ALPHAGEN™ Broadband Generator Systems

AlphaGen PN-6x 7.5kW 48V/96V Generator

Installation, Operation, and Maintenance Manual

Effective: February, 2003

Alpha Technologies

AlphaGen PN-6x 48V/96V

Installation, Operation, and Maintenance Manual

745-020-B0-001, Rev. A

Effective Date: February, 2003

NOTE: Alpha denies responsibility for any damage or injury involving its enclosures, power supplies, generators, batteries, or other hardware when used for an unintended purpose, installed or operated in an unapproved manner, or improperly maintained.

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

NOTE: Review the drawings and illustrations contained in this manual before proceeding. If there are questions regarding the safe operation of this powering system, please contact Alpha Technologies or your nearest Alpha representative.

Contacting Alpha Technologies:

For general **product information and customer service**

1-800-863-3930

(7:00 AM to 5:00 PM Pacific Time)

For complete **technical support**

1-800-863-3364

(7:00 AM to 5:00 PM Pacific Time, or 24/7 emergency support)

ALPHAGEN Brodband Generator Systems

Table of Contents

1.0 System Installation

ALPHAGEN Brodband Generator Systems

Table of Contents

Part Two: APU Operation and Maintenance

List of Figures

List of Figures

List of Tables

Important Safety Instructions Contained in This Manual
Read this manual before proceeding!

CAUTION

HAZARDOUS CONDITION

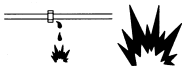
To reduce the risk of electrical shock, injury or death caused by explosion of fuel or moving parts, and to ensure the safe operation of this unit, the following symbols have been placed throughout the manual. Where these symbols appear, servicing should be performed only by qualified personnel.

DANGEROUS VOLTAGE
This symbol indicates a “dangerous voltage” exists in this area of the product. Use caution whenever working in the area to prevent electrical shock.

INHALATION HAZARD - DON’T BREATHE VAPORS
This symbol indicates an “inhalation hazard” exists in this area of the product. Use caution whenever working in the area to prevent possible inhalation of harmful (fuel or exhaust) vapors.

NO MATCHES OR OPEN FLAMES
This symbol indicates a fire or explosive hazard exists in this area of the product. Use caution whenever working in the area to prevent possible combustion of fuel vapors.

MECHANICAL OR MOVING PARTS HAZARD
These symbols indicate the presence of a “mechanical or moving parts hazard” in this area of the product. Use caution whenever working in the area to prevent possible injury to the operator or service personnel.



LEAK HAZARD
This symbol indicates a “leak hazard” exists in this area of the product. Use caution whenever working in the area to prevent and correct any leaks detected.

CRUSH HAZARD
This symbol indicates the presence of crushing hazard in this area. Keep hands clear of areas under extended battery trays and equipment drawers.

ATTENTION
This symbol indicates important installation, operation or maintenance instructions. Always follow these instructions closely.

Battery Safety Notes

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

Chemical Hazards

NOTE: 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, which are electrically conductive and corrosive.

If any battery emission contacts the skin, wash immediately and thoroughly with water. Follow your company's approved chemical exposure procedures.

If any battery emission contacts the eye, wash immediately and thoroughly with water for 10 minutes with pure water or a special neutralizing eye wash solution and seek immediate medical attention. 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 1 lb. bicarbonate of soda to 1 gallon of water. Report chemical spill using your company's spill reporting structure and seek medical attention if necessary.

To avoid injury

Wear protective clothing (insulated gloves, eye protection, etc.) whenever installing, maintaining, servicing, or replacing batteries. 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 that 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. Do not smoke or introduce sparks in the vicinity of the b attery. Under extreme overcharging conditions, Lead-acid batteries can vent a mixture of Hydrogen gas which is explosive. 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.

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 cable 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 has not sifted 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.

Safety Precautions

- The system must be serviced only by qualified personnel.
- Remove all rings, watches and other jewelry before servicing batteries or servicing the system.
- Verify the voltage requirements of the equipment to be protected (load), the AC input voltage to the power supply (line), and the output voltage of the system prior to installation.
- The utility service panel must be equipped with a properly rated circuit breaker for use with this power supply.
- When connecting the load, DO NOT exceed the output rating of the system.
- Always use proper lifting techniques whenever handling units, modules or batteries.
- If batteries are being stored prior to installation, they should be charged at least once every three months to ensure optimum performance and maximum battery service life.
- The battery pack, used to provide backup power, contains dangerous voltages. Battery inspection and replacement must be performed by qualified personnel.
- Always wear protective clothing, insulated gloves and eye protection (i.e. safety glasses or a face shield) whenever working with batteries.
- Always carry a supply of water, such as a water jug, to wash the eyes or skin in the event of exposure to battery electrolyte.
- Do not allow live battery wires to contact the enclosure chassis. Shorting battery wires can result in a fire or possible explosion.
- Batteries must be inspected every three to six months for signs of cracking, leaking or swelling.
- Always replace batteries with those of an identical type and rating. Never install old or untested batteries.
- Avoid using uninsulated tools or other conductive materials when handling batteries or working inside the enclosure.
- Spent or damaged batteries are considered environmentally unsafe. Always recycle used batteries or dispose of in accordance with all Federal, State, and local regulations.

Important Installation Notes

The system must be installed ONLY by qualified service personnel.

Consult local utility codes for additional cabinet grounding and utility requirements.

ALPHA TECHNOLOGIES is not responsible for broken welds or other damage to the cabinet caused by improper installation.

All dimensions are given in inches.

For further information regarding this installation, contact ALPHA TECHNOLOGIES or your nearest ALPHA representative.

For general product information and Customer Service
7:00AM to 5:00PM Pacific Time
1-800-863-3930

To obtain complete Technical Support,
7:00AM to 5:00PM Pacific Time
or
For after-hours Emergency support
7 days per week, 24 hours a day
1-800-863-3364

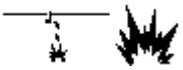
NOTE: Alpha Technologies' products are subject to change through continual improvement processes. Therefore, specifications and/or design layouts may vary slightly from descriptions included in this manual. Updates to the manual will be issued when changes affect form, fit or function.

Save these instructions for future reference

Auxiliary Power Unit (APU) Notes

NOTE: When the engine is stopping, a small amount of unburned fuel may be detected by the odor of gas fumes. 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.

NOTE: 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% - 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.



NOTE: If gas fumes are detected before the engine is run, or in excess *of* approximately 10 minutes after running the engine, you must check the system for leaks and correct as necessary.

1.1 System Overview

The AlphaGen PN-6x enclosure from Alpha Technologies has been designed to meet the needs of today's outside plant powering requirements.

The procedures in this document describe the installation, operation and maintenance of a PN-6x Generator Enclosure.

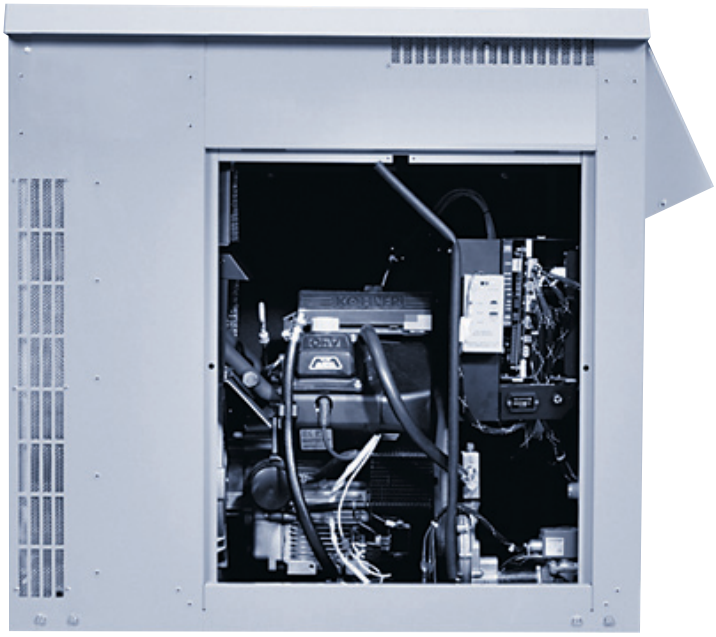


Fig.1.1 PN-6x generator and enclosure viewed from operators side

1.2 Specifications

DC Output voltage	52.0 +/- 0.5 VDC @ no load 48 VDC configuration 104 +/- 0.5 VDC @ no load 96 VDC configuration
Output current	52V @ 144A max. /104V @ 72A max.
Engine	624cc Air Cooled Twin OHV, 15Hp Rated
RPM	1800 to 3600 RPM max. (variable speed)
System size:	Height 39.0" (57" with optional pedestal) Width 39.25" Depth 24" Weight 338lbs. (370lbs with optional pedestal)
Acoustic	70.3 dBa @ 10 feet, *(8 point average @ 100% load)*
APU Fuel Consumption	
Propane - 2520 BTU/ft^3	1.48 cubic meters per hour 54 ft^3 per hour
Natural Gas - 1000 BTU/ft^3	156 ft^3/hr (@7500W load)
Gas Inlet Pressure	0.5-2 psi NOTE: Contact Alpha Technologies for low pressure operation below 0.5 psi.
Ign. charger voltage	13.5 VDC max. (14.15 VDC max. for 96V version)
Ign. charger current	6A max. (1.5A max for 96V version)
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. Gas Hazard, Pad Shear, Water Intrusion, Tamper

Full System Control and Status Monitoring included on all models:

Sensors:	Low oil shutdown Oil over-temp
Safety Shutdowns:	Engine overspeed Over-crank (Crank limit) Gas hazard (LPG or Natural Gas) Low fuel pressure shutdown (LPG) Water intrusion Pad shear

1.3 Block Diagram

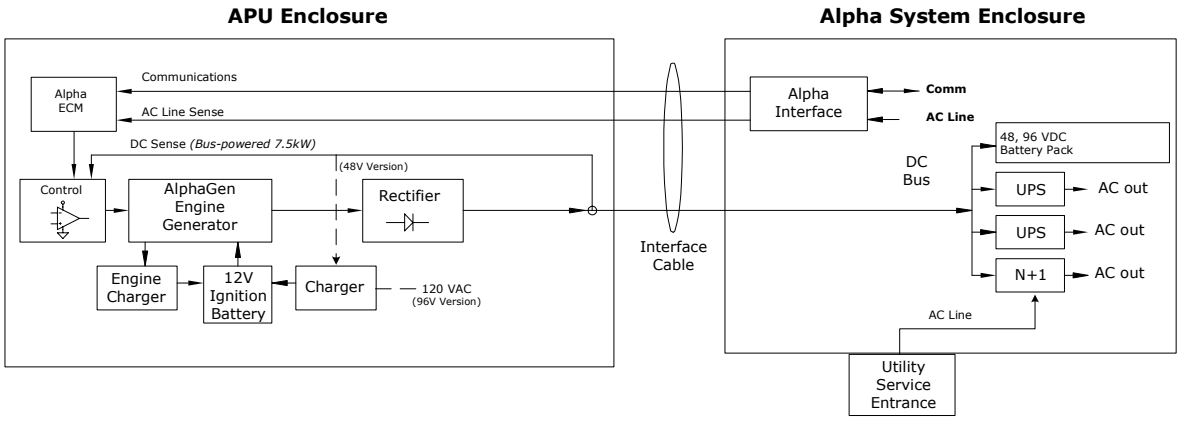


Fig.1.2 Block diagram, system with DC Engine Generator

1.4 Acoustics

The presence of a curbside engine-generator and its placement causes many concerns in the local communities, but nuisance noise is perhaps of most 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 also vary due to absorption and reflection caused by the immediate surroundings).

These concerns with audible impact on neighborhoods are 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 7.5kW generator. Note the symmetry of these emissions. The elimination of nuisance noises and the reduction of directional impact within a residential community is critical for deployment.

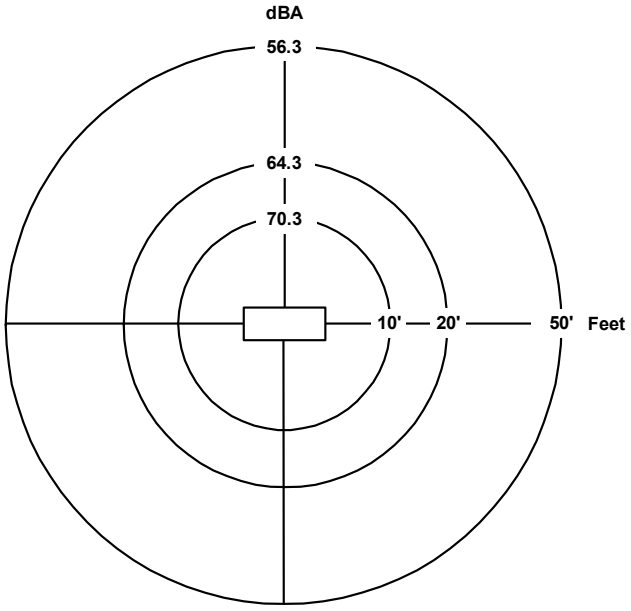


Fig. 1.3 Generator sound levels at 100% load

1.4 Acoustics, *continued*

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

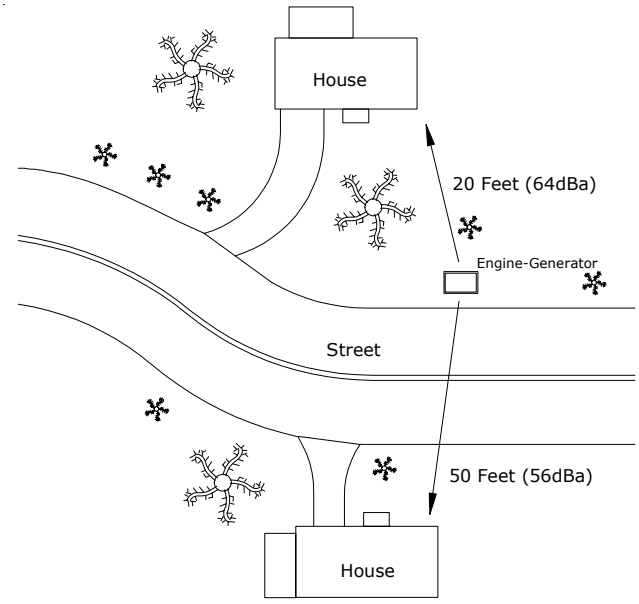


Fig. 1.4 E-G Acoustical Measurements in relation to placement near residences
(Generator sound levels at full load)

1.5 Collocated Configuration

Typical Configuration

PN6x APU

PN-6 Powernode Enclosure
-Populated with 1 to 3 power supplies and up to two 48V battery strings.

Dimensions: 91" W x 39" H x 24" D
(231cm x 99cm x 61cm)

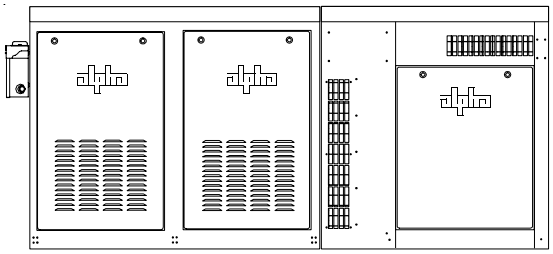


Fig. 1.5 Collocated with PN-6

Extended Battery Backup Configuration

Optional BD-8 Battery Drawer
-Provides up to 2 additional 48V battery strings.

Optional Generator Pedestal

Dimensions: 91" W x 57" H x 24" D
(231cm x 145cm x 61cm)

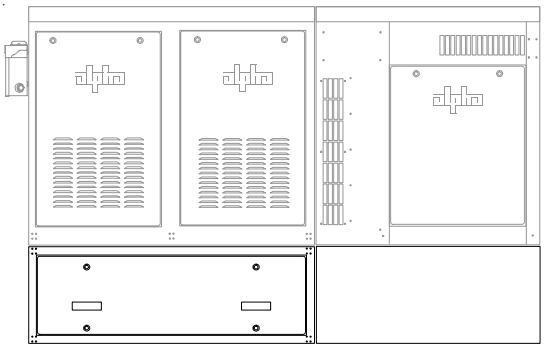


Fig. 1.6 Collocated with PN-6, BD-8

Remote Cabinet Configuration

PN cabinet and APU may be separated by up to 12 feet (sweep to sweep). Contact Alpha Technologies for installations that require greater separation.

If desired, the BD-8 battery drawer may be used in this configuration.

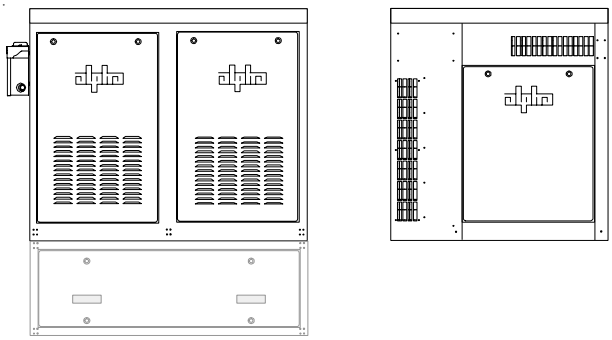


Fig. 1.7 Remote with PN-6 (BD-8)

1.6 Enclosure Impact Protection

1.6.1 Installation Topology

The National Fire Protection Agency (NFPA) requires that equipment utilizing natural gas or LP-gas be protected, based on good engineering practices, in areas were vehicle traffic is normally expected at that location. The requirement that good engineering practices be used allows for flexibility in the design and materials. The required protection is based upon 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 reasonable expected speed.

Alpha Technologies, Inc. cannot anticipate all of 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 for Alpha's Standby Generator systems are general recommendations and 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.

1.6.2 Natural Gas Protection, Vehicular Areas

Several variations of installation are possible, the intent of the diagrams are to 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.

