

## Telecom Engine Control Module (ECM)

*Operation & Maintenance*

*Effective: October, 2000*



# ALPHA GEN

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**Overview:** The purpose of the AlphaGen ENGINE CONTROL MODULE (ECM) Operation and Maintenance Manual is to provide a high-level overview of the system and to detail the operation and maintenance of the module.

**Audience:** This manual intended for the operator of the system.

## **About this guide:**

**Contents:** This Operation and Maintenance Manual is comprised of five sections:

- Section 1.** System Overview. This section describes the theory of operation of the ECM.
- Section 2.** ECM Indicators and Controls. Describes the various module controls.
- Section 3.** ECM Alarms and Notifications. Describes the functions monitored and reported by the ECM.
- Section 4.** ECM Configuration and system interface. Describes the setup and connection of the module.
- Section 5.** System self-test and maintenance. Describes testing of the engine generator and module.

# Telecom Engine Control Module (ECM) Operation and Maintenance Manual

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# IMPORTANT SAFETY INSTRUCTIONS CONTAINED IN THIS MANUAL



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 must 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.



## **ATTENTION**

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



## **ELECTROSTATIC DISCHARGE SENSITIVITY**

This symbol indicates the need for following approved procedures for handling electrostatic-sensitive components.



## **INHALATION HAZARD**

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 indicate a fire or explosive hazard exists in this area of the product. Use caution whenever working in the area to prevent the possible combustion of fuel or 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.



## **HOT SURFACES**

This symbol indicates the presence of high temperatures which result from the operation of the system. To prevent burns, do not touch these areas while the system is in operation or immediately after it has been turned off.

## SAFETY PRECAUTIONS

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**NOTE:** Failure to follow these precautions could result in injury or death caused by the explosion of fuel, moving parts hazards or electrocution.



**CAUTION:** This set of procedures will require the operation of the generator and should only be performed by qualified, experienced personnel in a well-ventilated area.

1. Technicians must have easy access to a fire extinguisher at all times.
2. Propane/Natural Gases are highly explosive. Use extreme caution while handling and operating the Generator gas package and equipment. Keep flame or spark away from Propane bottles. Do not smoke during assembly of gas package.
3. Any test equipment used in the testing of the CE Series system must have isolated inputs to prevent shock hazards and short circuits with the enclosure or other grounded objects.
4. Run Generator only in properly ventilated areas. Exhaust gasses can be lethal. Prolonged exposure can cause nausea, headaches, dizziness, or Carbon Monoxide poisoning.
5. All pipe connections must be leak tested immediately.
6. Output of upper air dam must be unobstructed.
7. "Test" Propane bottles **MUST** not come into contact with the cabinet(s). Use a Digital Voltmeter (DVM) to ensure proper cabinet grounding.
8. "Test" Propane bottles must remain upright at all times.
9. All generator grid screens, covers, and access panels on the generator must be closed before operation. Moving parts are a hazard.
10. Both generator compartment fans must be operational any time gas pressure is applied.

## **SAFETY PRECAUTIONS**

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- The Engine Control Module (ECM) must be serviced only by qualified personnel.
- Remove all rings, watches and other jewelry before servicing batteries or installing the ECM.
- 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

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The system must be installed ONLY by qualified service personnel.

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

In regions where the CE Mark is required, locate unshielded electronic and electrical equipment outside a 3-meter radius of the Alphagen enclosure.

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

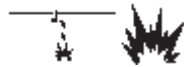
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**NOTE:** When the engine is stopping, a small amount of unburned fuel may be detected by the odor of gas fumes. Fans are used to expel these fumes from the enclosure and may be detected outside the enclosure for a short period of time after engine 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. Also, 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 as described in the INSTALLATION manual and correct as necessary.

## **Battery Safety Notes**

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### **Chemical Hazards**

Any gelled or liquid emissions from a Valve-Regulated Lead-Acid (VRLA) battery is electrolyte which contains dilute sulfuric acid which is harmful to the skin and eyes; is electrically conductive; and is corrosive.

If electrolyte contacts the skin, wash immediately and thoroughly with water. If electrolyte enters the eyes, wash thoroughly for 10 minutes with clean water or a special neutralizing eye wash solution and seek immediate medical attention.

