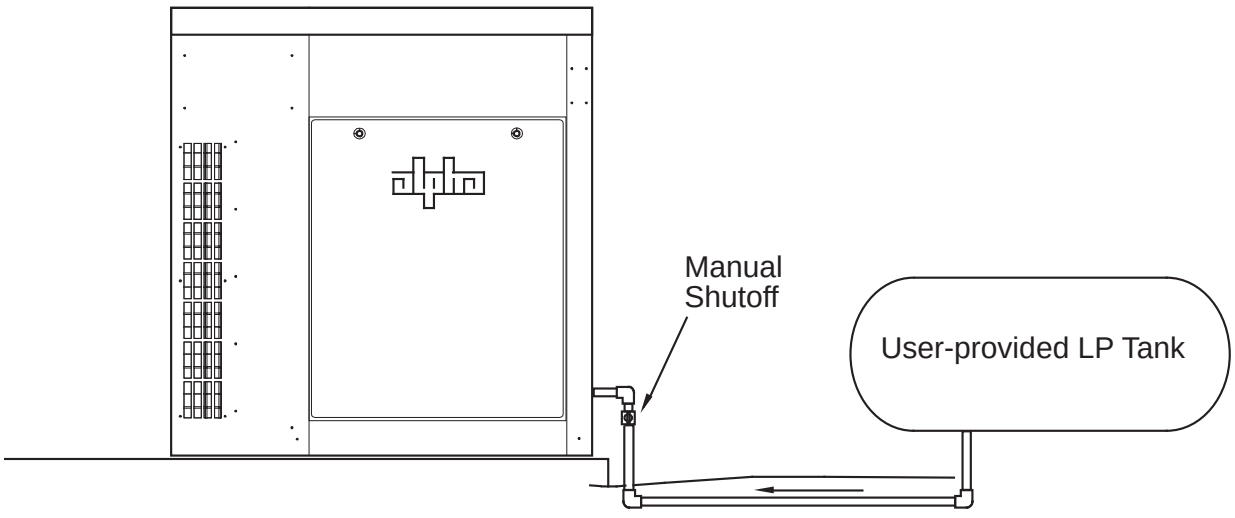


Fig. 3-17, Propane Fuel Hookup, PN-6x-T 7.5kW

3.10 Making the DC Output Connection, CE-3x2 5K-T

Verify proper polarity with a digital voltmeter, and connect the Load to the DC output connector.

Fig, 3-18, DC Output, CE-3x2 5K-T

3.11 Making the DC Output Connection, PN-6x-T 7.5kW

1. Locate and remove the safety shroud. The shroud is held in place with two thumb screws.

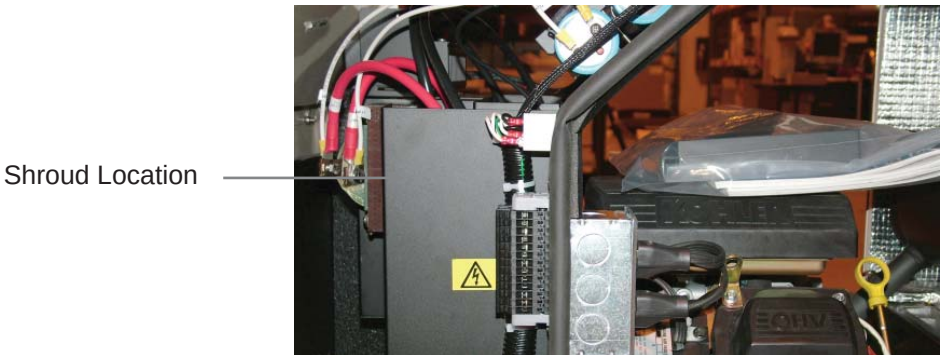


Fig. 3-19, DC Output Safety Shroud

2. Strip the user-supplied DC load wires 3/4". Loosen the 3/16" Allen screws and insert the DC load wires. Torque to 120 in-lbs and replace the safety shroud.

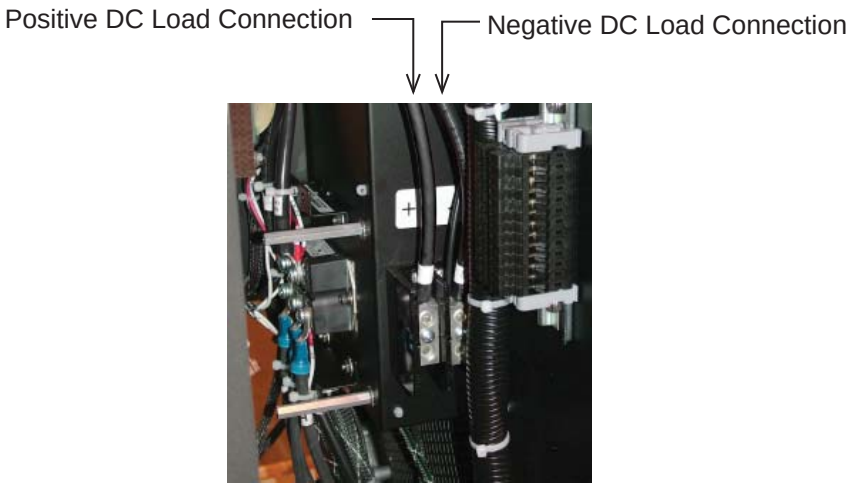


Fig. 3-20, DC Output Connections, PN-6x-T 7.5kW

NOTE:

Before connection, read polarity with a multimeter. To connect a -48V customer load, make the negative load connection to the postive terminal on the output terminal block, and make the positive load connection to the negative terminal on the output terminal block.

3.12 Connecting the Ignition Battery, CE-3x2 5K-T

WARNING!

For further information regarding the safe handling of batteries, refer to the Battery Safety Notes at the beginning of this manual.

1. Set the RAS switch on the ECM to the STOP position.
2. Using a voltmeter, check ignition battery voltage. Battery voltage should be at least 12.5Vdc. If low, recharge before placing into operation.
3. Coat the battery terminals with battery corrosion preventative compound (NCP-2).
4 Connect the positive (red) battery terminals and torque to 60 in-lbs.
5. Connect the negative (black) battery terminals and torque to 60 in-lbs.
6. Secure the battery hold-down bracket.
7. To remove the battery, reverse procedure.

CAUTION!

To reduce the risk of arcing, disconnect the negative cable first when removing the ignition battery from the enclosure.

3.13 Connecting the Ignition Battery, PN-6x-T 7.5kW

The ignition battery is calcium/silver chemistry, 585 CCA , group 55 battery (Alpha P/N 181-076-10).

WARNING!

For further information regarding the safe handling of batteries, refer to the Battery Safety Notes at the beginning of this manual.

1. Set the RAS switch on the ECM to the STOP position.
2. Using a voltmeter, check ignition battery voltage. Battery voltage should be at least 12.5Vdc. If low, recharge before placing into operation.
3. Place the battery onto the pan located to the left of the generator, with the POS terminal closest to the sweep opening.
4. Coat the battery terminals with battery corrosion preventative compound (NCP-2).
5 Connect the positive (red) battery terminals and torque to 60 in-lbs.
6. Connect the negative (black) battery terminals and torque to 60 in-lbs.
7. Secure the battery hold-down bracket.
8. To remove the battery, reverse procedure.

CAUTION!

To reduce the risk of arcing, disconnect the negative cable first when removing the ignition battery from the enclosure.

3.14 Terminal Block 2 (AC Line) Connections, CE-3x2 5K-T

Terminal Block 2 is above the ignition battery, located in the rear of the enclosure. Connect the user-supplied wiring using a #1 flat-head screwdriver. Strip wires 3/8" (9.5mm) and torque to 7 in-lbs (0.8 Nm). Refer to the table and photo below for alarm definitions.

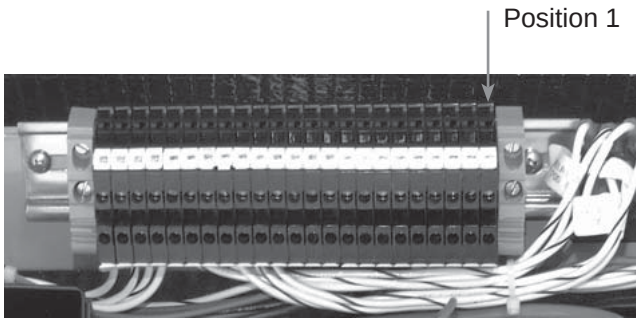


Fig. 3-21, Terminal Block 2 (TB2) Position 1, 5kW

Terminal Block 2	
Pos #	**Function**
23	Major Alarm NC
22	Major Alarm NO
21	Major Alarm Com
20	See Note
19	Alarm Bypass Com
18	Alarm Bypass NO
17	Alarm Bypass NC
16	Eng Run Com
15	Eng Run Com NO
14	Eng Run Com NC
13	Minor Alarm NO
12	See Note
11	Minor Alarm COM NO
10	Door NO
9	Door COM
8	LPG Monitor PWR (-12V)
7	LPG Monitor PWR (+12V)
6	AC Line Fail NC
5	AC Line Fail NO
4	AC Line Fail COM
3	AC Input Ground
2	AC Input Neutral
1	AC Input Line

Table 3-1, Terminal Block 2 (TB2) Connections, CE-3x2 5K-T

NOTE:

For customers requiring a Normally Closed (NC) logic minor alarm, make connections to TB2 positions 12 and 20.

3.15 Terminal Block 2 (AC Line) Connections, PN-6x-T 7.5kW

Terminal Block 2 is located on the bulkhead next to the convenience outlet. Connect the user-supplied wiring using a #1 flat-head screwdriver. Strip wires 3/8" (9.5mm) and torque to 7 in-lbs (0.8 Nm). Refer to the table and photo below for alarm definitions.

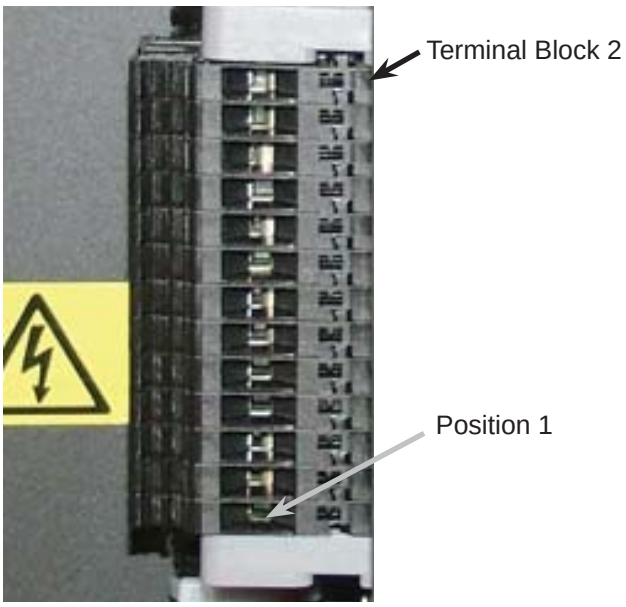


Fig. 3-22, Terminal Block 2 (TB2), PN-6x-T7.5kW

Terminal Block 2	
Pos #	**Function**
23	Major Alarm NC
22	Major Alarm NO
21	Major Alarm Com
20	See Note
19	Alarm Bypass Com
18	Alarm Bypass NO
17	Alarm Bypass NC
16	Eng Run Com
15	Eng Run Com NO
14	Eng Run Com NC
13	Minor Alarm NO
12	See Note
11	Minor Alarm COM NO
10	Door NO
9	Door COM
8	LPG Monitor PWR (-12V)
7	LPG Monitor PWR (+12V)
6	AC Line Fail NC
5	AC Line Fail NO
4	AC Line Fail COM
3	AC Input Ground
2	AC Input Neutral
1	AC Input Line

Table 3-2, Terminal Block 2 (TB2) Connections, PN-6x-T 7.5kW

NOTE:

For customers requiring a Normally Closed (NC) logic minor alarm, make connections to TB2 positions 12 and 20.

3.16 Final Inspection Checklist

CAUTION!

Set the ECM Run/Auto/Stop (RAS) switch to the STOP position before initially powering up the ECM. This allows the operator to manually control the START and STOP functions of the APU until the system is set up. This also prevents the APU from starting unexpectedly.

Once the installation is complete, verify the following:

1. Engine oil at proper level
2. All electrical connections securely made
3. Engine Control Module (ECM) set to STOP
4. Battery connections made
5. Battery voltage normal.
6. Gas connections checked for leak integrity
7. Gas pressure normal

When the above checks are complete, the unit is ready for initial turn-up.