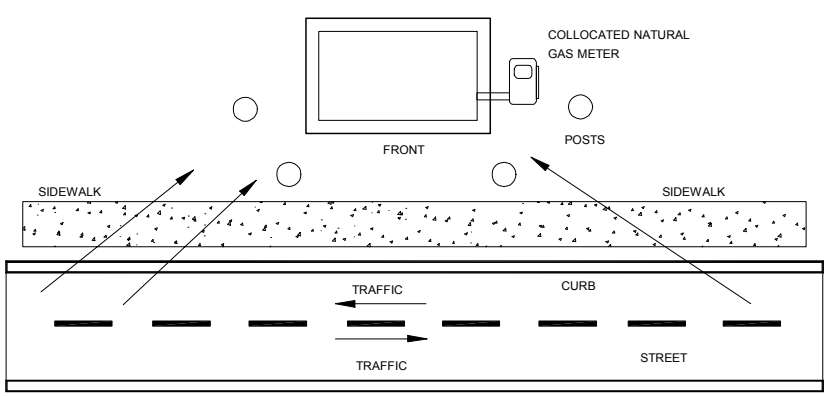


Fig.1.8 Impact protection, collocated Natural Gas meter, vehicular area

1.6 Enclosure Impact Protection, *continued*

1.6.2 Natural Gas Protection, Vehicular Areas, *continued*

The Remote located Natural Gas meter shown below may require two to four bollard posts depending on locations, site surveys, and traffic patterns. This design, shown below is another typical installation, with gas meters located near the cabinet (less than 25 feet), and supported by dual risers.

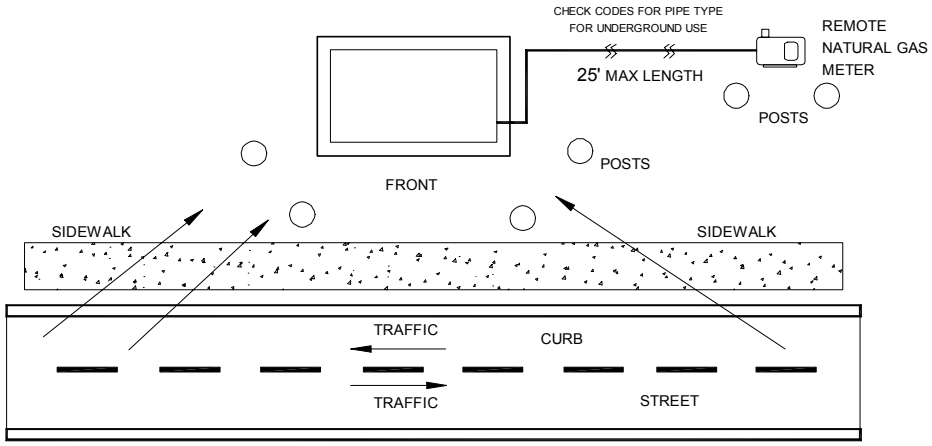


Fig.1.9 Impact protection, remote Natural Gas meter, vehicular area

1.6.3 Natural Gas Protection, Non-Vehicular Areas

For residential, private property, or other non-vehicular traffic areas, bollards may not be necessary.

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1.7 Natural Gas Systems

1.7.1 Fuel System Block Diagram.

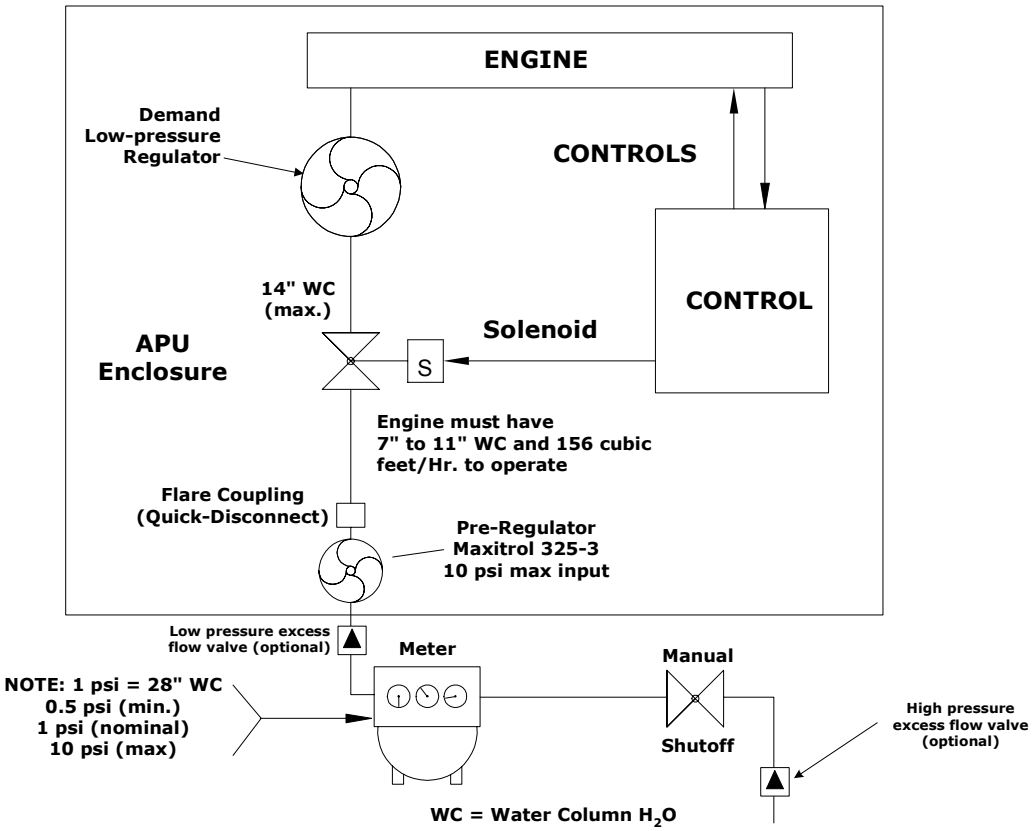


Fig.1.10 Arrangement of Metered, Nominal Pressure (1-2psi) Natural Gas System

1.7 Natural Gas Systems, *continued*

NOTE: For added safety, excess flow valves may be installed in either or both locations.

NOTE: Effective February 3, 1999, a new law, 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 for builders or notify builders about EFVs' benefits and availability. EFVs are valves installed on gas service lines during pre-construction site work that automatically activate when a gas line is ruptured. Excess flow valves should never be used as in-line regulators. They will not perform this function, and may damage equipment.

Fig. 1.11 Low pressure Excess Flow Valve
(above ground ¾" x 4" NPT nipple)
Alpha p/n 042-146-10

1.8 Meter Configurations

1.8.1 Natural Gas, Collocated Meter

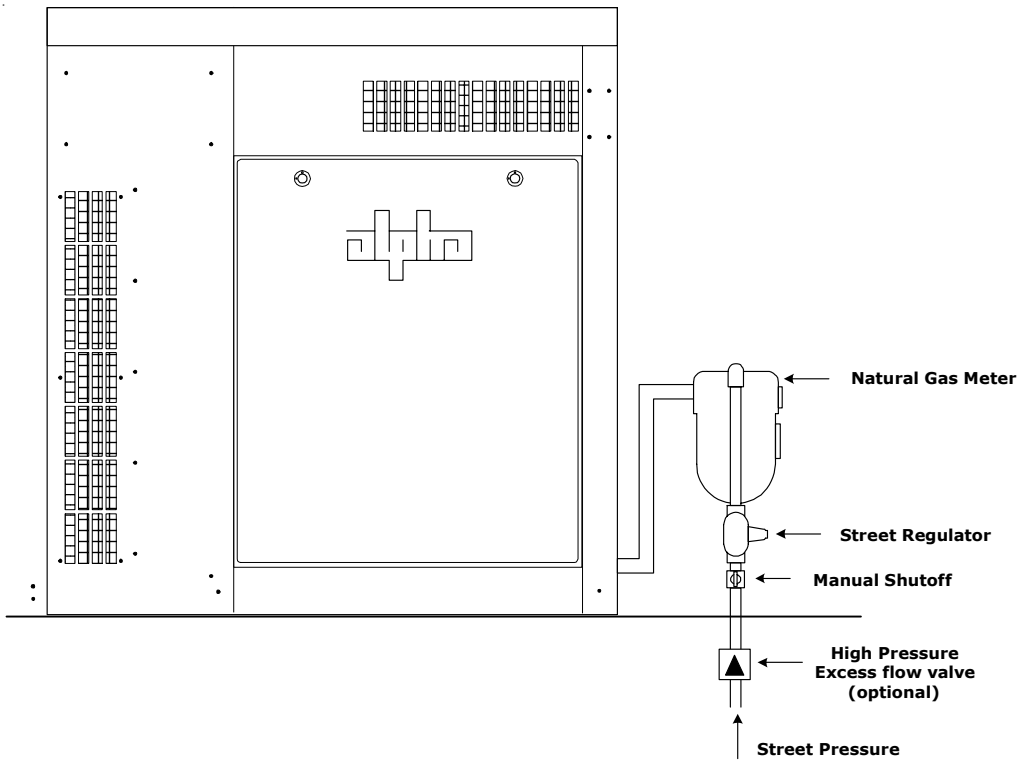


Fig.1.12 Enclosure with Co-Located Natural Gas meter

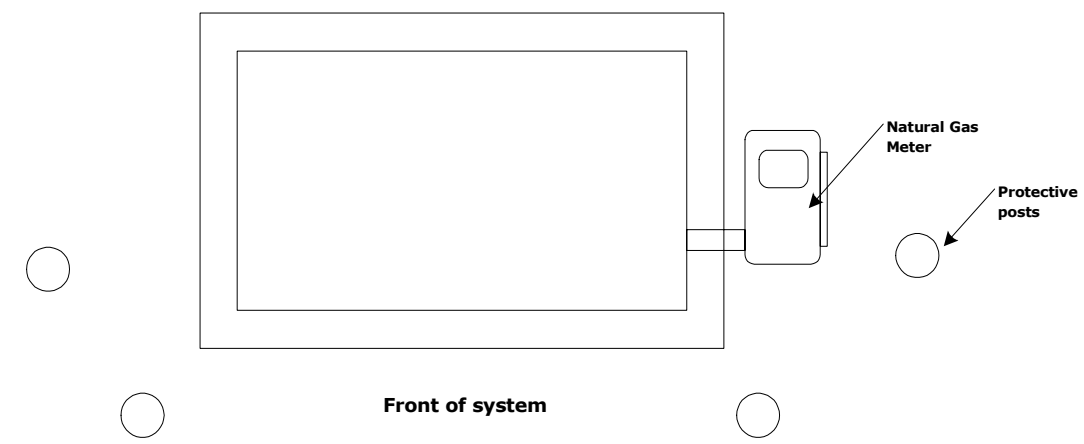


Fig.1.13 Overhead view of system with Co-Located Meter

1.8 Meter Configurations, *continued*

1.8.2 Natural Gas, Remote Meter

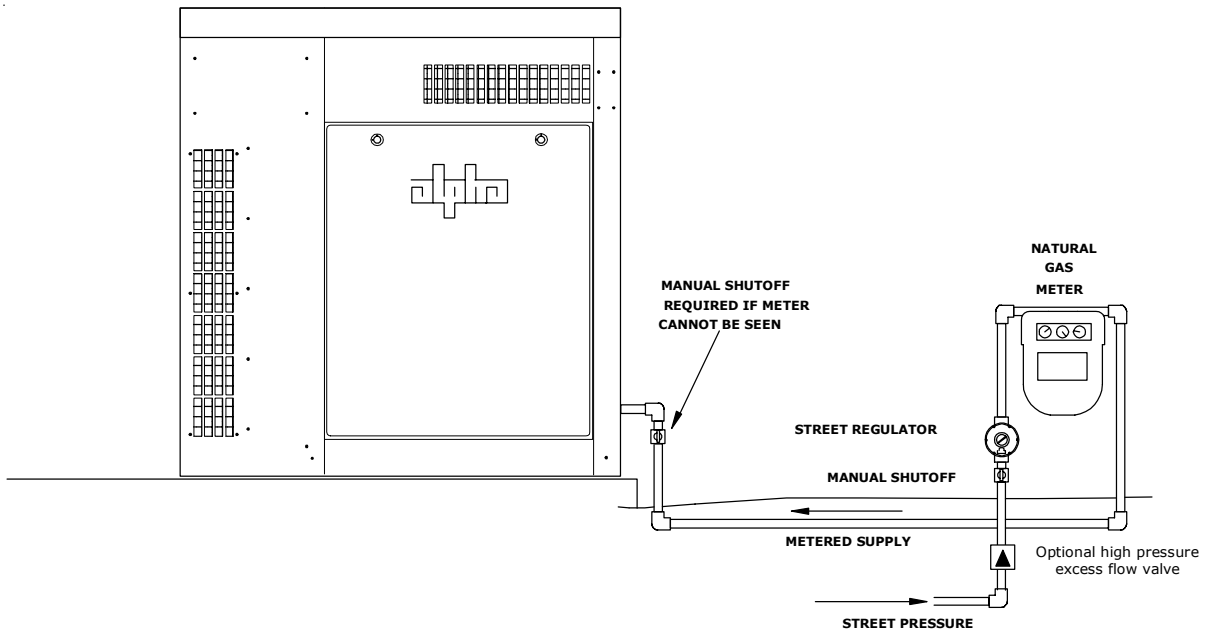


Fig.1.14 Enclosure with remote Natural Gas meter

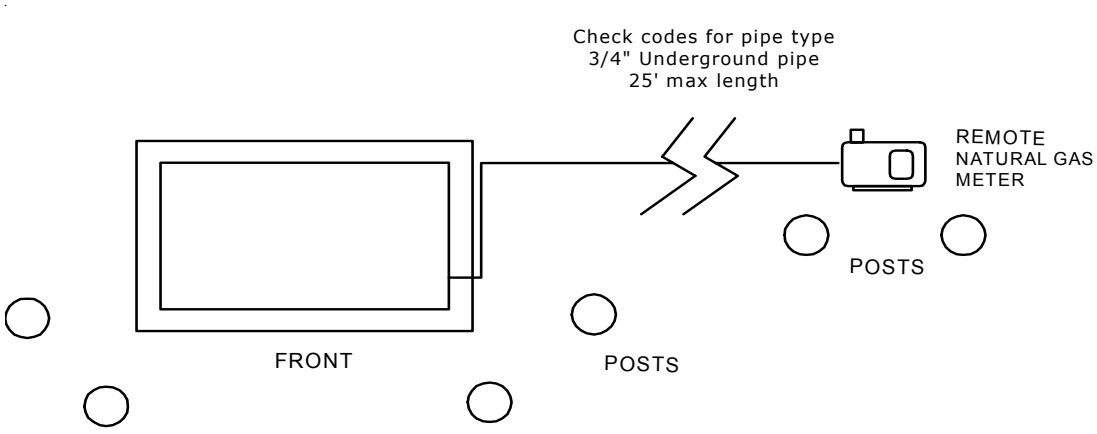


Fig.1.15 Overhead view of system with remote meter

2.1 Site Considerations

- Where possible, select a site that is above the 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 wind-borne dust.
- Evaluate the soil conditions for suitability for the installation of the required grounding system applicable to your particular installation.
- Verify utility power cabling has been run, and terminated at the site.

2.2 Introduction to Procedures

Description

This section describes the procedure for installing the PN-6x enclosure.

When to use this document:

Upon receipt of the Enclosure.

Before installation:

Verify the following:

- All necessary grounding rods and materials are in place.
- Utility power has been run to site in accordance with 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 and local requirements.

To perform the installation procedures, the installer(s) will need to have the following materials on hand:

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 (Pad shear).

NOTE: The batteries used in this application may vary slightly depending upon optional configurations, battery types, or customer requirements. The batteries are typically gelled-electrolyte valve-regulated, such as the Alpha Cell or absorbent glass-mat (AGM). Should a battery be found damaged, refer to the battery manufacturer's documentation regarding the safe handling of the battery.

2.3 Concrete Pad Layout

The illustration below *(Fig.2.1)* shows the general dimensions for the precast concrete pad. When placing the pad, allow at least 36 inches of clearance to beyond the front and rear doors. *Follow the manufacturers instructions when installing the precast pad.*

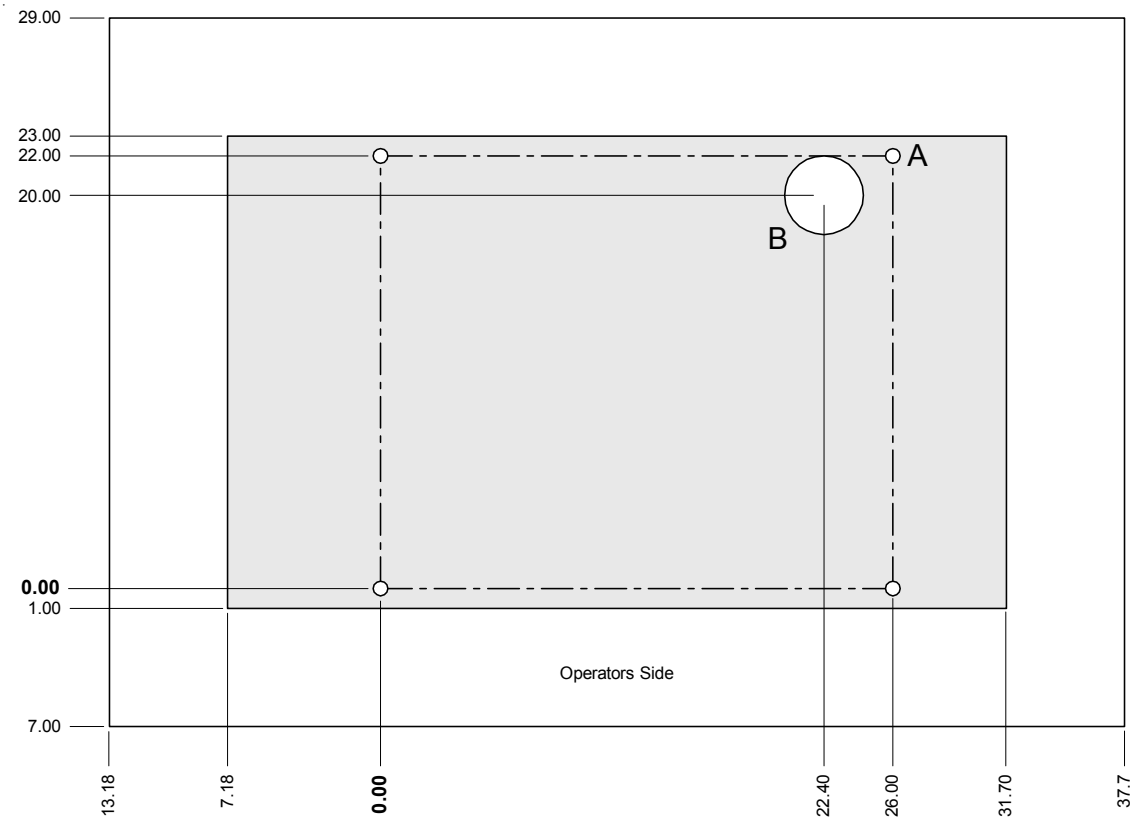


Fig.2.1 Pad dimensions, stand-alone cabinet

Stand-alone pad notes:

A 3/8" to 1/2" Bolts (4 places) The bolts should extend AT LEAST 2” above the surface of the cement (or threaded inserts of same thread and length).