Neutralize any spilled electrolyte with the special solutions contained in a "spill kit" or with a solution of 1 lb. Bicarbonate of soda to 1 gal. of water.

### **Fire, Explosion, and Heat hazards**

Lead acid batteries can contain an explosive mixture of hydrogen gas which can vent under overcharging conditions.

Do not smoke or introduce sparks in the vicinity of the battery.

Prior to handling the batteries, touch a grounded metal object, such as the rack, to dissipate any static charge that may have developed in your body.

Do not charge batteries in a sealed container. The individual batteries should have 0.5 inches of space between them to allow for convection cooling. If contained, assure the container or cabinet and room have adequate ventilation to prevent an accumulation of potentially dangerous gas.

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## 1.1 Introduction

The primary purpose of Alpha's Engine Control Module (ECM) is to control and monitor an AlphaGen Auxiliary Power Unit (APU) set, such as the CE-3X2 3.5kW and 5.0kW Series Engine-Generators. The ECM is used in conjunction with a Generator Remote Interface (GRI) PCBA, often referred to as the Power Board. The ECM/Power Board Assembly is mounted to the top of the Engine-Generator housing, to the left of the ignition battery. The Power Board is attached to the ECM via three ribbon cables.

The GRI provides power to the ECM, steps down high voltages for the ECM, and provides interface connectors for the enclosure sensors, engine controller, battery sense, line sense, and other equipment. Depending upon the standby powering configuration, the ECM and generator combination are installed remotely, or collocated, with other Alpha equipment such as power supplies and batteries.

The Engine Control Module 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 to prevent the backup batteries from discharging to a reduced voltage level which would compromise the ability of the system to provide a continuous, reliable source of power.

In addition to starting the APU, the ECM monitors the entire system for abnormal operating conditions such as low engine oil pressure, engine over-temperature, gas leak, enclosure pad shear, etc. If certain abnormal conditions or alarms are present, the ECM will either prevent the generator from starting or shut it down immediately. This provides for public safety, while preventing any serious damage to the APU. The system operator also has the ability to override the ECM and control the APU manually or remotely.

Finally, the ECM provides the interface between the APU and Alpha Technologies' communication devices. The ECM is designed to control and monitor the APU while responding 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 Light Emitting Diodes (LEDs) on the unit's front panel, or by four "Form C" relay contacts. The ECM is capable of reporting 9 major alarms, 8 minor alarms, and 2 notifications.

# 1. System Overview

## 1.1 Introduction, *continued*

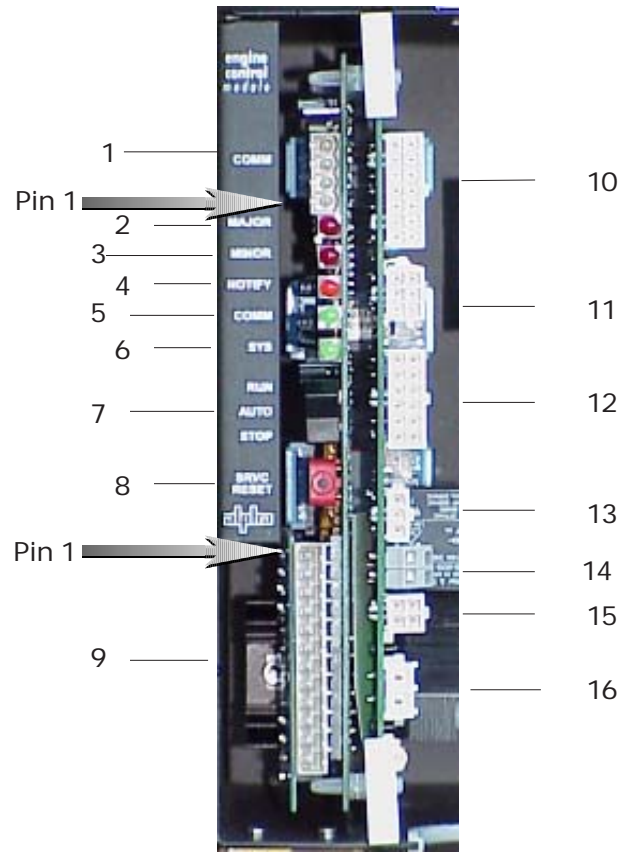


Fig. 1-1 Front view, "Telecom" Engine Control Module (ECM) showing LED indicators, switches and interface connections.

