

AlphaGen™

7.5kW Generator Set



Installation and Operation Manual

PN-6x-T 7.5kW 48VDC Telecom Generator

Effective: January, 2006

Alpha Technologies ®

Power

AlphaGen PN-6x-T 7.5kW 48VDC Telecom Generator Installation and Operation Manual

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Effective Date: January, 2006

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 **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 power 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, 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

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Table of Contents

Safety Notes	8
1.0 System Overview	13
1.1 System Diagram	14
1.2 Natural Gas System Block Diagram	15
1.3 Liquid Propane System Block Diagram	16
1.4 Specifications.....	17
2.0 Site Preparation	19
2.1 Site Considerations.....	19
2.2 Acoustics.....	19
2.3 Enclosure Impact Protection.....	21
2.3.1 Generator Protection, Vehicular Areas.....	21
2.4 Natural Gas Meter Configurations	23
2.5 Liquid Propane Systems	24
2.6 Grounding Requirements.....	25
3.0 Installation	26
3.1 Transportation	27
3.2 Lifting Procedure.....	28
3.3 Enclosure Installation Procedure	29
3.4 Natural Gas Utility Fuel Hookup.....	30
3.5 Liquid Propane Utility Fuel Hookup.....	31
3.6 Enclosure Grounding	32
3.7 Connecting the Ignition Battery.....	33
3.8 Connecting the DC Output Connection.....	34
3.9 Terminal Block 2 (AC Line) Connection	35
3.10 Final Inspection Checklist	36
4.0 The Engine Control Module	37
4.1 Theory of Operation	39
4.1.1 Standby Operating Condition Less Than Three Minutes	39
4.1.2 Standby Operating Condition More Than Three Minutes.....	39
4.1.3 Normal APU Shutdown	40
4.1.4 Abnormal APU Shutdown.....	40
4.2 ECM Operating Mode Summary.....	40
4.3 LED Indicators	41
4.4 Control Functions.....	42
4.5 Alarm Classifications.....	43
4.6 ECM Alarm Overview.....	45
4.7 Connecting the Alarm and Control Connections	46

Table of Contents, continued

4.8	ECM DIP Switch and Fuse Configuration	47
4.9	ECM Interface Block Diagram and Connectors	49
4.10	ECM Input Voltage and Line Sense Configurations.....	50
4.11	ECM Self-test.....	51
4.12	Maintenance Functions	52
5.0	Turn-up and Test.....	53
5.1	Appearance and Condition of Components.....	55
5.2	System Preparation	55
5.3	Performing a Local APU Test.....	56
5.4	Generator System Sensor Verification.....	56
5.4.1	Enclosure Alarm Verification	58
5.4.2	AC and DC Line Sense Verification	57
6.0	Operation.....	58
6.1	Normal Operating Condition	58
6.1.1	AC Line Fail.....	58
6.1.2	Low DC Bus Level.....	58
6.2	Ignition Battery Charger Overview.....	59
7.0	Maintenance	60
7.1	Servicing the APU	61
7.2	Filter Cleaning.....	62
7.3	Pad Shear Magnetic Switch Replacement.....	63
7.4	Replacing Gas Hazard Sensor	64
7.5	Replacing Ignition Battery Charger Module Assembly.....	65
7.6	Replacing Engine Control Module	66
7.7	Fuel Conversion – Natural Gas to LP	67
7.7.1	Pre-regulator Removal with Low Pressure Switch Installation.....	67
7.7.2	Switching the LP Port to the NG Port.....	68
7.8	Gas Solenoid Replacement Procedure.....	69
7.9	Maxitrol Pre-regulator Calibration	70
8.0	Interconnection.....	74
8.1	Gas Hazard Alarm Interface Connector.....	74
8.2	Low Fuel Pressure Interface Connector	74
8.3	Gas Solenoid Interface Connector	75
8.4	48V Charger Module Control Interface Connector.....	75
8.5	ECM Enclosure Alarm Interface Connector	76
8.6	Inverter Battery DC Sense Interface Connector	76
8.7	48VDC Charger Control Interface Connector	77
8.8	ECM AC Line Sense 120/240V Interface.....	77
8.9	ECM APU Control Interface	78
8.10	ECM Alarm Interface & Communications	78

List of Figures and Tables

Fig. 1-1, PN-6x-T Generator and Enclosure (operator's side).....	13
Fig. 1-2, System Diagram.....	14
Fig. 1-3, Arrangement of Metered, Nominal Pressure (1-2psi) Natural Gas System.....	15
Fig. 1-4, Excess Flow Valve	15
Fig. 1-5, LP Propane Vapor Withdrawal Block Diagram.....	16
Fig. 2-1, Generator Sound Levels at 100% Load	19
Fig. 2-2, Acoustical Measurements in Relation to Placement Near Residences.....	20
Fig. 2-3, Vehicular Area Impact Protection for Collocated Natural Gas Meter	21
Fig. 2-4, Vehicular Area Impact Protection for Remote Natural Gas Meter	22
Fig. 2-5, Collocated Natural Gas Meter Setup.....	23
Fig. 2-6, Remote Natural Gas Meter Setup	23
Fig. 2-7, Liquid Propane Setup	24
Fig. 2-8, Grounding Requirements	25
Fig. 3-1, Sweep Dimensions.....	26
Fig. 3-2, Pallet Bolt Locations.....	27
Fig. 3-3, Lifting Plates Attached to Cabinet	28
Fig. 3-4, Pad Shear Sensor/Magnet Assembly.....	29
Fig. 3-5, Enclosure Grounding.....	30
Fig. 3-6, Utility Gas Service Input	31
Fig. 3-7, Propane Fuel Hookup	32
Fig. 3-8, DC Output Safety Shroud	33
Fig. 3-9, DC Output Block	33
Fig. 3-10, Ignition Battery Installation	34
Fig. 3-11, Terminal Block 2 Location.....	35
Fig. 4-1, Location of Engine Control Module (ECM)	37
Fig. 4-2 (a), ECM LED Indicators, Switches, and Interface Connections.....	38
Fig. 4-2 (b), ECM Printed Circuit Boards	38
Fig. 4-3, LED Indicators and Control Functions.....	42
Fig. 4-4, RS-488 Communications Input Connector.....	46
Fig. 4-5, Terminal Block 1	46
Fig. 4-6, SW5 and Fuse Locations	47
Fig. 4-7, SW5 Settings.....	48
Fig. 4-8, ECM/APU Interconnection	49
Fig. 4-9, Input Voltage and Line Configuration Schematic	50

List of Figures and Tables, continued

Fig. 5-1, Generator Set Master Switch and Run/Auto/Stop (RAS) Switch	54
Fig. 6-1, Ignition Battery Charger LED	59
Fig. 6-2, Wiring for ECM, Ignition Battery Charger, and Ignition Battery	59
Fig. 7-1, Air Filter Removal	62
Fig. 7-2, Pad Shear Sensor	63
Fig. 7-3, Gas Hazard Sensor Location	64
Fig. 7-4, Ignition Battery Charger	65
Fig. 7-5, ECM with Connectors Attached.....	66
Fig. 7-6, Pre-regulator Removal	67
Fig. 7-7, Switch Assembly Installed.....	67
Fig. 7-8, Load Block.....	68
Fig. 7-9, Changing Load Block Configuration.....	68
Fig. 7-10, Fuel Solenoid Valve.....	69
Fig. 7-11, Primary Fuel Regulator.....	70
Fig. 7-12, Pre-regulator Calibration	71
Fig. 7-13, Secondary Demand Regulator.....	71
Fig. 7-14, Manometer Connection	72
Fig. 8-1, Gas Hazard Detector Interface Connector	74
Fig. 8-2, Low Fuel Pressure Interface Connector.....	74
Fig. 8-3, Gas Solenoid Interface Connector	75
Fig. 8-4, Charger Control Interface Connector	75
Fig. 8-5, ECM Enclosure Alarm Interface Connector.....	76
Fig. 8-6, Inverter Battery DC Sense Interface Connector.....	76
Fig. 8-7, 48VDC Charger Control Interface Connector.....	77
Fig. 8-8, ECM AC Line Sense, 120/240V Interface	77
Fig. 8-9, APU Control Interface.....	78
Fig. 8-10, ECM, SCM Connector Arrangement	78
Table 3-1, Terminal Block 2 Connections	35
Table 4-1, Engine Crank Cycle	39
Table 4-2, Major/Minor Alarm Indications and Notifications.....	45
Table 4-3, Telecom Defaults	47
Table 4-4, DIP Switch Settings	48

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

- When 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 the engine is run, or more than 10 minutes after engine shutdown, you must check the system for leaks and correct as necessary.

1.0 System Overview

The AlphaGen PN-6x-T curb side generator system is designed to 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.

The procedures in this document describe the installation, operation and maintenance of the PN-6x-T generator and enclosure.

Features:

- Cost effective extended runtime solution for outdoor powering applications
- Quiet operation, small size, and low profile allow 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, operators and the public
- Safe unattended operation designed to UL2200, NFPA 37, 54, 58 & 70 standards



Fig. 1-1, PN-6x-T Generator and Enclosure (operator's side)

1.0 System Overview, continued

1.2 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.

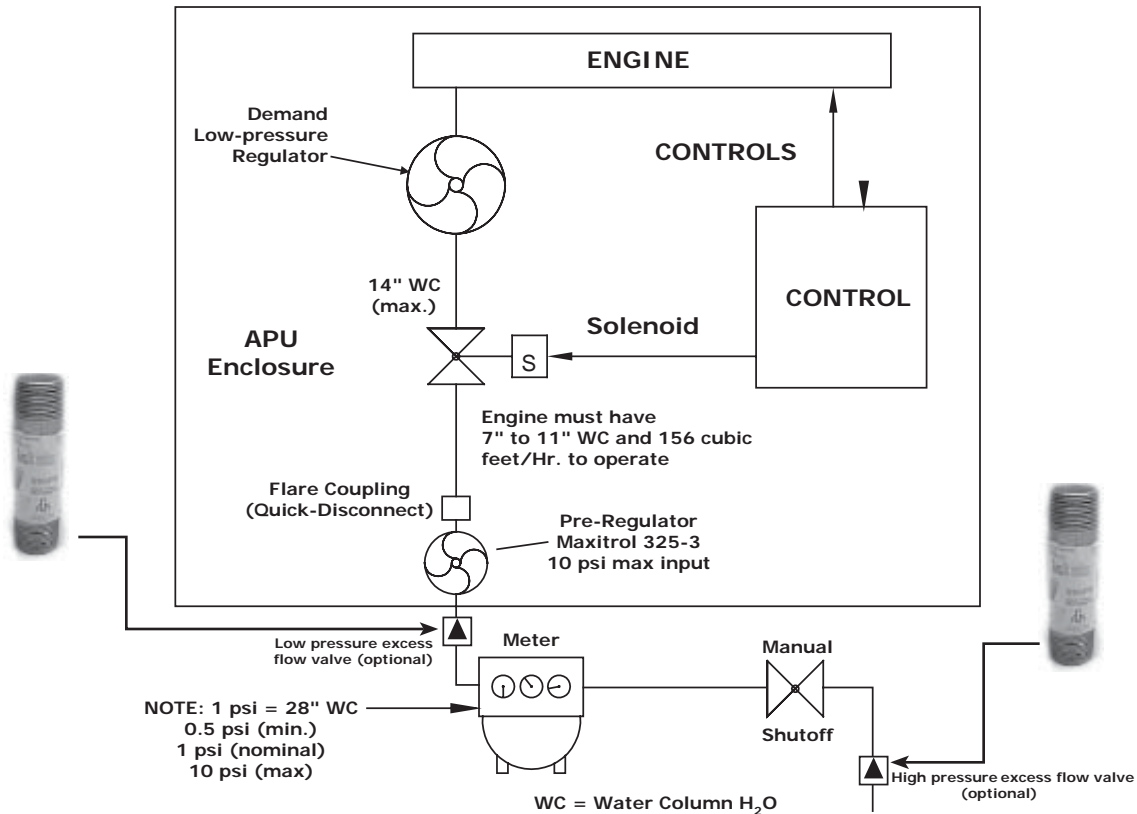


Fig. 1-3, Arrangement of Metered, Nominal Pressure (1-2psi) Natural Gas System



NOTE:

For added safety, a low pressure and/or 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. 1-4, Excess Flow Valve
(above ground $\frac{3}{4}$ " x 4" NPT nipple)
Alpha P/N 042-146-10