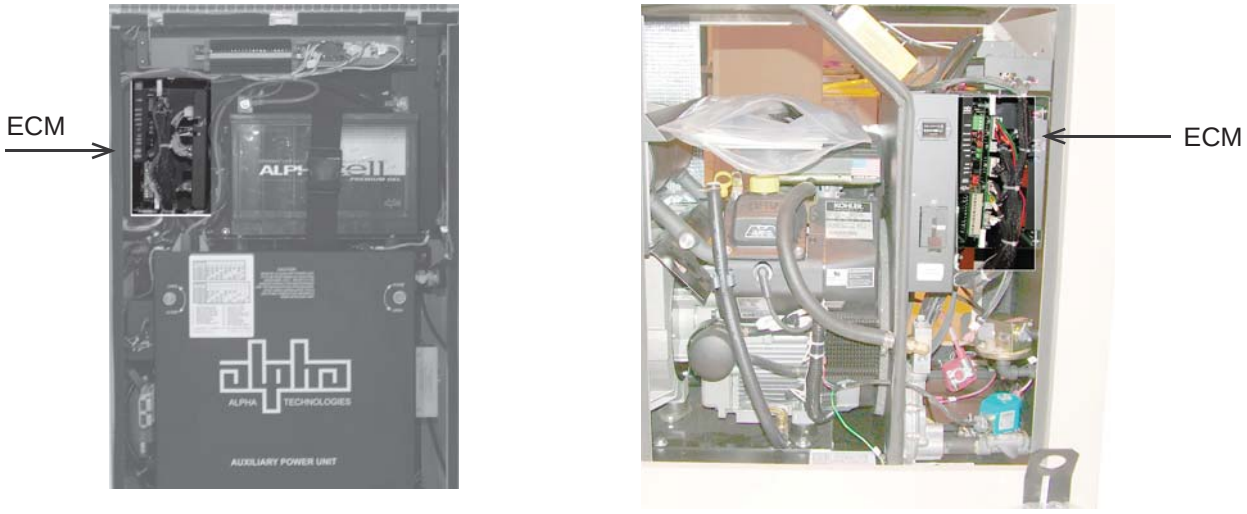
4.0 The Engine Control Module

The Engine Control Module (ECM) controls and monitors the generator's Auxiliary Power Unit (APU). The ECM is a two part assembly made up of the ECM Printed Circuit Board (ECM PCB) and the Generator Remote Interface (GRI) board. The GRI is attached to the ECM PCB with three ribbon cables.

The ECM provides interface connectors for the enclosure sensors, engine controller, battery sense, line sense, and other equipment. The ECM monitors AC line and DC bus status to determine when to start and stop the APU. In the event of an extended power outage or low DC bus voltage, the ECM starts the APU to prevent the backup batteries from discharging to a level that could compromise the ability of the system to provide a continuous, reliable source of power.

The ECM monitors the entire system for abnormal operating conditions such as low engine oil pressure, engine over-temperature, gas leaks, enclosure pad shear, etc. If certain abnormal conditions or alarms are present, the ECM prevents the generator from starting or shuts it down immediately. This provides public safety, and prevents damage to the APU.

The ECM provides an interface between the APU and Alpha communication devices. The ECM controls and monitors the APU. Status information and alarms can be read from the front panel LEDs, or by four "Form C" relay contacts. The ECM is capable of reporting 9 major alarms, 8 minor alarms, and 2 notifications.



CE-3x2 5K-T PN-6x-T 7.5kW

Fig. 4-1, Location of Engine Control Module (ECM)

4.0 The Engine Control Module, continued

ECM PCB LED Indicators and Switches	
1	Communications Input (J4) **(Pin #1 at bottom of connector)**
2	Major Alarm Indicator (Red LED)
3	Minor Alarm Indicator (Red LED)
4	Notify Indicator (Orange LED)
5	Comm Indicator (Green LED)
6	System Indicator (Green LED)
7	Run-Auto-Stop (RAS) Switch
8	Service/Reset Push Button Switch (SW3)
9	Transponder Interface (J6) **(Pin #1 at top of connector)**
10	Enclosure Alarm Input Connector (J10)
11	Fuel Enclosure Alarm Connector (J5)
12	Interface Input Connector from APU (J4)
13	Inverter Battery String Connector (J8)
14	Battery Charger Control Interface
15	AC Generator Voltage, Current Connector (J7)
16	AC Line Input Connector (J6) (Connected at all times)

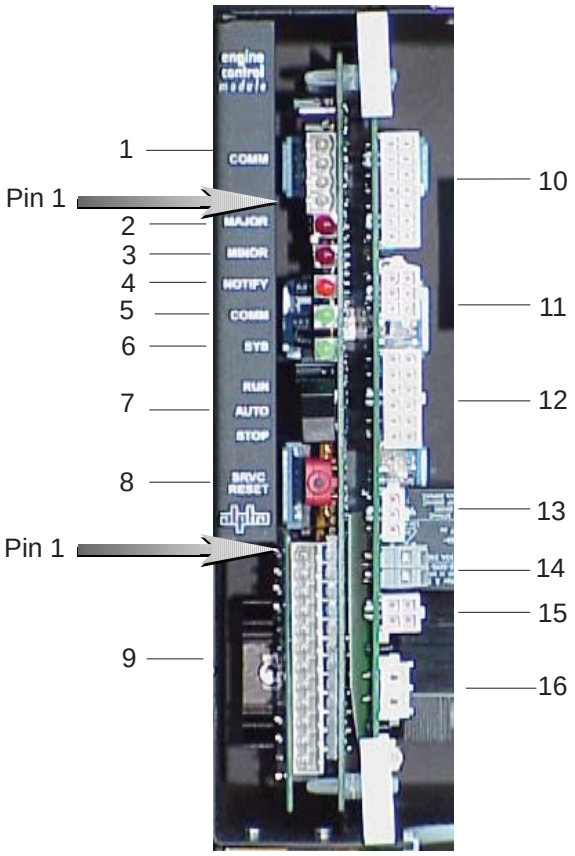


Fig. 4-2 (a), ECM LED Indicators, Switches, and Interface Connections

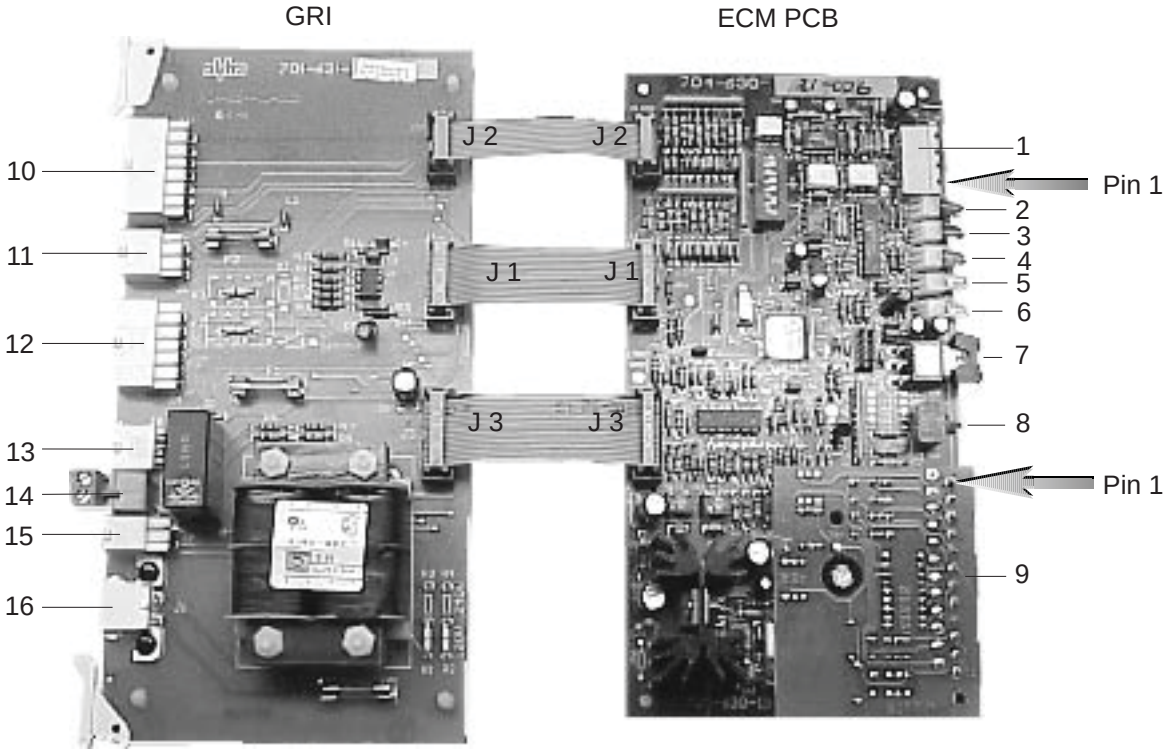


Fig. 4-2 (b), ECM Printed Circuit Boards

4.1 Theory of Operation

Under normal operating conditions (no alarms) the ECM Run-Auto-Stop (RAS) switch is in the AUTO (center) position. The ECM has control of the APU while in the Auto mode. When the RAS switch is switched from the STOP position to the AUTO position the ECM will run the APU for a one minute self-test after a short delay. This indicates the ECM is in the Auto mode and is capable of starting and stopping the APU automatically.

The APU can be controlled manually by placing the RAS switch in the RUN (up) position or the STOP (down) position. In Auto mode, the ECM continuously monitors the AC line voltage, DC bus voltage, enclosure sensors, and APU status. If a fault occurs, the ECM determines whether to start or inhibit the APU based on the type of failure.

4.1.1 Standby Operating Condition Less Than Three Minutes

If an AC line disturbance or outage lasts less than three minutes, the ECM will not start the APU, unless the battery bus voltage drops below the default threshold (Low DC Bus Level) of 49V. The ECM indicates line failure locally using the front panel LEDs (see Fig. 4-2a), and remotely by the appropriate Terminal block 2 terminal positions (see Fig. 3-21 and 3-22.

4.1.2 Standby Operating Condition More Than Three Minutes

If an AC line disturbance or outage lasts more than three minutes, the ECM start delay timer expires, and the ECM attempts to start the APU. The ECM will attempt to start the engine 9 times with either a 30 second or a 60 second pause between attempts (See Table 4-1). If the engine fails to start, the ECM reports an Engine Over-crank alarm. Otherwise, the ECM starts and runs the APU until either a normal shutdown, or major alarm, occurs.

Crank Cycle									
Crank Attempt	1	2	3	4	5	6	7	8	9
Crank Duration	15 Sec	15 Sec	15 Sec	15 Sec	15 Sec	15 Sec	15 Sec	15 Sec	15 Sec
Pause (no crank)	30 Sec	30 Sec	60 Sec	30 Sec	30 Sec	60 Sec	30 Sec	30 Sec	Engine Over-crank Alarm

Table 4-1, Engine Crank Cycle

4.1.3 Normal APU Shutdown

The ECM initiates a normal APU shutdown when the AC line is within normal limits, the DC bus alarm is not active, the 12 minute cool-down period has elapsed, and the Engine Run command is not active. If started due to low DC Bus voltage, the ECM continues to run the APU until specific conditions are met (see below) or a major alarm occurs. The APU will run until the DC voltage of approximately 53V is obtained and then the 12 minute cool-down period has elapsed.

4.1.4 Abnormal APU Shutdown

The ECM immediately shuts down the APU under the following conditions:

- Major alarm
- Activation of manual engine stop switch
- Receipt of software engine stop command
- General generator failure

4.2 ECM Operating Mode Summary

The ECM monitors the status of the AC line and DC bus to make a determination when to start and stop the generator. The ECM also monitors APU status while the engine is running and immediately shuts down the unit if certain alarm conditions are detected. The ECM reports status information via a parallel data interface and/or an Alphabus serial data (RS-485) interface.

The following conditions can cause the ECM to start the generator:

1. Loss of AC line for a period of time in excess of Start Delay (programmable).
2. DC bus voltage drops below Low DC bus voltage (default, 49V).
3. Manual run switch is activated.
4. Software run command is received.
5. A self-test is initiated manually.
6. An automatic self-test is initiated.

The following conditions are required for normal engine shutdown:

1. AC line is qualified.
2. DC bus voltage is greater than 49Vdc (if the unit is started due to low DC bus voltage, DC bus voltage must reach >53V).
3. Cool-down period has expired.
4. Engine Run command is not active.

4.2 ECM Operating Mode Summary, continued

The following conditions cause immediate engine shutdown:

1. Manual engine stop switch is activated.
2. Software engine stop switch is received.
3. Any of the following engine alarms become active:
   - Low oil
   - Engine over-temperature
   - Low fuel
   - Over-speed
   - Over-crank
   - Over-voltage
4. Any of the following system alarms become active:
   - Gas hazard
   - Pad shear
   - Water intrusion
   - General APU failure

4.3 LED Indicators

The ECM uses five LEDs to display alarms and system status.

The red **Major** alarm LED indicates failure of a critical component, or some other situation (i.e. pad shear) where the system has gone off-line or system failure/shutdown is imminent. The engine is shuts down immediately during major alarms. Most major alarms are latched (will not self-clear) by the ECM. A site check by service personnel is required to repair the fault and clear the system.

The red **Minor** alarm LED indicates a system fault which, although not indicative of imminent system failure, requires service attention before the condition worsens. A site check by service personnel is recommended.

The amber **Notify** LED represents status information that is not significant enough to be classified as an alarm. At present, only two items fit into this category: AC Line Status and Engine Service Required.

The green **COMM** (Communications) LED illuminates for two seconds after each communications session on the Alphabus. This is standard with Alphabus communications systems.

The green **SYS** (System) LED indicates that the microprocessor has power and is operating normally. This LED normally flashes once a second. When the ECM is in factory test mode, the LED flashes twice a second.

4.4 Control Functions

The Run-Auto-Stop (RAS) switch controls the Auxiliary Power Unit (APU). Typically the RAS switch is in the AUTO position so the ECM has control of the generator. When the RAS is not in the AUTO position a minor alarm is displayed. The STOP position is used to stop or prevent APU operation during maintenance. **Placing the RAS switch in the STOP position for three (3) seconds, then switching back to AUTO will clear any latched alarms and start the generator (if the cause of the alarm has been corrected).** The RUN position will start and run the engine until the switch is released to AUTO. The engine may not shut down immediately after the switch is returned to the AUTO position because shutdown criteria must first be met. Placing the RAS switch in the AUTO position from the STOP position will start and run the APU for one minute, after a short delay.

The Service Reset switch resets the engine service timer and displays all active alarms. The ECM's programmable service interval defaults to 100 hours. When 100 hours of engine runtime elapses, a Service Required notification is sent and the notification LED illuminates. After the engine has been serviced, pressing and holding the service reset switch for five seconds resets the 100-hour service counter. All of the LEDs flash while the switch is depressed. The LEDs then remain on solid until the switch is released. This provides feedback to the technician, indicating the effective resetting of the engine service counter.