### Engine Control Module LED Indicators and switches:

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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" (RAS) switch
8. "Service/Reset" Push button switch (SW3)
9. Transponder Interface (J6) **Note: Pin #1 at top 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

1.1 Introduction, *continued*

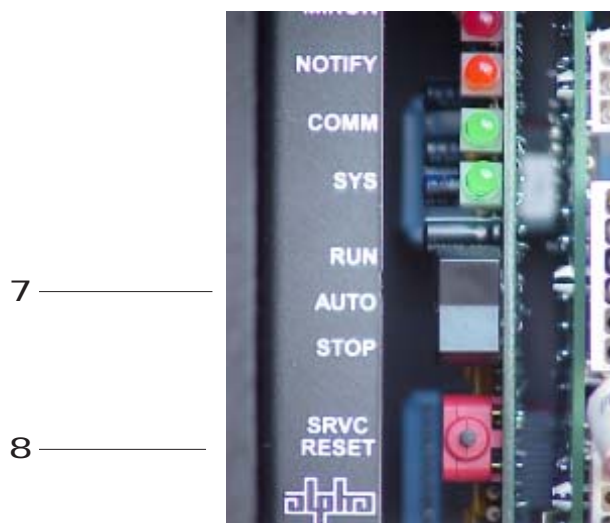


Fig. 1-2 Detail of ECM showing Run/Auto/Stop and Service/Reset switches

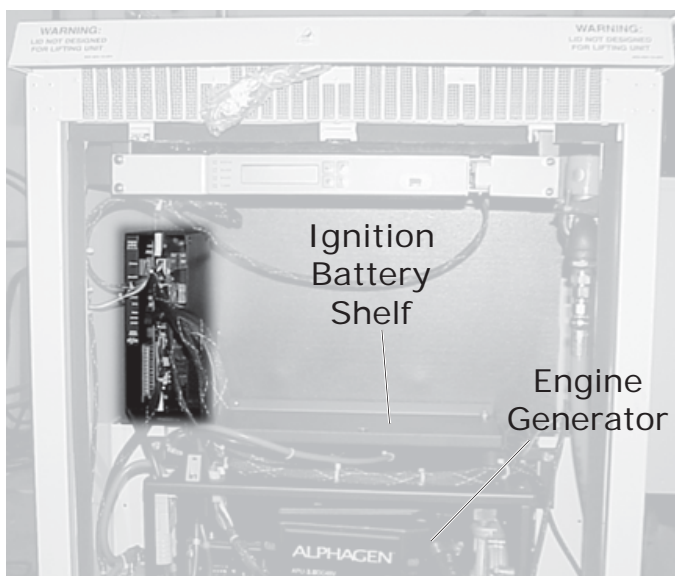


Fig. 1-3 Location of Engine Control Module (ECM) within the Engine-Generator Cabinet.