1.0 System Overview, continued

1.3 Liquid Propane System Block Diagram

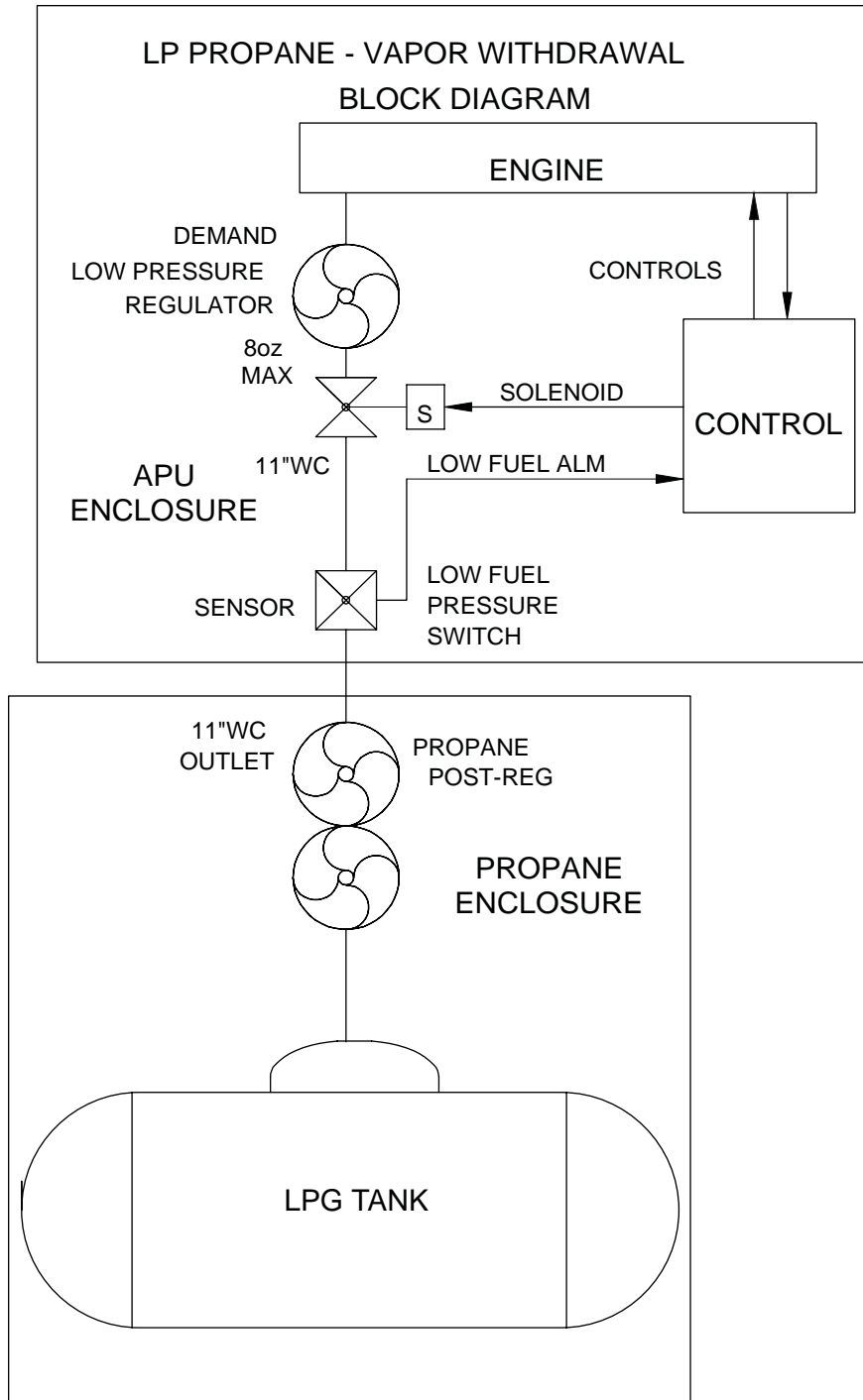


Fig. 1-5, LP Propane Vapor Withdrawal Block Diagram

1.0 System Overview, continued

1.4 Specifications

System Specifications	Specification
System Size	Height: 39.0" (57" with optional pedestal) Width: 39.25" Depth: 24" Weight: 338 lbs (370 lbs with optional pedestal)
Acoustic	70.3 dBa @ 10 feet, (100% load)
DC Electrical Noise (PN-6x-T)	RF: <100mV RMS in any 3kHz Band, 3kHz to 20MHz Broadband: <250mV Pk to Pk Voice Freq. Noise: Less than 56dBnc
Gas Inlet Pressure	0.5-2 psi NOTE: Contact Alpha Technologies for low pressure operation below 0.5 psi.
Integral Ignition Battery Charger Voltage	13.5 to 14.3VDC regulated, 15A max,
Remote Interface Length	12' max. (sweep to sweep) NOTE: Distance depends upon proper installation, derating, and wire gauge. Contact Alpha Technologies for installations requiring greater distances.
Agency Compliance	UL 1778, UL2200, CSA 22.2 No. 107.1, and applicable sections of NFPA 37/54/58 and 70, EMC/FFC Part 15 Class A
Exterior Surface Temperature	70°C max. (meets requirements of UL/CSA)
Fuel System Controls & Monitoring	The controls and fuel system meet appropriate sections of NFPA 37,54, and 58 for automatic, unattended remote operation of enclosed generators.
Sensors	Gas Hazard, Pad Shear, Water Intrusion, Tamper, Low Fuel Pressure
Safety Shutdowns	Low oil shutdown Oil over-temp Engine over-speed Over-crank (Crank limit) Gas hazard (LPG or natural gas) Low fuel pressure shutdown (LPG) Water intrusion Pad shear Alternator over-voltage

1.0 System Overview, continued

1.4 Specifications, continued

Engine Specifications	Specification
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)
Fuel Consumption at 7.5kW: Natural Gas, 1000 BTU/ft. ³ Propane, 2516 BTU/ft. ³	150 cfh 50 cfh
Battery Voltage	12VDC
Battery Ground	Negative
Battery Recommendation (min.)	585 CCA @ 0°F (-18°C)
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, °F (°C)	305 (152)

Generator Set Specification	48VDC
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
* Derate approximately 4% per 1000 ft (300m) over 500 ft (153m) above sea level. Derate 1% for each 10°F (5.5°C) increase in temperature above 77°F (25°C).	

Generator Specifications	48VDC
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

2.0 Site Preparation

2.1 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 is an obstruction and would 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 applicable required grounding system.
- Verify utility power cabling has been run and terminated at the site.

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 PN-6x-T 7.5kW generator at full load. Note the symmetry of these emissions. Deployment decisions must include noise consideration. The elimination of nuisance noise, and the reduction of directional impact within a residential community, is critical.

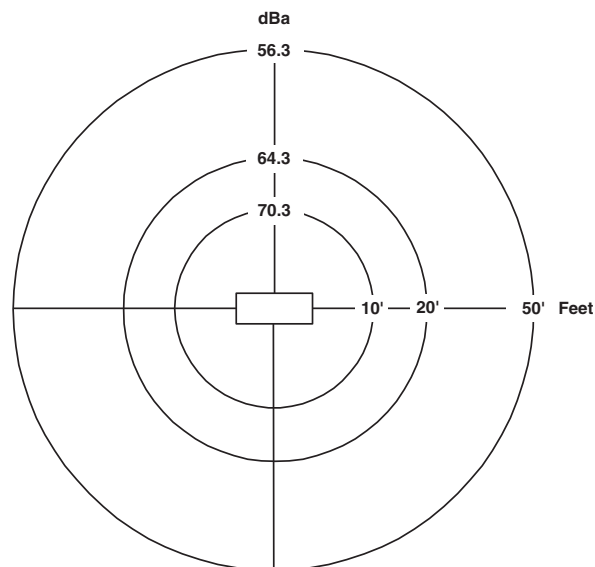


Fig. 2-1, Generator Sound Levels at 100% Load

2.0 Site Preparation, continued

2.2 Acoustics, continued

The design of the engine-generator system should direct a majority of the operational noise toward the street and away from residences that may be located behind the curb side system. This strategic cabinet design and placement within the community can minimize nuisance noise and city ordinance issues.

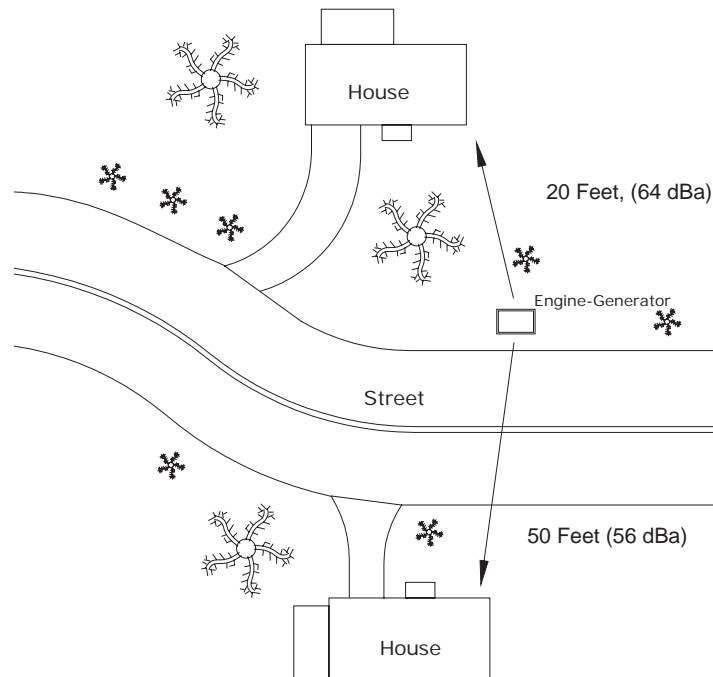


Fig. 2-2, Acoustical Measurements in Relation to Placement Near Residences (generator sound levels at full load)

2.0 Site Preparation, continued

2.3 Enclosure Impact Protection

The National Fire Protection Agency (NFPA) requires that equipment utilizing 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 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.

2.3.1 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.

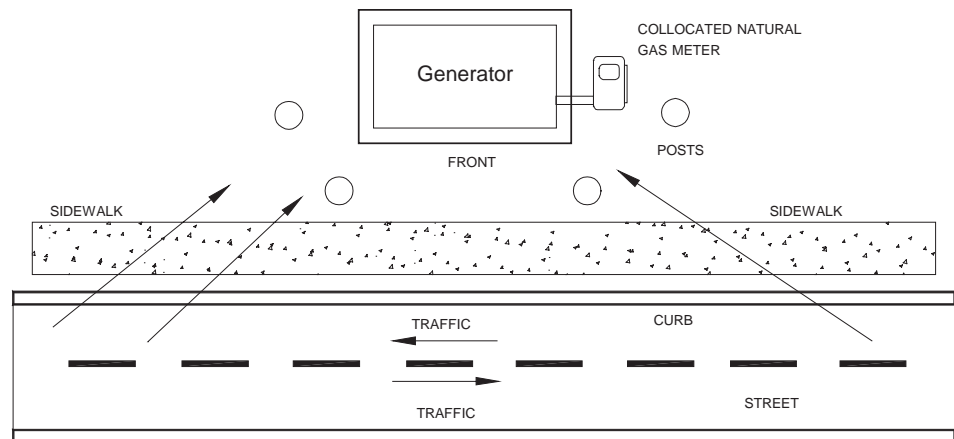


Fig. 2-3, Vehicular Area Impact Protection for Collocated Natural Gas Meter

2.0 Site Preparation, continued

2.3 Enclosure Impact Protection, continued

2.3.1 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 (within 25 feet).

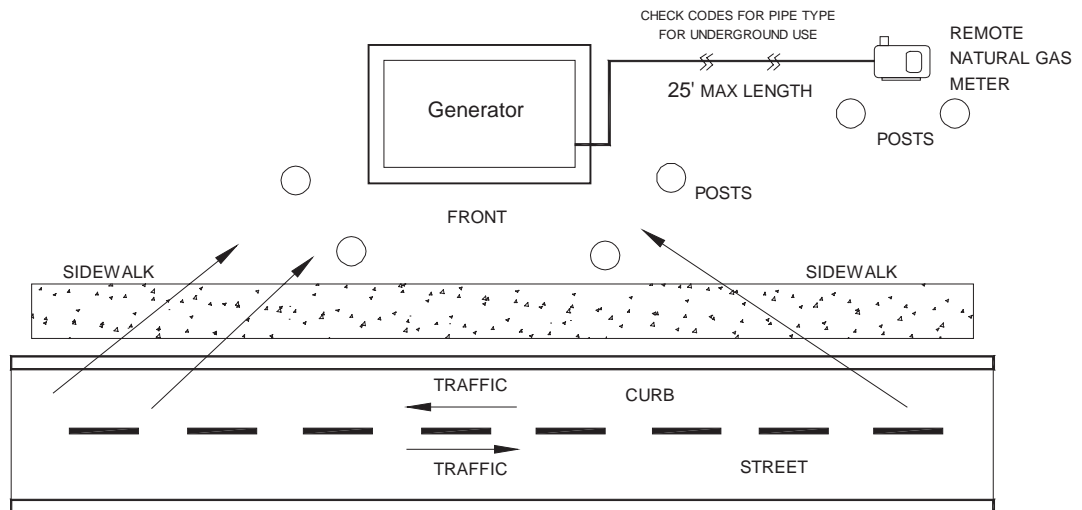


Fig. 2-4, Vehicular Area Impact Protection for Remote Natural Gas Meter

2.0 Site Preparation, continued

2.4 Natural Gas Meter Configurations

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

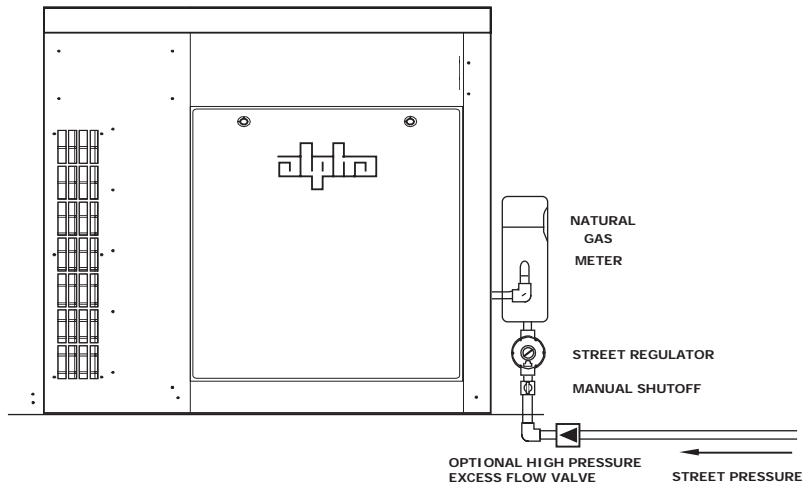


Fig. 2-5, Collocated Natural Gas Meter Setup

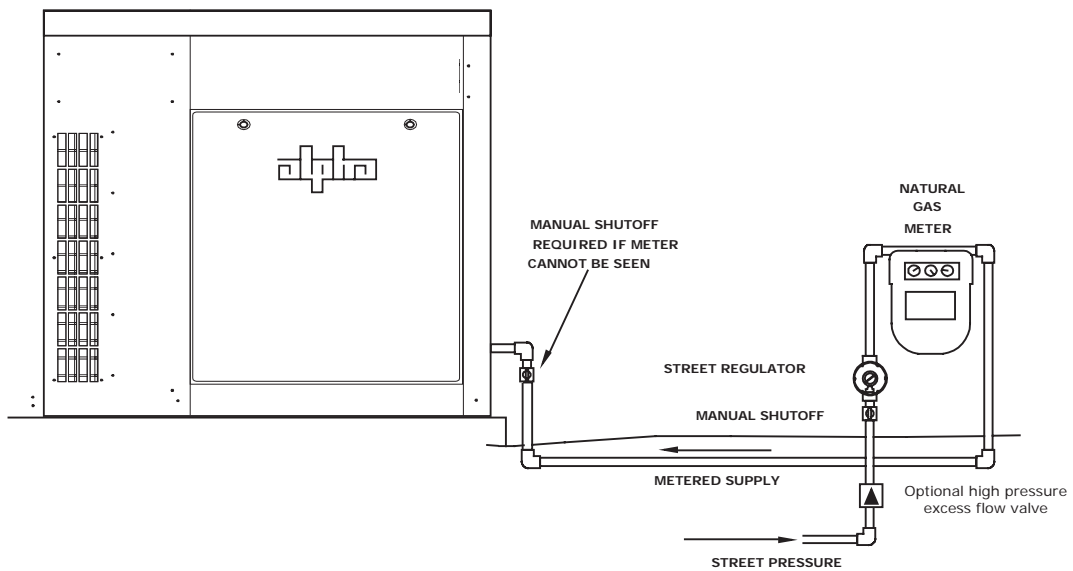


Fig. 2-6, Remote Natural Gas Meter Setup

2.0 Site Preparation, continued

2.5 Liquid Propane Systems

For systems using liquid propane, the end user must provide a suitable LP tank.