The Service Reset button also displays alarm information. To retrieve details about an active alarm, press and release the Service Reset button. Active alarms (major and minor) are indicated by the LED display (See Fig. 4-3). Press the button again to display the next active alarm. Pressing the button when there are no more active alarms will reset the LEDs to their normal state. Several quick flashes of all five LEDs indicates the end of the alarm list. If the Service Reset button is not depressed again after an alarm is indicated, the LEDs return to their normal display after 30 seconds. Resetting alarms using status monitoring or the manual stop switch also clears the alarm pattern indicated by the LEDs.

NOTE:

Depressing the Service Reset button for five seconds causes the service timer to clear, possibly disrupting the preventive maintenance schedule.

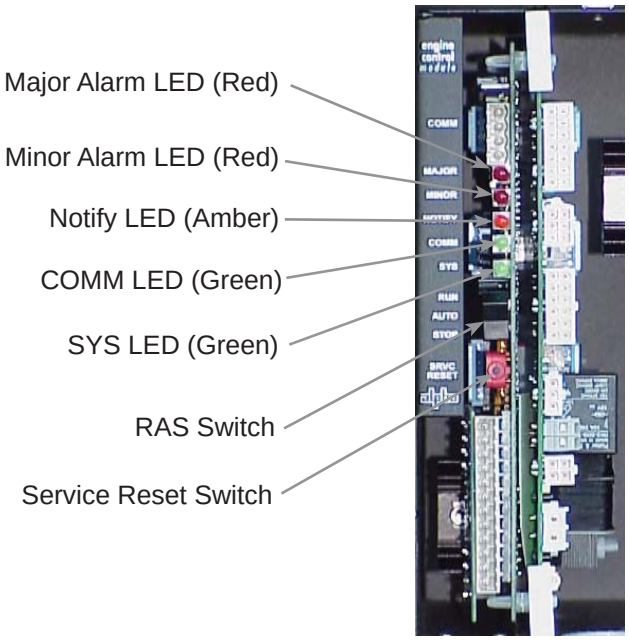


Fig. 4-3, LED Indicators and Control Functions

4.5 Alarm Classifications

Major Alarms:

A major alarm indicates a critical failure or situation that causes the system to go off-line. Major alarms cause the engine to shutdown immediately and generally prevent further operation. Most major alarms are latched by the ECM. Placing the RAS switch to the STOP position for three seconds, then switching back to AUTO clears any latched alarms and starts the generator (if the cause of the alarm has been corrected). A site check by service personnel is required to repair the fault and clear the system.

- **Low Oil Pressure (Latching):** Engine oil pressure is below safe limits. APU operation is suspended. The alarm is cleared when the *Reset* command is issued or when the manual stop switch is activated.
- **Engine Over-temp (Non-latching):** Engine temperature has exceeded safe limits. APU operation is suspended. The alarm is reset when the engine temperature falls within safe limits.
- **Engine Over-speed (Latching):** Engine rpm has exceeded safe limits. APU operation is suspended. The alarm is cleared when the *Reset* command is issued or when the manual stop switch is activated.
- **Engine Over-crank (Latching):** Engine failed to start. The alarm is cleared when the *Reset* command is issued or when the manual stop switch is activated.
- **Alternator Over-voltage (Latching):** The generator set has detected the alternator output voltage is too high. Depending on generator type, this likely means that the voltage regulator or engine speed governor has failed. Operation of the unit has been suspended. The alarm is cleared when the Reset command is issued or when the manual stop switch is activated.

  The alternator over-voltage alarm can be triggered in three ways:

  1.) The generator controller can signal the ECM that an over-voltage condition exists.

  2.) A programmable threshold of 57V (Hi DC Bus Level) is exceeded for five seconds (programmable for a range of 5-15 seconds; five seconds is the default value).

  3.) A fixed threshold of 2.5V/cell (60V for a 48V system) is exceeded for five seconds.
- **Gas Hazard (Latching):** The concentration of hydrocarbon fuel in the power system's enclosure air space has exceeded safe limits or 10%-20% of the Lower Explosive Limit (LEL) for more than three (3) seconds. APU operation is suspended. The alarm is cleared when the Reset command is issued or when the manual stop switch is activated.
- **Water Intrusion (Non-latching):** Water level within the main or fuel enclosure has exceeded safe limits. APU operation is suspended while the alarm is active. The alarm is cleared and the engine will re-start when the water level falls below maximum limits.
- **Pad Shear (Latching):** The main or fuel enclosure has shifted from its pad mounting position. APU operation is suspended. The alarm is reset when the unit is returned to its original position and the *Reset* command is issued or the manual stop switch is activated. The APU will not start if the pad shear magnet is not correctly installed below the pad shear sensor.
- **Low Fuel Pressure (Latching – after five activations):** Site fuel supply (propane-fueled APU only) is insufficient for extended engine operation. The alarm is reset five minutes after the fuel supply is replenished.

4.0 The Engine Control Module, continued

4.5 Alarm Classifications, continued

Minor Alarms:

Minor alarms indicate a system fault which, though not indicative of imminent system failure or shutdown, requires service attention before the condition worsens. A site check by service personnel is recommended.

- **Control Fail (Latching – after five activations):** A control failure between the ECM and the generator set. Typically this means the engine did not start or stop when commanded to do so. The alarm is cleared when the *Reset* command is issued or the manual stop switch is activated.
- **Alternator Off (Non-latching):** This alarm is active if the generator controller has disabled the alternator output. A generator controller may disable the alternator output if the output voltage cannot be held above some threshold.
- **Self-test Fail (Latching):** Activates when the most recent generator self-test fails. The alarm is cleared when the *Reset* command is issued, the manual stop switch is activated or another *Self-Test* command is issued.
- **Low Ignition Battery:** The generator's ignition battery voltage has fallen below 11.5Vdc. Alarm is cleared when battery voltage rises above 12Vdc indicating battery recovery has begun. The low ignition battery voltage does not trigger an alarm during engine cranking.
- **Auto Mode Disabled:** The position of the ECM control select switch. When the Run-Auto-Stop (RAS) switch is in a manual (STOP or RUN) position, the ECM has no control over engine operation and therefore raises an alarm. This is a hardware 'lockout' input and cannot be changed via status monitoring.
- **Tamper:** One of the enclosure doors is open. The alarm clears when the door is closed (disabled).
- **DC Bus Fault:** The power system DC bus voltage, as measured at the ECM, is less than the DC bus voltage (programmable - default = 49V). This alarm clears automatically when the bus voltage exceeds 2V above nominal (i.e., 50Vdc in a 48V system). Note the *alarm* clears, but the generator starts when DC bus level drops to 49Vdc or lower.
- **Engine Disabled:** Command to disable normal operation of the generator set. When set to DISABLE the engine is shutdown under all conditions. A *Minor Alarm* indicator is active if this switch is set to DISABLE. The engine is disabled by software after five consecutive Low Fuel alarms, or five consecutive Control Fail alarms. This alarm is cleared by issuing a "Reset" command or when the "Manual Stop" switch is activated.
- **Output Circuit Breaker OFF or Disabled (PN-6x-T Only):** No ECM indication. Verify circuit breaker position visually.

Notifications:

Notifications represent important information not urgent enough to be considered an alarm. There are currently two notifications.

- **Line Failure:** The ECM's determination of the state of AC line voltage. Loss of AC utility input is one of the criteria for starting the generator.
- **Service Required:** Routine maintenance of the engine/generator is due. This alarm activates when the *Service Countdown* reaches 0. It is cleared by depressing the service timer reset button for five seconds (Refer to Section 7.0, System Maintenance, for further information).

4.6 ECM Alarm Overview

Alarms are indicated in three ways: ECM LEDs, RS-485 communications, and alarm contact closures on the ECM transponder interface. Alarm indications on the ECM LEDs are displayed by pressing the service reset button momentarily. Pressing the service reset switch again will reveal the next alarm in the list. When the alarm list has been exhausted, all LEDs will flash several times and then return to their normal functions. **Placing the RAS switch to the STOP position for three (3) seconds, then switching back to AUTO will clear any latched alarms and start the generator if the cause of the alarm has been corrected.** The following table shows the LED patterns and the alarms they represent.

Major Alarms	1	2	3	4	5	6	7	8	9
Abbreviation	LO	OT	OS	OC	OV	GH	WI	PS	LP
Major	●	●	●	●	●	●	●	●	●
Minor	●	●	●		●	●		●	
Notify	○	○		○	○				○
Comm	◐		◐	◐			◐	◐	
System		◐	◐	◐		◐	◐		◐

Major Alarms	10	11	12	13	14	15	16	17	18	19
Abbreviation	CF	AO	TF	IB	AD	TP	DC	ED	LF	SR
Major										
Minor	●	●	●		●	●	●			
Notify	○	○		○	○			○		
Comm	◐		◐	◐			◐			◐
System		◐	◐	◐		◐		◐	◐	

● Red
○ Amber
◐ Green

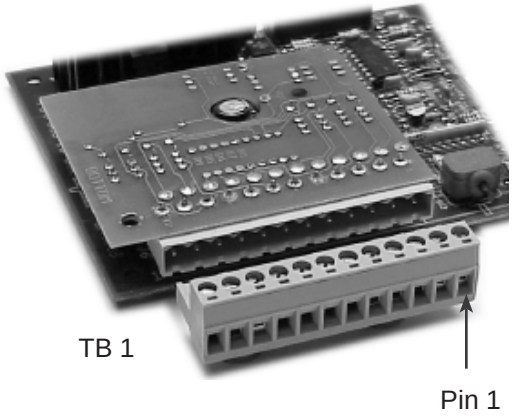
1. (LO)***** Low Oil Pressure
2. (OT) Engine Over-temp
3. (OS)***** Engine Over-speed
4. (OC)***** Engine Over-crank
5. (OV)***** Alternator Over-voltage
6. (GH)***** Gas Hazard
7. (WI) Water Intrusion
8. (PS)***** Pad Shear
9. (LP)*** Low Fuel Pressure
10. (CF)******* Control Fail
11. (AO) Alternator OFF
12. (TF)***** Self-Test Fail
13. (IB) Low Ignition Battery
14. (AD) Auto-mode Disabled
15. (TP) Tamper (Default, Disabled)
16. (DC) DC Bus fault
17. (ED) Engine Disable
18. (LF)** Line Failure
19. (SR)** Service Required

Legend: * = Latching Alarm
** =Notifications
*** =Alarm “latches” after 5 activations

Table 4-2, Major/Minor Alarm Indications and Notifications
(LEDs displayed on the ECM)

4.7 Connecting the Alarm and Control Connections

Alarm output and communication connections are located on Terminal Block 1.



Terminal Block 1		
Pin	Alarm Signal Description	Alarm Active State
1	Engine Run Common	Common
2	Engine Run	Closed with respect to Pin 1
3	Engine Run	Open with respect to Pin 1
4	Major Alarm Common	Common
5	Major Alarm	Closed with respect to Pin 4
6	Major Alarm	Open with respect to Pin 4
7	Minor Alarm Common	Common
8	Minor Alarm	Closed with respect to Pin 7
9	Minor Alarm	Open with respect to Pin 7
10	Not used	Not used
11	Not used	Not used
12	Not used	Not used

Fig. 4-4, Terminal Block 1

4.8 ECM DIP Switch and Fuse Configuration

The ECM PCB has an eight-position DIP switch (SW5) used to configure the generator interface, APU output voltage (AC or DC), and utility voltage.

The GRI board has three fuses, F1, F2, and F3.