# 1. System Overview

## 1.1 Introduction, *continued*

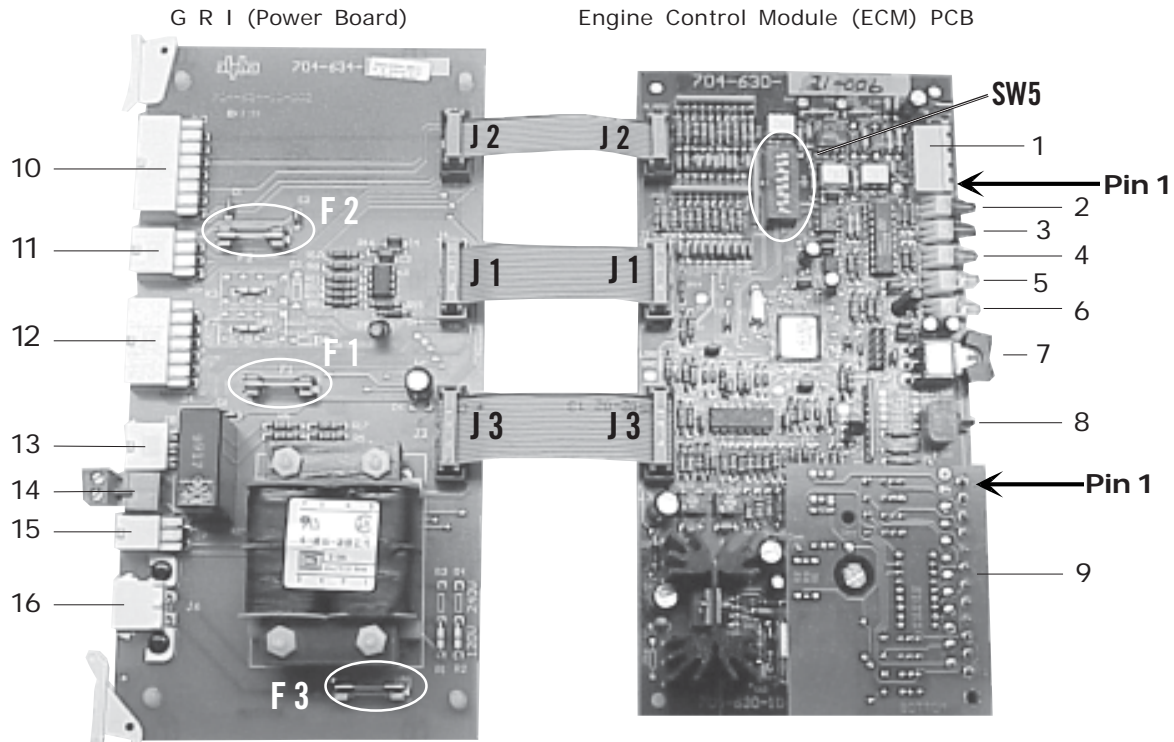


Fig.1-4 Telecom ECM Printed circuit boards

### 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" (RAS) switch
8. "Service/Reset" Push button switch (SW3)
9. Transponder Interface (J6) **Note: Pin #1 at top 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

## 1.2 Theory of Operation

### 1.2.1 Normal Operating Condition

Under normal operating conditions (no alarms) the ECM's Run-Auto-Stop (RAS) three-position rocker switch will be in the "center" or AUTO position as shown in figure 1.2. 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.



**NOTE:** The Run/Stop switch on the Generator Control Board **MUST** be in the center (ECM) position before the ECM will automatically control the Auxiliary Power Unit.

The APU can be controlled manually by placing the RAS switch in the "up" or RUN position and the "down" or STOP position. If a system controller is attached to the ECM via the RS-485 bus, the APU can be controlled remotely.

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.

### 1.2.2. Standby Operating Condition less than 3 minutes

If an AC line disturbance or outage is less than 3 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 49 Volts for 48 Volt systems. However, 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.

### 1.2.3. Standby Operating Condition more than 3 minutes

If an AC line disturbance or outage is greater than 3 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 1-1). 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 3.1).

# 1. System Overview

## 1.2 Theory 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

Table 1-1 Normal Mode Crank Cycle

### 1.2.4. 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.

### 1.2.5. 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

## 1.2 Theory of Operation, *continued*

### 1.2.6. 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.

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* (programmable).
2. DC bus voltage drops below *Low DC bus voltage* (programmable - 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 Volts (i.e., 50V for a 48V system).
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

## 1. System Overview

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## 2. ECM Indicators and Control Functions

### 2.1 Indicators

*Refer to the illustration on the following page:*

The ECM user interface consists of 5 LEDs (2-6), a three-position rocker switch (7), and a momentary contact, push-button switch (8). The COMM Interface (1) can be used to attach an Alpha Technologies system controller. Provisions are made for Transponder connections through the Interface connector (9).

The **Major** and **Minor** alarm LEDs (2,3) are red and reflect the state of the discrete major and minor alarms monitored by the ECM.

A **Major** alarm indicates failure of a critical component or some other situation (pad shear, for example) where the system either has gone off-line, or system failure and/or shutdown is imminent. Major alarms cause the engine to shutdown immediately and generally prevent further operation. Most major alarms are latched by the ECM. A site check by service personnel is required to repair the fault and clear the system.

A **Minor** alarm indicates a system fault which, though not indicative of imminent system failure or shutdown, requires service attention as the fault condition could worsen to shut down the system. A site check by service personnel is recommended.