B 3" Opening for DC Output Cable, AC Sense and Status Monitoring harness.

A 25+ year *continuous vapor barrier* must be used between the enclosure and pad to prevent moisture ingress and possible corrosion caused by metal to concrete contact. The vapor barrier material (such as 30 lb. felt, neoprene pond liner, or heavy grade tar paper) should initially extended at least 6" in all directions around the perimeter of the enclosure, then be trimmed closer to the enclosure after installation is complete, using the appropriate knife or cutting tool.

3. Installation

3.1 Transportation and Lifting

The enclosure as shipped contains the Auxiliary Power Unit (APU) and, therefore, is **heavy** (approximately 338 pounds). 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.

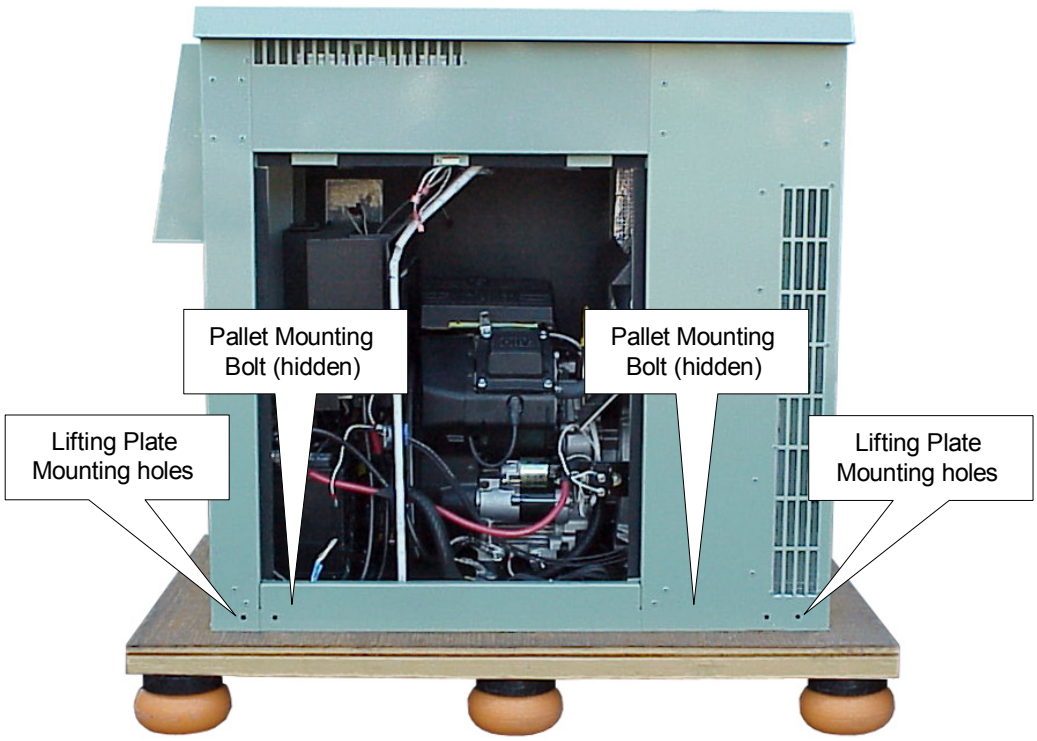


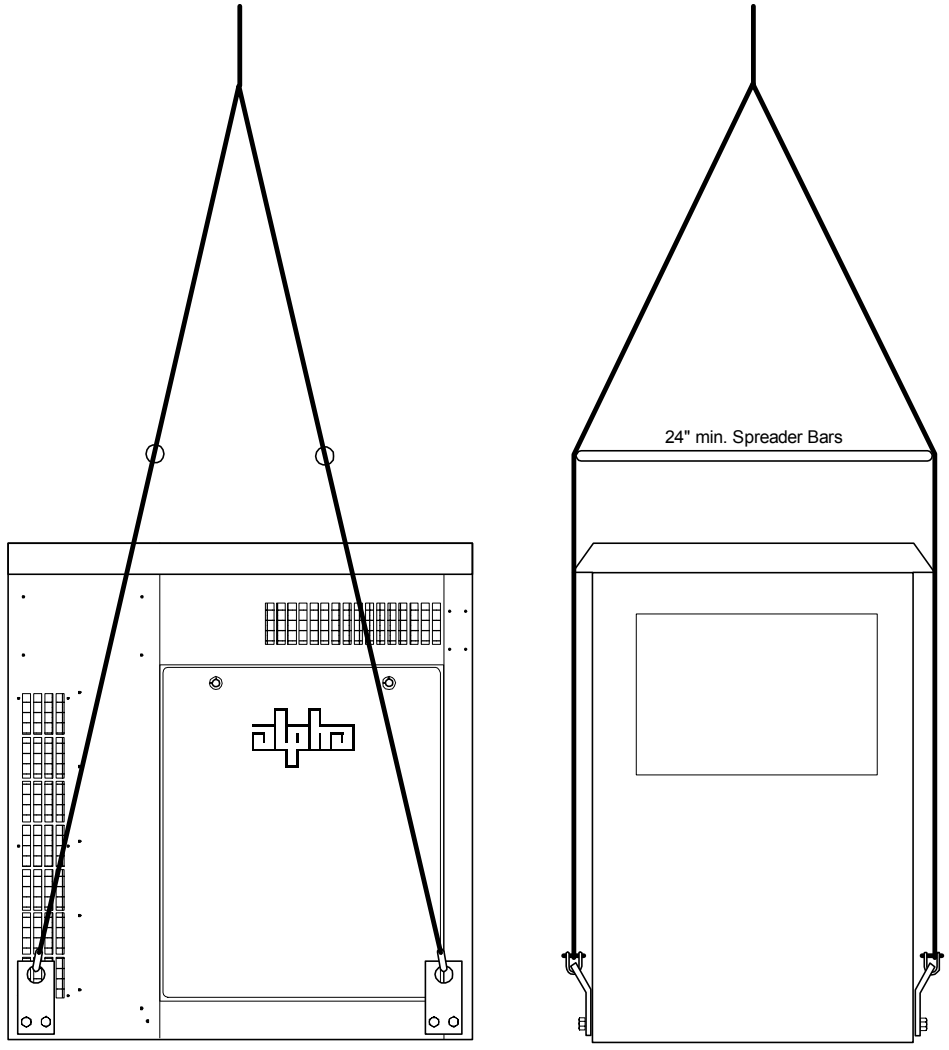
Fig. 3.1 Pallet Bolt Locations

3.1 Transportation and Lifting, *continued*

3.1.1 Lifting Procedure

CAUTION: **Do not allow personnel to walk beneath the suspended unit during the lifting operation. Use steel-toe work shoe protection. Use "Hard Hats" at all times during this procedure.**

The enclosure is lifted via four lifting platesincluded 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 to 80-90 in-lbs.



Front View Side View

Fig.3.2 Lifting plates attached to cabinet

3.2 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 30 lb. felt, neoprene pond liner, or heavy grade tar paper) should initially extend at least 6" in all directions around the perimeter of the enclosure. After the enclosure is in place, the material should be cut closer to the enclosure, using the appropriate knife or cutting tool.

2. Secure the enclosure using 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 HARDWARE MANUFACTURERS' RATINGS.

NOTE: 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 place the magnet, remove the two screws holding the sensor into place, and lift out. Glue the magnet to the pad in the center of the hole. After the glue has set, replace the sensor.

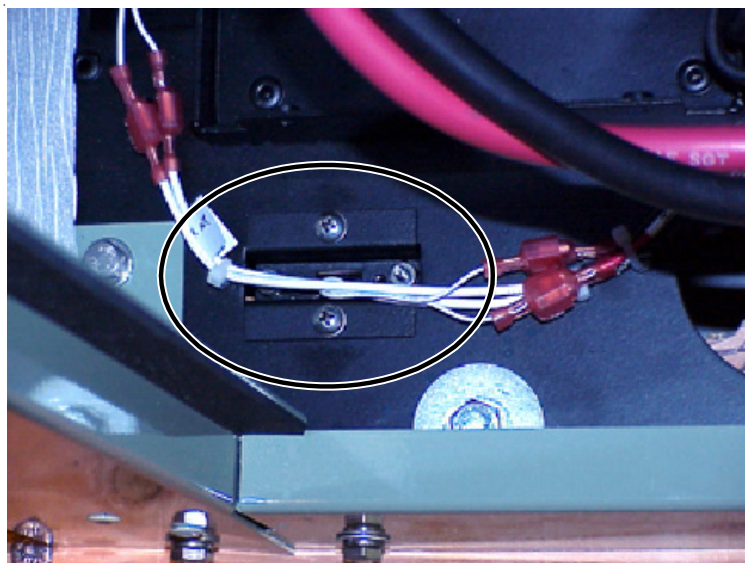


Fig. 3.3 Pad shear sensor/magnet assembly

CAUTION: 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.

3.3 Connecting the Ignition Battery

NOTE: For further information regarding the safe handling of batteries, refer to the Preface.

1. Install the battery into the enclosure from the rear, in the pan located to the left of the generator, with the POS terminal closest to the sweep opening.

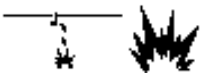
WARNING: Observe battery polarity. DO NOT short battery terminals together or allow metal tools to come into contact with the battery terminals or cables. Shorted batteries can explode causing severe acid and or electrical burns.

WARNING: Batteries contain ACID. Do not allow this acid to come into contact with skin or clothing. Wash affected area immediately with soap and water. Seek immediate medical attention if acid comes into contact with eyes.

2. Before connecting the battery cables, coat the battery terminals with an anti-oxidizing gel such as NCP-2. Install the battery cables.

3. Battery voltage should be at least 12.5VDC; if low, recharge before placing into operation.

3.4 Utility Fuel Hookup



CAUTION: Fuel vapors can be explosive!

NOTE: These general instructions are applicable for either remote or collocated systems.

Check fuel system for leakage using 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. For an accurate leakage check, DO NOT use test solutions that contain ammonia or chlorine, since they will prevent the soap from bubbling.

CAUTION: 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.

Utility Fuel Connection *(Please refer to Section 1 for block diagrams of various configurations)*

The 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. Suitable pipe thread sealant must be used on ALL (except flare fittings) fuel line connections. Thoroughly check the fuel system for vapor leaks. Check all local codes before connecting gas to the fuel system.

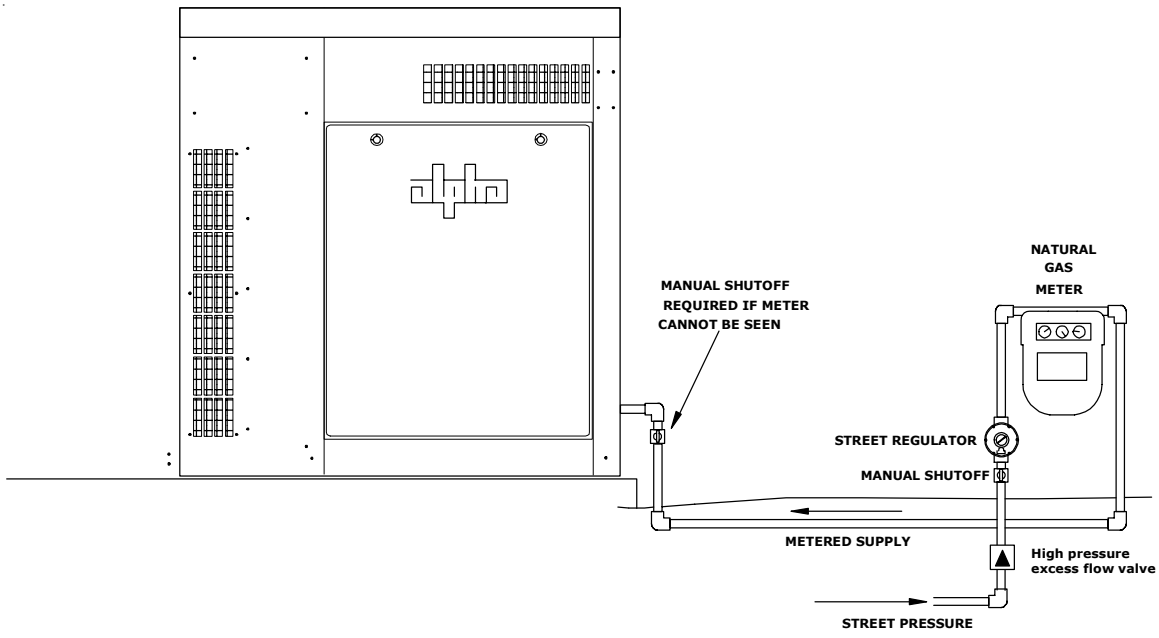


Fig. 3.4 Utility Gas Service Input

3.5 Final Inspection Checklist

Once the installation has been completed verify the following:

Engine oil at proper level
All electrical connections securely made
Engine Control Module (ECM) set to "STOP"

CAUTION: It is recommended that the ECM Run/Auto/Stop (RAS) switch be set 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.

Battery connections made
Battery voltage normal
Gas connections checked for leak integrity
Gas pressure normal

When the above test/checks have been made, the unit is ready for initial turn-up. Refer to the Engine Control Module Manual (Alpha p/n 744-862-C0).

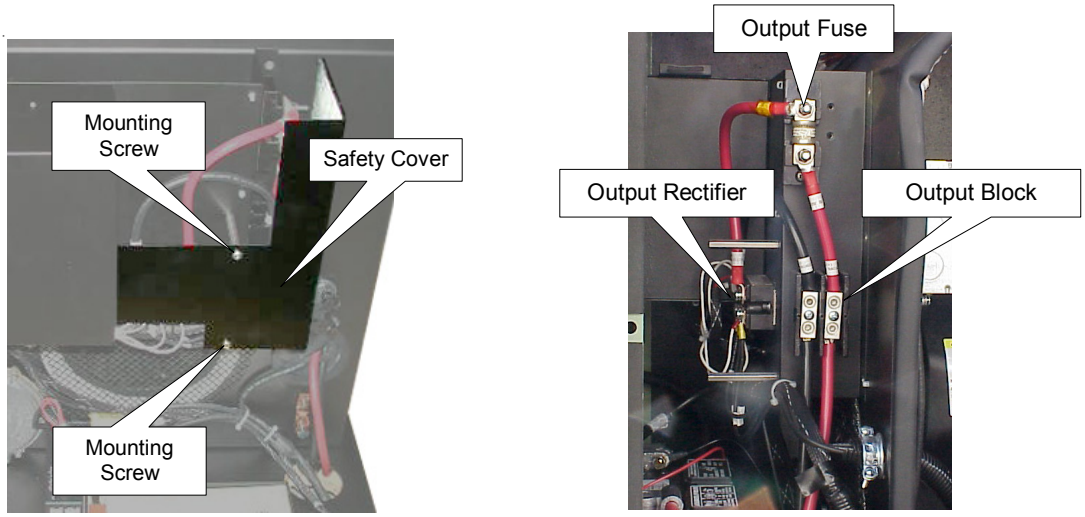


Fig. 3.5 Safety Cover and Output Terminal Block Location

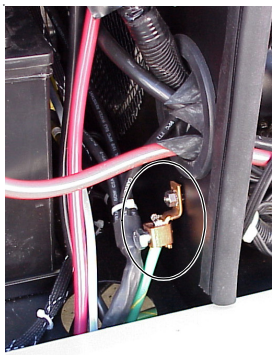


Fig. 3.6 Enclosure Grounding Lug

4. System Overview

4.1 Engine Control Module Overview

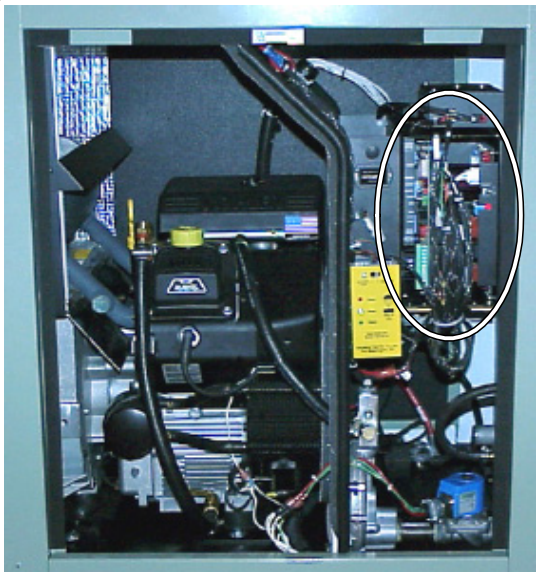


Fig. 4.1 Location of Engine Control Module within the Engine-Generator Cabinet.