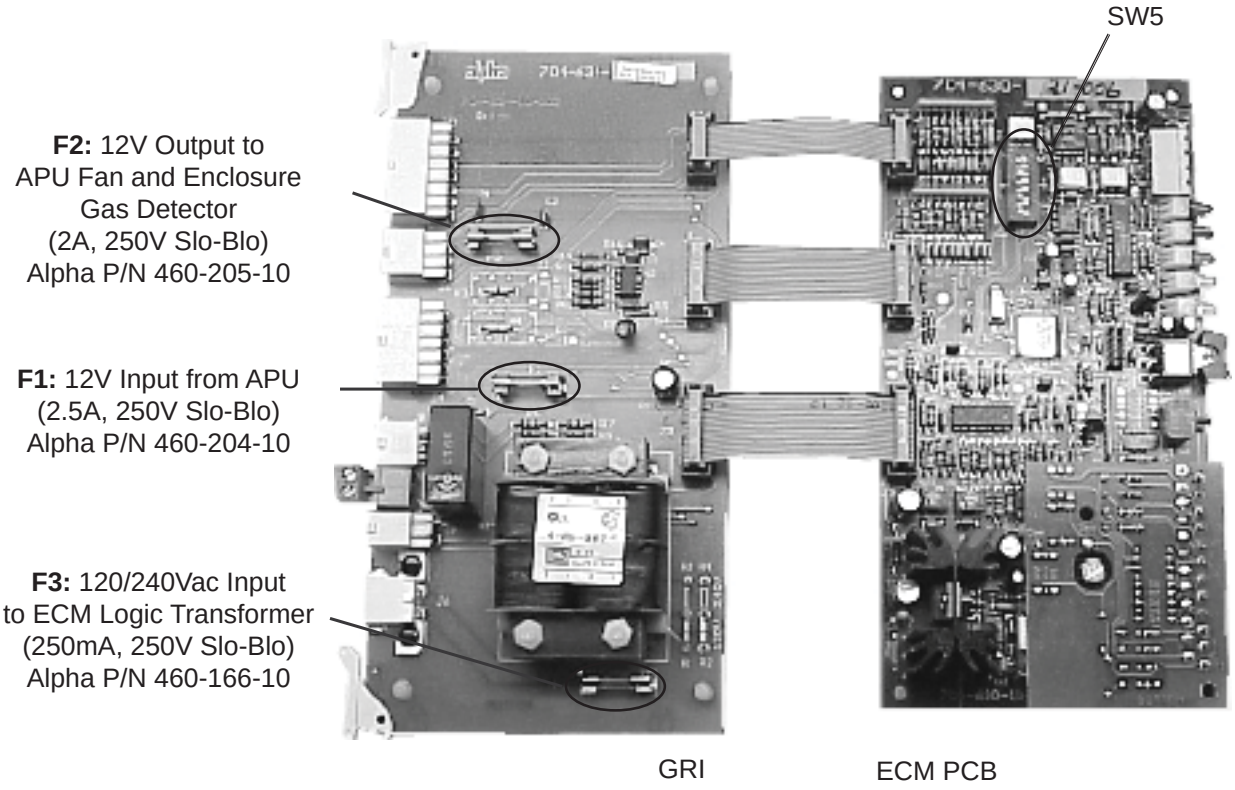


Fig. 4-5, SW5 and Fuse Locations

Telecom Defaults	
Low DC Bus Level	Default 49V (2V/cell)
High DC Bus Level	Default to 57V (2.38V/cell)
Service Interval	Default 100 hours
Autotest Interval	Will auto set to 14 days when SW5-8 is set ON
Autotest Duration	Default 10 minutes
Start Delay	Default 180 seconds (3 minutes)
Shutdown Delay	Default 720 seconds (12 minutes)
Over-voltage Duration	Default 5 seconds

Table 4-3, Telecom Defaults

ECM SW5 Settings								Meaning
1	2	3	4	5	6	7	8	1 = ON, 0 = OFF
1								Standard Configuration
	0	0	0					Invalid output voltage configuration
	0	0	1					24Vdc Output
	0	1	0					36Vdc Output
	0	1	1					48Vdc Output
				0	0			N/A
				0	1			120Vac Input
				1	1			240Vac Input
1						0		ECM drives starter with the "Engine Start" signal
1						1		"Engine Start" signal becomes "Engine Run" signal
							0	Autotest OFF
							1	Autotest sequence enabled with 14-day test interval

Table 4-4, DIP Switch Settings

NOTE:

Programming parameters that affect the Autotest feature via status monitoring will override this switch setting. To reset factory defaults, turn all DIP switches off, power up the ECM (plug in AC line sense) for 10 seconds, remove power, then reset DIP switches.

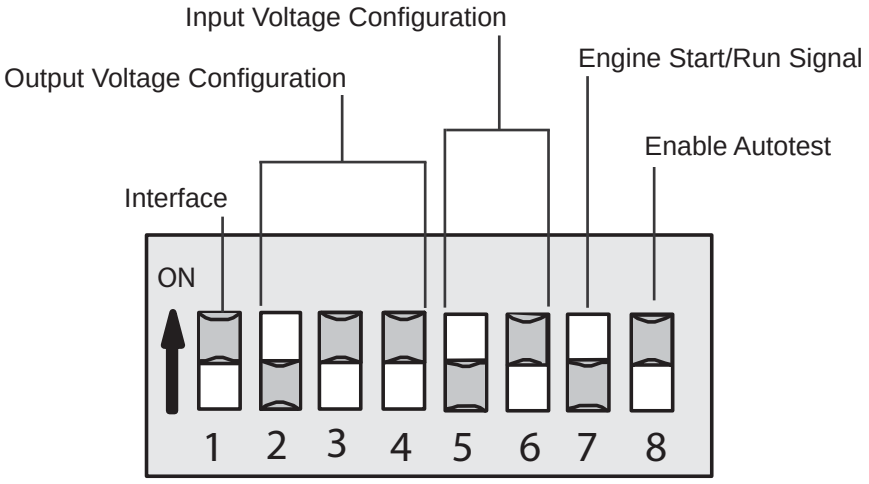


Fig. 4-6, SW5 Settings

4.9 ECM Interface Block Diagram and Connectors

The Generator Remote Interface provides power conditioning to the ECM PCB, and connection between cabinet sensors and the APU control. The interface supplies all necessary signals, alarms, logic power, and analog voltages required for telemetry at the central office or relevant monitoring station, and allows the ECM to start and stop the engine alternator as part of the network controlled periodic test sequence.

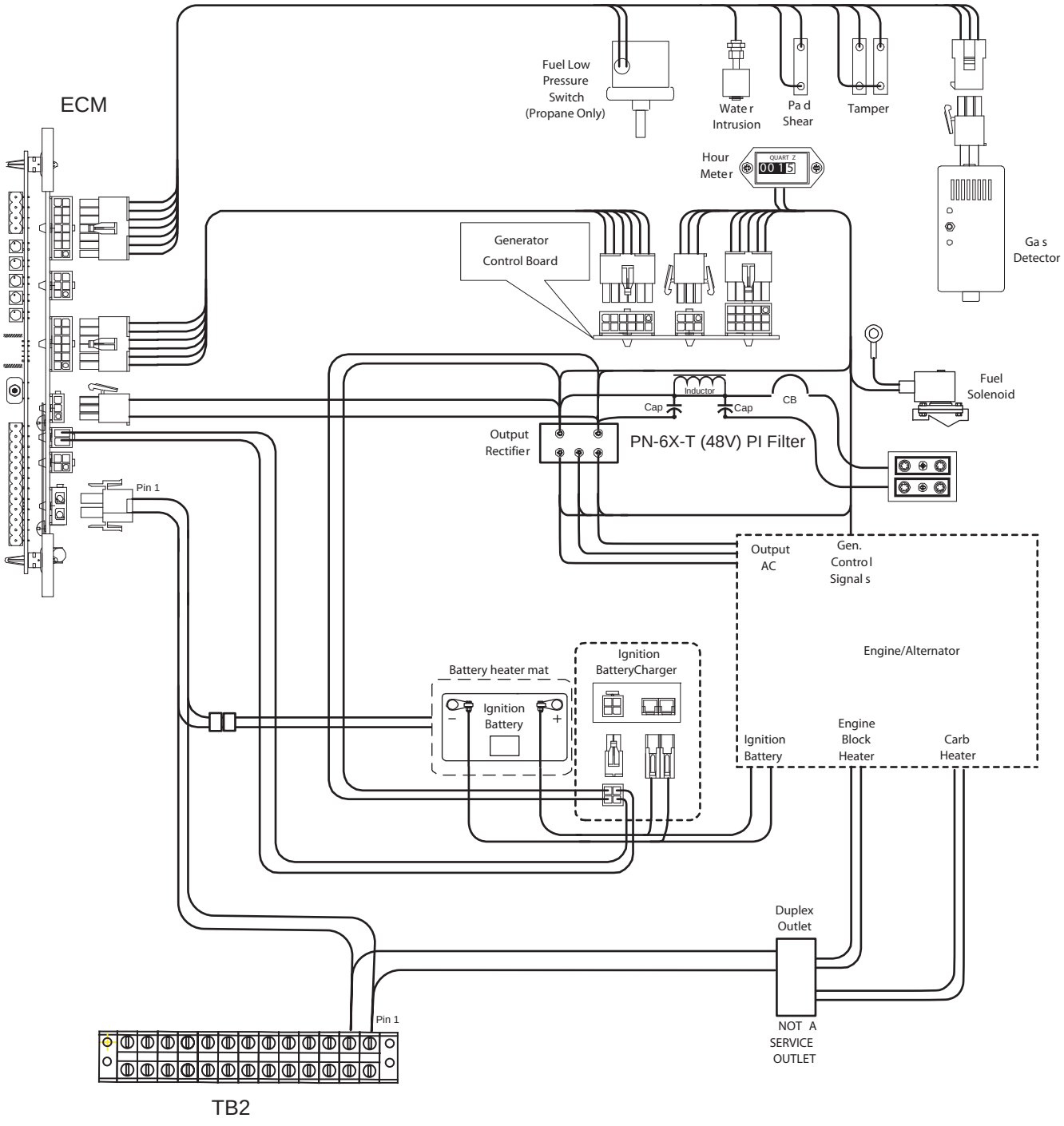


Fig. 4-7, ECM/APU Interconnection

4.10 ECM Self-test

Generator testing consists of starting and running the generator for a duration of 10 minutes. Generator testing can be initiated two ways:

1. The ECM is configured to periodically run an automatic test.
2. A one-minute automatic test is performed when the manual control switch is returned to Auto from Stop.

The ECM monitors all engine-related signals and will declare a self-test as failed if any of the following alarms activate during the test:

- Low Oil Pressure
- Engine Over-temperature
- Engine Over-speed
- Engine Over-crank
- Low Fuel
- Alternator Over-voltage
- ECM Control Failure
- Alternator Not On
- Low Ignition Battery
- Low DC Bus Voltage

The ECM will not start a self-test if the engine is disabled, the stop switch is engaged, or the engine is already running.

If the AC line fails during a test, the test will terminate normally, but the engine will continue to run until line voltage returns. If the test fails because the DC Bus alarm activates, the test will terminate. The Self-test Fail alarm becomes active and the generator runs until the DC Bus alarm clears.

The Self-test Fail alarm may be cleared using a reset command, or by successfully running a subsequent test.

4.10 ECM Self-test, continued

The following programmable, internal ECM variables control automatic self-tests.

- **Autotest Interval:** The number of days between automatic tests.
- **Autotest Countdown:**
- **Autotest Duration:** Each Autotest is measured in minutes. The test duration is 10 minutes.

Manually Enabling the Autotest Feature:

Use SW5-8 to enable the Autotest feature with a 14-day test interval. The first autotest begins 14 days from the time the ECM is powered up with the configuration switch changed from 0 to 1 (OFF to ON). To disable the autotest sequence, put SW5-8 in the OFF position and restart the ECM. On power up, the ECM looks for a *change* in the switch position before it changes the test control parameters.

1. Go to the site on the day of the week and time of day you want the self-test to occur.
2. Disconnect and remove the ECM.
3. Turn OFF SW5-8.
4. Install and re-power the ECM briefly (15 second minimum powerup time). If AC is present, this can be done by connecting J6 (AC line, the 2-position mate-n-lock plug at the bottom of the ECM). Disconnect and remove the ECM (again).
5. Turn ON SW5-8.
6. Reinstall the ECM with all connectors.

The self-test will occur 14 days from the time the ECM is powered.

4.11 Maintenance Functions

The ECM monitors time between periodic maintenance of the engine-generator. The service interval is the number of hours of engine runtime between servicing. When the engine runtime is equal to service interval, the ECM activates the Service Required notification and turns on the amber notification LED. The default value of Service Interval is 100 hours, and can be programmed from 0 to 250.

Service Due is the number of engine runtime hours before the next periodic maintenance is required. Pressing and holding the Service Reset switch for five seconds resets the service counter and it is updated with the current value of the service interval.

5.0 Turn-up and Test

5.1 Appearance and Condition of Components

Prior to applying power, open each door of the enclosure. Observe and note the condition of the following:

- Doors and locking mechanisms
- Seals
- Door intrusion switches

5.2 System Preparation

The following procedure involves starting and stopping the engine using the Engine Control Module (ECM). It assumes the engine is properly connected to the 12V ignition battery, and the natural gas (or propane) fuel has been installed, pressurized, and tested for leaks. Before beginning, verify the circuit breaker (located near the ECM) is in the ON position.

1. Ignition Battery Test Procedure:

    A. Connect a digital voltmeter (DVM) set for DC Volts to the ignition battery terminals. Connect the Red (+) lead to the positive terminal and the Black (-) lead to the negative terminal.

    B. The DVM should read at least 12Vdc (+ 2V). If this reading is lower than specified, recharge the batteries to 13.8Vdc before proceeding.

2. Check Engine Lubrication. Check the engine crankcase oil level. If necessary, add oil to the FULL mark. DO NOT OVERFILL. Refer to the engine manufacturers' operation manual for proper fill capacities and oil types. Ensure that the same brand of oil is used for topping the oil level (some oil manufacturer's additives are not compatible with each other). Never attempt to measure the oil level, or add oil, when the engine is in operation. Placing the ECM in the Stop position disables the generator for maintenance.

WARNING!

- To prevent injury, never attempt to start a generator that has an active Leak Detect alarm. Correct the alarm condition before starting the generator.
- Do not use batteries (AGM or Gell Electrolyte) that read below 9V. Batteries discharged below a safe point can cause an explosion hazard by gassing during recharge.
- Do not attempt to crank or start the engine before servicing with the recommended oil, or engine failure will result.

5.3 Performing a Local APU Test

Procedure:

1. Locate the ECM and set the Run/Auto/Stop (RAS) switch to the STOP position.
2. Verify ignition battery and AC line sense connection to ECM.
3. Verify all alarms on ECM are OFF, except Tamper Alarm & Auto Mode Disabled.
4. Remove gas port plug from input side of demand regulator, install brass manometer port connection fitting and connect manometer to fitting (see Section 7-9 for details).
5. Move the RAS switch from Stop to Auto**.**
6. Verify the engine starts within 9 crank cycles. If engine fails to start within 9 crank cycles and Engine Over-crank is activated, the gas line needs to be purged by removing the air filter and placing your hand over the carburetor throat and cranking the engine until it starts.
7. Verify 11" of water column pressure is present at the input of the demand regulator.
8. If necessary, adjust the pre-regulator or dual regulator (located on gas bottle assembly for propane) by removing regulator cap and adjusting for 11" ± 1" of water column pressure. Perform under NO-LOAD condition (see Section 7.9 for details).
9. Set RAS switch to Stop.
10. Remove brass manometer fitting and reinstall plug to demand regulator input monitoring port using approved pipe sealant.
11. Check demand regulator input monitoring port for leaks.
12. Set RAS to Auto.