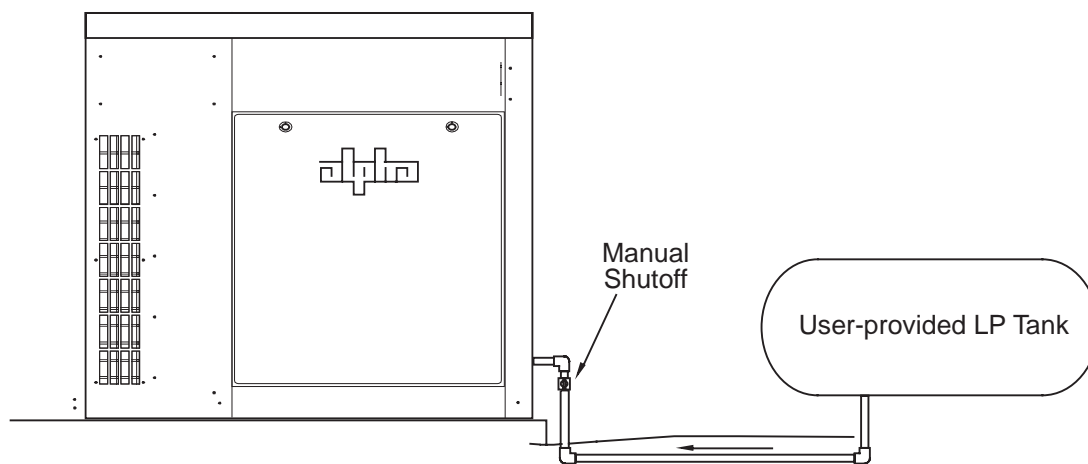
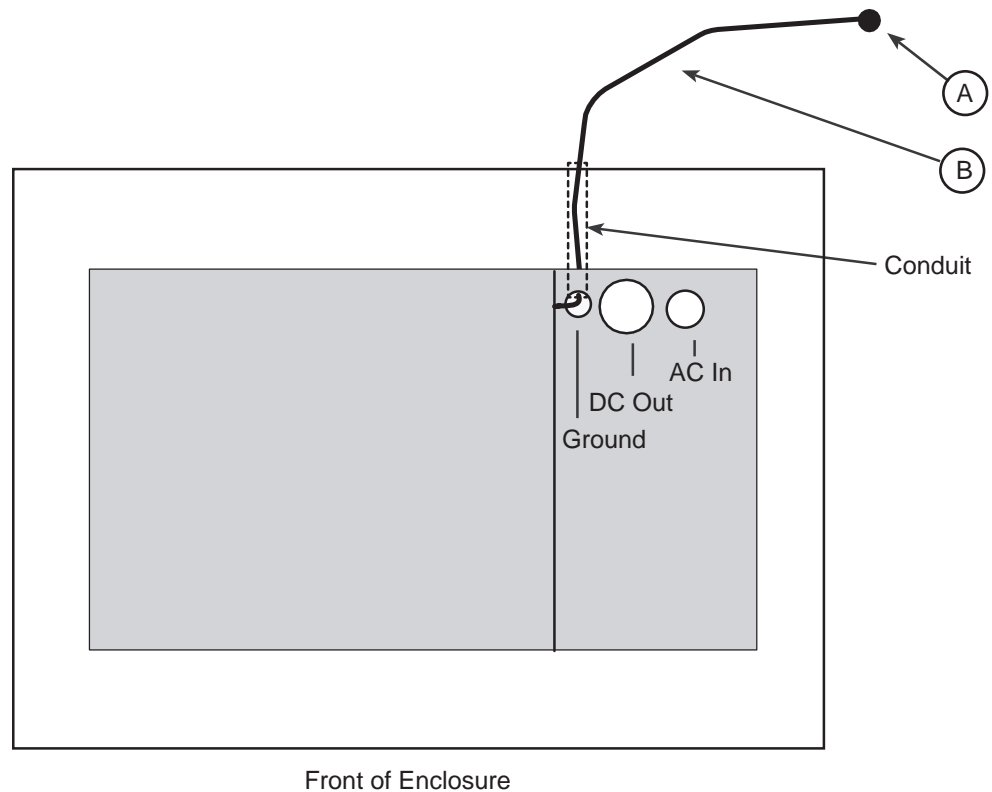


Fig. 2-7, Liquid Propane Setup

2.0 Site Preparation, continued

2.6 Grounding Requirements

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.



- (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. 2-8, Grounding Requirements

3.0 Installation

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

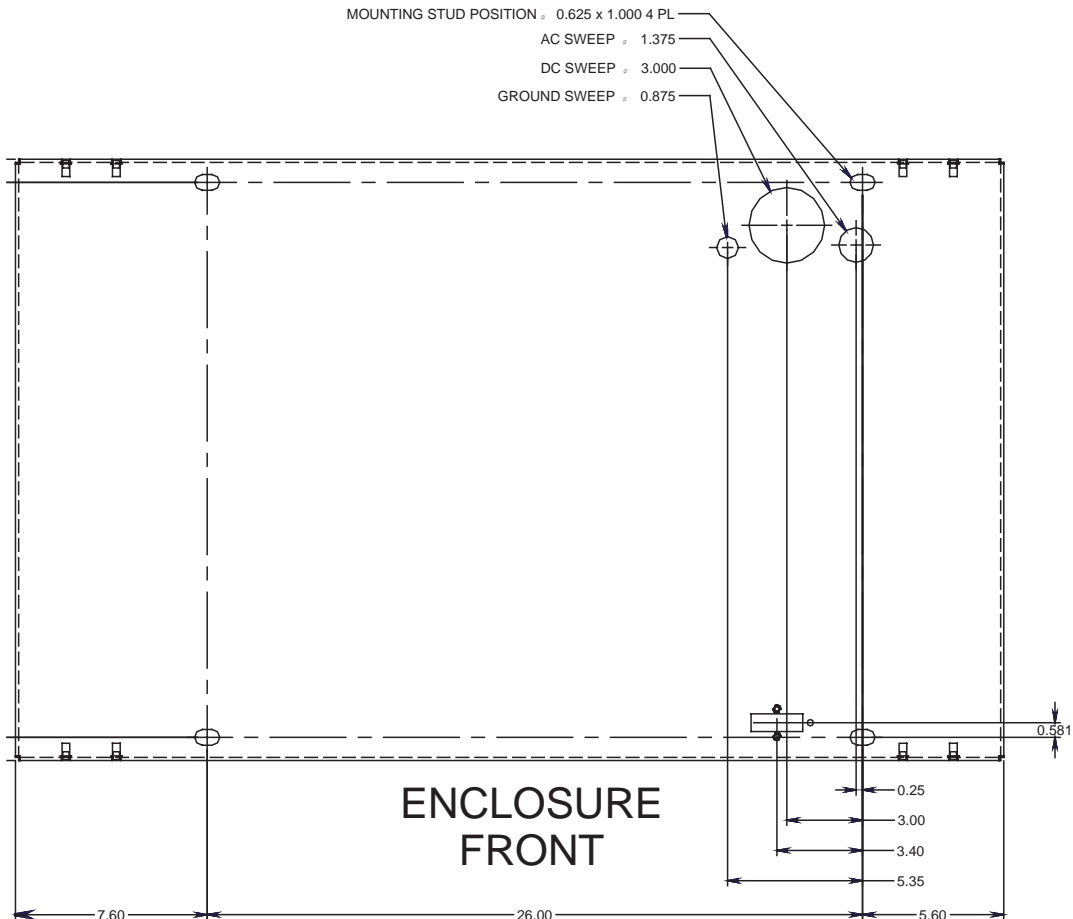


Fig. 3-1, Sweep Dimensions (in inches)

3.0 Installation, continued

3.1 Transportation

The enclosure as shipped contains the Auxiliary Power Unit (APU) and, therefore, is **heavy** (approximately 338 lbs). A safe means of transportation 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.



CAUTION!

The ignition battery **MUST NOT** be installed until the enclosure is set in place at its permanent location.

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.



Fig. 3-2, Pallet Bolt Locations

3.0 Installation, continued

3.2 Lifting Procedure

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 between 80 and 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.

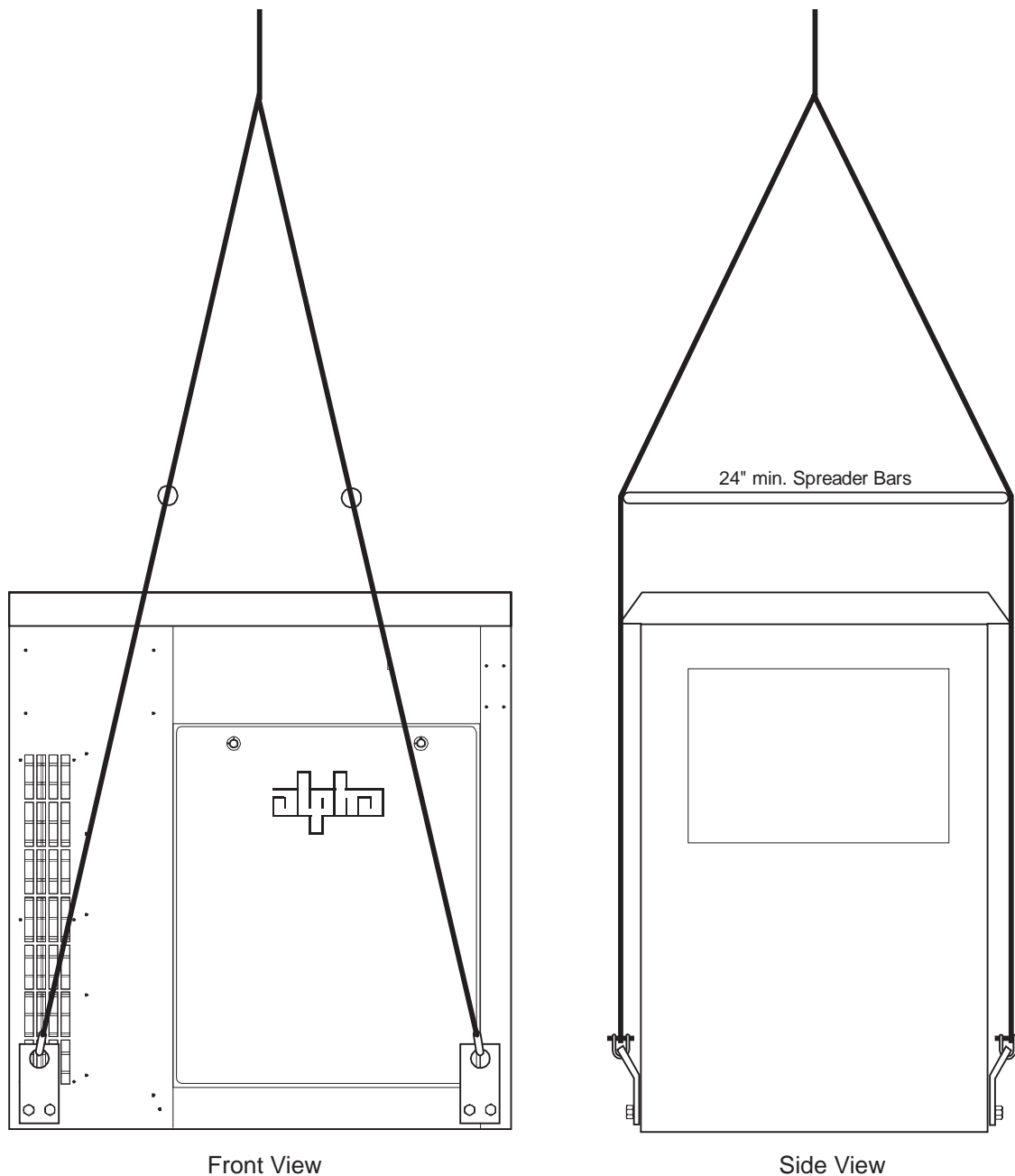


Fig. 3-3, Lifting Plates Attached to Cabinet

3.0 Installation, continued

3.3 Enclosure Installation Procedure

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.



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.

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 into 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 face down with the two Phillips screws so it contacts 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).

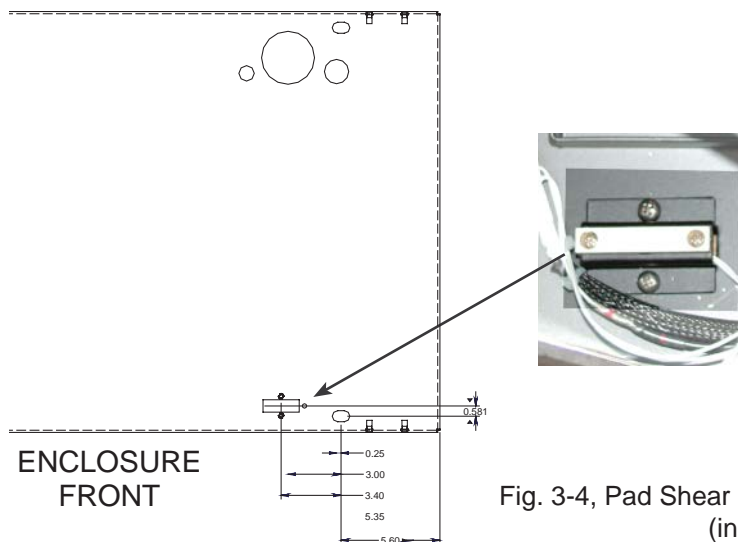


Fig. 3-4, Pad Shear Sensor/Magnet Assembly (in inches)



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.

3.0 Installation, continued

3.4 Enclosure Grounding

ATTENTION:

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

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. 3-5 below.

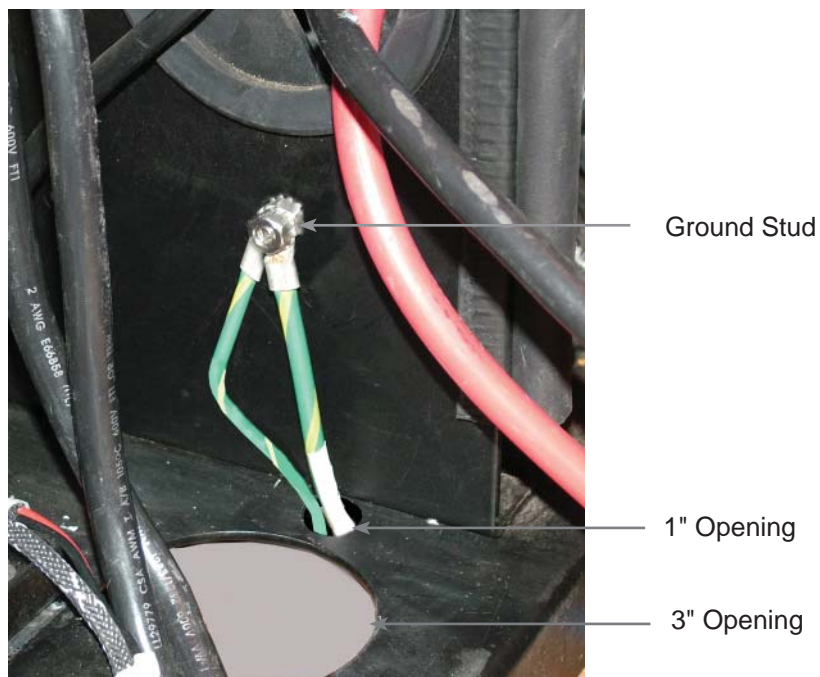


Fig. 3-5, Enclosure Grounding

3.0 Installation, continued

3.5 Natural Gas Utility Fuel Hookup

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.