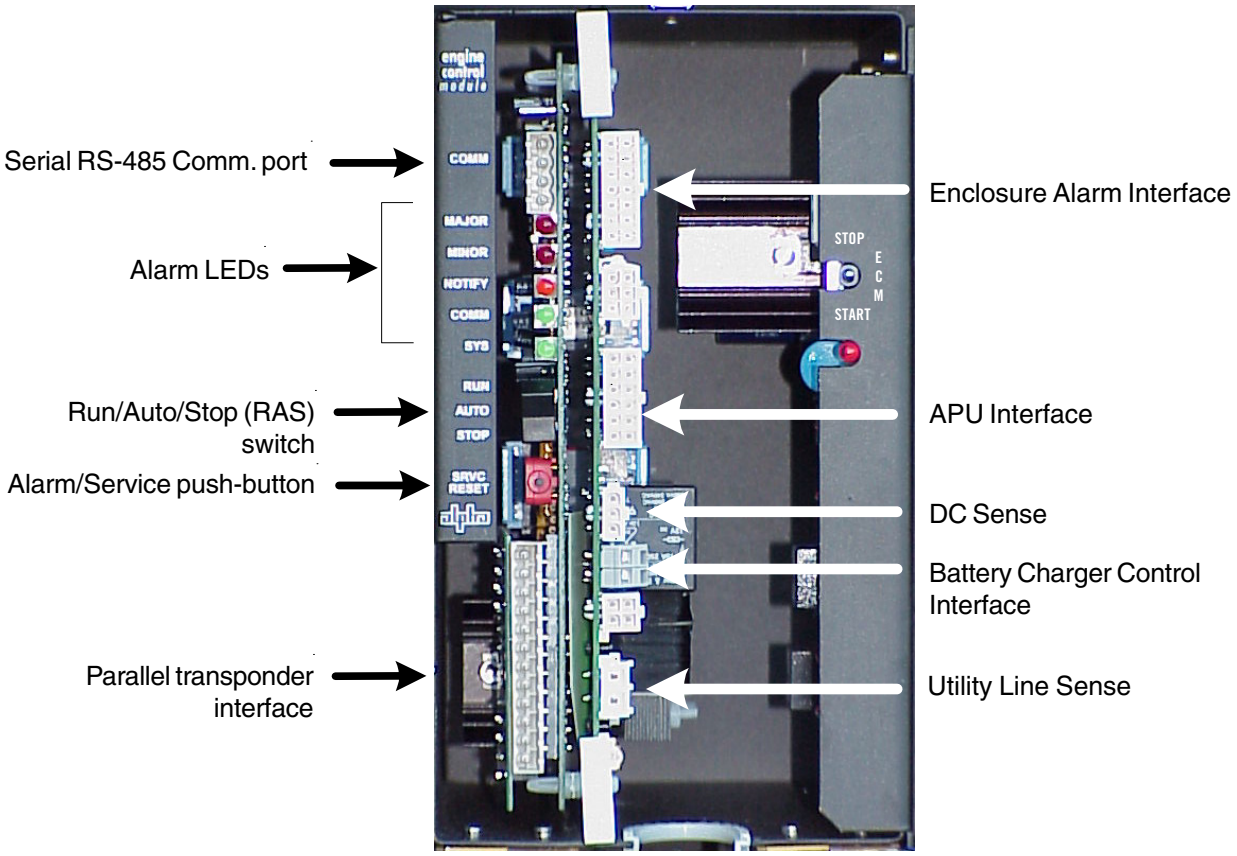


Fig. 4.2 Front view, Engine Control Module (ECM)

4.2 Generator Modes of Operation

4.2.1 Normal Operating Condition

Under normal operating conditions (no alarms) the ECM's RAS three-position rocker switch will be in the "center" or AUTO position. The ECM has complete control over the APU while in the AUTO mode. Also, each time the RAS switch is moved from the STOP position, to the center or AUTO position, the ECM will run the APU for one minute after a short delay. This is an indicator to the system operator that the ECM is truly in the AUTO mode and is fully capable of starting and stopping the APU automatically.The APU can be controlled manually by placing the RAS switch in the “up” or RUN position, or the “down” STOP position. If a system control is attached to the ECM via the RS-485 bus, the APU can be controlled remotely. Similarly, the APU can be started via the transponder interface on the ECM. In the AUTO mode, the ECM continuously monitors the AC line voltage, and DC bus voltage, enclosure sensors, and the APU status. If a fault occurs, the ECM will determine whether to start or inhibit the APU based on the type of failure.

4.2.2 Standby Operating Condition (<10 minutes)

If an AC line disturbance or outage is less than 10 minutes, the ECM will not start the APU unless the battery bus voltage drops below a programmable threshold (Low DC Bus Level) which defaults to 1.95 Volts per cell or 46.8/93.6 Volts for 48/96 Volt systems respectively. The ECM will notify the system operator of a line failure via the front panel LED’s (see alarm section). Otherwise, the ECM will appear to be in a “normal” operating condition.

4.2.3 Standby Operating Condition (>10 minutes)

If an AC line disturbance or outage is greater than 10 minutes, the ECM start delay timer will expire 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 will start and continue to run the APU until either a normal shutdown or Major alarm occurs (refer to Alarm section 4.4).

4.2 Generator Modes of Operation, *continued*

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 Overcrank Alarm

Table 4-1 Normal mode crank cycle

4.2.4 Normal APU Shutdown

The ECM will initiate a normal APU shutdown when AC line is qualified, DC bus alarm is not active, the 12 minute cool-down period has elapsed, and the Engine Run command is not active. Otherwise, the ECM will continue to run the APU until the above conditions are met or a major alarm occurs. Also, the APU will run for a minimum of 30 minutes if started due to low DC Bus voltage.

4.2.5 Abnormal APU Shutdown

The ECM will immediately shutdown 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 Generator Modes of Operation, *continued*

4.2.6 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 will immediately shut down the unit if certain alarm conditions are detected. The ECM reports status information via a parallel data interface and/or an Alpha-Bus serial data (RS-485) interface, and locally from the LEDs on the front panel.

Any of 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* (10 minutes).
2. DC bus voltage drops below 1.95 Volts/cell (46.8/93.6 VDC for 48/96 Volt systems, respectively).
3. Manual run switch is activated.
4. Software run command received.
5. Engine run is commanded via the transponder interface.
6. A self-test is initiated manually.
7. 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 nominal +2 Volts *(i.e., +50VDC /+98VDC)*.
3. Cool-down period has expired.
4. Engine Run command is not active.
5. Engine has run for a minimum of 30 minutes if it started due to low DC bus voltage.

The following conditions will 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
   - Overvoltage

4. Any of the following system alarms become active:

   - Gas hazard
   - Pad shear
   - Water intrusion
   - General APU failure

4.3 Operator's Interface Overview

Refer to Figure 4.3 on the following page:

The three positions of the rocker switch are RUN - AUTO - STOP (RAS). The RAS switch is normally left in the center, AUTO, position so that the ECM has control of the generator set. A minor alarm is indicated when the RAS switch is not in the AUTO position. The STOP ("down") position is used to stop or prevent APU operation during maintenance. **Placing the RAS switch to the STOP position for 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.** Placing the RAS switch in the RUN ("up") position will cause the engine to start and run until this switch is released to AUTO. The engine may not shut down immediately when the switch is returned to AUTO from RUN, because the ECM's shutdown criteria must be met in order to shutdown the engine. Also, each time the RAS switch is placed in the AUTO position (from the STOP position), the ECM will start and run the APU for one minute after a short delay.

The service reset push-button switch has two purposes. It resets the engine service timer when depressed for 5 seconds and can be used to determine which alarms are active (see ***"ECM Alarm Overview"*** section 4.4). The service interval is a programmable counter within the ECM that defaults to 100 hours. When 100 hours of engine run time elapses, the *Service Required* notification is set and the notification LED illuminates. After the engine has been serviced, pressing and holding the service reset switch for 5 seconds will reset the 100-hour service counter. All of the LEDs flash while the switch is depressed until a five-second timer elapses, at which time all of the LEDs remain on solid until the switch is released. This provides feedback to the technician, indicating the effective resetting of the engine service counter.

4.3 Operator's Interface Overview, *continued*

The service reset push-button is also used to obtain information about active alarms. The Major and Minor alarm LEDs are very general and a technician will need more detailed information upon arrival to the site of an alarming ECM. To retrieve details about an active alarm, the user presses and releases the service-reset switch. An active alarm (Major or Minor) will be indicated by the LEDs as indicated in Table 4-2.

NOTE: Depressing the service-reset switch for 5 seconds will cause the service timer to clear, possibly disrupting the preventive maintenance schedule.

When the service-reset button is pressed again, the LEDs will represent the next active alarm. Pressing the button when there are no more active alarms will reset the LEDs to their normal usage. Several quick flashes of all five LEDs will indicate end of the alarm list before the LEDs return to normal operation. If the service reset button is not depressed again when an alarm is indicated, the LEDs will return to normal operation after 30 seconds have elapsed. Resetting alarms via status monitoring or via the manual stop switch will also clear the alarm pattern indicated by the LEDs.

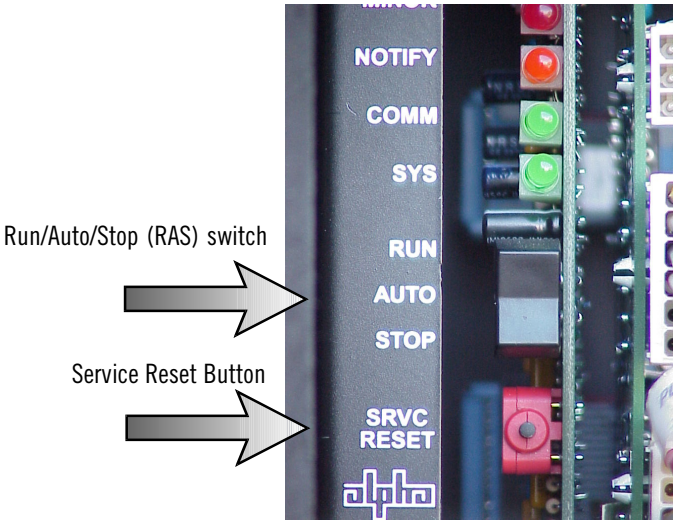


Fig. 4.3 Detail of Run-Auto-Stop (RAS) switch

4.4 ECM Alarm Overview

Alarms are indicated in three ways: ECM LEDs, RS-485 communications and alarm contact closures on ECM transponder interface. Alarm indication on the ECM LEDs is obtained by pressing the service reset button momentarily and noting the combination of illuminated LEDs. 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		●	●	●		●		●	●	

Table 4-2 Major, Minor alarm indications, and notifications.

(LEDs as displayed on the ECM)

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

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

4.5 Ignition Battery Charger Overview

The Ignition Battery Charger keeps the ignition battery sufficiently charged to start the Auxiliary Power Unit (APU) in the event of an extended power outage.

48V Systems

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

1. DC bus greater than 49 VDC
2. Battery pack temp less than 35° C or battery volts less than 12.6
3. Battery volts less than 13.2

Any of the following conditions will turn the ignition battery charger off:

1. Engine off and DC bus less than 48 VDC
2. Battery pack temp greater than 40° C and battery volts greater than 13.2
3. Battery volts greater than 14.5

96V Systems

The 96VDC units have a 120VAC stand-alone, self regulating battery charger, located next to the ignition battery. The ignition battery charger turns on at approx. 13.1 VDC and off at approx. 14.1 VDC. A flashing LED indicates that the battery is topped off, and the output is being cycled on and off to maintain a float charge.

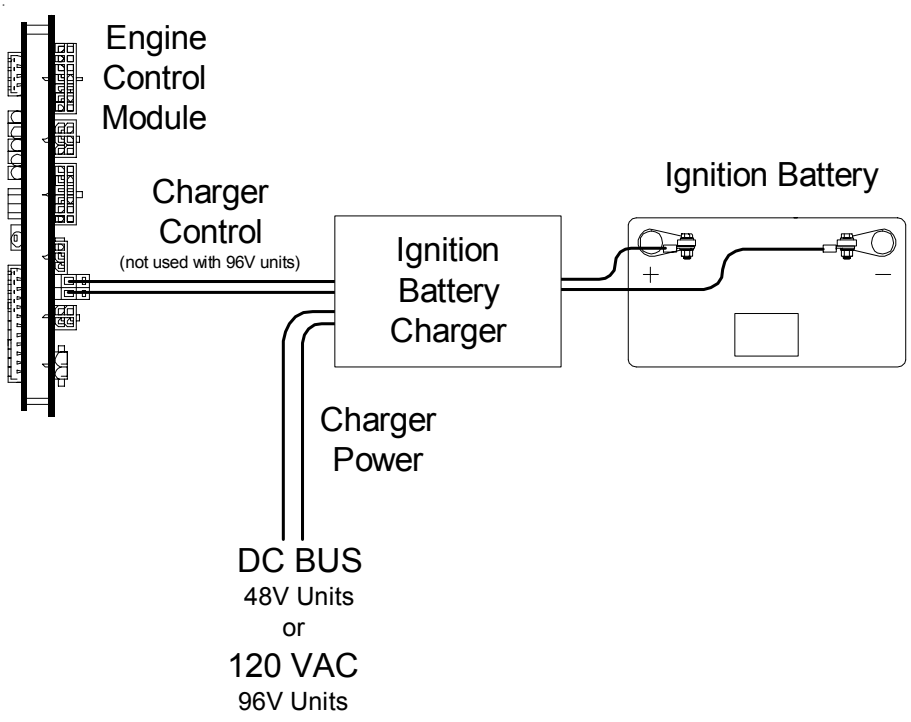


Fig. 4.4 Wiring for ECM, Ignition Battery Charger, and Ignition Battery

5. Turn-Up and Test

5.1 Appearance and condition of components

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

For each (front and rear) door assembly:

1. Doors and locking mechanisms.
2. Seals.
3. Door Intrusion switches.

5.2 Initial Operation

The following procedure involves starting and stopping the engine using the Engine Control Module (ECM). For the purpose of this procedure, it is assumed that the engine is properly connected to the 12 Volt ignition battery and that the natural gas (or propane vapor) fuel has been installed, pressurized and tested for leaks.

All engine operation will be controlled by the ECM. Verify that any switches on the engine/generator (or engine/alternator) are switched to the center (neutral) position and that all circuit breakers on the generator are switched ON (if applicable).

NOTE: Refer to the ECM Operator's Manual (p/n 744-862-C0) for complete ECM operating instructions.

5.2.1 Ignition Battery Test Procedure

1. Connect a DVM (set for DC Volts) to the IGN BATT terminals. Connect the Red (+) lead of the DVM to the (+) terminal and the Black lead (-) of the DVM to the (-) terminal.

2. The DVM should indicate 12 VDC (+ 2 V , - 0 VDC). If this reading is lower than specified, recharge the batteries to 13.8 VDC before proceeding.

WARNING: Do not use batteries (AGM or Gell Electrolyte) that read below 9.0 VDC, as the battery may be discharged below a safe point and could cause gassing during recharge.

5.2 Initial Operation, *continued*

5.2.2 Engine Lubrication

Check Engine lubrication Level Procedure:

Check the engine crankcase oil level. If necessary, add oil to fill it to the FULL mark. **DO NOT OVERFILL**. Refer to the engine manufacturers' operator's manual for proper fill capacities and oil types. Ensure that the same brand of oil is used for topping the oil level, as 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.

CAUTION: Do not attempt to crank or start the engine before it has been serviced with the recommended oil, or engine failure will result.

5.2.3 Starting a Local APU Test

Procedure:

1. Locate APU control board (mounted alongside the ECM).

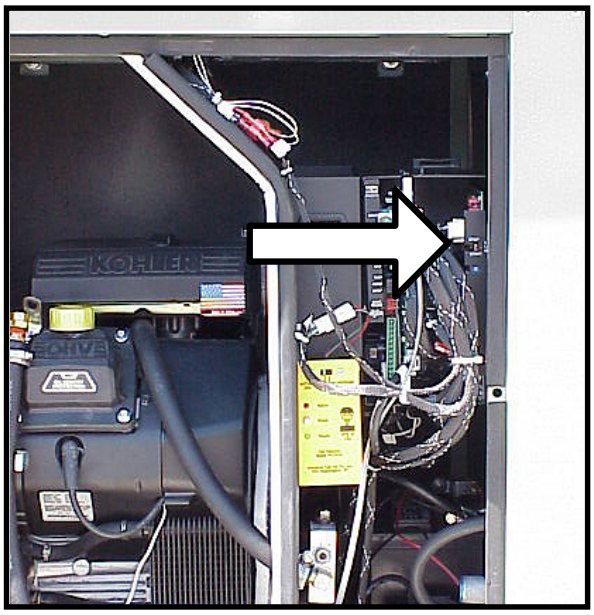


Fig. 5.1 Location of APU Control Board

5.2 Initial Operation, *continued*

5.2.3 Starting a Local APU Test, *continued*

2. Place generator set master switch to the middle (ECM) position.

CAUTION: The Kohler Control Board master switch will override the Run/Auto/Stop (RAS) switch on the ECM. This switch defaults to the center, or "ECM" position. Verify that the Fuel Load Block is configured for the fuel being used.

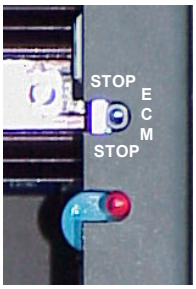


Fig.5.2 Generator set master switch

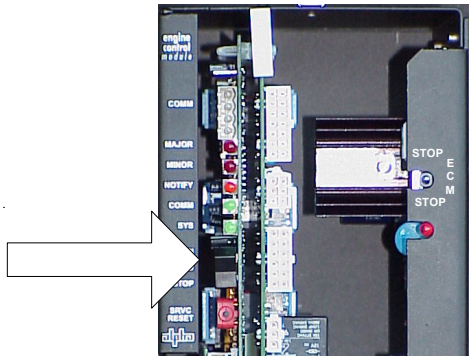


Fig. 5.3 Location of ECM Run/Auto/Stop switch

3. Set RAS switch to “STOP”.
4. Verify Ignition Battery & AC Line Sense connection to ECM.
5. Verify all alarms on ECM are OFF except **Tamper Alarm & Auto Mode Disabled.**
6. Remove gas port plug from input side of demand regulator, install brass manometer port connection fitting and connect manometer to fitting (Refer to section 6.11 for details).
7. Move **RAS** switch from “**STOP”** to “**AUTO”.**
8. Verify the engine starts within 3 salvo cycles per Table 4-1, Normal Mode Crank Cycle.
9. If engine fails to start within 3 salvo cycles and **Engine Over Crank** is activated, the gas line needs to be purged by removing air filter and placing hand over the carburetor throat to choke while cranking engine until engine starts.
10. Verify 11” of water column pressure is present at the input of the demand regulator.