NOTE:

The Generator Control Board master switch will override the Run/Auto/Stop (RAS) switch on the ECM. This switch defaults to the center (ECM) position.

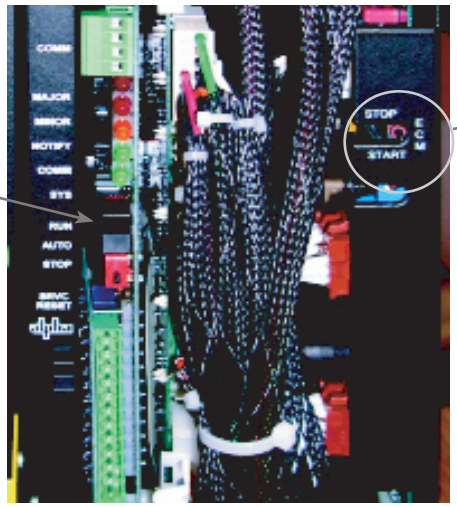


Fig. 5-1, Generator Set Master Switch and Run/Auto/Stop (RAS) Switch

5.4 Generator System Sensor Verification

The ECM has a built-in self-test feature. Each time the ECM's RAS (Run-Auto-Stop) switch is placed in the AUTO position, a one minute self-test is performed and any failures are reported as major or minor alarms. Latched alarms can be reset after the fault has been cleared by placing the RAS switch to the STOP position for three seconds and then back to the AUTO position.

5.4.1 Enclosure Alarm Verification

1. Place the RAS switch in the AUTO position. Verify the generator runs for one minute and the only alarm reported by the ECM is a minor Tamper alarm.

2. Place the RAS switch in the STOP position for three seconds and then back to Auto to start a generator self-test. During the one minute self-test, unscrew the pad shear sensor from the enclosure, and slowly lift sensor away from magnet. Verify the generator stops running and the ECM reports a major Pad Shear alarm. Replace pad shear sensor.

3. Place the RAS switch in the STOP position for three seconds, and then back in the AUTO position to start a generator self-test. During the one minute self-test, trip the gas sensor by placing a cloth moistened with isopropyl alcohol over the gas sensor for at least three seconds. The red LED on the gas sensor must illuminate for three seconds before the ECM will recognize and report the alarm. Verify the generator stops and the ECM reports a major Gas Hazard alarm.

NOTE:

Gas from an unlit butane lighter can also be used to trip the gas sensor.

4. Place the RAS switch in the STOP position for three seconds and then back to the AUTO position to start a generator self-test. During the one minute self-test, trip the Water Intrusion sensor by lifting the small plastic float located behind the Ignition Battery. Verify the generator stops running and the ECM reports a major Water Intrusion alarm.

NOTE:

The Water Intrusion alarm is non-latching (self-clearing), and must be in the active state for the ECM to report an alarm.

5.4.2 AC and DC Line Sense Verification

The ECM monitors the AC line and DC bus status to determine when to start and stop the APU. In the event of an extended power outage or low battery bus voltage the ECM will start the APU. The following test verifies these functions.

1. Verify the ECM RAS switch is in the AUTO position, the APU is not running, and there are no major or minor alarms reported other than the Tamper alarm.
2. Place the Output Circuit Breaker in the OFF position.
3. ECM reports a minor DC Bus Fault alarm.
4. Verify the APU starts and alarm clears. Return the Output Circuit Breaker to the ON position.
5. After the ECM verifies 53Vdc (or greater) the generator will run for a12-minute cooldown period and shut down
6. Remove the AC Utility Line sense cable from the front of the ECM.
7. Verify the ECM reports a Line Failure notification and the APU starts running after a three minute time delay.
8. Replace the AC Utility Line sense cable and verify the notification clears.
9. Verify the APU stops running after the 12-minute cooldown period

6.0 Operation

6.1 Normal Operating Condition

Under normal operating conditions (no alarms) the ECM's RAS switch is in the AUTO position. The ECM has control over the APU while in Auto mode. Each time the RAS switch is moved from the STOP position to the AUTO position, the ECM, after a short delay, runs the APU for one minute. This indicates that the ECM is in the Auto mode, and is capable of starting and stopping the APU automatically. The APU can be controlled manually by placing the RAS switch in the RUN or STOP positions. In Auto mode, the ECM continuously monitors the AC line voltage, DC bus voltage, enclosure sensors, and APU status. If a fault occurs, the ECM determines whether to start or inhibit the APU based on the type of fault.

6.1.1 AC Line Fail

Standby Operating Condition Less Than Three Minutes

If an AC line disturbance or outage is less than three minutes, the ECM will not start the APU unless the battery bus voltage drops below a programmable threshold (Low DC Bus Level). The default is 49V. The ECM will notify the system operator of a line failure via the front panel LEDs, and through the AC Fail Relay located on Terminal Block 2 (see Table 3-1).

Standby Operating Condition More Than Three Minutes

If an AC line disturbance or outage is longer than three minutes, the ECM start delay timer expires and the ECM starts the APU. The ECM starts and runs the APU until either a normal shutdown or major alarm occurs. If the APU fails to start, the ECM attempts to start the engine up to nine times, with either 30 or 60 second intervals between attempts. If the engine will not start, the ECM reports an Engine Over-crank alarm.

6.1.2 Low DC Bus Level

If the DC bus voltage level drops to 49Vdc, or below, the APU will start. The APU continues to run until the ECM DC Sense Voltage increases to 53.5Vdc or higher. Once the ECM DC Sense Voltage level is reached, and the 12-minute cool-down period expires, the APU will stop.

The 53.5Vdc threshold is set to assure rectifiers are supporting the DC bus before the generator goes into cool down and shuts off. The level assumes a rectifier set point of 54.5Vdc at 25°C and a battery temperature compensation of -70mV/c.

** Note: Under very hot battery temperature conditions the voltage threshold may not be eclipsed by rectifier output until temperatures cool.

6.2 Alpha Ignition Battery Charger Overview

The Alpha Ignition Battery Charger (Alpha P/N 744-870-21)) keeps the ignition battery charged to start the Auxiliary Power Unit (APU) in the event of an extended power outage. The charger is active when the yellow LED on the face of the unit is lit. When the generator starts, the Alpha Ignition Battery Charger (IBC) shuts off and internal engine charger takes over ignition battery charging.

48V Systems

The ECM monitors ignition battery voltage via the generator control board. The following conditions must be met for the ECM to turn on the ignition battery charger:

- DC bus greater than 49Vdc
- Ambient temperature less than 35°C and battery voltage less than 13.2Vdc, or battery voltage less than 12.6V at any temperature

The following conditions turn the ignition battery charger off:

- Engine off and DC bus less than 48Vdc
- Ambient temperature greater than 40°C and battery volts greater than 13.2
- Battery volts greater than 14.5

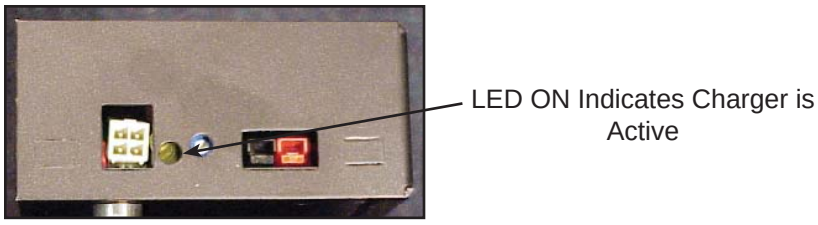


Fig. 6-1, Ignition Battery Charger LED

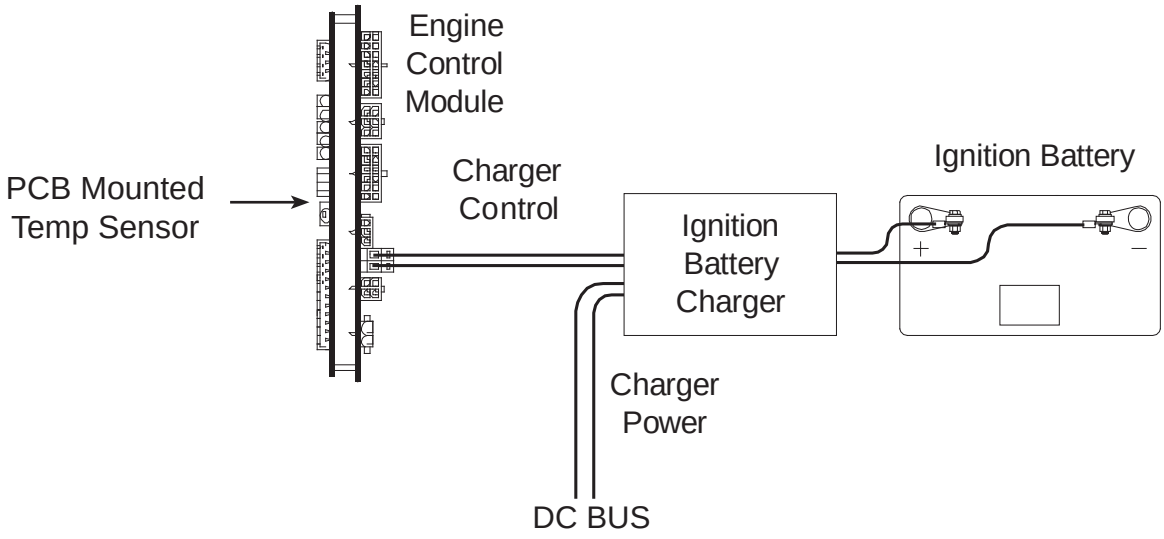


Fig. 6-2, Wiring for ECM, Ignition Battery Charger, and Ignition Battery

7.0 Maintenance

The engine/alternator requires maintenance at regular intervals to remain reliable and ready to provide backup power when needed. Please refer to the following table for general maintenance guidelines. For specific recommendations regarding maintenance intervals, please refer to the supplied engine manufacturer's operator's manual.

	Maintenance Procedures					
System Component or Procedure	Visual Inspection	Verify	Change	Clean	Test	Frequency
FUEL						
Inspect flexible lines and connections	X		R			Q
Check fuel supply		X				W or AS
Inspect fuel piping	X					Y
LUBRICATION						
Check oil level	X	X				D, AS
Change oil			R			Y or 100
Replace oil filter			R			Y or 100
COOLING						
Verify air ducts, filters, and louvers are free from debris		X		X		Y or AS
EXHAUST SYSTEM						
Check for leakage. carbon or soot residue indicates leaks. Repair immediately.	X	X	X			Y
Check for fire hazards	X					Y
Check for loose or broken hangers and supports. Clean exhaust outlet	X		R			Y or AS
BATTERY CONNECTIONS						
Check battery charger operation, charge rate	X					M
Clean, re-torque battery terminals	X	X		X		Y or 100
ELECTRICAL SYSTEM						
General inspection	X					Q
Inspect cables for abrasion (Generator compartment)	X	X				S
Reapply corrosion-inhibiting coating on all exposed connector assemblies			X			Y
ENGINE & MOUNTING						
General inspection	X					W
Inspect air cleaner element			R			Y or 100
Inspect spark plugs			R			Y or 500
CONTROL SYSTEM						
Verify remote control operation					X	M
Run generator set					X	W
GENERATOR SET						
Inspect generator set	X					Prestart
Exercise generator set					X	M
GENERAL CONDITION OF EQUIPMENT						
Check for signs of damage due to vibration, leakage, excessive noise, extreme temperature, or deterioration.	X	X		X		W
Inspect and clean cabinet interior	X			X		Q or AS

Maintenance Procedures: X = Action, R = Replace as necessary
Frequency: D = Daily, W = Weekly, M = Monthly, Q = Quarterly, AS = Attended Startup, S = Six Months
Y = Yearly (all numbers in hours)

Table 7-1, Scheduled Maintenance

7.1 Servicing the APU

Required Tools and Equipment:

- Phillips screwdriver
- 10mm socket wrench
- 3/8" open-end wrench
- Digital Voltmeter (DVM) capable of displaying true RMS
- Battery operated frequency counter (or DVM with this function)

Prior to Performing Maintenance Activities:

1. For routine engine maintenance procedures, refer to the Kohler Power Systems COM7.5 Operation Manual included with your generator.
2. Notify contact personnel that the unit will be out of service for maintenance.
3. Disable the generator ECM (RAS switch to Stop) to prevent unexpected engine start.
4. Switch the DC Output circuit breaker to the OFF position.
5. Verify the gas sensor has no alarms.
6. Ensure the engine/generator is cool to the touch. Exhaust pipes can cause serious burns.

The following components on the APU are accessible from the front, and do not require removing the enclosure cover:

Air filter replacement
Oil filter
Dual fuel load block (propane/natural gas)
Demand regulator pressure tap
Rectifier replacement
Oil fill
Electrical interface connections

WARNING!

Avoid exhaust pipes while checking oil. Exhaust pipes can cause serious burns.

CAUTION!

- The duplex outlet is designed for the carburetor and block heaters only. This is NOT a service outlet.
- Failure to perform recommended maintenance will result in equipment damage, and may void the equipment warranty.
- Failure to use recommended replacement parts or procedures may result in equipment damage, and may void the equipment warranty.

Duplex Outlet

NOTE:

A corrosion inhibiting coating (i.e. LPS 3) must be used on all exposed connectors (battery posts, fuse tabs, etc.) and reapplied annually per the manufacturer's instructions.

7.2 Filter Cleaning, CE-3x2 5K-T

The air intake filter (Alpha P/N 561-216-10) is located on the rear door of the enclosure.