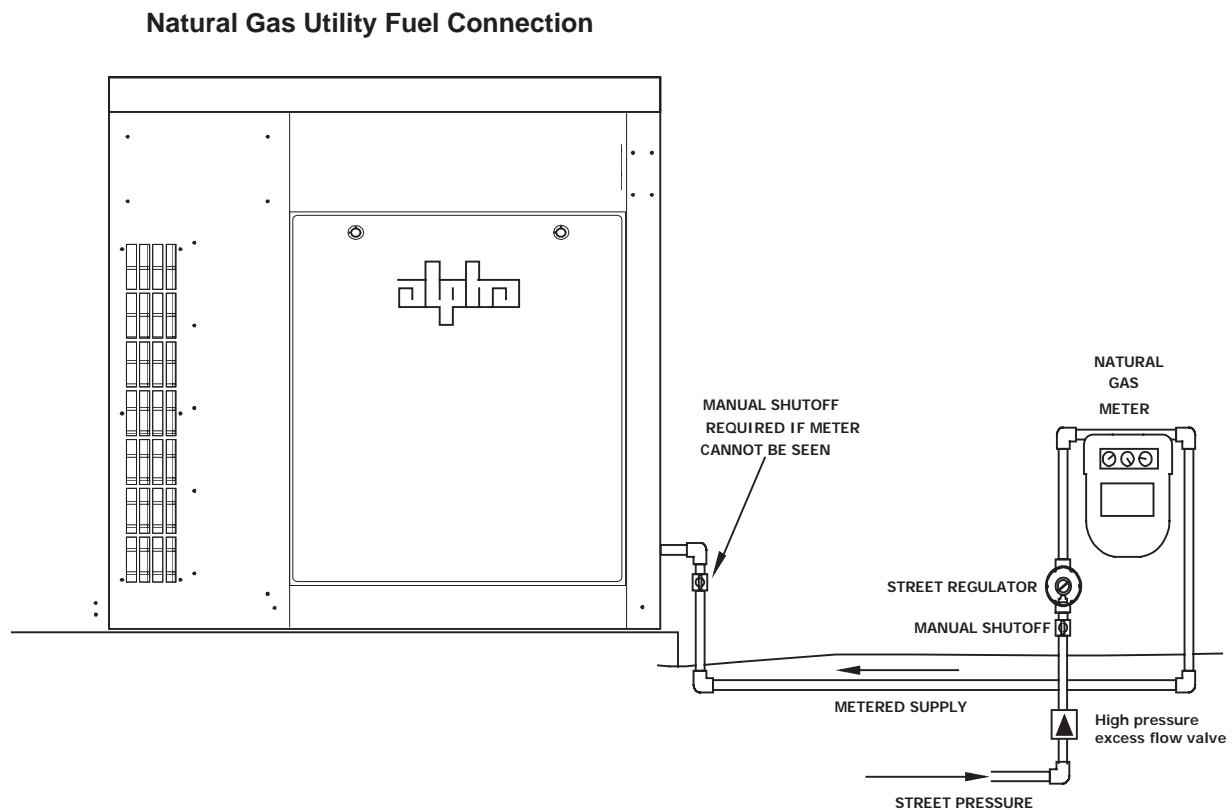


Fig. 3-6, Utility Gas Service Input

3.0 Installation, continued

3.6 Liquid Propane Utility Fuel Hookup

- 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.

Liquid Propane Fuel Connection

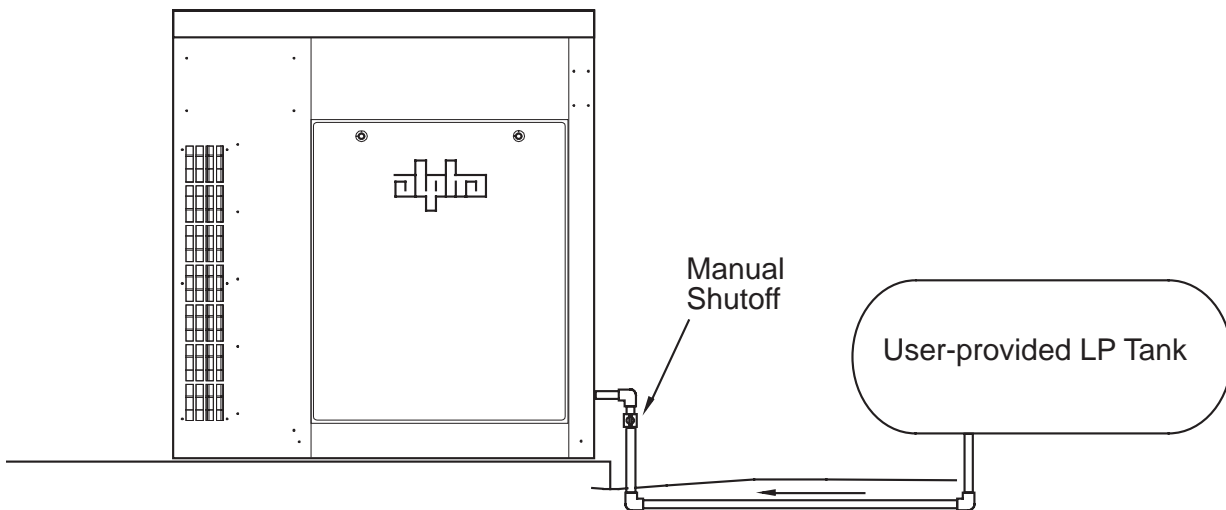


Fig. 3-7, Propane Fuel Hookup

3.0 Installation, continued

3.7 Connecting the DC Output Connection

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

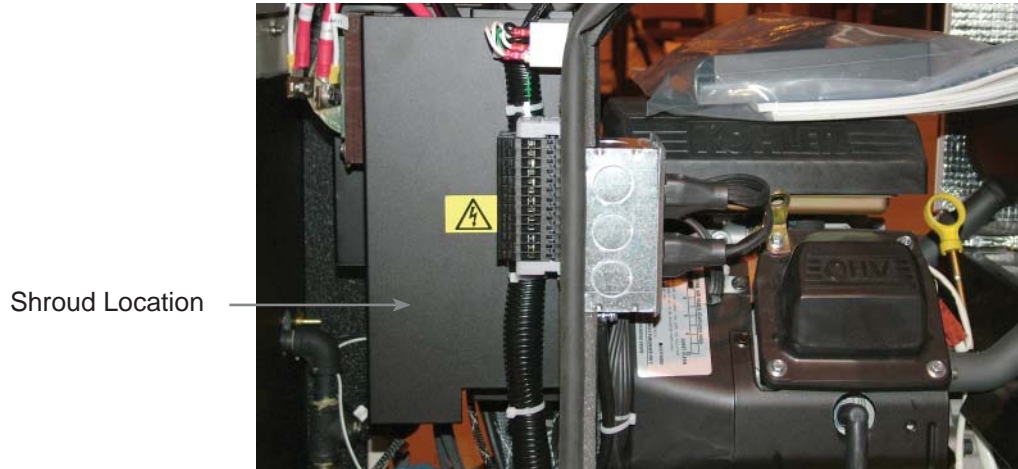


Fig. 3-8, DC Output Safety Shroud

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.

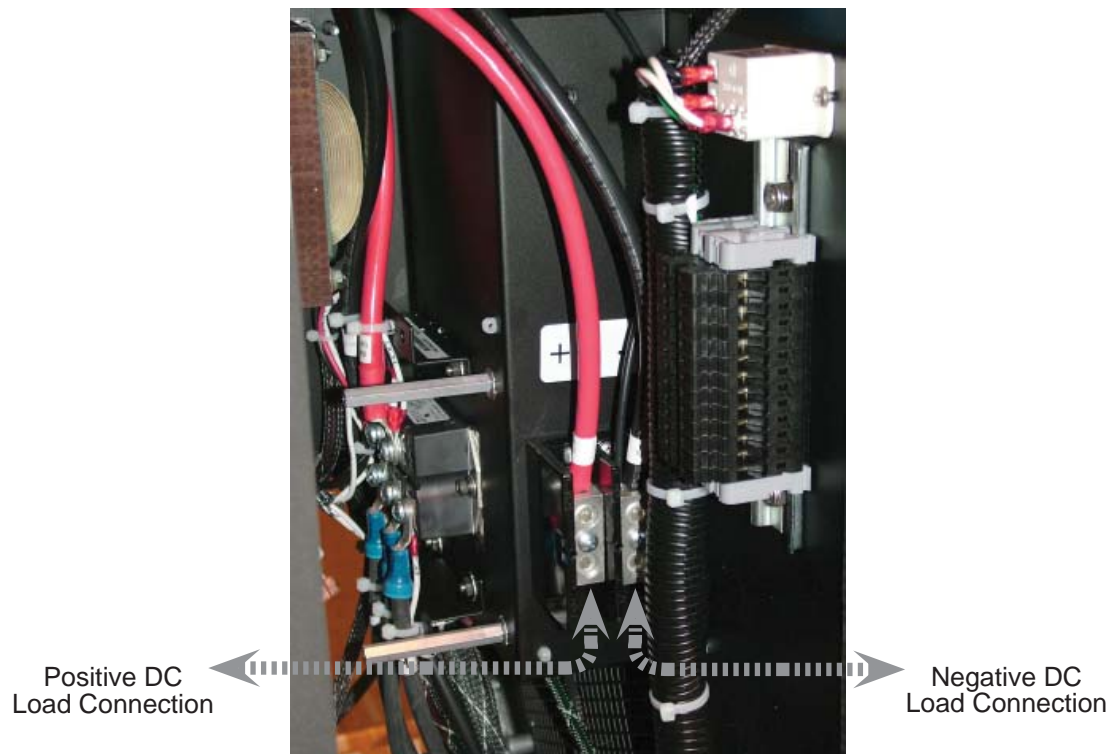


Fig. 3-9, DC Output Block

3.0 Installation, continued

3.8 Connecting the Ignition Battery

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.

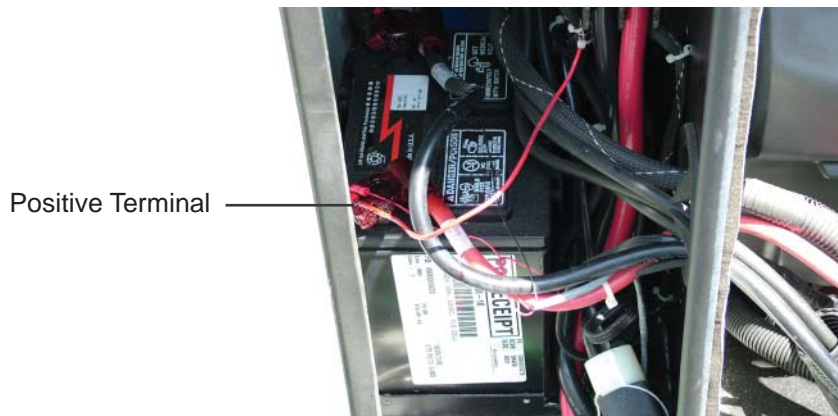


Fig. 3-10, Ignition Battery Installation

3.0 Installation, continued

3.9 Terminal Block 2 (AC Line) Connections

Terminal Block 2 is located in the rear of the enclosure, 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.

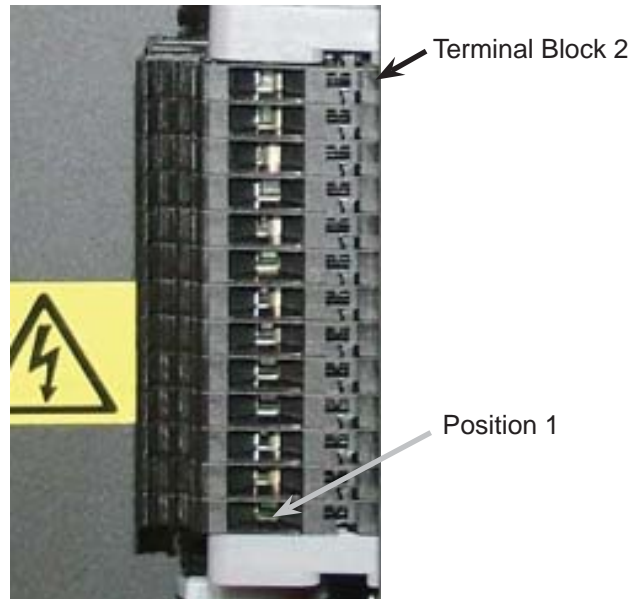


Fig. 3-11, Terminal Block 2 (TB2)

Terminal Block 2	
Pos #	Function
23	Major Alarm NO
22	Major Alarm NC
21	Major Alarm Com
20	*Special Use
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	*Special Use
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

NOTE:

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

3.0 Installation, continued

3.10 Final Inspection Checklist



CAUTION!

Alpha recommends setting the ECM Run/Auto/Stop (RAS) switch to the STOP position before initially powering up the ECM. This allows the operator to 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 has been completed 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 test/checks have been made, 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 ECM PCB/GRI assembly is mounted to the top of the generator housing, to the left of the ignition battery. The GRI is attached to the ECM PCB via three ribbon cables.

The GRI powers the ECM and steps down high voltage. It provides interface connectors for the enclosure sensors, engine controller, battery sense, line sense, and other equipment. Depending on the standby powering configuration, the ECM and generator combination are collocated with other Alpha equipment such as power supplies and batteries, or installed remotely. 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 battery 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 system operator can override the ECM and control the APU manually or remotely.

The ECM provides an interface between the APU and Alpha communication devices. The ECM controls and monitors the APU and responds to commands and queries from a system controller via an isolated RS-485 data bus. Status information and alarms can be read from the ECM remotely via the data bus, locally 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.