The amber **Notify** LED (4) 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 **COMMunications** LED (5) illuminates for two seconds after each communications session on the Alpha bus. This is a standard that is used throughout the Alpha bus communications system.

The green **SYStem** status LED (6) indicates that the microprocessor has power and is operating normally. This LED flashes at a 1 Hz rate with a 50% duty cycle. When the ECM is in factory test mode, this LED will flash at a 0.5 Hz rate.

## 2. ECM Indicators and Controls Functions

### 2.1 Indicators, *continued*

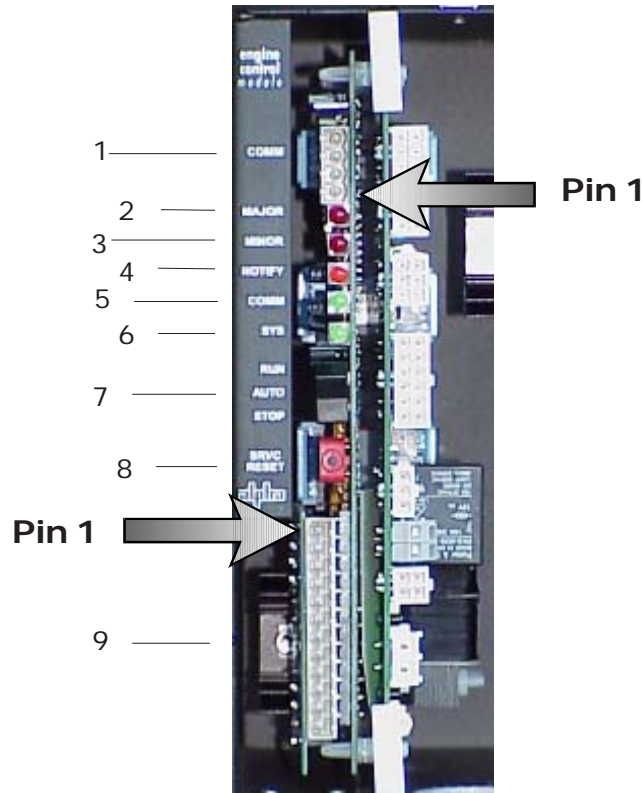


Fig. 2-1 Front view, ECM

Engine Control Module LED Indicators and switches:

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1. Communications Input (**note: Pin #1 at bottom of connector**)
2. "Major" Alarm Indicator (Red LED)
3. "Minor" Alarm Indicator (Red LED)
4. "Notify" Indicator (Amber 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. Parallel Transponder Interface (**note: Pin #1 at top of connector**)

## 2. ECM Indicators and Controls Functions

### 2.2 Control Functions

*Refer to Figure 2-2 on the following page:*

The three positions of the rocker switch (7) 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 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.** 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 (8) 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 "**Alarms**" section 3.3). 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.

## 2. ECM Indicators and Controls Functions

### 2.2 Control Functions, *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 Figure 3-1. Note that 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.

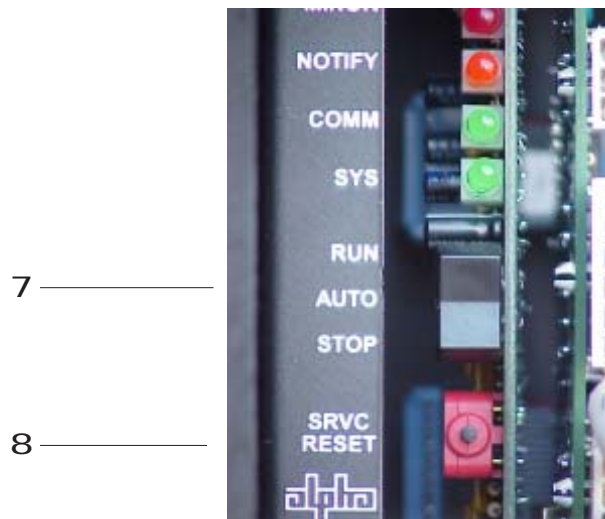


Fig. 2-2 Run-Auto-Stop (RAS) switch, Service/Reset push-button switch.

### 3.1 Alarm Classifications

The ECM is capable of reporting 9 "Major" alarms, 8 "Minor" alarms and 2 "Notifications". The following are detailed descriptions of each.