CAUTION!

Failure to keep the filter clean, or using improperly installed filters, may cause system failure due to dirt buildup or lack of cooling air. Equipment failures caused by filter blockage, incorrect filter substitution, or dirt ingress due to clogged or improperly installed filters are not covered under warranty.

Filter Removal, Replacement, and Cleaning

1. Unlock and remove the rear door.
2. Pull the four captive fasteners out, Fig. 7-1.
3. Tilt the filter frame away from the door and remove the filter, Fig. 7-2.
4. Clean the filter using a vacuum or compressed air (if available) to remove loose dust and dirt. Then use a soap and water solution to remove any trapped dirt. Use compressed air to dry the filter. After cleaning, re-coat the filters using RP Super Filter Coat Adhesive, available from local suppliers.
5. Replace the filter (Verify the “Air Flow” indicating mark faces into the enclosure) and refasten the filter frame.
6. Replace and lock the rear door.

Fig. 7-1, Captive Fastener Location, CE-3x2 5K-T

Fig. 7-2, Air Filter Removal, CE-3x2 5K-T

7.3 Filter Cleaning, PN-6x-T 7.5kW

The air intake filter (Alpha P/N 561-216-10) is located inside the air intake vent on the side of the enclosure.

CAUTION!

Failure to keep the filter clean, or using improperly installed filters, may cause system failure due to dirt buildup or lack of cooling air. Equipment failures caused by filter blockage, incorrect filter substitution, or dirt ingress due to clogged or improperly installed filters are not covered under warranty.

Filter Removal, Replacement, and Cleaning:

1. Unlock and remove the enclosure rear door.
2. Locate and loosen the filter bracket thumbscrew on the inside wall of the enclosure, opposite the air intake vent.
3. Lower the bracket and remove the filter.
4. Clean the filter using a vacuum or compressed air (if available) to remove loose dust and dirt. Then use a soap and water solution to remove any trapped dirt. Use compressed air to dry the filter. After cleaning, re-coat the filters using RP Super Filter Coat Adhesive, available from local suppliers.
5. Replace the filter.

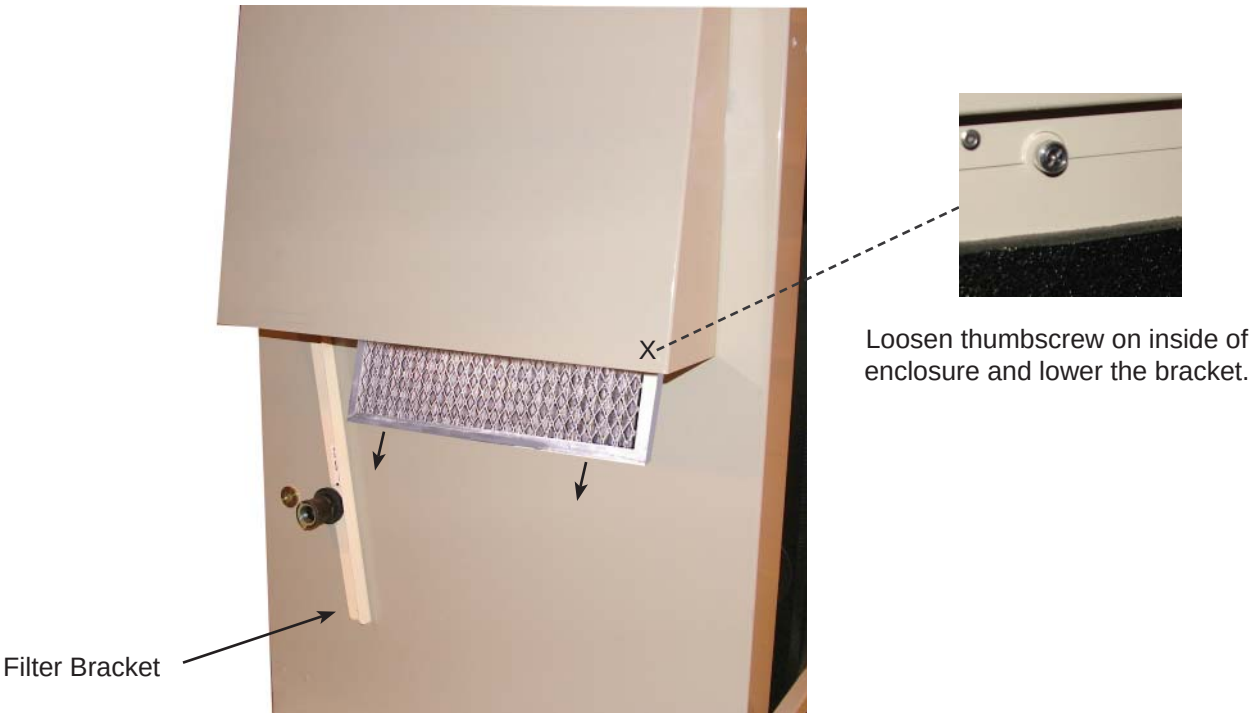


Fig. 7-3, Filter Replacement, PN-6x-T 7.5kW

7.4 Pad Shear Magnetic Switch Replacement

Required Tools:

#2 Phillips screwdriver

1. Unlock and remove rear enclosure door.
2. Locate the pad shear switch on the left side of the enclosure floor.
3. Remove the two screws holding the switch bracket to the floor.
4. Disconnect electrical connections, and remove the switch assembly (inset).
5. Unbolt the switch from the bracket, and replace with a new unit.
6. Reinstall in reverse order.

NOTE:

Electrical connections are NOT polarized. Leads can be connected in any order.

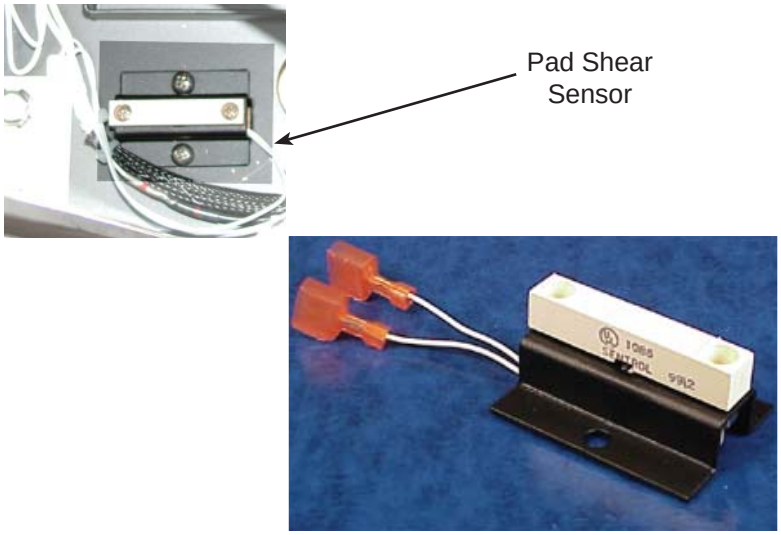


Fig. 7-4, Pad Shear Sensor (Alpha P/N 425-503-10)

7.5 Replacing Gas Hazard Sensor

1. Unlock and remove the front enclosure door.
2. Locate and remove the gas hazard sensor. The gas hazard sensor is located to the left of the ECM cage and above the hour meter. It is attached to the sheet metal with a hook and loop fastener. Disconnect the wire harness.
3. Verify the selector switch of the new sensor is in the proper position for your fuel source.
4. Reconnect wire harness.
5. Place new sensor on the hook and loop pad. There is a 10 minute self-calibration period following power-up (Ready LED is blinking). Following the self-calibration, verify the green Ready LED is lit.

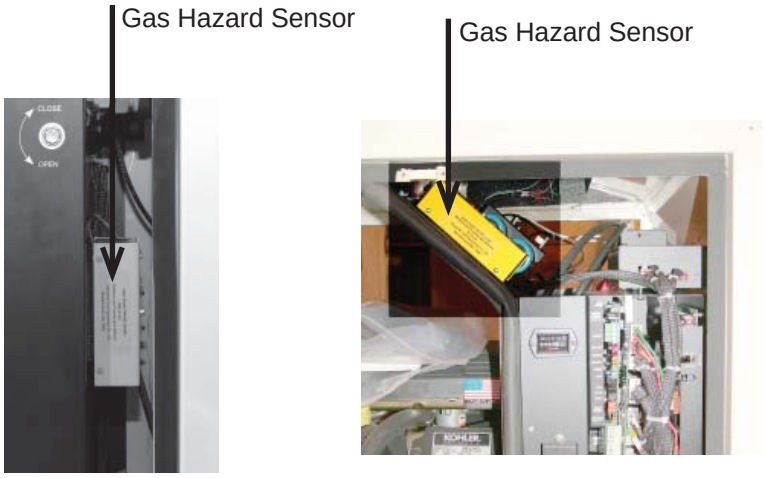


Fig. 7-5, Gas Hazard Sensor Location (Alpha P/N 744-891-20)

7.6 Replacing Ignition Battery Charger Module Assembly

Required Tools:

#2 Phillips screwdriver

The 48Vdc charger module is located above the ECM housing.

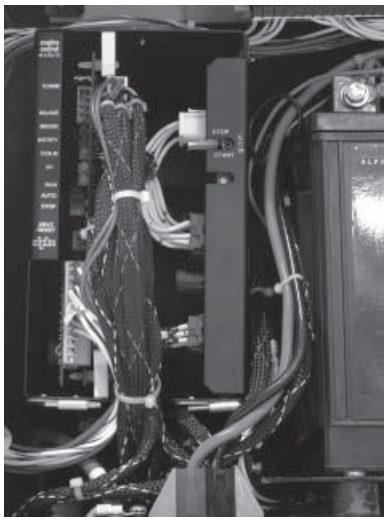
1. Disconnect the connectors from the front of the module.
2. Remove the Phillips screw holding the front of the charger to the ECM housing.
3. The back of the charger is held in place by a tab that fits into a slot on to the ECM housing. Slide the charger free and lift it out of the enclosure.

Fig. 7-6, Ignition Battery Charger (Alpha P/N 744-870-21)

7.7 Replacing Engine Control Module

1. Set RAS to STOP.
2. Turn OFF the 200A DC circuit breaker (PN-6x-T) or disconnect the output connector (CE-3x2).
3. Disconnect wire harnesses on ECM top to bottom.
4. Release the ECM captive latch and slide the ECM out of its housing.
5. Check new ECM DIP switch configuration per Table 4.4 (page 61).
6. Verify 120V/240V jumpers in the 120V position.
7. Install new ECM card. Verify card edges are in rails and latch card in place.
8. Verify RAS is OFF.
9. Reconnect wire harnesses top to bottom.
10. Set RAS to AUTO.
11. Verify APU runs for the one minute self-test.
12. Check and clear any alarms.

CE-3x2 5K-T



PN-6x-T 7.5kW

Release ECM captive latch and slide ECM from its housing. Perform steps in reverse order to replace ECM.

Fig. 7-7, ECM (Alpha P/N 744-726-23)

7.8 Fuel Conversion, Natural Gas to LP

7.8.1 PN-6x-T Pre-regulator Removal with Low Pressure Switch Installation

WARNING!

The following procedure must only be performed by qualified personnel. To prevent injury, disable generator and disconnect gas supply prior to beginning the gas conversion procedure.

Required Tools:

7/8" open-end wrench

In this procedure, the pre-regulator is removed, and a low pressure switch is installed in its place. Reverse this procedure if changing from (LP) liquid propane to (NG) natural gas.

1. Remove the inlet nipple that passes through the enclosure wall.
2. Loosen the quick disconnect fitting just below the pre-regulator, and remove the pre-regulator assembly.
3. Do not apply pipe sealant to the Quick Disconnect fitting. Install the low pressure assembly onto the Quick Disconnect fitting and tighten.
4. Reinstall the inlet nipple through the enclosure wall. Connect alarm plug into the ECM wiring harness.

Fig. 7-8, PN-6x-T Pre-regulator Removal

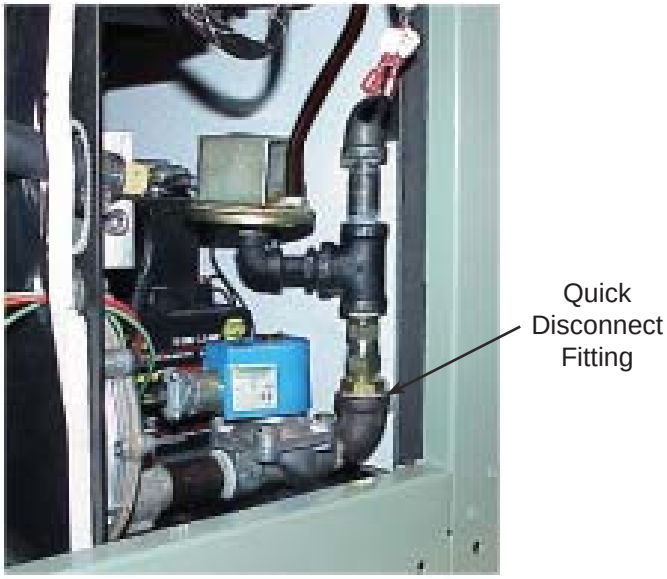


Fig. 7-9, PN-6x-T Switch Assembly Installed

7.8.2 Switching the LP Port to the NG Port, PN-6x-T

WARNING!

The following procedure must only be performed by qualified personnel. To prevent injury, disable generator and disconnect gas supply prior to beginning the gas conversion procedure.

Required Tools:

- 7/8" open-end wrench
- NFPA-approved pipe sealant

In this procedure, the gas inlet hose is switched from the LP port to the NG port. Reverse this process if converting from natural gas to liquid propane.