5.2 Initial Operation, *continued*

5.2.3 Starting a Local APU Test, *continued*

11. Adjust pre-regulator, or dual regulator (located on gas bottle assembly for Propane) if necessary by removing regulator cap and adjusting for 11" +/- 1" of water column pressure. Perform under NO-LOAD condition (refer to section 6.11 for details).
12. Set RAS to "STOP".
13. Remove brass manometer fitting and reinstall plug to demand regulator input monitoring port using approved pipe sealant.
14. Check demand regulator input monitoring port for leaks.
15. Set RAS to "AUTO".
16. To continue functional test on power node system, refer to ECM certification section in ECM manual (744-862-C0).

5.3 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 1 minute self-test is performed and any failures will be 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 3 seconds and then back to the Auto position.

5.3.1 Enclosure Alarm Verification

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

2. Place the RAS switch to Stop for 3 seconds and then back to Auto to start a generator self-test. During the 1 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 to Stop for 3 seconds and then back to Auto to start a generator self-test. During the 1 minute self-test, trip the gas sensor by placing a cloth moistened with isopropyl alcohol directly on the gas sensor for at least 3 seconds. The red LED on the Gas sensor must illuminate for 3 seconds before the ECM will recognize and report the alarm. Verify the generator stops running 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 to Stop for 3 seconds and then back to Auto to start a generator self-test. During the 1 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 activate state for the ECM to report an alarm.

5.3 Generator System Sensor Verification, *continued*

5.3.2 AC and DC line Sense Verification

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 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 “Tamper”. Remove the DC sense cable from the front of the ECM (see page 70, item 13). Verify the APU starts running and the ECM reports a minor “DC Bus Fault” alarm. Replace the DC sense cable and verify the alarm clears.

NOTE: As the ECM will continue to run the APU for 30 minutes after the “DC Bus Fault” alarm clears, the technican may move the RAS switch to the STOP position after 4 to 5 minutes

2. Verify the RAS switch is in the Auto position, and the APU has run for 1 minute. Remove the AC Utility Line sense cable from the front of the ECM (see page 70, item 16). Verify the ECM reports a “line Failure” notification and the APU starts running after a 10 minute time delay. Replace the AC Utility Line sense cable and Verify the notification clears. Verify the APU continues to run for a 12 minute “cool down” period.

6. Maintenance

6.1 Cleaning and Lubrication

The Auxiliary Power Unit, being a gas-driven, air-cooled, combustion engine, requires periodic maintenance. Maintenance items may include, but are not limited to:

- Changing the engine oil at recommended intervals.
- Cleaning and/or replacing the engine air filter.
- Checking the intake and exhaust vents for debris.
- Cleaning and/or replacing the enclosure filters.

NOTE: A corrosion-inhibiting coating (such as LPS3 by LPS Corp.) must be used on all exposed connectors (battery posts, fuse tabs, Etc.) and reapplied annually per the manufacturer's instructions.

6.2 Scheduled Maintenance

6.2.1 Maintenance Intervals

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.

	Procedure X = Action, R = Replace as Necessary					
System component or Procedure	Visual Inspection	Verify	Change	Clean	Test	Frequency
FUEL						
Inspect flexible lines and connections	**X**		**R**			**Q**
Check fuel supply		**X**				**W or AS**
Inspect Fuel piping	**X**					**Y**
LUBRICATION						
Check Oil Level	**X**	**X**				**D, AS**
Change Oil			**R**			**Y or 100**
Replace oil filter			**R**			**Y or 100**
COOLING						
Verify air ducts 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**

D = Daily, W= Weekly, M = Monthly, Q = Quarterly, AS = Attended Startup, S = Six Months, Y = Yearly, all numbers are in Hours.

Table 6.1 Scheduled maintenance

6.3 Servicing the APU

Some tools and equipment may be required such as:

- Phillips screwdriver
- 10 mm socket wrench
- 3/8 inch open end wrench
- DVM capable of displaying true RMS AC voltage and frequency (e.g., Fluke 87)
- Battery operated frequency counter (needed only if a frequency reading DVM is not available).

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	

CAUTION: **Exhaust system becomes extremely hot during normal operation. Avoid exhaust pipes while checking engine oil.**

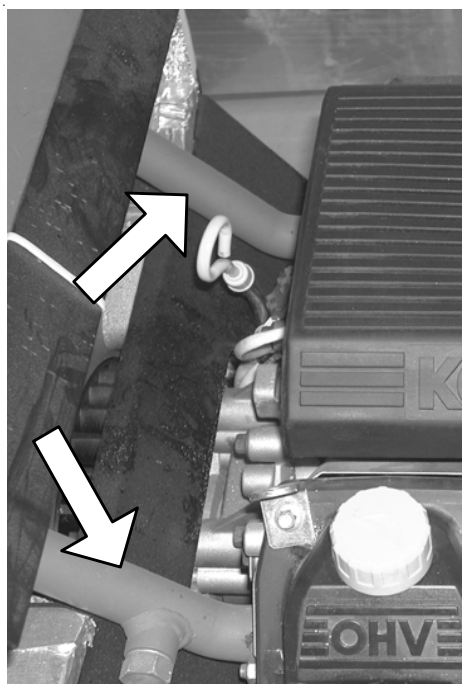


Fig. 6.1 Location of Generator Exhaust Pipes

6.4 Filter Cleaning

The air intake filter is located in the roof of the enclosure, above the electronics compartment.

WARNING: Failure to keep the filters clean or using improperly installed filters, may cause internal system failures due to lack of cooling air or dirt buildup. Equipment failures caused from filter blockage or dirt ingress due to clogged or improperly installed filters is not covered under warranty.

Filter Removal, Replacement, and Cleaning

1. Unlock and remove both doors.
2. The filter is held against the roof of the enclosure by four black plastic restraining clips (see inset below) release the clips by pulling firmly away from the enclosure roof.
3. Remove the filter and frame through the rear door of the enclosure.
4. Clean or replace the filter and reinstall in the reverse order, ensuring that the clips are firmly seated into the roof of the enclosure.

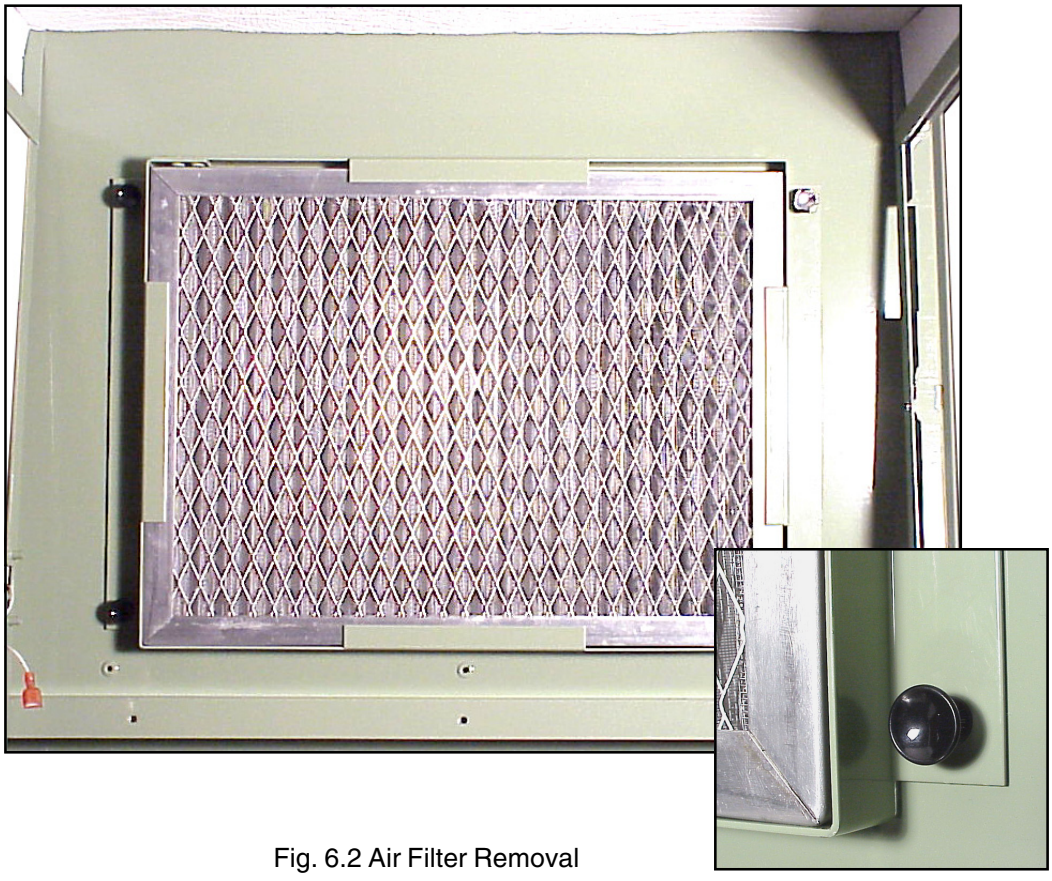


Fig. 6.2 Air Filter Removal

6.5 Pad Shear Magnetic Switch Replacement

Allow 15 minutes for completion of procedure.

Tools required:

#2 Phillips screwdriver

Removal and replacement procedure:

1. Unlock and remove rear enclosure door.
2. Pad Shear switch is located 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 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.

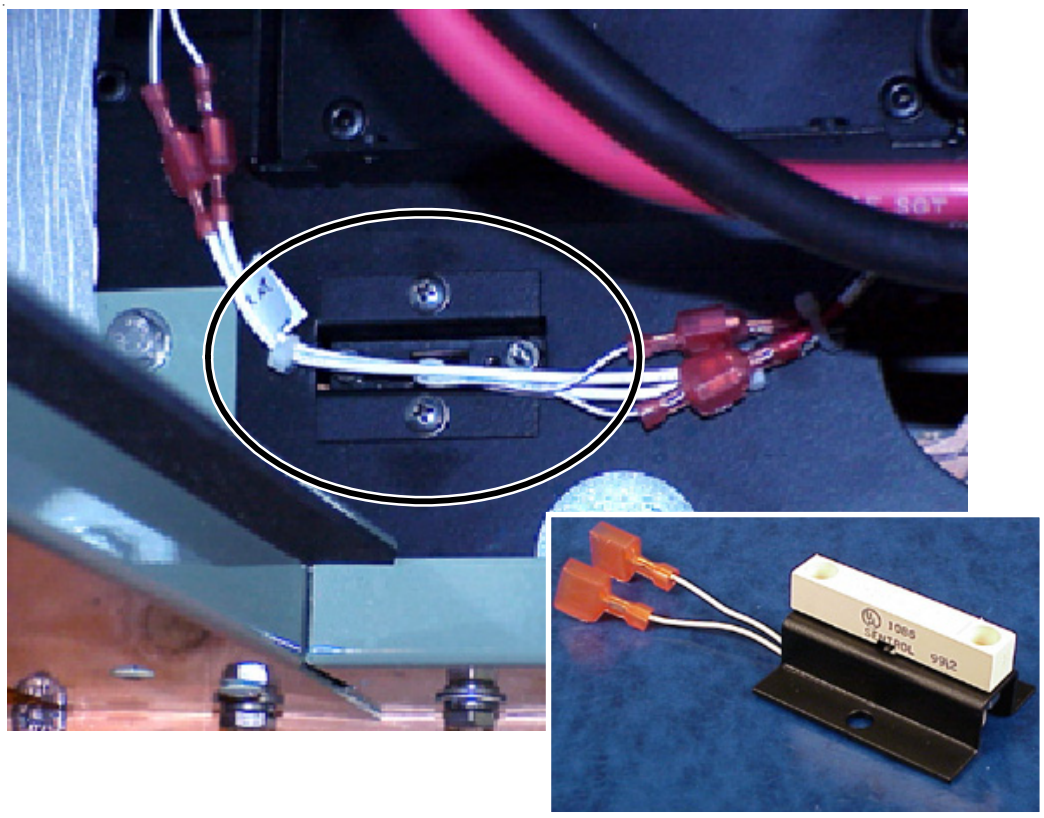


Fig. 6.3 Pad Shear sensor

6.6 Replacing Gas Hazard Sensor

Allow 5 minutes for completion of procedure.

Tools required:

None

Removal and replacement procedure:

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 below the Hour Meter. It is attached to the sheet metal by means of a hook and loop fastener. Disconnect the wire harness.
3. Verify the selector switch (circled below) of the new sensor is in the proper position.
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 solid.

Fig. 6.4 Gas Hazard Sensor (Alpha P/N 744-891-20)

6.7 Replacing Ignition Battery Charger Module Assembly

Allow 15 minutes for completion of procedure.

Tools required:

#2 Phillips screwdriver

Removal and replacement procedure:

Locate and remove the charger module, as shown below.

Unlock and remove the front door. The charger module in 48VDC units is located above the ECM housing, to the right of the generator. Disconnect the connectors from the front of the module. Remove the Phillips screw holding the front of the charger to the ECM housing, and lift the charger out of the enclosure.

The back of the charger is held in place by a mounting flap that fits into a slot on to the ECM housing.

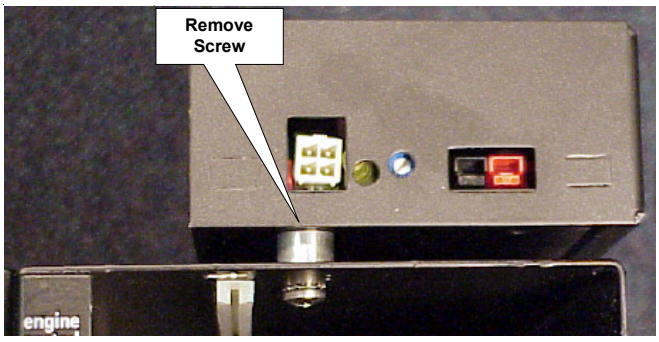


Fig. 6.5 48Vdc Ignition Battery Charger

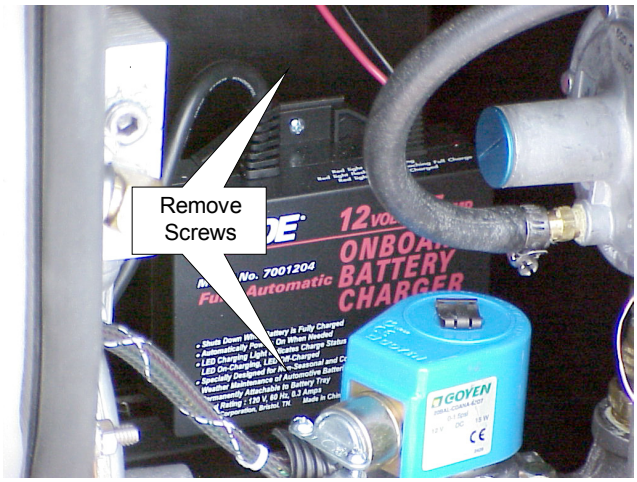


Fig. 6.6 96Vdc Ignition Battery Charger

The charger module in 96VDC units is located behind the fuel solenoid valve, in the lower right corner of the enclosure. To replace the charger, unplug the 120VAC cord, then remove the leads from the ignition battery. Remove the screws at the top and bottom of the charger, and lift out of the enclosure. Reverse procedure for installation.

End of Procedure

6.8 Replacing Engine Control Module

Allow 5 minutes for completion of procedure.

Tools required:

None

Removal and replacement procedure:

1. Verify APU is OFF.
2. Locate and remove the ECM as shown below.

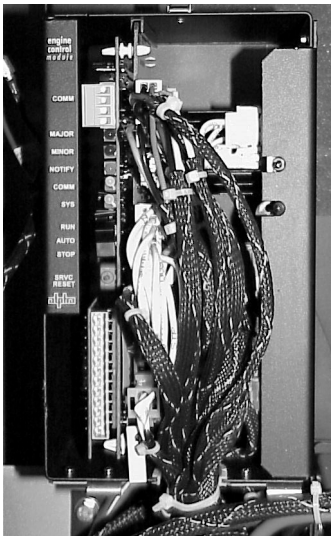


Fig. 6.7 ECM with Connectors Attached

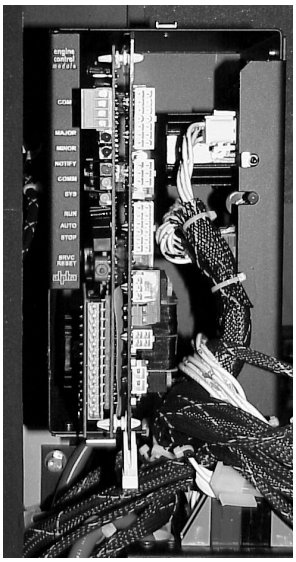


Fig. 6.8 ECM with Connectors Removed

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

Fig. 6.9 Removing ECM from Housing

6.9 Fuel Conversion - Natural Gas to LP

6.9.1 Fuel Load Block Configutation

Allow 15 minutes for completion of procedure.

Tools required:

7/8” open-end wrench

Repair and/or replacement procedure:

In this procedure, the Pre-Regulator will be removed, and the low pressure switch will be installed in its place. Reverse this procedure if changing from (LP) Liquid Propane to (NG) Natural Gas.

NOTE: Before starting this procedure, disconnect the gas supply.

Remove the inlet nipple that passes through the enclosure wall.

Loosen the Quick Disconnect fitting just below the Pre-Regulator, and remove the Pre-Regulator assembly.

DO NOT apply pipe sealant to the Quick Disconnect fitting. Install the Low-Pressure assembly onto the Quick Disconnect fitting and tighten.

Reinstall the inlet nipple through the enclosure wall. Connect alarm plug into the ECM Wiring Harness (see section 4.3.2).