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)
GRI Connectors	
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)

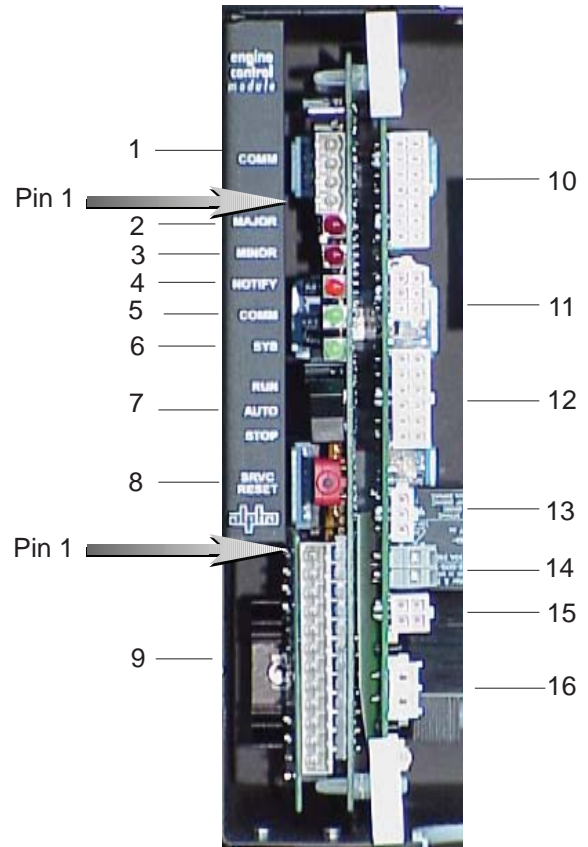


Fig. 4-2 (a), ECM LED Indicators, Switches, and Interface Connections

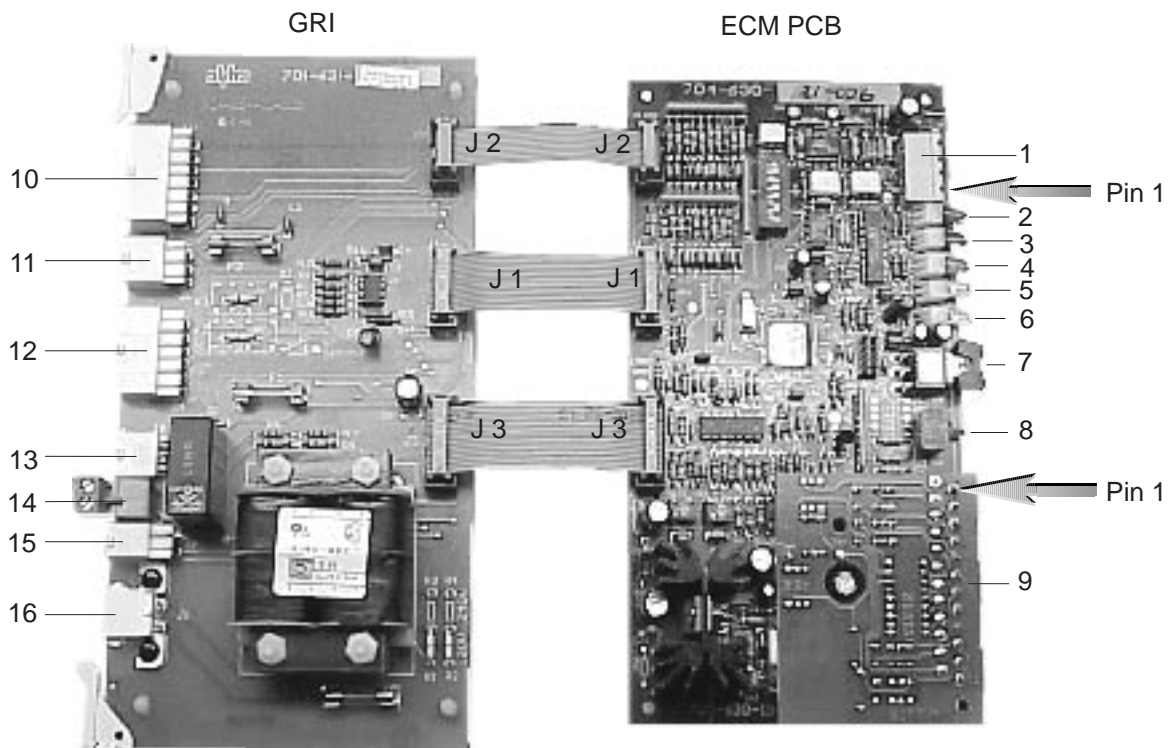


Fig. 4-2 (b), ECM Printed Circuit Boards

4.0 The Engine Control Module, continued

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 one minute, 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. If a system controller is attached to the ECM via the RS-485 bus, the APU can be controlled remotely. 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 will notify the system operator of a line failure via the front panel LED's (see Fig. 4-2a).

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 will attempt 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 will report 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
Cranking Engine	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

Table 4-1, Engine Crank Cycle

4.0 The Engine Control Module, continued

4.1 Theory of Operation, continued

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. The ECM continues to run the APU until the above conditions are met or a major alarm occurs. The APU will run a minimum of 30 minutes if started due to low DC Bus voltage.

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 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 2V/cell +2 V (i.e., 50V for a 48V system).
3. Cool-down period has expired.
4. Engine Run command is not active.
5. If the unit is started due to low DC bus voltage, DC bus voltage must reach >53V.

4.0 The Engine Control Module, continued

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 shutdown 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 Alphasus. This is standard with Alphasus 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.


4.0 The Engine Control Module, continued

4.4 Control Functions

The Run-Auto-Stop (RAS) switch controls the Auxillary 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 will reset 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 via status monitoring or via the manual stop switch will also clear the alarm pattern indicated by the LEDs.

 **NOTE:** Depressing the Service Reset button for five seconds will cause the service timer to clear, possibly disrupting the preventive maintenance schedule.

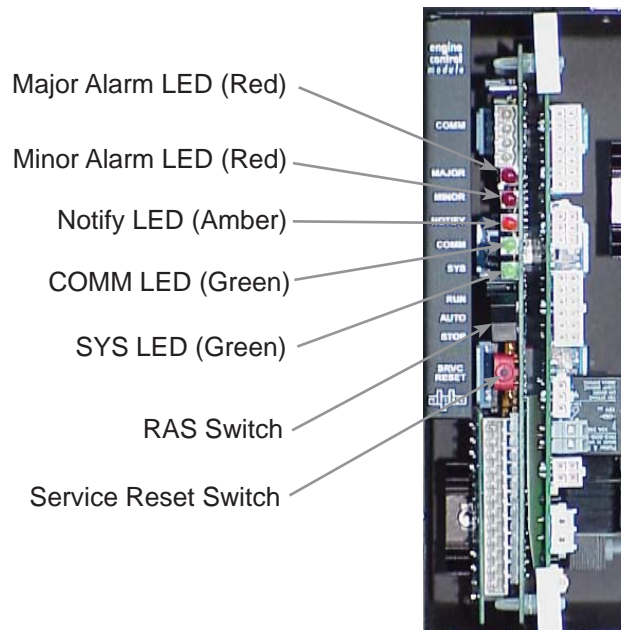


Fig. 4-3, LED Indicators and Control Functions

4.0 The Engine Control Module, continued

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):** Indicates 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):** Indicates 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):** Indicates 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):** Indicates the 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 reset when the water level falls below maximum limits.
 - **Pad Shear (Latching):** Indicates 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.



NOTE:

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):** Indicates that 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):** Indicates 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:** Indicates 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. Note that low ignition battery voltage does not trigger an alarm during engine cranking.
- **Auto Mode Disabled:** Indicates 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:** Indicates 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).
- **Engine Disabled:** Command to disable normal operation of the generator set. When set to DISABLE the engine is shutdown and will remain so under all conditions. A *Minor Alarm* indicator will be 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:** 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:** Indicates 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).

4.0 The Engine Control Module, continued

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
● Yellow
● Green

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

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

Legend: * = Latching Alarm
 ** = Notifications
 *** = Alarm "latches" after 5 activations

4.0 The Engine Control Module, continued

4.7 Connecting the Alarm and Control Connections

The Alarm output interface and communications connectors are shown below.

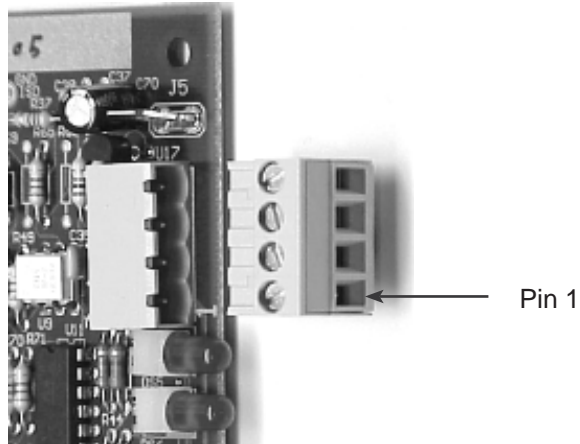
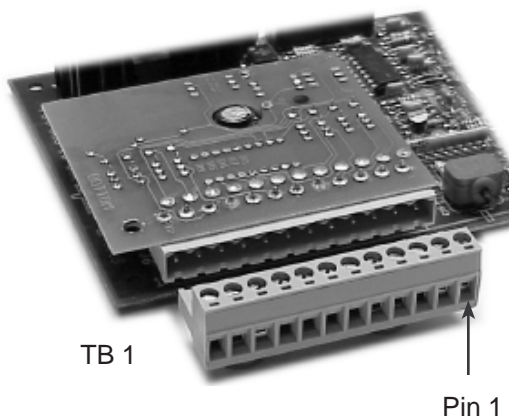


Fig. 4-4, RS-488 (AlphaBus) Communications Input Connector



Terminal Block 1		
Pin	Alarm Signal Description	Alarm Active State
1	Engine Run Common	N/A
2	Engine Run	Closed with respect to Pin 1
3	Engine Run	Open with respect to Pin 1
4	Major Alarm Common	N/A
5	Major Alarm	Closed with respect to Pin 4
6	Major Alarm	Open with respect to Pin 4
7	Minor Alarm Common	N/A
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. 4-5, Terminal Block 1

4.0 The Engine Control Module, continued

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.

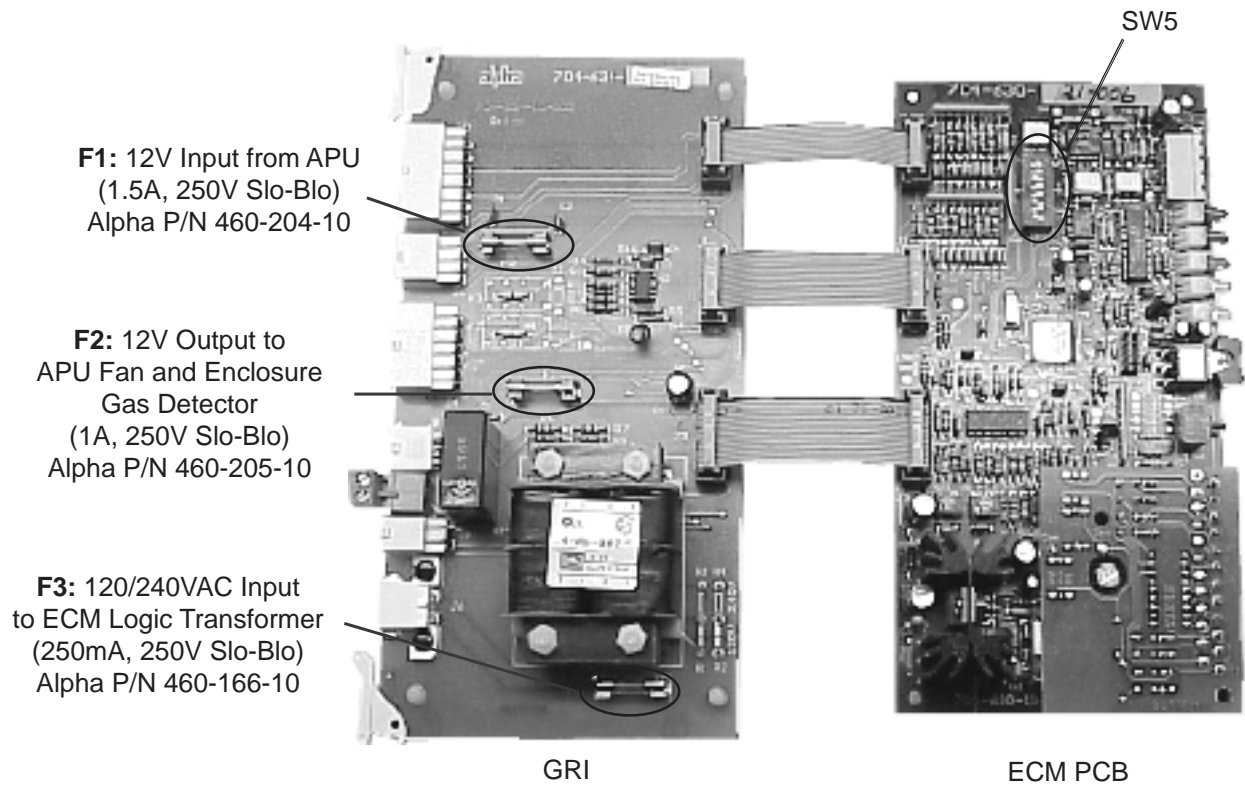


Fig. 4-6, SW5 and Fuse Locations

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

4.0 The Engine Control Module, continued

4.8 ECM DIP Switch and Fuse Configuration, continued

ECM SW5 Settings								Meaning
1	2	3	4	5	6	7	8	1 = ON, 0 = OFF
0								Non standard GRI interface (7.5kW Series)
1								Standard GRI interface
	0	0	0					Invalid output voltage configuration
	0	0	1					24VDC Output
	0	1	0					36VDC Output
	0	1	1					48VDC Output
	1	0	0					96VDC Output
	1	0	1					120VDC Output
	1	1	0					208VDC Output
	1	1	1					240VDC Output
				0	0			Invalid input voltage configuration
				0	1			120AC input
				1	0			208 3-phase input
				1	1			240VAC input
0						0		No effect
0						1		No effect
1						0		ECM Drives starter with the "Engine Start" Signal.
1						1		"Engine Start" Signal becomes "Engine Run" and is held low by ECM
							0	Autotest turned 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.