1. Loosen swivel connector and remove from flare fitting.
2. Turning counterclockwise, remove flare fitting and plug from unused port.
3. Coat all but last two threads of the flare fitting and plug.
4. Reinstall flare fitting and plug into the opposite holes, reconnect hose.
5. Set the selector switch on the Gas Hazard Sensor to the correct setting**.**
6. Apply gas pressure and test all fittings for leaks with test solution or soapy water.

Fig. 7-10, Load Block, PN-6x-T 7.5kW (natural gas configuration)

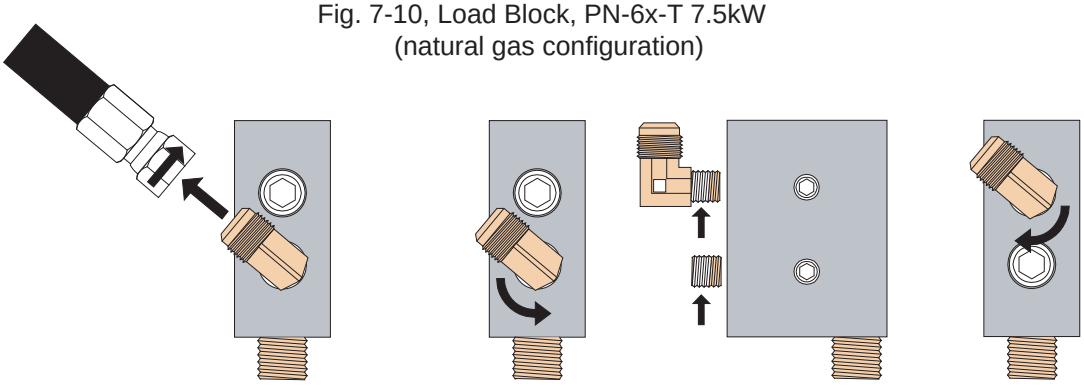
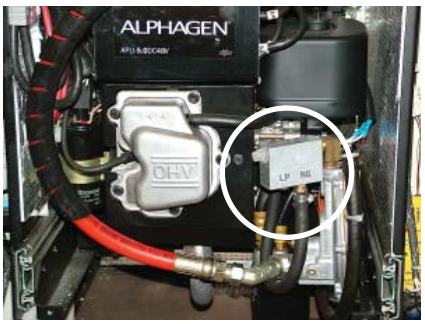


Fig. 7-11, Changing Load Block Configuration, PN-6x-T 7.5kW

7.8.3 Switching the NG Port to the LP Port, CE-3X2

WARNING!

The following procedure must only be performed by qualified personnel. To prevent injury, disable generator and disconnect gas supply prior to beginning the gas conversion procedure.



Required Tools:

- 7/8" open-end wrench
- NFPA-approved pipe sealant
- 1/4" Allen wrench
- Flathead screwdriver

In this procedure, the gas inlet hose is switched from the NG port to the LP port. Reverse this process if converting from liquid propane to natural gas.

1. Locate the Loosen the hose clamp on the gas line (1).
2. Holding the gas hose, loosen the gas fitting from the NG port (2).
3. Using the 1/4" Allen wrench, remove the plug from the LP port. Coat the plug with pipe sealant and reinstall in the NG port (3).
4. Coat all but last two threads of the gas fitting and install in the LP port (4).
5. Set the selector switch on the Gas Hazard Sensor to the correct setting**.**
6. Apply gas pressure, and test all fittings for leaks with test solution or soapy water. Clean and dry fittings after leak testing to avoid rust.

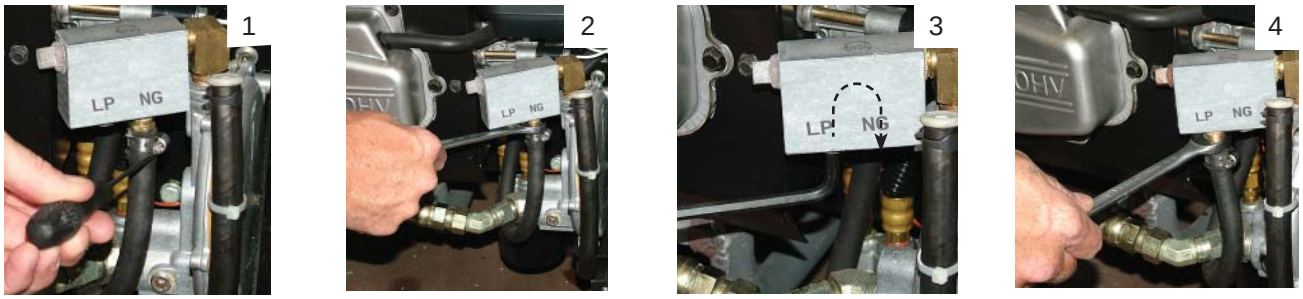


Fig. 7-12, Changing Load Block Configuration, CE-3x2 5K-T

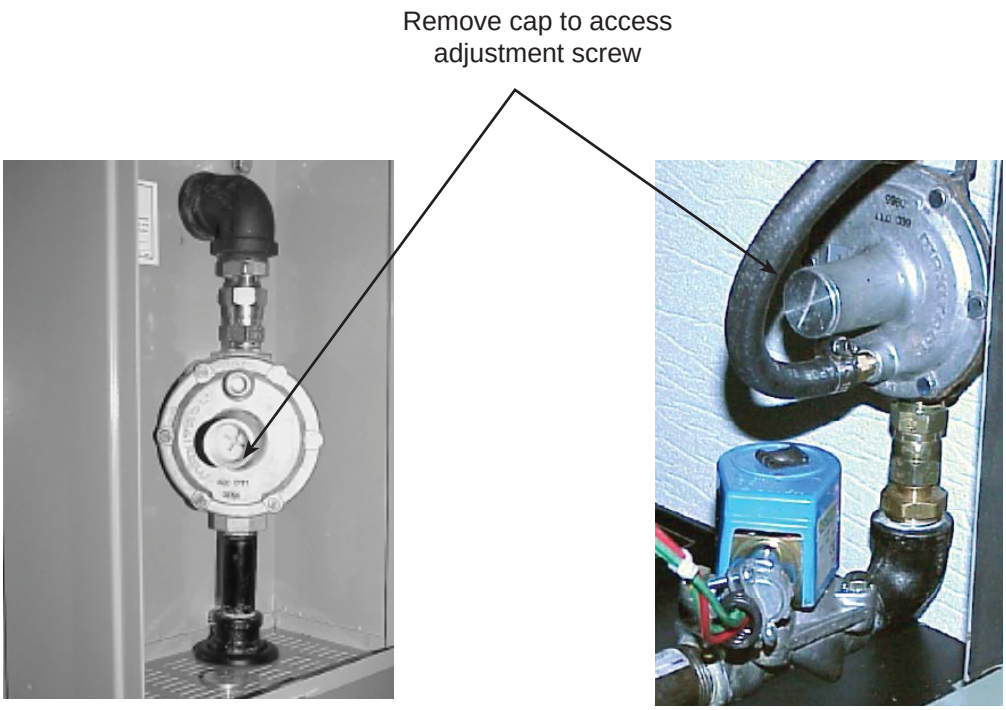
7.9 Maxitrol Pre-regulator Calibration

Required Tools and Materials:

- Flat Tip Screwdriver
- DWYER # 1212 water column (0-16") gas pressure test kit
- Allen head wrench set
- NFPA-approved pipe sealant (i.e. Megaloc Multipurpose Thread Sealant)
- Leak detector compound (soapy water)

The Maxitrol 325-3 regulator has a maximum inlet pressure of 10 PSI. Alpha Technologies recommends all installations range between 1-2 PSI for consistent of gas flow.

An external water trap must be supplied outside the enclosure in accordance with local, state, and National Fire Protection Agency (NFPA) codes. Water sent through the gas lines to the regulator system can damage the secondary demand regulator.



CE-3x2 5K-T PN-6x-T 7.5kW

Fig. 7-13, Primary Fuel Regulator

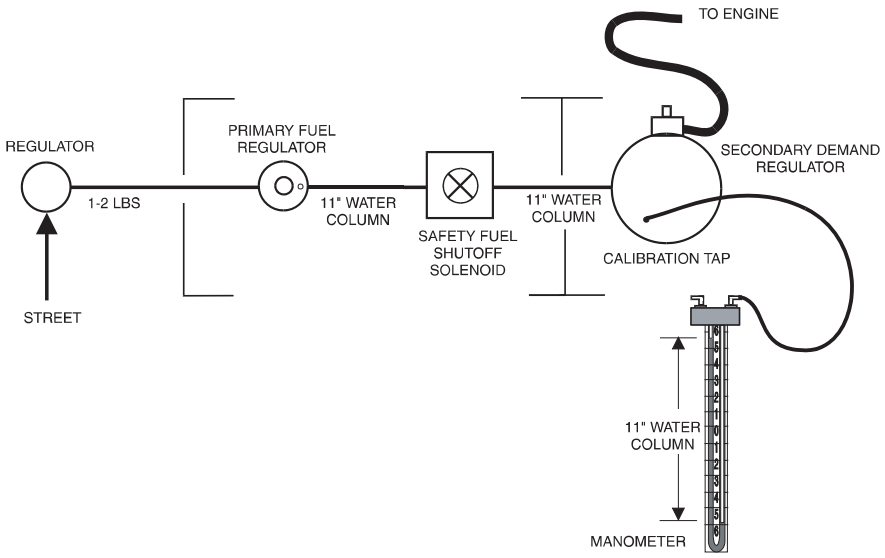


Fig. 7-14, Pre-regulator Calibration

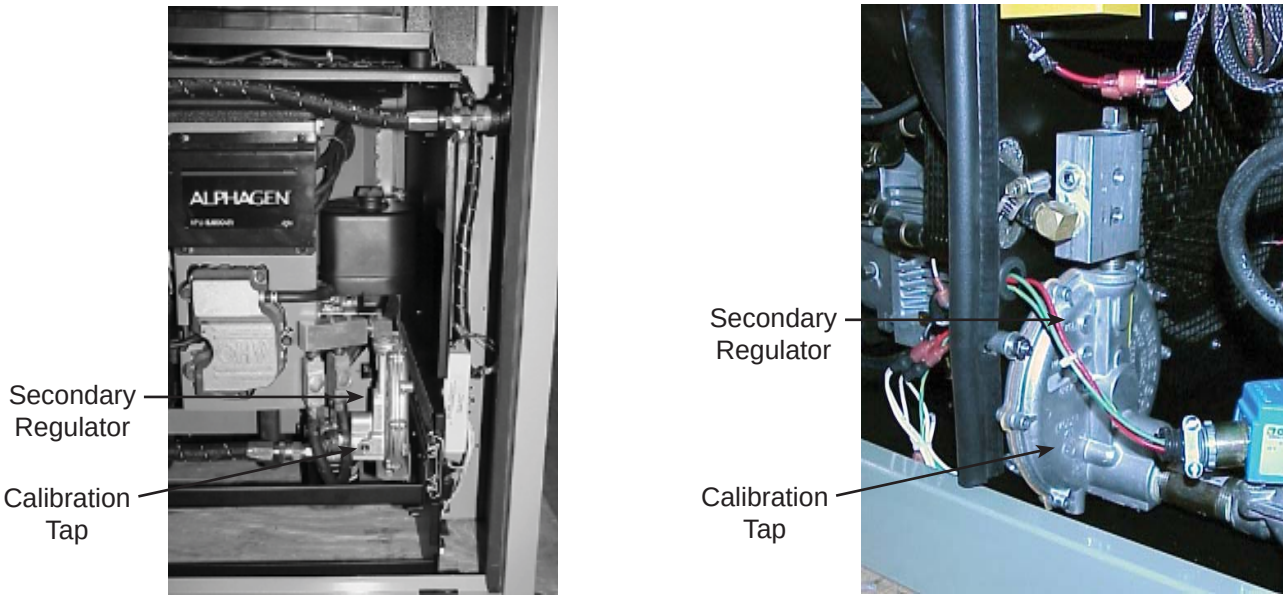


Fig. 7-15, Secondary Demand Regulator

7.9 Maxitrol Pre-regulator Calibration, continued

WARNING!

- No matches or open flame or sparks. Use caution whenever working in the area to prevent possible combustion of fuel vapors.
- Leak Hazard: Use caution whenever working in the area to prevent and correct any leaks detected.

Calibration Procedure:

1. Set the ECM Run/Auto/Stop (RAS) switch to the STOP position.
2. Remove the Allen-head screw located on the secondary or demand regulator.
3. Open both ports on the DWYER #1212 manometer.
4. Set the scale of “0” between the water lines. Connect the pressure test hose.
5. Remove the Maxitrol regulator adjustment cover *(located in the gas service box outside of the enclosure)*.
6. Apply 0.5 psi to 2.0 psi gas pressure to the gas package.
7. Place the ECM’s RAS switch in the RUN position. The starter then cranks the engine until the generator starts (this may take a few seconds to draw excess air from hoses). When the ECM RAS switch is placed in the RUN position, the ECM starts the engine.
8. Verify the DWYER #1212 manometer reads 5-1/2" above the “0” mark, and 5-1/2" below the “0” mark. This equals 11" water column of pressure. Adjust the Maxitrol regulator in a clockwise direction to increase pressure, and in a counterclockwise direction to decrease pressure.

CAUTION!

Do not bottom out the regulator adjust screw. If you cannot get a reading, retest the inlet pressure to the Maxitrol gas package.

9. Press and hold the ECM’s RAS switch in the STOP position until the generator stops.
10. Disconnect the DWYER #1212 manometer gas pressure test kit from the secondary demand regulator.
11. Reapply a small amount of an approved pipe sealant to the Allen-head cap screw, replace and tighten into the demand regulator.
12. Replace the Maxtrol regulator access cap and gasket, and tighten.