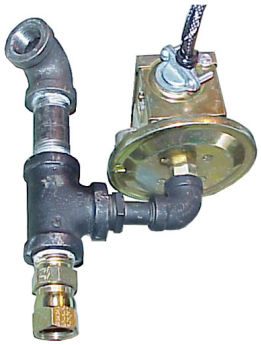


Fig. 6.10 Low Pressure Switch Assembly

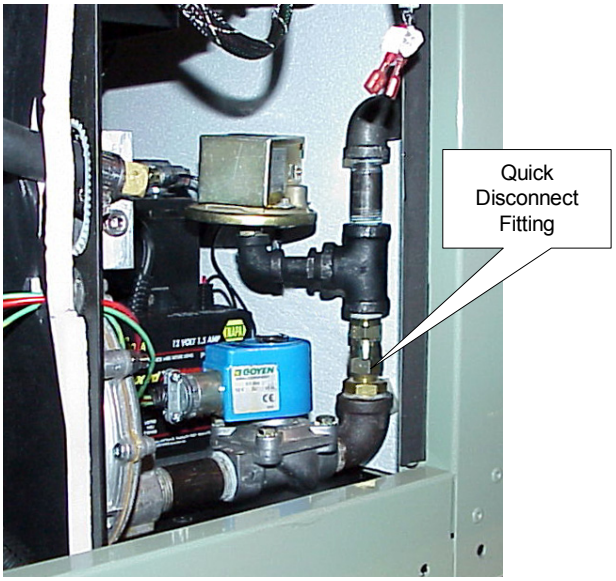


Fig. 6.11 Switch assembly Installed

End of Procedure

6.9 Fuel Conversion - Natural Gas to LP, *continued*

6.9.1 Fuel Load Block Configutation

Allow 15 minutes for completion of procedure.

Tools required:

7/8" open-end wrench
NFPA-approved pipe sealant - Megaloc Multipurpose thread sealant (stock #15-808) - or equivalent

Repair and/or replacement procedure:

In this procedure, the gas inlet hose will be switched from the LP port to the NG port. Reverse this process if converting from Natural Gas to Propane.

NOTE: Before starting this procedure, disconnect the gas supply.

1. Loosen swivel connector and remove from flare fitting.
2. Turning counter-clockwise, 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. 6.12 Load Block
(Natural Gas Configuration)

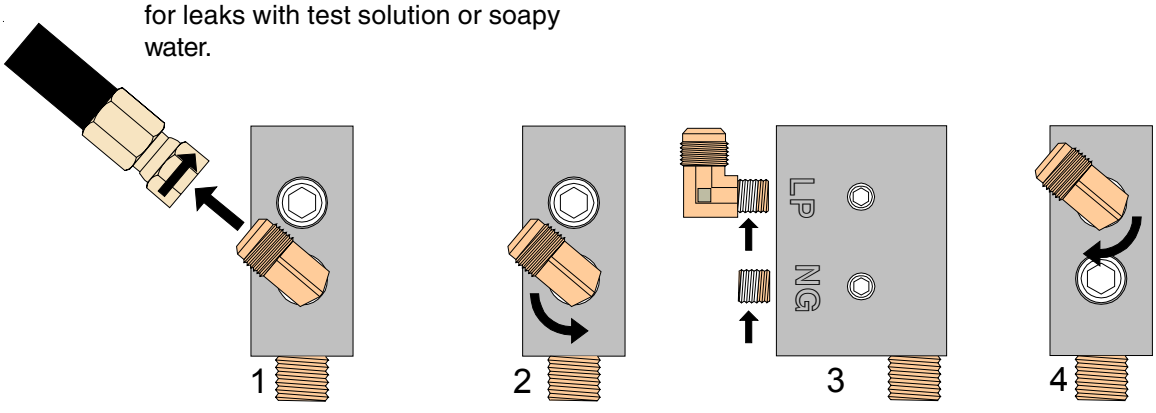


Fig. 6.13 Changing Load Block Configuration

End of Procedure

6.10 Gas Solenoid Replacement Procedure

Allow 45 minutes for completion of procedure.
Assistance will be required to perform this procedure.

Tools and materials required:

Crescent wrench
Pipe thread compound
Leak Detector

Removal and replacement procedure:

To replace the Fuel Solenoid, the entire regulator 'Package' must be replaced.

1. Ensure that 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.

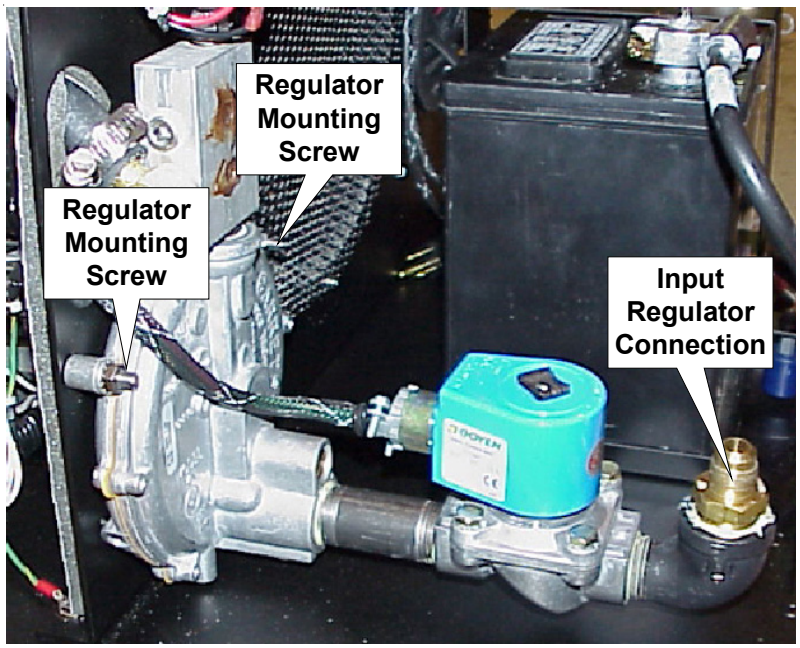


Fig. 6.14 Fuel Solenoid Valve

End of Procedure

6.11 Maxitrol Pre-Regulator Calibration

Allow 45 minutes for completion of procedure.
Tools and materials required:

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

Removal and replacement procedure:

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

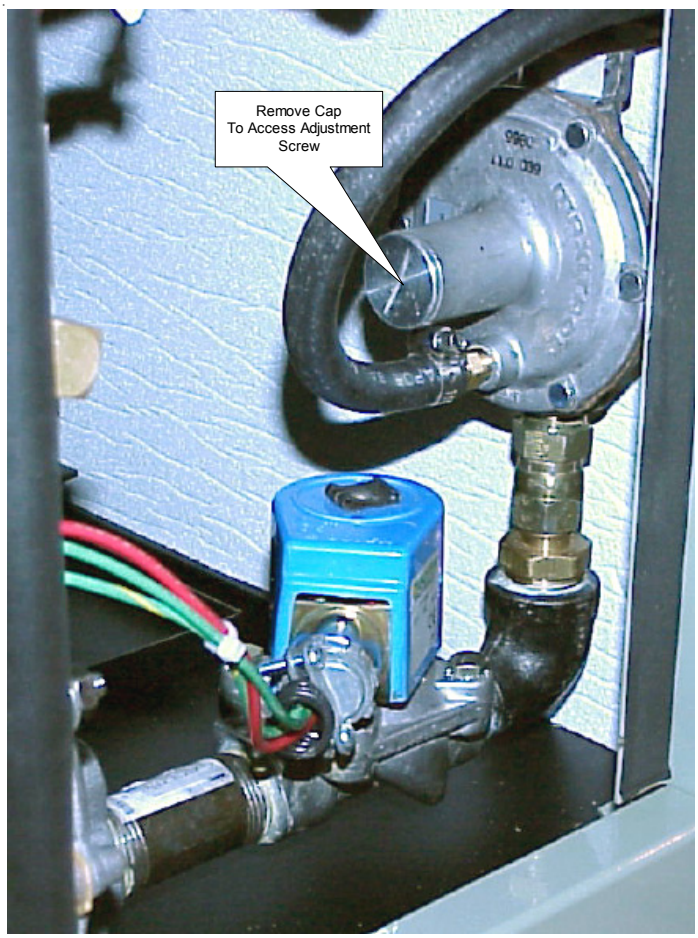


Fig. 6.15 Primary Regulator

6.11 Maxitrol Pre-Regulator Calibration, *continued*

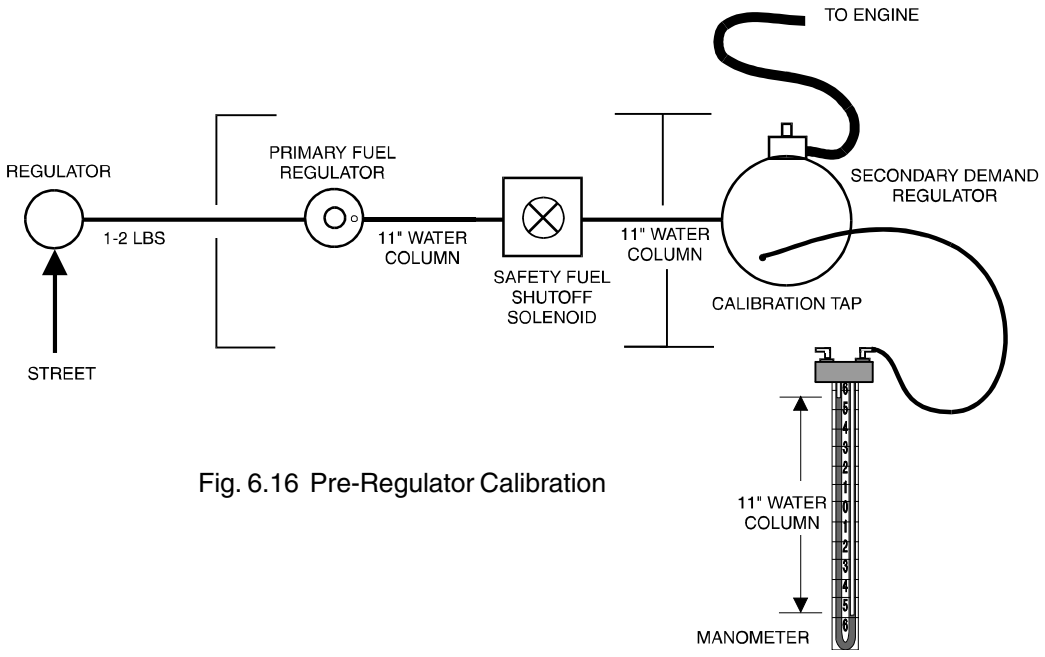


Fig. 6.16 Pre-Regulator Calibration

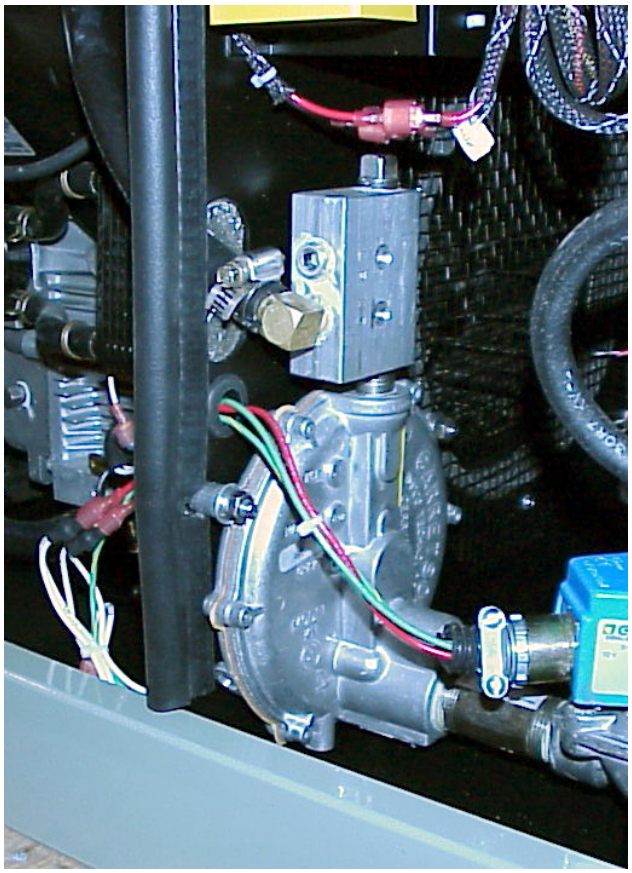


Fig. 6.17 Secondary 'Demand' Regulator

6.11 Maxitrol Pre-Regulator Calibration, *continued*

NO MATCHES OR OPEN FLAMES:
Use caution whenever working in the area to prevent possible combustion fuel vapors.

LEAK HAZARD:
Use caution whenever working in the area to prevent and correct any leaks detected.

Calibration Procedure:

1. On the ECM, perform the following:

   Set the ECM Run/Auto/Stop (RAS) switch to the STOP position. Remove the Allen-head screw located on the "Secondary" or "Demand" Regulator.

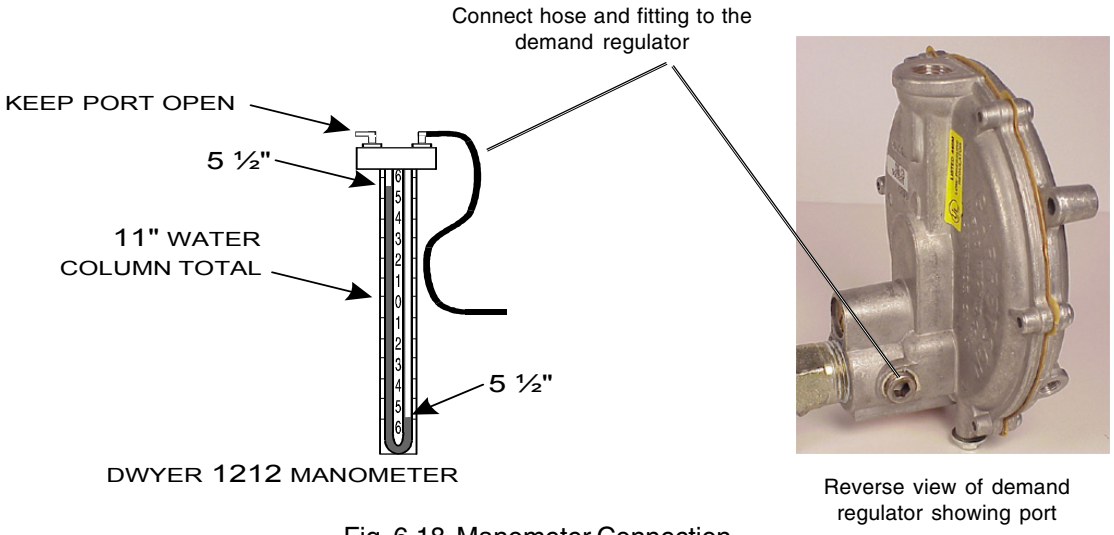


Fig. 6.18 Manometer Connection

On the DWYER # 1212, perform the following:

2. Open both ports.
3. Set the scale of "0" between the water lines. Connect the pressure test hose (see above).
4. Remove the Maxitrol regulator adjustment cover *(located in the gas service box <u>outside</u> of the enclosure)*.
5. Apply 0.5psi-2psi gas pressure to the gas package.
6. 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 controls the starting of the engine.

6.11 Maxitrol Pre-Regulator Calibration, *continued*

7. 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 READING CAN NOT BE ATTAINED, RETEST THE INLET PRESSURE TO THE MAXITROL GAS PACKAGE.

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

6.12 Output Fuse Replacement

Allow 15 minutes for completion of procedure.
Tools required:

7/16" Open-end wrench

Removal and replacement procedure:

The output fuse is located above and to the right of the Ignition Battery, behind the rear door.

DANGER! **Disconnect the battery pack from the generator prior to replacing the fuse! Shorting the battery pack terminals can result in fire and explosion!**

48 and 96 VDC Generators:

1. Verify the ECM RAS (Run-Auto-Stop) switch is in the STOP position, and the generator output is disconnected from the battery pack or power supply.
2. Remove the safety shield covering the fuse and output block.
3. Remove the nuts holding the fuse and cables to the fuse holder.
4. Remove the fuse.
5. Replace ONLY with an identical fuse:
   48 VDC Units: Alpha P/N 460-240-10 (200 Amp)
   96 VDC Units Alpha P/N 460-140-10 (100 Amp)
6. Install the new fuse with the cables ON TOP of the fuse tabs.
7. Replace the nuts, and tighten to 12 Inch-Pounds.
8. Replace the safety shield.
9. Reconnect the battery pack, and set the ECM RAS switch to it's previous setting.

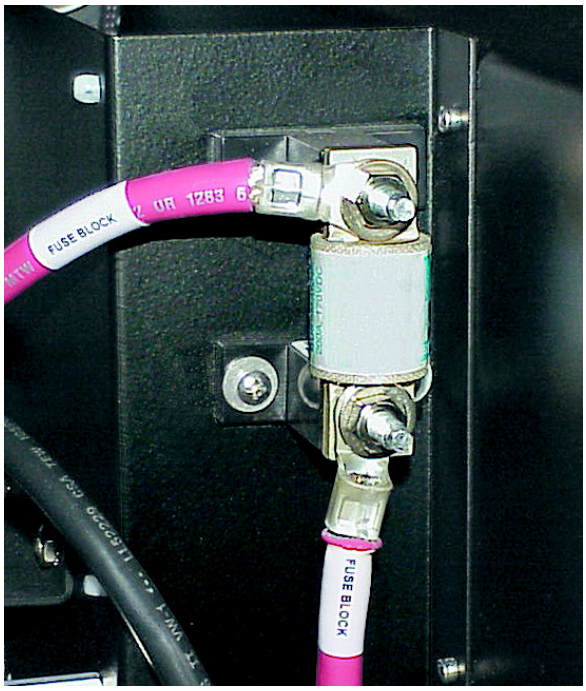


Fig. 6.19 Fuse Block

7. Interconnection

7.1 Alarm Sensor States

The signals from the sensors to the ECM should follow the state table below. The signals sent to the status monitoring system are described in the ECM Operator's and Maintenance Manual (Alpha p/n 744-862-C0).