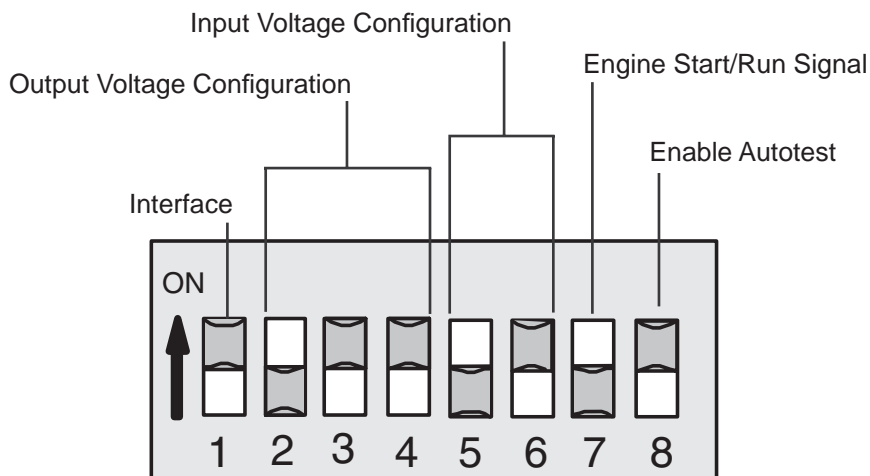


Fig. 4-7, SW5 Settings

4.0 The Engine Control Module, continued

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 head end. These signals are also supplied to the central office, or network manager, to allow the Alpha Systems control module to start and stop the engine alternator as part of the network controlled periodic test sequence.

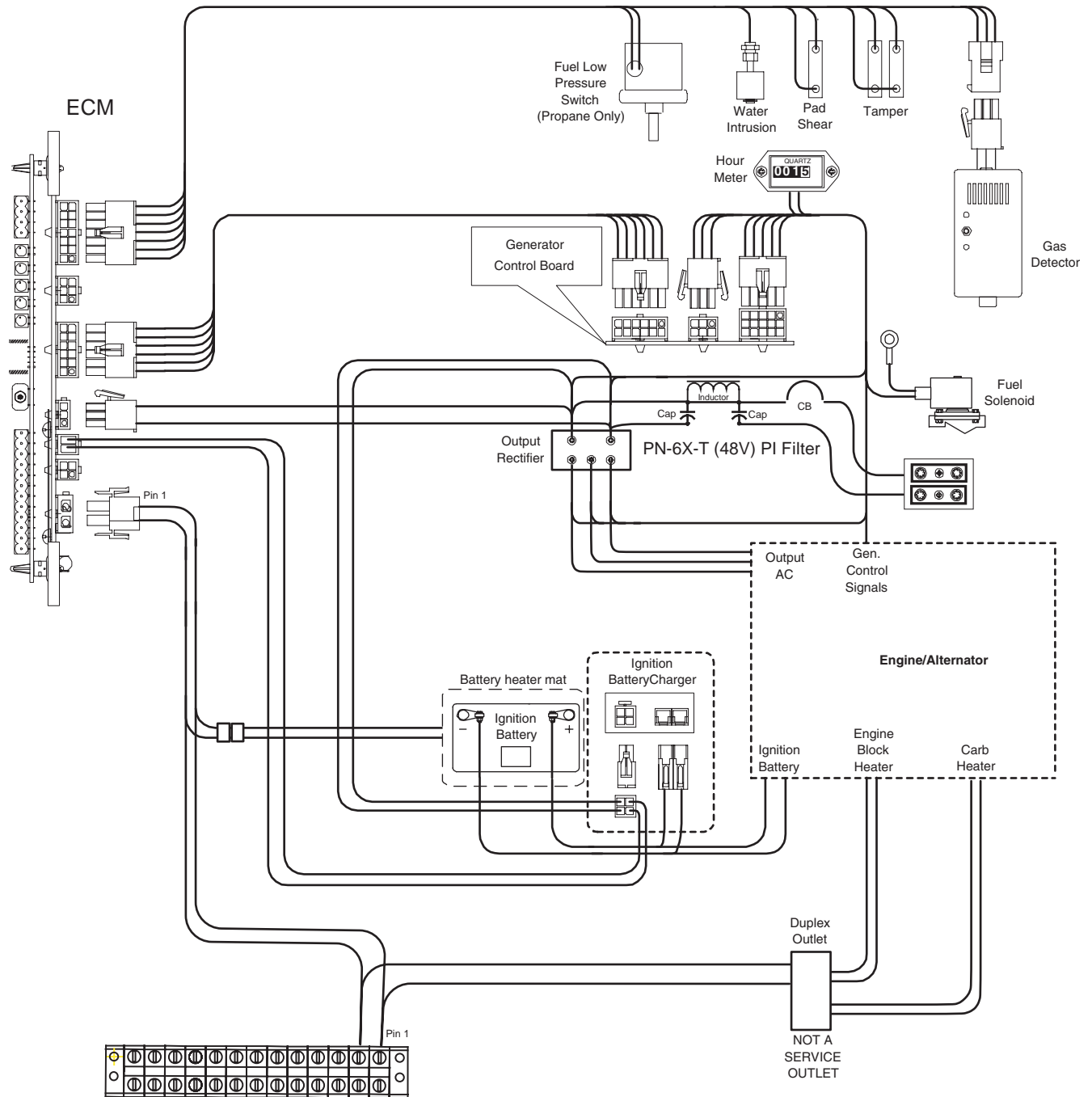


Fig. 4-8, ECM/APU Interconnection

4.0 The Engine Control Module, continued

4.10 ECM Input Voltage and Line Sense Configurations

The ECM has 120/240VAC input voltage and line sense capability that must be configured **separately**. The ECM PCB must be configured for 120/208/240VAC *line sense* via DIP Switch SW5-5 and SW5-6 as shown in Table 4-7. The default setting is 120VAC.

The logic transformer (T1) located on the GRI power board must also be configured for the correct **input voltage** by installing zero ohm jumpers R1-R4. Install R1 and R2 for 120VAC operation or R3 and R4 for 240VAC operation (see Fig. 4-9). The default setting is 120VAC.

Always configure ECM power board for an *input voltage* of 120VAC by installing zero ohm jumpers R1 and R2 and removing zero ohm jumpers R3 and R4 (default). Configure DIP SW5 on the ECM board for either 120VAC or 240VAC *line sense* depending on the input voltage configuration of the rectifiers being used. Always power the ECM with 120VAC and set DIP SW-5 for the input voltage of the rectifiers being used (120VAC or 240VAC). As long as SW5 is set correctly, the ECM will properly scale the voltage for status monitoring purposes.

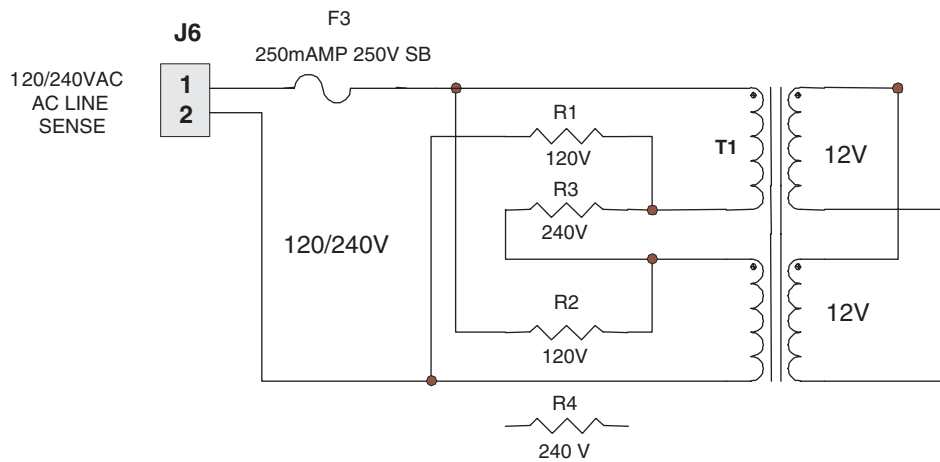


Fig. 4-9, Input Voltage and Line Configuration Schematic



NOTE:

The battery heater mat and engine block heater are wired in a parallel circuit within the ECM line sense; therefore, the ECM must be set for an input voltage of 120VAC.

4.0 The Engine Control Module, continued

4.11 ECM Self-test

**NOTE:**

The Telecom Power Monitor (TPM) option is required to access all ECM programmable parameters. These parameters cannot be changed without the TPM.

Generator testing consists of starting and running the generator for a programmable period of time (the default test duration is 10 minutes). Generator testing can be initiated in three ways:

1. The ECM is configured to periodically run an automatic test.
2. A Self-test can be commanded via status communications.
3. 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 via a reset command, or by successfully running a subsequent test.

4.0 The Engine Control Module, continued

4.11 ECM Self-test, continued

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

- **Autotest Interval:** This feature represents the number of days between automatic tests. Programming this variable to 0 disables the automatic test feature.
- **Autotest Countdown:** This countdown timer is monitored by the ECM to determine when the next automatic test is due. Although the timer is normally used as a status indicator, it can be used to set the start time for the next autotest. For example, if you want to start the automatic test sequence at 2:30pm and it is presently 12:30pm, program the Autotest Countdown to 2 hours. Subsequent tests will begin at the same time of day as long as the ECM doesn't lose power. The ECM resets the Autotest Countdown whenever the Autotest interval is changed. Thus, if the Autotest Interval is changed to 10 days, the ECM will set the Autotest Countdown to 240 hours.
- **Autotest Duration:** The length of each Autotest is measured in minutes. The default test duration is 10 minutes. The test duration may be set between 10 and 120 minutes.

Manually Enabling the Autotest Feature:

Use SW5-8 to enable the Autotest feature with a 14-day test interval. The first autotest will begin 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.

Follow the procedure below to set a self-test for a specific time of day. This procedure assumes you are not using a Telecom Power Monitor (TPM), and SW5-8 was ON.

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).
5. Disconnect and remove the ECM (again).
6. Turn ON SW5-8.
7. Reinstall the ECM with all connectors.

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

4.12 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 runs for a number of hours 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 represents 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 is assumed 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.



WARNING!

To prevent injury, never attempt to start a generator that has a leak detect alarm active. Correct the alarm condition before starting the generator.

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 indicate at least 12VDC (+ 2V). If this reading is lower than specified, recharge the batteries to 13.8VDC before proceeding.



WARNING!

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.

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 will disable the generator for maintenance.



CAUTION!

Do not attempt to crank or start the engine before servicing with the recommended oil, or engine failure will result.

5.0 Turn-up and Test, continued

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.

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.

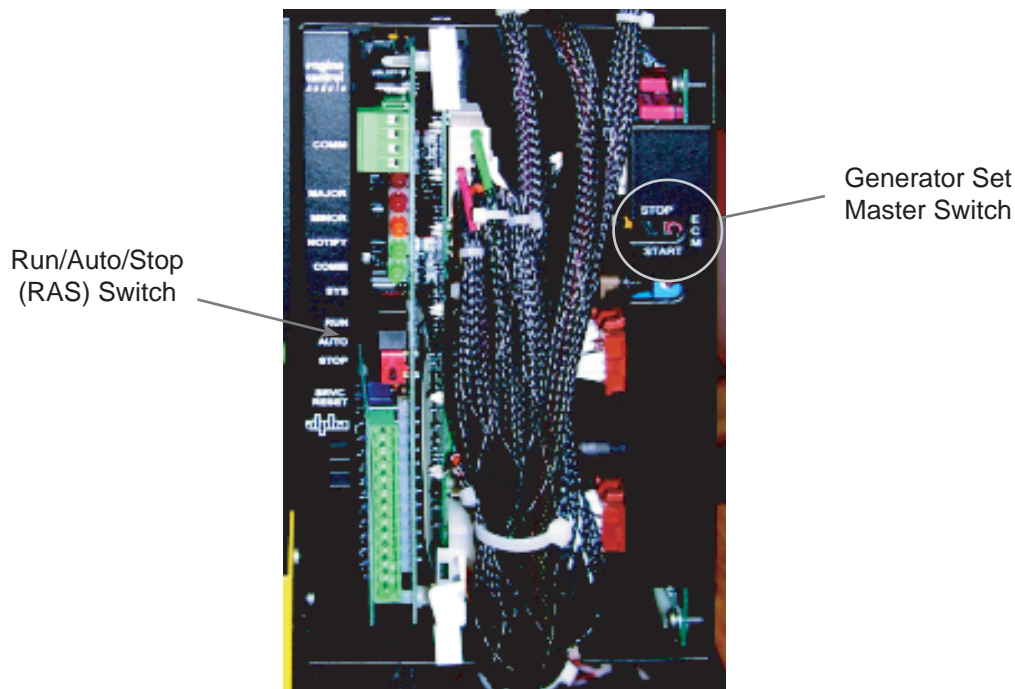


Fig. 5-1, Generator Set Master Switch and Run/Auto/Stop (RAS) Switch

5.0 Turn-up and Test, continued

5.3 Performing a Local APU Test, continued

9. If necessary, adjust the pre-regulator or dual regulator (located on gas bottle assembly for propane) by removing regulator cap and adjusting for $11" \pm 1"$ of water column pressure. Perform under NO-LOAD condition (see Section 7.9 for details).
10. Set RAS switch to Stop.
11. Remove brass manometer fitting and reinstall plug to demand regulator input monitoring port using approved pipe sealant.
12. Check demand regulator input monitoring port for leaks.
13. Set RAS to Auto.

5.0 Turn-up and Test, continued

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 needs to be in the active state for the ECM to report an alarm.

5.0 Turn-up and Test, continued

5.4 Generator System Sensor Verification, continued

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 will verify 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. Verify the APU starts and the ECM reports a minor DC Bus Fault alarm.
4. Verify the alarm clears, and return the Output Circuit Breaker to the ON position.
5. Verify the RAS switch is in the AUTO position, and the APU has run for one minute.
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 continues to run for a 12 minute “cool down” 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 will determine 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 greater 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 falls to 49V, the APU starts and runs until the DC bus voltage reaches 53V. The APU continues to run for a cool-down period (default 720 seconds).

6.0 Operation, continued

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 13.2V, or battery voltage less than 12.6V at any temperature.