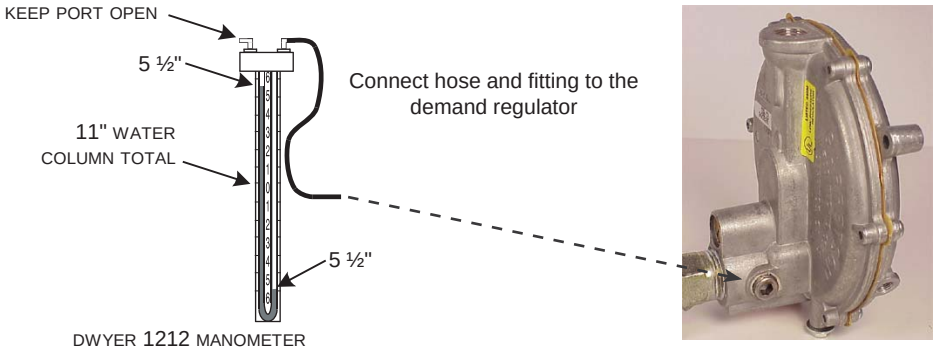


Fig. 7-16, Manometer Connection

Reverse view of demand regulator showing port

8.0 Interconnection

8.1 Gas Hazard Alarm Interface Connector

The Gas Hazard Detector Interface Connector is connected between the wire harness and detector unit as shown. The interface control is a 3-pin (1x3 row) Universal Mini Mate-'N'-Lok style male connector.

Pin	Description	Function
1	Gas Hazard Sensor Switch	Active OPEN signal denotes gas hazard (Logic HIGH)
2	Gas Hazard Power/Alarm Common	Return signal path for sensor
3	Gas Hazard Logic Power +12Vdc Fused	Logic Power for Logic PCB & sensor

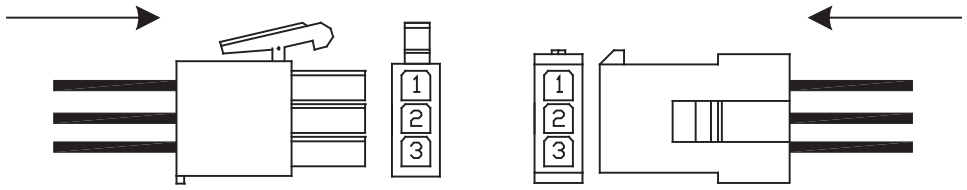


Fig. 8-1, Gas Hazard Detector Interface Connector

8.2 Low Fuel Pressure Interface Connector

The interface control is a 2 pin Mini Mate-'N'-Lok connector (near gas solenoid):

- Pin 1 = +12Vdc activates (opens) solenoid ONLY when APU is running. Controlled by APU engine ON command
- Pin 2 = Low fuel pressure switch (negative)

Pin	Description	Function
1	Low Fuel Pressure Sensor Contact	Closed (LOW signal) denotes Low Fuel Pressure (LP Versions only)
2	Low Fuel Pressure Common	Return signal path for sensor

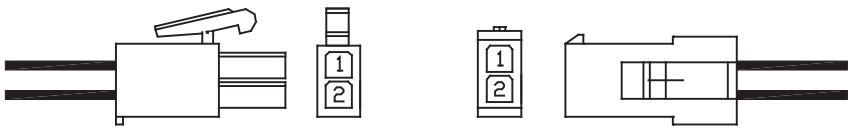


Fig. 8-2, Low Fuel Pressure Interface Connector

8.3 Gas Solenoid Interface Connector

Pin	Description	Function
1	Gas Solenoid +12V	+12Vdc supplied to gas solenoid only when APU is ON (running). APU Shuts OFF gas supply to cabinet during any fail safe or fault condition.
2	Gas Solenoid Common	Return path for gas solenoid.

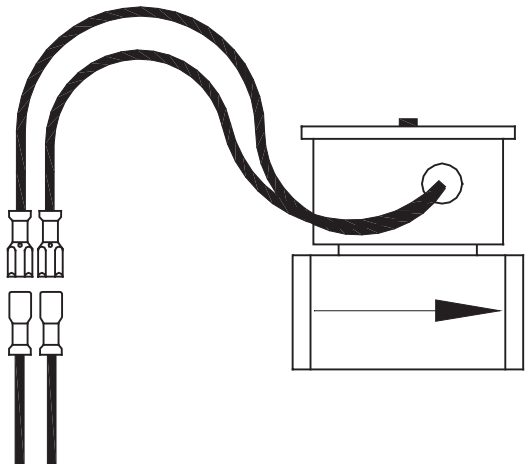


Fig. 8-3, Gas Solenoid Interface Connector

8.4 Charger Module Control Interface Connector

The Charger Module – Control Interface Connector is connected between the charger module and ECM with Sense/Power leads connected to the APU output DC bus. The interface control is a 4-pin (2x2 row) Universal Mini Mate-'N'-Lok style male connector.

Pin	Description	Function
1	ECM Charger Control (+) Yellow Wire	Connects pins 1 and 2 together, turning the charger ON, i.e. Closed (LOW signal).
2	Inverter Battery (+) Red Wire	Input power to charger module, operates on 48Vdc battery pack to charge ignition battery.
3	ECM Charger Control Orange Wire	ECM turns charger ON by applying a LOW signal to this pin (referenced to ignition battery negative).
4	Inverter Battery (-) Black Wire	NEGATIVE input power to charger module, operates on 48Vdc battery pack to charge ignition battery.

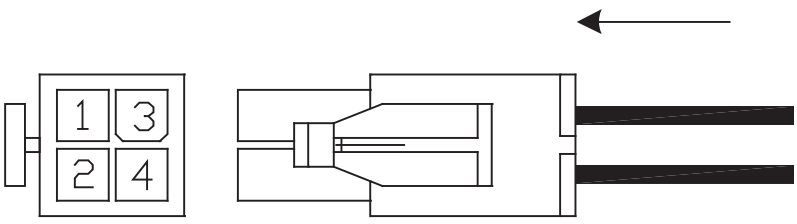


Fig. 8-4, Charger Control Interface Connector

8.5 ECM Enclosure Alarm Interface Connector

The Alarm Interface Connector (J10) is connected to the Power PCBA. The interface control is a 14-pin (2x7 row) Universal Mini Mate-'N'-Lok style male connector.

Pin	Description	Function
1	Water Intrusion Sensor	Contact OPEN (HIGH signal) denotes water
2	Water Intrusion Common	Return signal path for sensor
3	Pad Shear Sensor	Contact CLOSED (LOW signal) denotes pad shear
4	Pad Shear Common	Return signal path for sensor
5	Low Fuel Pressure Sensor	Contact CLOSED (LOW signal) denotes low fuel pressure (LP versions only)
6	Low Fuel Pressure Common	Return signal path for sensor
7	Gas Hazard Sensor Switch	Active OPEN signal denotes gas hazard (Logic HIGH)
8	Gas Hazard Power/Alarm	Return signal path for sensor (Common)
9	Gas Hazard Logic Power	Logic power for Logic PCB & sensor (+12Vdc Fused)
10	Door Open Sensor	Contact CLOSED (LOW signal) denotes door is open
11	Door Open Common	Return signal path for sensor
12	No Connection	
13	+12V Fused	Fan
14	Common	Fan

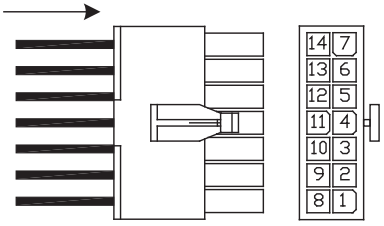


Fig. 8-5, ECM Enclosure Alarm Interface Connector

8.6 Inverter Battery DC Sense Interface Connector

ECM - Inverter Battery DC Sense Interface Connector J8. The interface control is a 3-pin (1x3 row) Mini Mate-'N'-Lok style connector.

Pin	Description	Function
1	DC Bus Sense (POS.)	Output inverter battery bus – positive connection, 48 and 98Vdc buses
2	No Connection	
3	DC Bus Sense (NEG.)	Output inverter battery bus – positive connection, 48 and 96Vdc buses

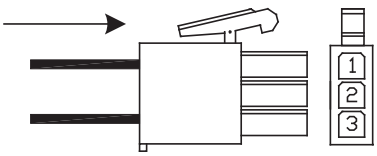


Fig. 8-6, Inverter Battery DC Sense Interface Connector

8.7 Charger Control Interface Connector

The Battery Charger Control Interface Connector is connected between the charger module and ECM as shown. The interface control is a terminal block 2-position plug-in connector.

Pin	Description	Function
1	Control Positive	Connects pin 1 & 2 together, turning the Charger ON, i.e. Closed (LOW signal)
2	Control Negative	Charger control common return

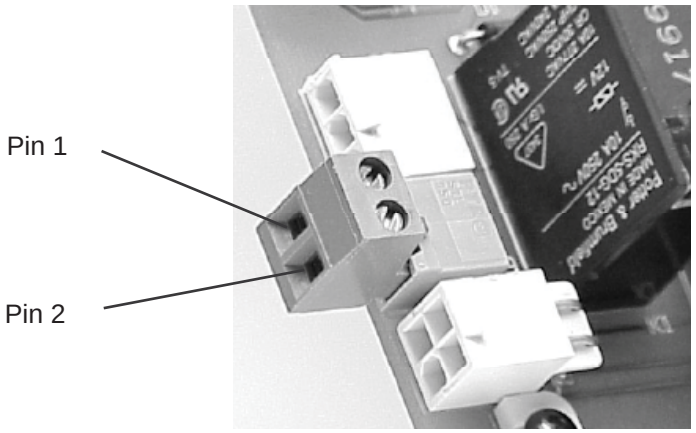


Fig. 8-7, 48Vdc Charger Control Interface Connector

8.8 ECM AC Line Sense 120/240V Interface

The interface control (J6) is a 2-pin (1x2 row) Mini Mate-'N'-Lok style connector.

Pin	Description	Function
1	Line 1, 120Vac AC Line Sense	The Line side that powers the ECM and Power PCB, and provides AC line sense to start the APU.
2	Line 2, Neutral	The Neutral side of the incoming line power.

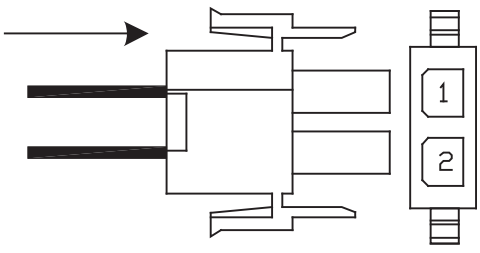


Fig. 8-8, ECM AC Line Sense, 120/240V Interface

8.9 ECM APU Control Interface

The interface control is a 12-pin (2x6 row) Mini Mate-'N'-Lok style connector.

Pin	Description	Function
1	+12V Ignition Battery	Ignition Battery Fused 12V from APU
2	Neg. Ignition Battery	Ignition Battery Negative from APU
3	Low Oil Pressure	Active LOW signal denotes low oil pressure.
4	Over-temp	Active LOW signal indicates Over-temp.
5	Start Command	Active LOW from ECM activates APU Start relay.
6	Common (Start – Stop)	Common return between START and STOP relays.
7	Stop Command	Active LOW from ECM activates APU Stop relay.
8	Over-speed	Active LOW signal denotes engine RPM was exceeded.
9	Over-crank	Active LOW signal denotes Over-crank Limit is reached.
10	Engine Run	Active LOW signal denotes the engine is running.
11	Not Used	
12	Not Used	

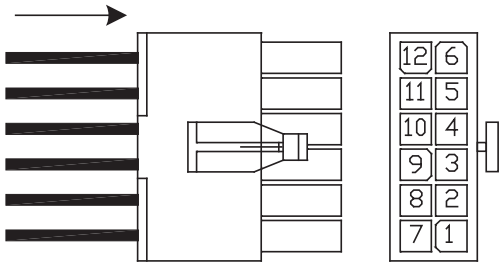


Fig. 8-9, APU Control Interface

8.10 ECM Alarm Interface

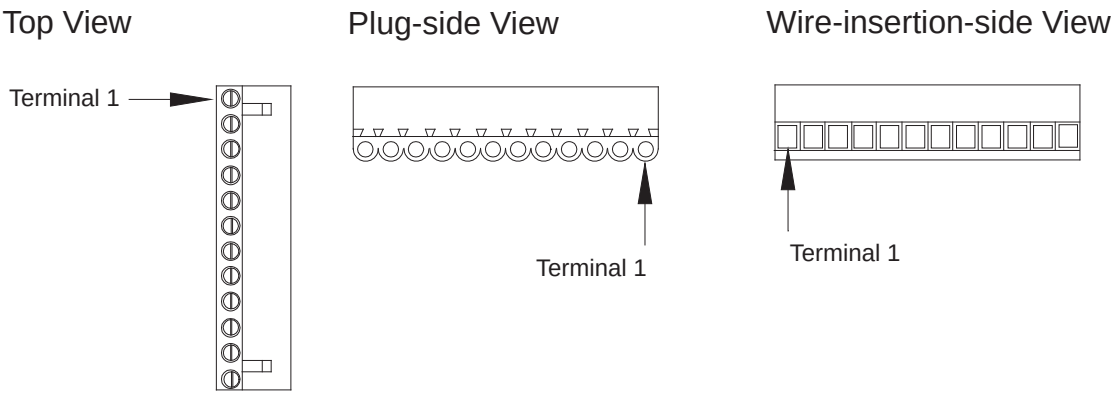


Fig. 8-10, ECM Connector Arrangement

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