APU SENSORS			
SENSOR	NORMAL STATE	ALARM STATE	ACTION
Low Oil	Contact Open - Oil Pressure Within Tolerance	Contact Closed - Low Pressure (or engine off)	Latched Shutdown
Oil/Elec Overtemp	Contact Open -Temp Within Tolerance (or engine off)	Contact Closed - Overtemp	Dynamic Shutdown
Engine Overspeed	Contact Open -Engine RPM ok (or engine off)	Contact Closed - Engine Overspeed	Latched Shutdown
Engine Overcrank	Contact Open -Cranking ok (or engine off)	Contact Closed - Cranking Cycle Exceeded	Latched Shutdown
Engine Run Status	Contact Open -Engine Off	Contact Closed - Engine On & RPM Within Tolerance	Status Only
Alternator Overvoltage	Analog Output- Alarm Generated By ECM	Analog Output- Alarm Generated By ECM	Latched Shutdown
Alternator Output On	Analog Output- Alarm Generated By ECM	Analog Output- Alarm Generated By ECM	Dynamic Status Signal
Switch Not In Auto	Contact Closed - Switch In Auto	Contact Open - Switch Not In Auto	Dynamic Status Signal
Low Ignition Battery	Analog Output- Alarm Generated By ECM	Analog Output- Alarm Generated By ECM	Dynamic Status Signal
ENCLOSURE SENSORS			
SENSOR	NORMAL STATE	ALARM STATE	ACTION
Gas Hazard	Contact Open - No Gas Present	Contact Closed - Gas Present, Sensor Fail, 12V Fail	Latched Shutdown
Pad Shear	Contact Open - Correct Position	Contact Closed - Pad Shear	Latched Shutdown
Water Intrusion	Contact Open -No Water Present	Contact Closed - Water In Enclosure Above Safe Level	Dynamic Shutdown
Low Fuel Gas Pressure	Contact Open -Gas Pressure Above 5" WC	Contact Closed - Gas Pressure Below 5" WC	Dynamic Shutdown 5 Min. Return
Door Open (Tamper)	Contact Open - Door Closed	Contact Closed - Door Open	Dynamic Status Signal

Table 7.1 Alarm Sensors

7.2 ECM Interface Block Diagram and Connectors

The ECM PWR - GRI PCBA provides the interface between cabinet sensors, APU control, and power conditioning to the ECM. In addition, the interface supplies all the necessary signals, alarms, logic power, and analog voltages required for telemetry at the cable 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.

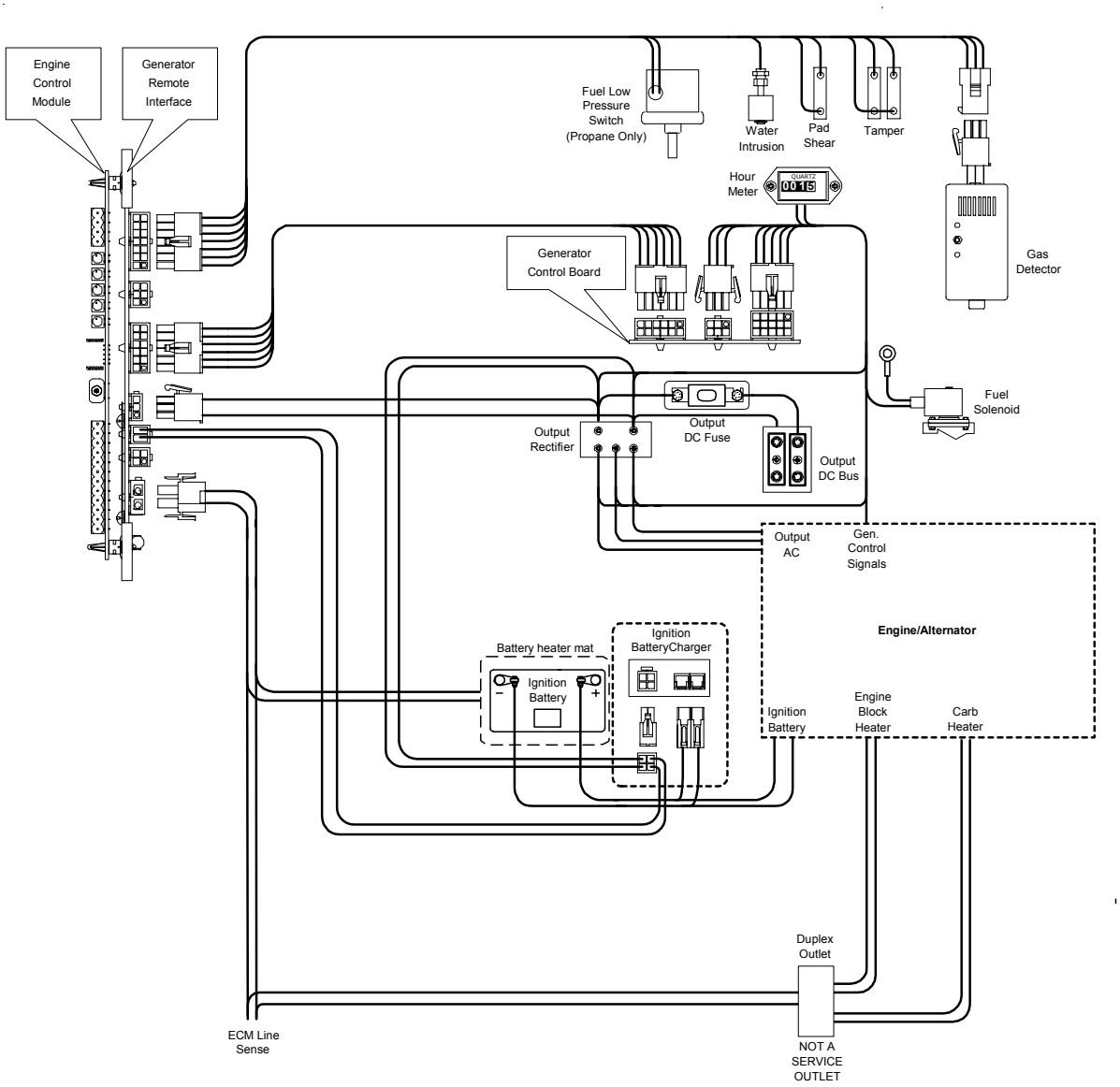


Fig. 7.1 ECM/APU Interconnection (48V Units)

7. Interconnection

7.2 ECM Interface Block Diagram and Connectors

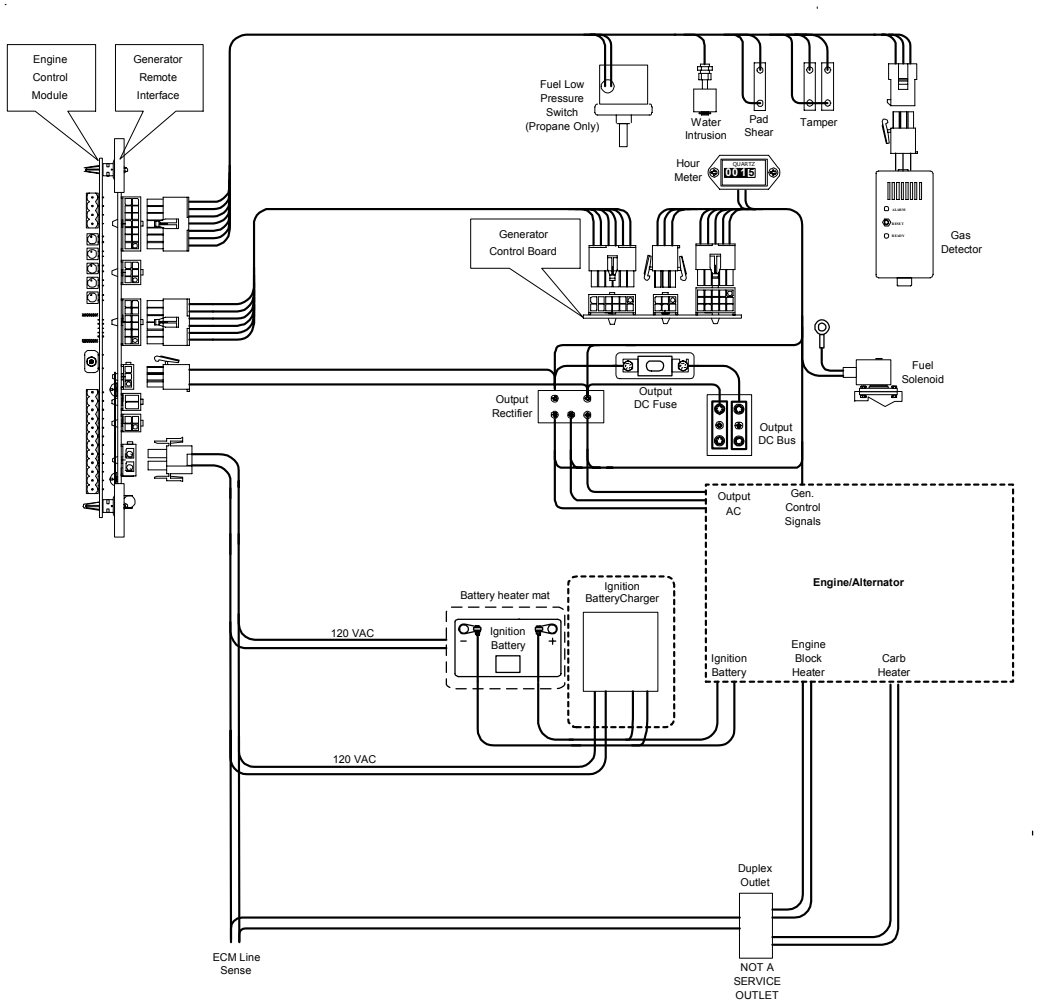


Fig. 7.2 ECM/APU Interconnection (96V Units)

The duplex outlet is designed for the carburetor and block heaters only. This is NOT a service outlet.

7.3 Connectors

7.3.1 Gas Hazard Alarm Interface

` 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

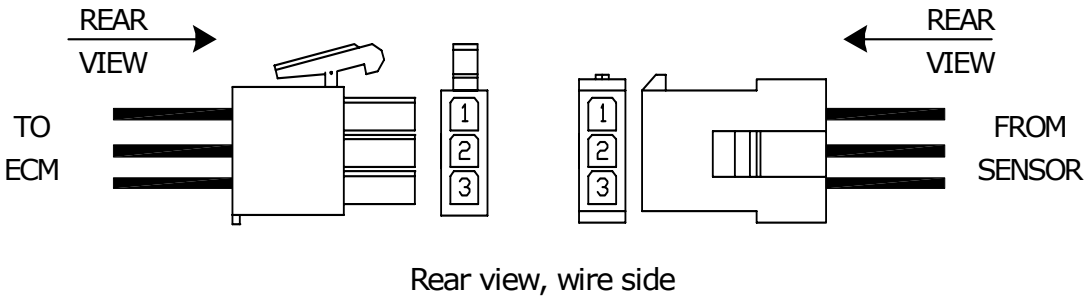


Fig. 7.3 Gas Hazard Detector Interface

7.3 Connectors, *continued*

7.3.2 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 = Solenoid common (negative) connection.

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

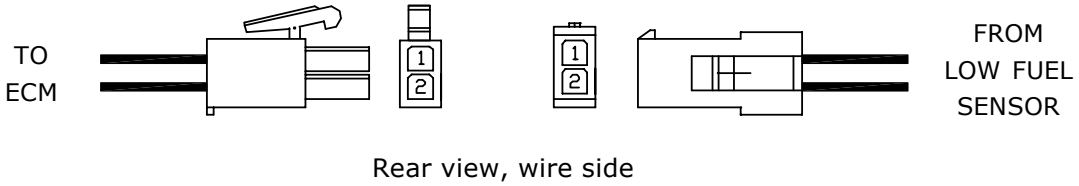


Fig. 7.4 Low Fuel Pressure Switch Interface

7.3 Connectors, *continued*

7.3.3 Solenoid

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.

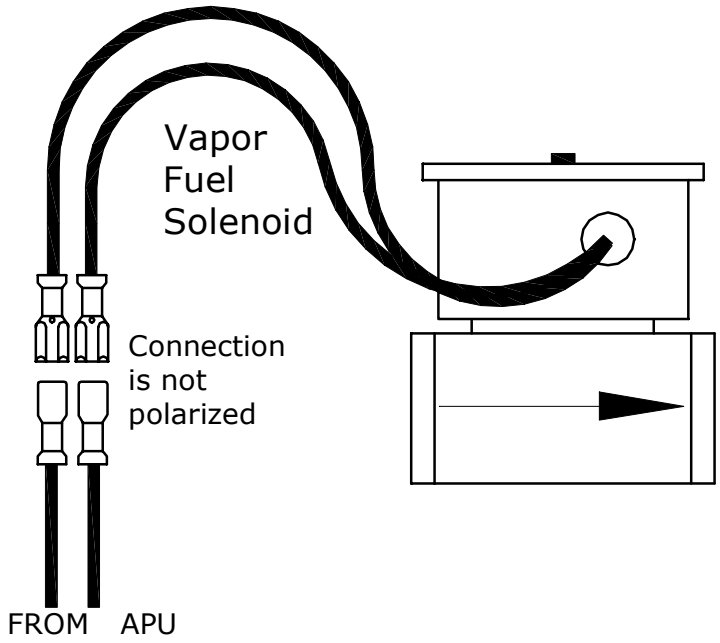


Fig. 7.5 Gas Solenoid Interface Connector

7.3 Connectors, *continued*

7.3.4 Charger Module – Control Interface Connector

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

Pin	Description	Function
1	ECM Charger Control (+) Yellow Wire.	This control connects pin 1&2 together, thereby 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 (refer enced to ignition battery negative).
4	Inverter Battery (-) Black Wire.	NEGATIVE Input power to charger module, operates on 48VDC battery pack to charge ignition battery.

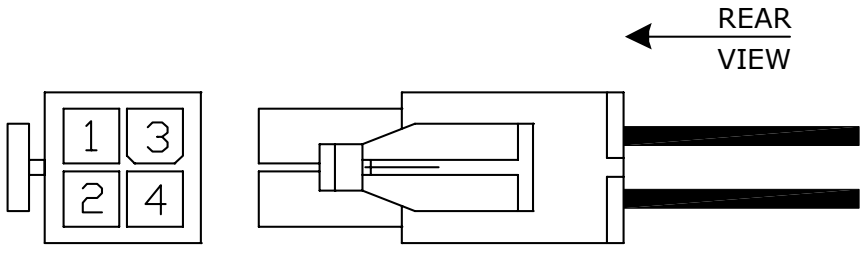


Fig. 7.6 Charger Control Interface

7.3 Connectors, *continued*

7.3.5 ECM PWR-GRI Interface

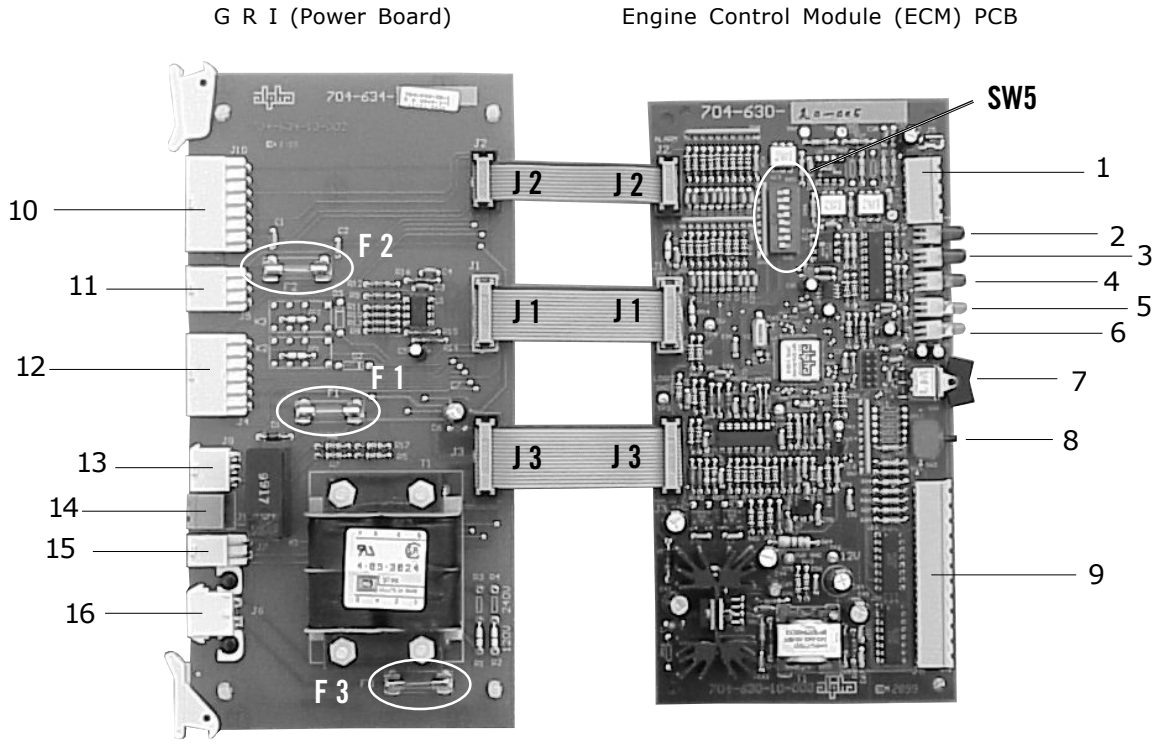


Fig.7.7 ECM Printed Circuit Boards

Engine Control Module LED Indicators and switches:

1. Communications Input (J4) ***Note: 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" switch
8. "Service/Reset" Push button switch (SW3)
9. Transponder Interface (J6) ***Note: Pin #1 at bottom of connector.***

GRI Power Board 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

Fuses and Switches:

F1 1.5A, 250V (Slo-Blo) *Alpha p/n 460-204-10*
F2 1.0A, 250V (Slo-Blo) *Alpha p/n 460-205-10*
F3 250mA, 250V (Slo-Blo) *Alpha p/n 460-166-10*
SW5 Configuration DIP switch

7.3 Connectors, *continued*

7.3.6 ECM - Enclosure Alarm Interface

The Alarm Interface Connector (J10) connected to the Power PCBA. The interface control is a 14-pin (2x7 row) Universal Mini Mate-'N'-Lok style male connector. See Fig. 7.7, item 10 for location.