#### **Major Alarm:**

A Major alarm indicates failure of a critical component or some other situation (pad shear, for example) where the system either has gone off-line, or system failure and/or shutdown is imminent. 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 (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.** A site check by service personnel is required to repair the fault and clear the system.

#### **MAJOR ALARMS:**

---

##### **Low Oil Pressure (Latching)**

Indicates engine oil pressure is below safe limits and 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.

##### **Engine Over-Temp**

Indicates engine temperature has exceeded safe limits and operation of the unit has been suspended. The alarm is reset when the engine temperature falls below safe limits.

##### **Engine Over-speed (Latching)**

Indicates engine rpm has exceeded safe limits and 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.

##### **Engine Over-Crank (Latching)**

Indicates the failure of the engine to start when commanded to do so. The alarm is cleared when the *Reset* command is issued or when the manual stop switch is activated.

## 3. ECM Alarms and Notifications

### 3.1 Alarms Classifications, *continued*

#### **MAJOR ALARMS** (*continued*):

---

##### **Alternator Overvoltage (Latching)**

The generator set has detected that the alternator output voltage is too high. Depending on generator type, this likely means that the voltage regulator or the 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 overvoltage alarm can be triggered in any of 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 5 seconds (programmable for a range of 5-15 seconds; 5 seconds is the default value).
- 3.) A fixed threshold of 2.5V/cell (60V for a 48V system) is exceeded for five (5) 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**

Water level within the main or fuel enclosure has exceeded safe limits for generator operation. APU operation is suspended while this alarm is active. The alarm is reset when the water level falls below maximum limits.

##### **Pad Shear (Latching)**

Indicates that 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 when the manual stop switch is activated.



**NOTE:** APU will not start if Pad Shear magnet is not correctly installed below the Pad Shear sensor.

##### **Low Fuel Pressure (Latching - after 5 activations)**

Indicates that site fuel supply (Propane-fueled APU only) is insufficient for extended engine operation. The alarm is reset 5 minutes after the fuel supply is replenished.

### 3.1 Alarms Classifications, *continued*

#### **Minor Alarm:**

These alarms indicate a system fault which, though not indicative of imminent system failure or shutdown, require service attention as the fault condition could worsen to shut down the system. A site check by service personnel is recommended.

#### **MINOR ALARMS:**

---

#### **Control Fail (Latching - *after 5 activations*)**

Indicates a control failure between the ECM and the generator set. Typically this means that the engine did not start or stop when commanded to do so. The alarm is cleared when the *Reset* command is issued or when the manual stop switch is activated.

#### **Alternator Off**

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)**

Status of most recent generator test. 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 that the generator's ignition battery voltage has fallen below 11.5VDC. Alarm is cleared when battery voltage rises above 12.0VDC indicating battery recovery has begun. Note that low ignition battery voltage is not alarmed during engine cranking.

## 3. ECM Alarms and Notifications

### 3.1 Alarms Classifications, *continued*

#### **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 doors on enclosure is open. The alarm clears when the door is closed.

#### **DC Bus Fault**

Indicates that 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 2 volts 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.

### 3.2 Notifications

Additionally, the ECM will report the following "Notification" information.

#### **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 that routine maintenance of the engine - generator is overdue. This alarm activates when *Service Countdown* reaches 0. It is cleared by depressing the service timer reset button for five seconds. (*Refer to Section 5.2 "System Maintenance" for further information*).

3.3 Alarm and Notification Indications

Alarms are indicated in three ways: ECM LEDs, RS-485 communications and alarm contact closures on ECM transponder interface. Alarm indication via 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 figures show 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		●	●	●		●		●	●	

Fig. 3-1 Major, Minor Alarm Indications, and Notifications (LEDs as displayed on the ECM)

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

Legend:

- \* = Latching Alarm
- \*\* = Notifications
- \*\*\* = Alarm "latches" after 5 activations

### 3. ECM Alarms and Notifications

#### 3.4 Telecom ECM Alarm and Communications Interface

##### 3.4.1 ECM - Alarm Interface & Communications

The Alarm output interface and communications connectors are shown below for clarity. See Fig. 2-1, items 1 and 9 for location. For RS-485 interface connection, please refer to Section 2., *Installation*, in the Telecom Power Monitor (TPM) Operator's Manual (p/n 017-913-B0).