Any of the following conditions will 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

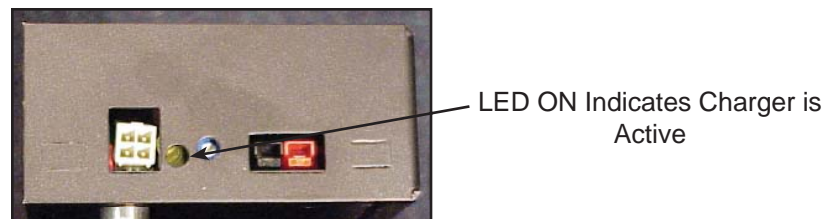


Fig. 6-1, Ignition Battery Charger LED

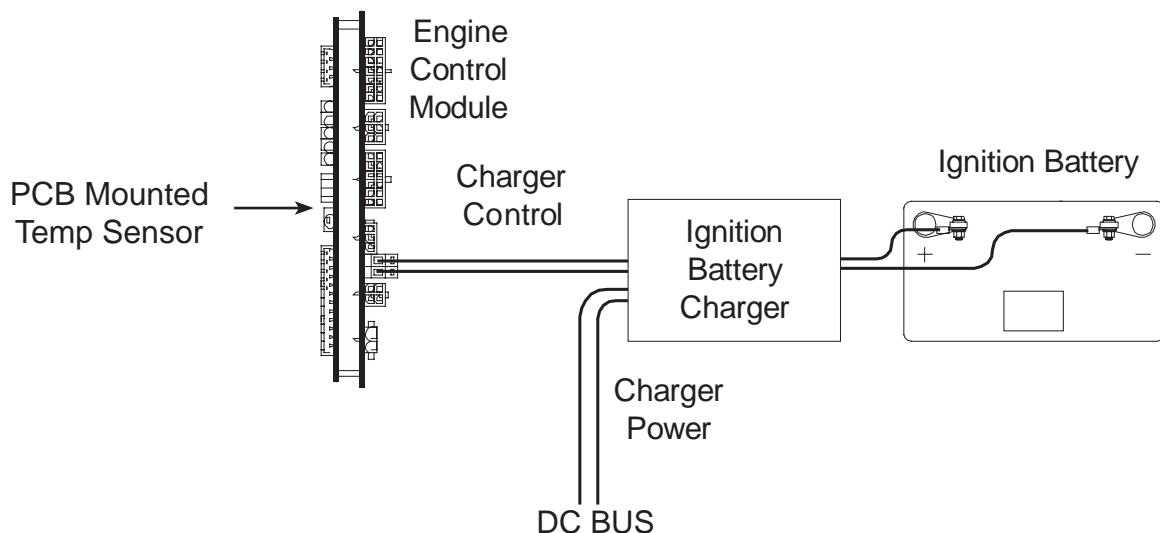


Fig. 6-2, Wiring for ECM, Ignition Battery Charger, and Ignition Battery

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.

System Component or Procedure	Maintenance Procedures					Frequency
	Visual Inspection	Verify	Change	Clean	Test	
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

7.0 Maintenance, continued

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



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.

7.0 Maintenance, continued

7.2 Filter Cleaning

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 or replace the filter and reinstall in the reverse order. Clean the filter using a vacuum or compressed air to remove loose dust or dirt. After cleaning, use compressed air to dry the filter.

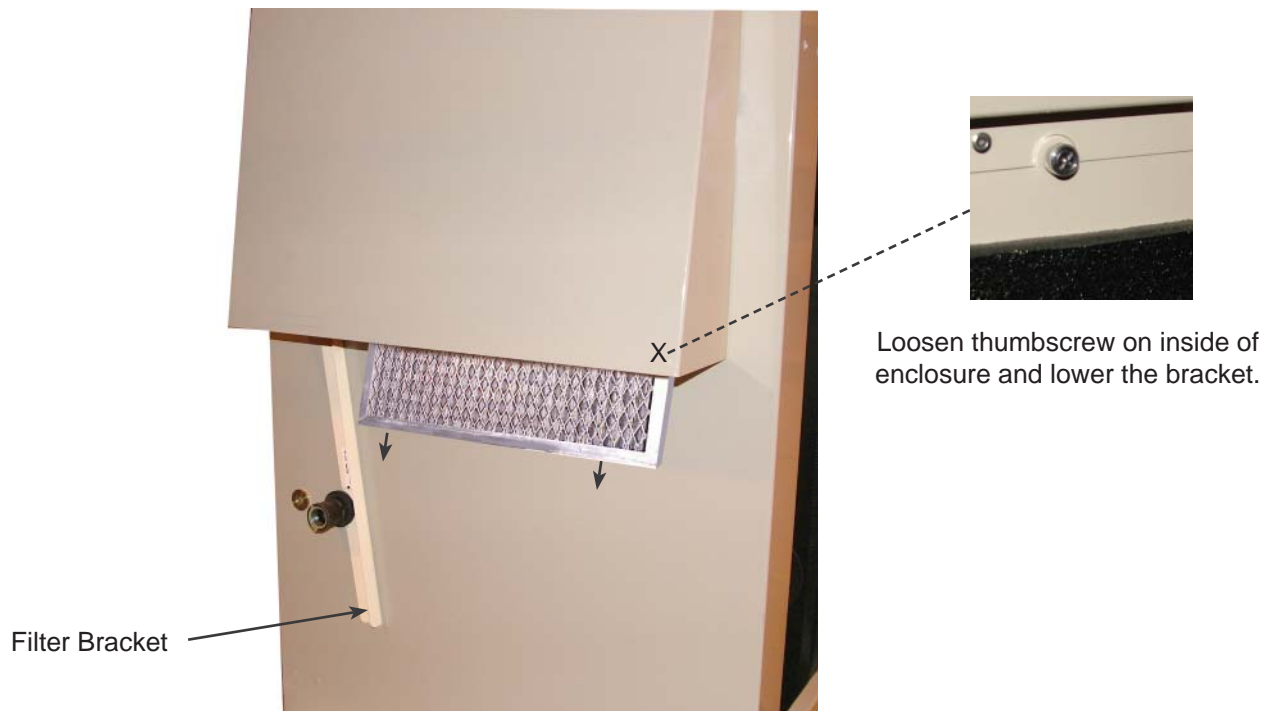


Fig. 7-1, Air Filter Removal

7.0 Maintenance, continued

7.3 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.
6. Reinstall in reverse order.



NOTE:

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

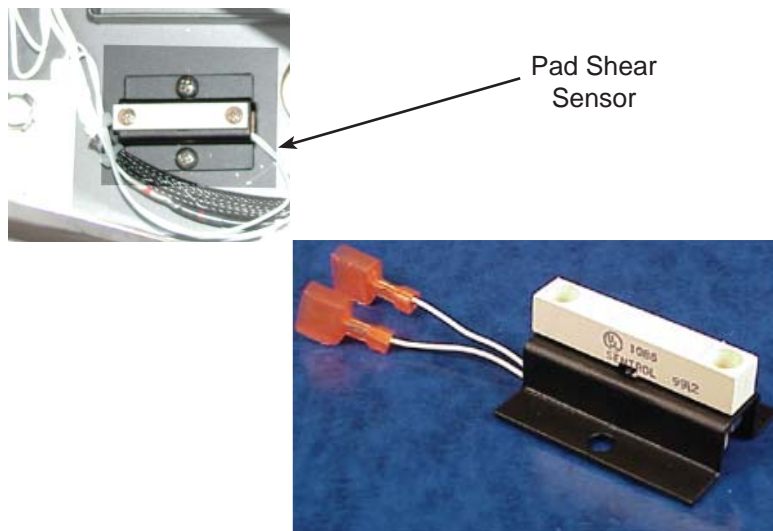


Fig. 7-2, Pad Shear Sensor

7.0 Maintenance, continued

7.4 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. 7-3, Gas Hazard Sensor Location (Alpha P/N 744-891-20)

7.0 Maintenance, continued

7.5 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. 7-4, Ignition Battery Charger

7.0 Maintenance, continued

7.6 Replacing Engine Control Module

1. Set RAS to STOP.
2. Turn off 200A DC circuit breaker.
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 on page 48.
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 ON.
11. Verify APU runs for the one minute self-test.
12. Check and clear any alarms.



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

Fig. 7-5, ECM with Connectors Attached

7.0 Maintenance, continued

7.7 Fuel Conversion – Natural Gas to LP

7.7.1 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. 7-6, Pre-regulator Removal

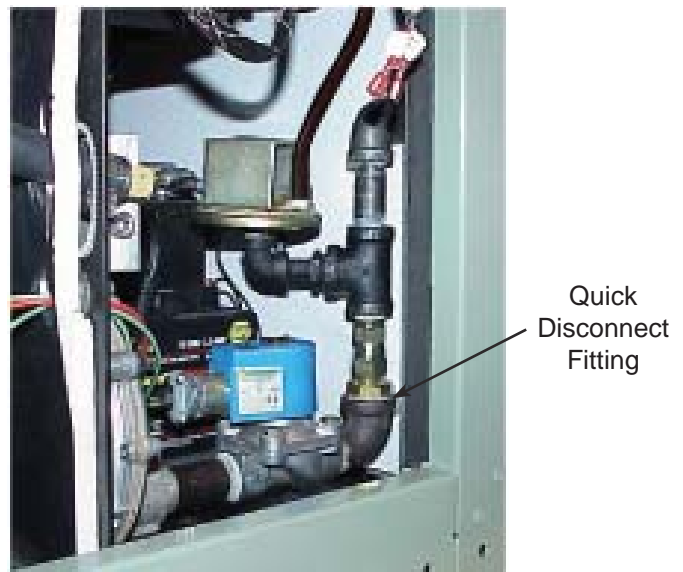


Fig. 7-7, Switch Assembly Installed

7.7 Fuel Conversion – Natural Gas to LP, continued

7.7.2 Switching the LP Port to the NG Port



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 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.

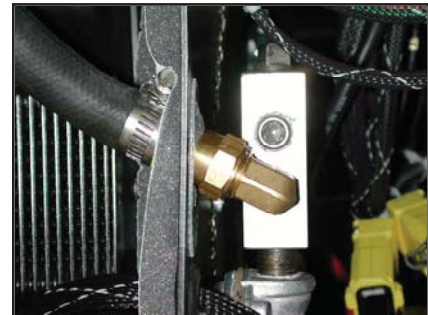


Fig. 7-8, Load Block
(natural gas configuration)

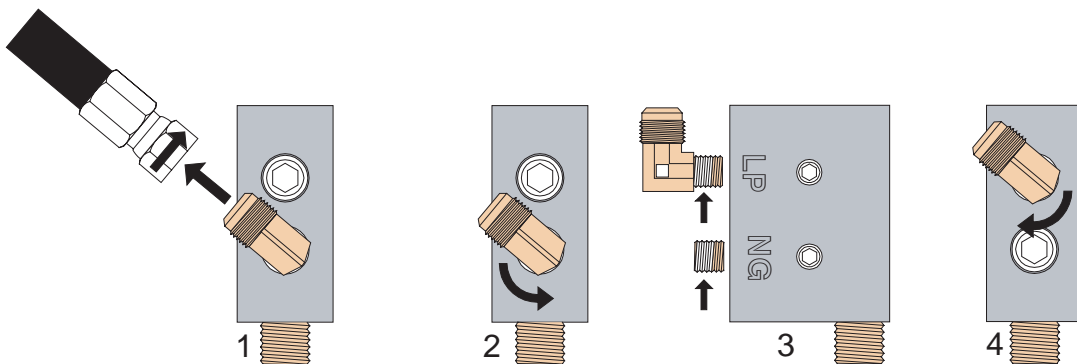


Fig. 7-9, Changing Load Block Configuration

7.0 Maintenance, continued

7.8 Gas Solenoid Replacement Procedure

Required Tools and Materials:

- Crescent wrench
- Pipe thread compound
- Leak detector compound (soapy water)

Two people are required to perform this procedure. To replace the fuel solenoid, the entire regulator package must be replaced.

1. Ensure the fuel supply is disconnected from the input regulator.
2. Remove the pre-regulator at the connection to the right of the solenoid.
3. Remove the flexible hose from the load block.
4. Remove the two mounting screws from the demand regulator.
5. Remove the demand regulator and solenoid assembly from the enclosure.
6. Reinstall new equipment in reverse order.
7. Check all new connections for leaks.

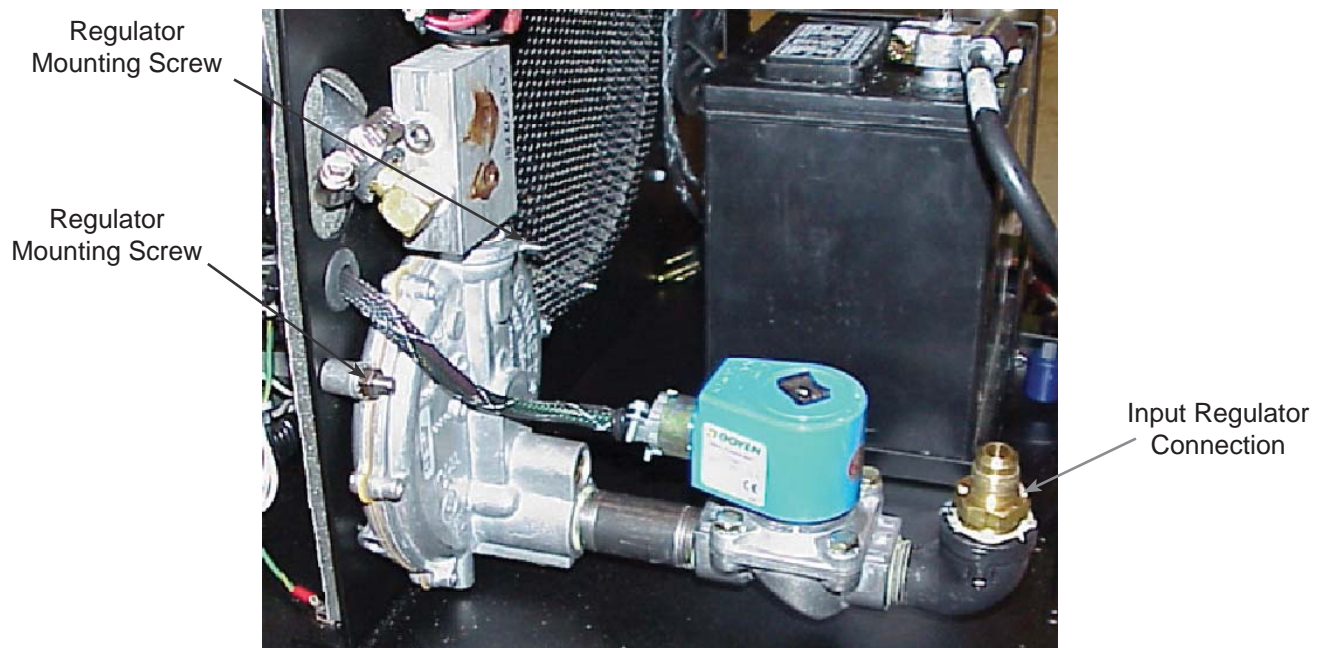


Fig. 7-10, Fuel Solenoid Valve

7.0 Maintenance, continued

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 via gas lines to the regulator system could damage the secondary demand regulator.