Pin	Description	Function
1	Water Intrusion Sensor Intrusion	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 Pressure (LPV Versions only)	Contact CLOSED (LOW signal) denotes Low Fuel
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 (Common)	Return signal path for sensor
9	Gas Hazard Logic Power (+12VDC Fused)	Logic Power for Logic PCB & sensor
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	Cabinet Fan +12V Fused	+12VDC supplied to Fan – non-switched
14	Cabinet Fan Common	Return path for Fan

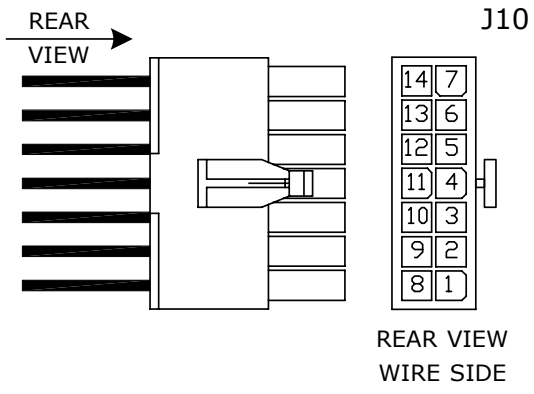


Fig.7.8 Enclosure Alarm Interface

7.3 Connectors, *continued*

7.3.7 Inverter Battery DC Sense Interface Connector

ECM - Inverter Battery DC Sense Interface Connector J8. See Fig. 7.7, item 13 for location.

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 96VDC busses
2	No Connection	
3	DC Bus Sense (NEG.)	Output inverter battery bus – positive connection, 48 and 96VDC busses

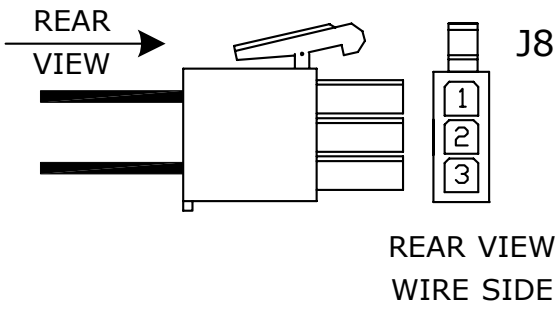


Fig. 7.9 Inverter Battery DC Sense

7.3 Connectors, *continued*

7.3.8 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. See Fig. 7.7, item 14 for location.

Pin	Description	Function
1	Control POSITIVE	This control connects pin 1 & 2 together, thereby turning the Charger ON, I.E. CLOSED (LOW signal)
2	Control Negative	Charger control common return

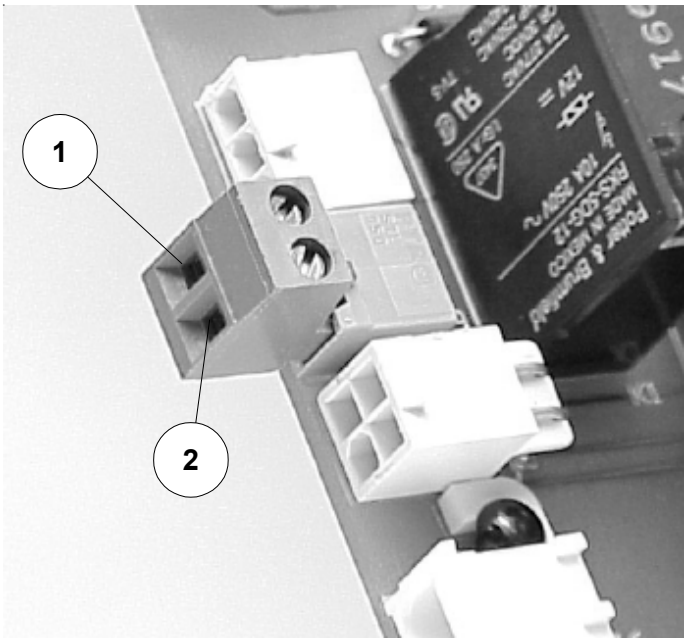


Fig. 7.10 Charger Control Interface Connector

7.3 Connectors, *continued*

7.3.9 ECM - APU Control Interface

The interface control is a 12-pin (2x6 row) Mini Mate-'N'-Lok style connector. See Fig. 7.7, item 12 for location.

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	

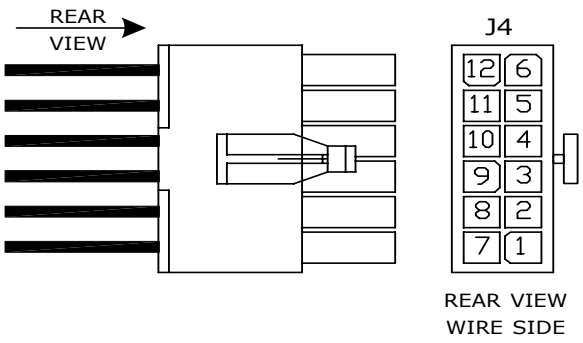


Fig.7.11 APU Control Interface

7.3 Connectors, *continued*

7.3.10 ECM - AC Sense 120/240V Interface

The interface control (J6) is a 2-pin (1x2 row) Mini Mate-'N'-Lok style connector. See Fig. 7.7, item 16 for location.

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

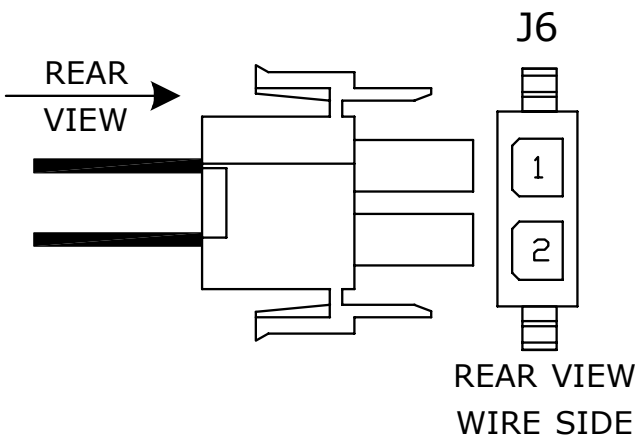


Fig.7.12 AC Sense, 120/240V Interface

7.3 Connectors, *continued*

7.3.11 ECM - Alarm Interface & Communications

The Alarm output interface and communications connectors are referenced and described in *Section 3.4, Transponder Interconnection,* of the ECM Operators manual (Alpha p/n 744-862-C0). See Fig. 7.7 items 1 and 9 for location.

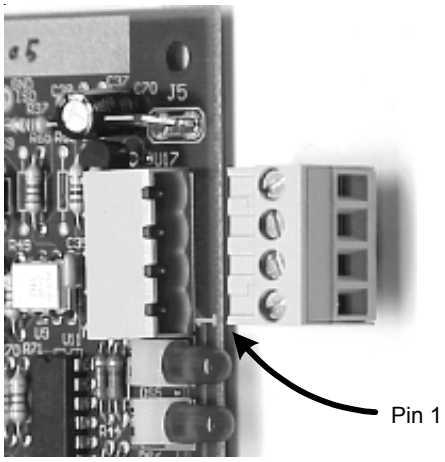


Fig.7.13 RS-485 Communications Input Connector

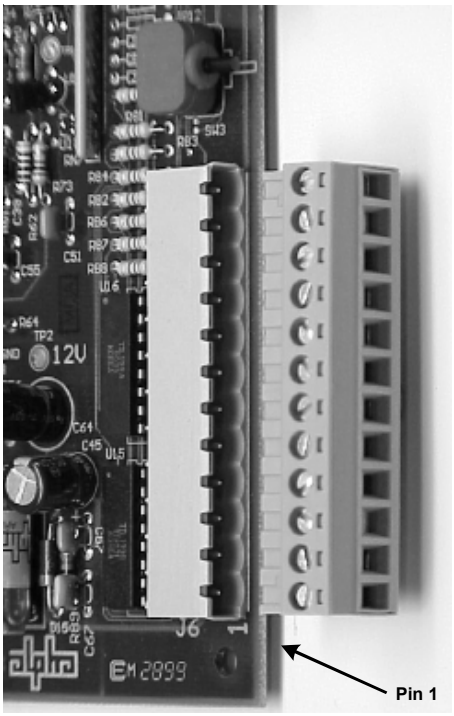


Fig.7.14 Transponder Interface Connector

7.3 Connectors, *continued*

7.3.12 ECM - Alarm Interface & Communications

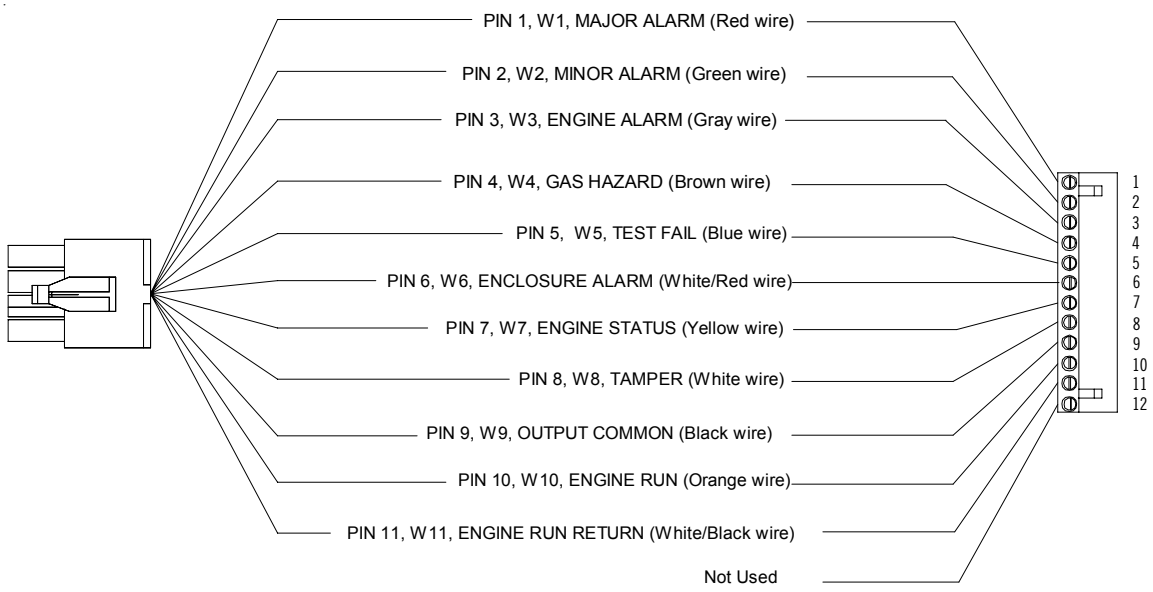


Fig. 7.15 Transponder-to-ECM interconnect cable

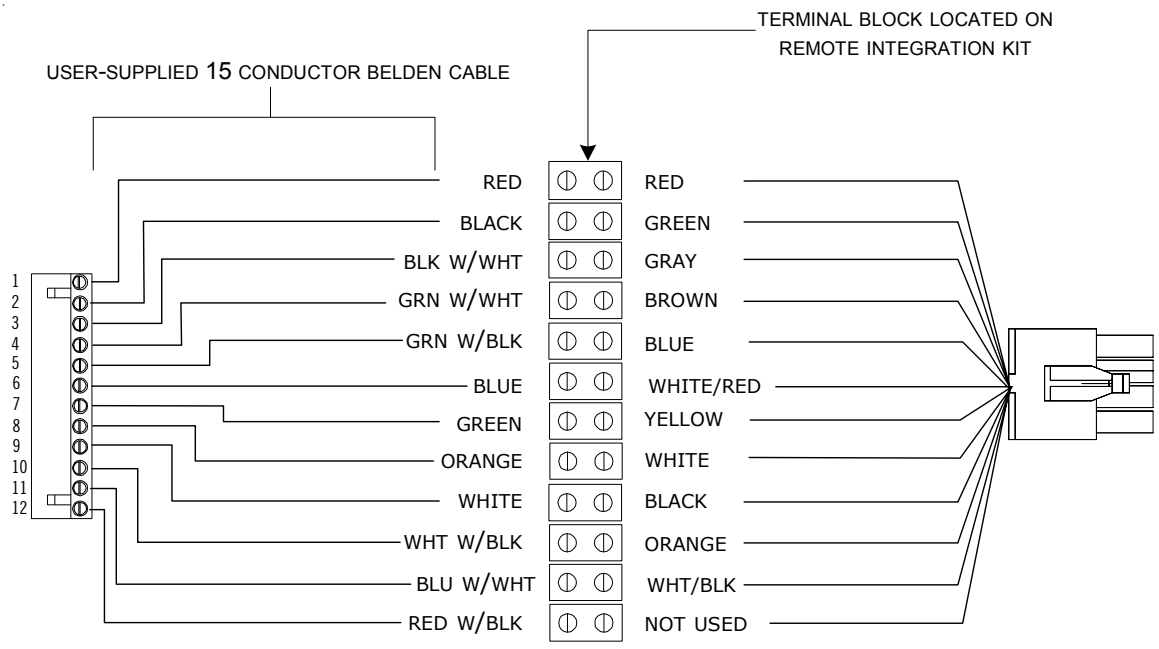


Fig. 7.16 Transponder-to-ECM interconnect cable, remote applications

7.3 Connectors, *continued*

7.3.13 ECM - Alarm Interface & Communications

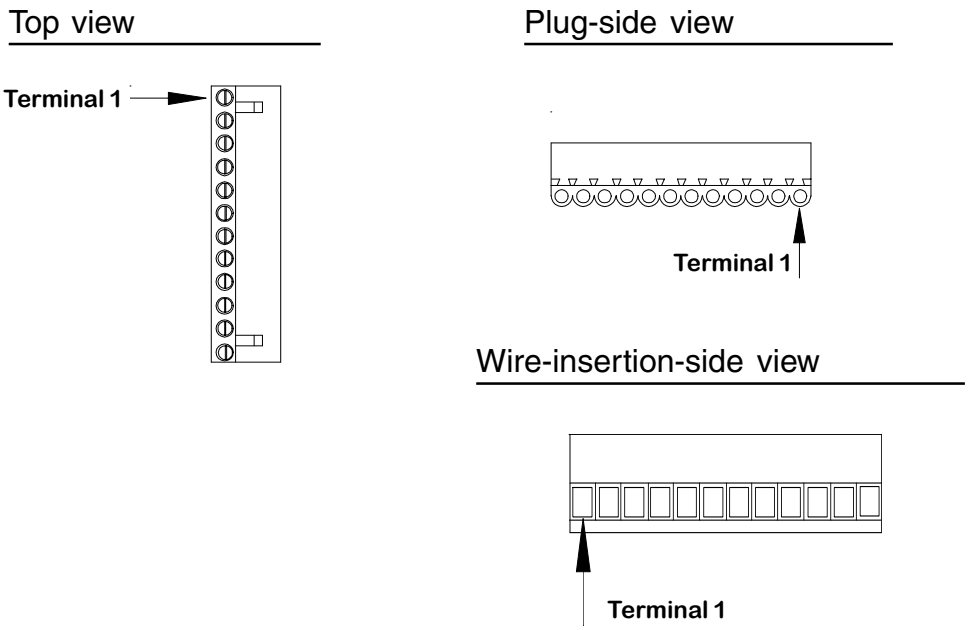


Fig. 7.17 ECM, SCM connector arrangement

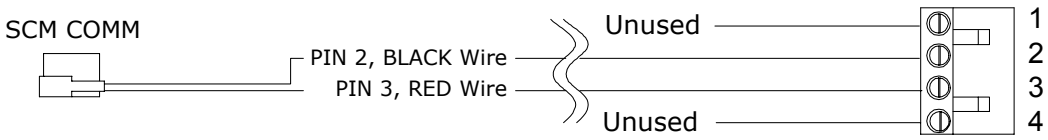


Fig. 7.18 SCM-to-ECM interconnect cable

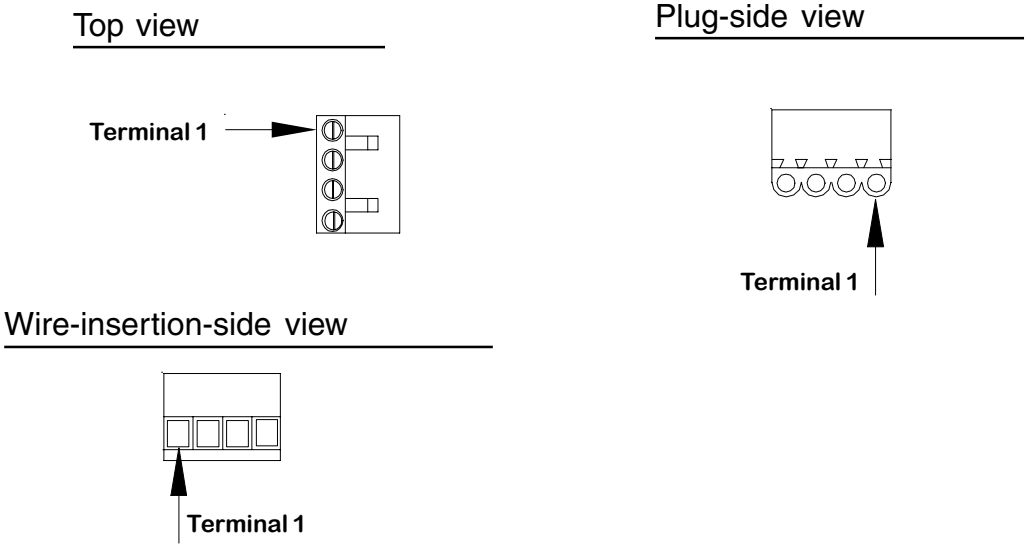


Fig. 7.19 RS-485-to-ECM interconnect cable

Power

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