Fig. 7-11, Primary Fuel Regulator

7.0 Maintenance, continued

7.9 Maxitrol Pre-regulator Calibration, continued

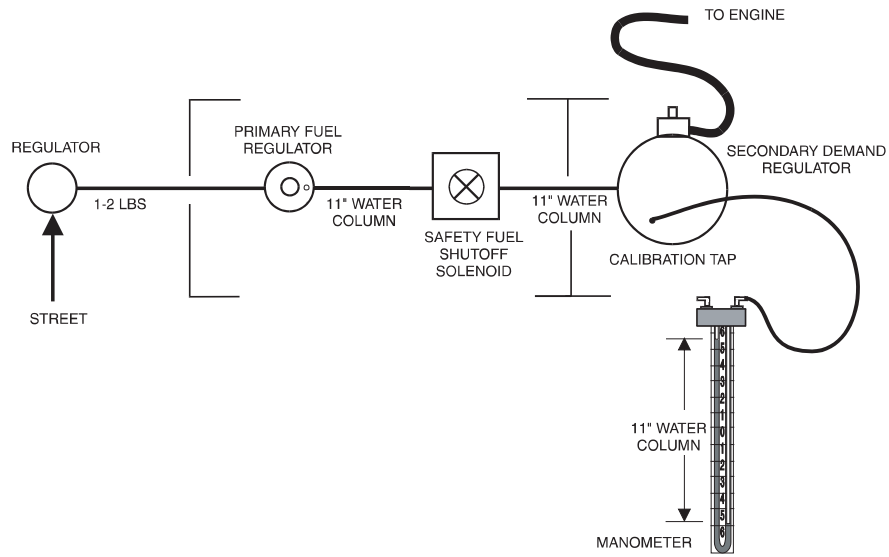


Fig. 7-12, Pre-regulator Calibration

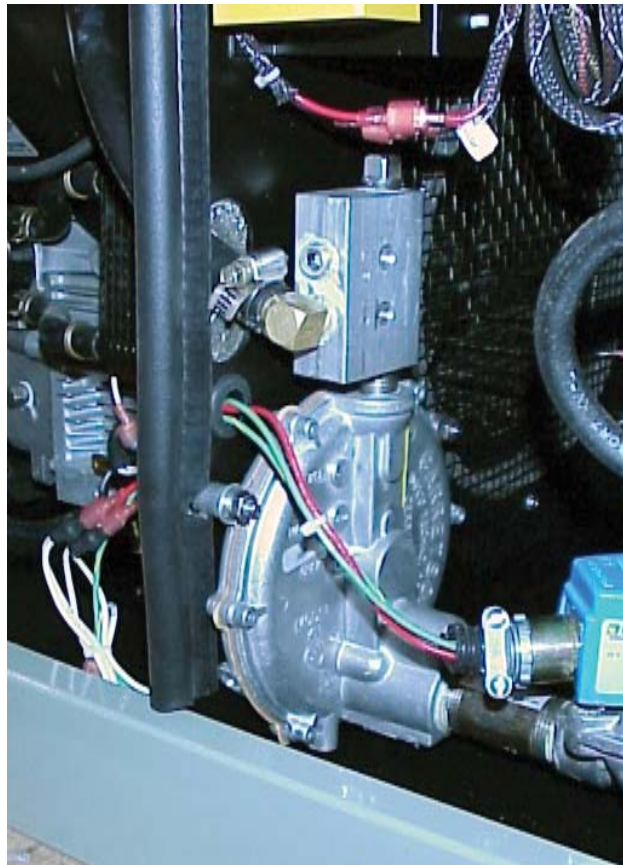


Fig. 7-13, Secondary Demand Regulator

7.0 Maintenance, continued

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 (see above).
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 will then crank 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 will start the engine.

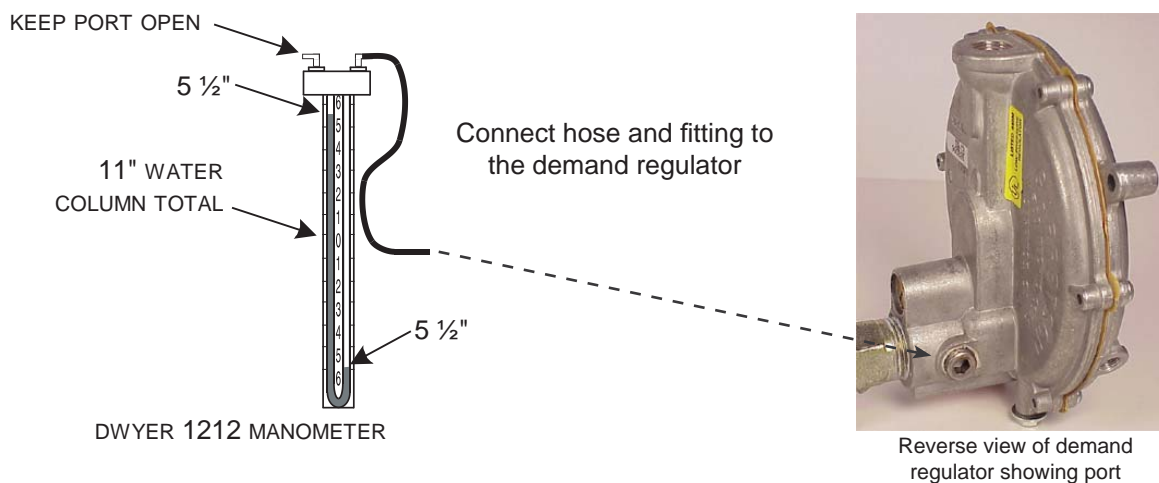


Fig. 7-14, Manometer Connection

7.0 Maintenance, continued

7.9 Maxitrol Pre-regulator Calibration, continued

6. 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.

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

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

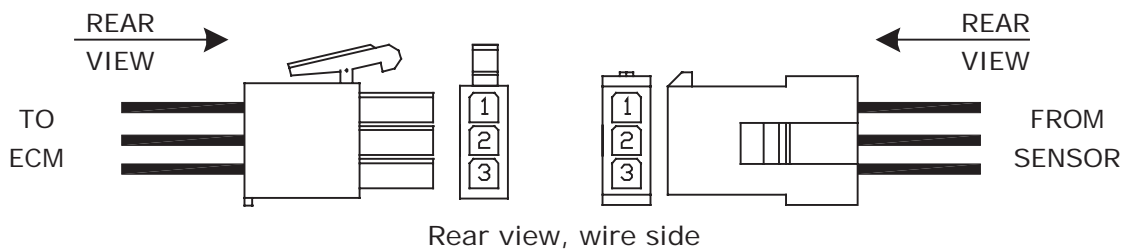


Fig. 8-1, Gas Hazard Detector Interface Connector

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

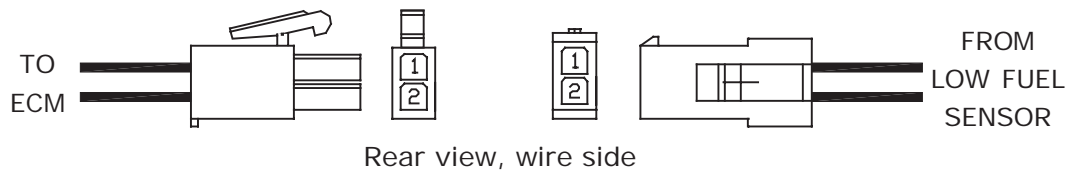


Fig. 8-2, Low Fuel Pressure Interface Connector

8.0 Interconnection, continued

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.

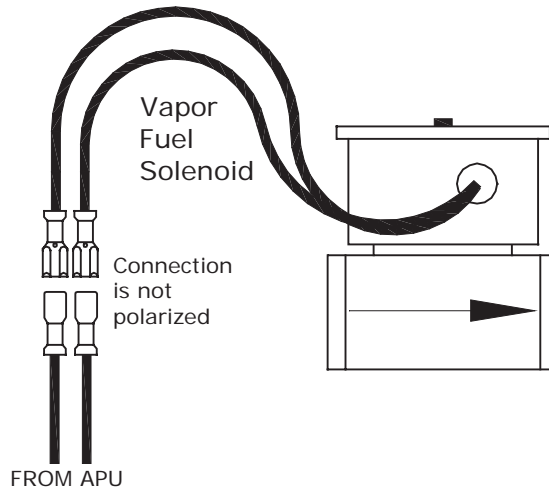


Fig. 8-3, Gas Solenoid Interface Connector

8.4 48V 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.

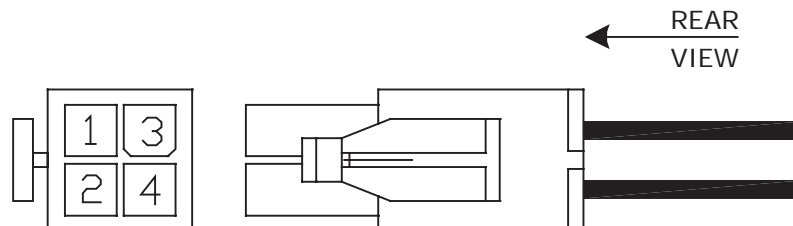


Fig. 8-4, Charger Control Interface Connector

8.0 Interconnection, continued

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	LPG fuel monitor
14	Common	Return path for LPG fuel monitor

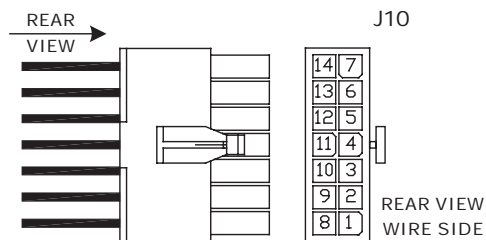


Fig. 8-5, ECM Enclosure Alarm Interface Connector

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

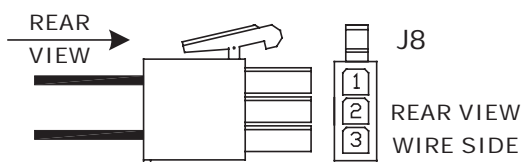


Fig. 8-6, Inverter Battery DC Sense Interface Connector

8.0 Interconnection, continued

8.7 48VDC 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

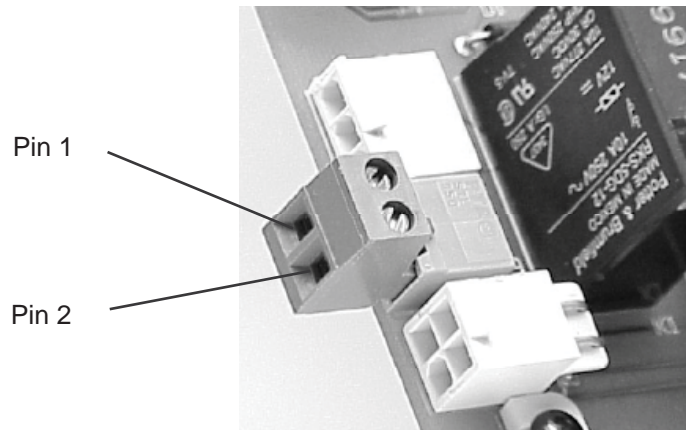


Fig. 8-7, 48VDC Charger Control Interface Connector

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.

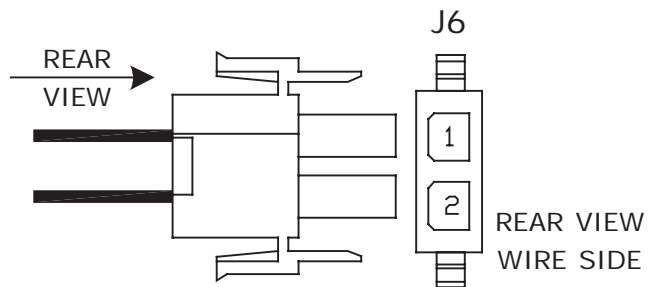


Fig. 8-8, ECM AC Line Sense, 120/240V Interface

8.0 Interconnection, continued

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	

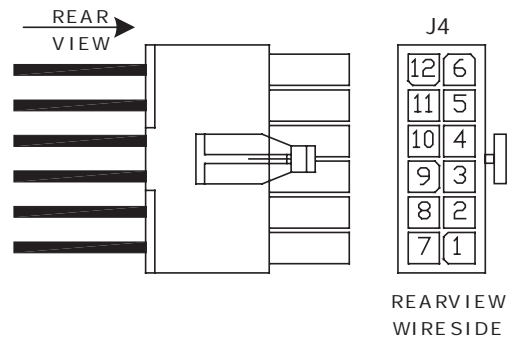


Fig. 8-9, APU Control Interface

8.10 ECM Alarm Interface & Communications

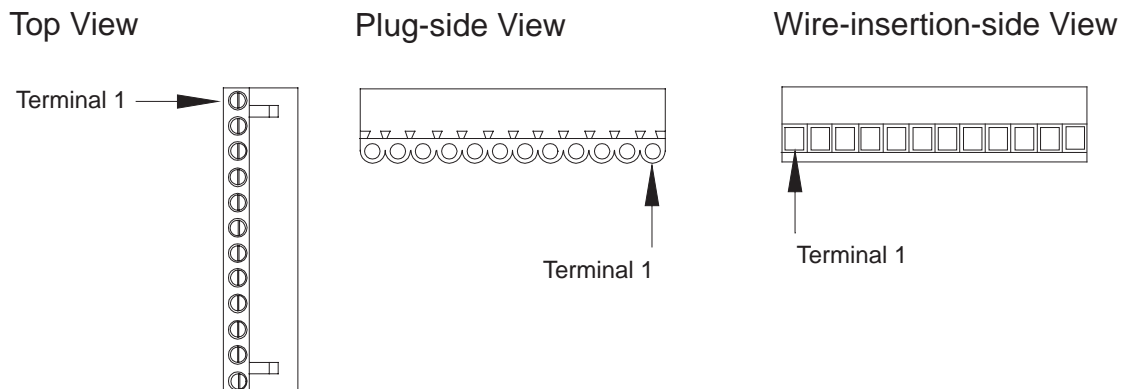


Fig. 8-10, ECM, SCM Connector Arrangement

Power

Alpha Technologies



Alpha Technologies
3767 Alpha Way
Bellingham, WA 98226
USA
Tel: +1 360 647 2360
Fax: +1 360 671 4936
Web: www.alpha.com

Alpha Technologies Ltd.
4084 McConnell Court
Burnaby, BC, V5A 3N7
CANADA
Tel: +1 604 430 1476
Fax: +1 604 430 8908

Alpha Technologies
Europe Ltd.
Twyford House
Thorley
Bishop's Stortford
Hertfordshire
CM22 7PA
UNITED KINGDOM
Tel: +44 (0)1279 501110
Fax: +44 (0)1279 659870

Alpha Technologies GmbH
Hansastraße 8
D 91126 Schwabach
GERMANY
Tel: +49 9122 79889 0
Fax: +49 9122 79889 21

Alphatec, Ltd
P.O. Box 56468
Limassol, Cyprus
CYPRUS
Tel: +357 25 375675
Fax: +357 25 359595

AlphaTEK ooo
Khokhlovskiy Pereulok 16
Stroenie 1, office 403
109028 Moscow
RUSSIA
Tel: +7 495 916 1854
Fax: +7 495 916 1349

Alphatec Baltics
S. Konarskio G. 49
Vilnius 2009
LITHUANIA
Tel: +350 5 210 5291
Fax: +350 5 210 5292

Alpha Technologies
5 Avenue Victor Hugo
F 92140 Calmart France
FRANCE
Tel: +33 3 41 90 07 07
Fax: +33 1 41 90 93 12