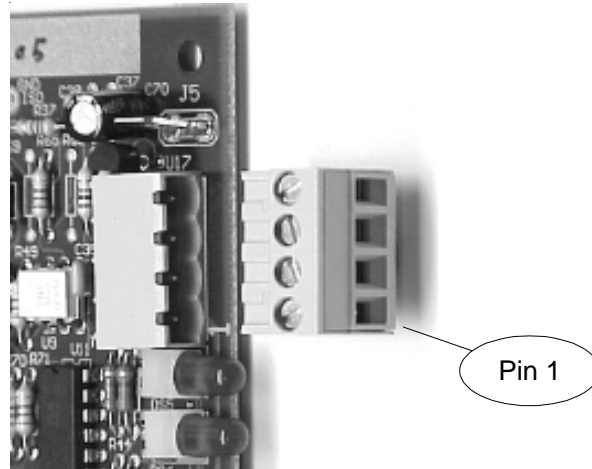


Fig.3-2 Communications RS-485 Input Connector

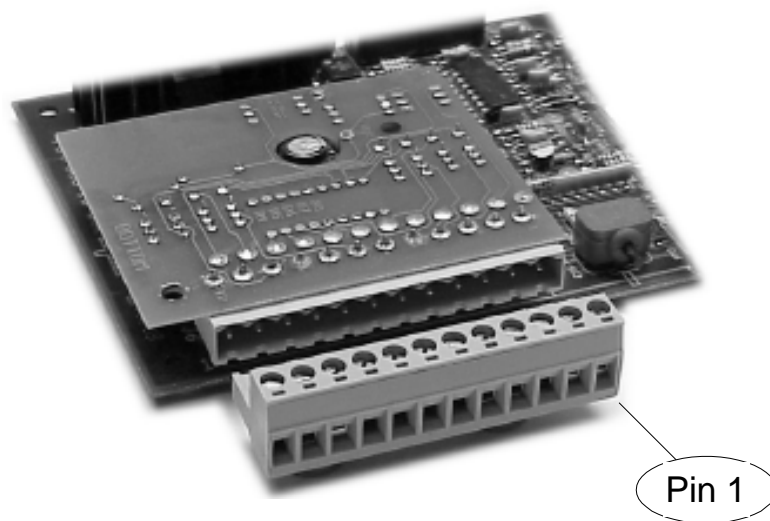


Fig.3-3 Transponder Interface Connector

### 3. ECM Alarms and Notifications

#### 3.4 Telecom ECM Alarm and Communications Interface, *cont'd*

In the Telecom version of the ECM, a relay board is built onto the ECM microboard. The alarm outputs of the ECM are remapped, and the pinout and alarm signal descriptions are shown in the table below.



**NOTE:** Pin 1 on the Alarm connector is located at the **TOP** of the ECM connector.

PIN	ALARM SIGNAL DESCRIPTION	ACTIVE STATE
1	Engine Run Common	
2	Engine Run	Closed with respect to Pin 1
3	Engine Run	Open with respect to Pin 1
4	Major Alarm Common	
5	Major Alarm	Closed with respect to Pin 4
6	Major Alarm	Open with respect to Pin 4
7	Minor Alarm Common	
8	Minor Alarm	Closed with respect to Pin 7
9	Minor Alarm	Open with respect to Pin 7
10	Door Intrusion Common	
11	Door Intrusion	Closed with respect to Pin 10
12	Door Intrusion	Open with respect to Pin 10

Table 3-1, Telecom ECM Transponder interface



## 4. ECM Configuration and System Interface

### 4.2 ECM Configuration

#### 4.2.1 Switch Settings

The ECM configuration is required for interface type, output voltage, input voltage and reserved functions. The following should be used to configure the ECM:

ECM Switch 5 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, CE-3X2
	0	0	0					Invalid output voltage configuration
	0	0	1					24 VDC Output
	0	1	0					36 VDC Output
	0	1	1					48 VDC Output
	1	0	0					96 VDC Output
	1	0	1					120 VDC Output
	1	1	0					208 VDC Output
	1	1	1					240 VDC Output
				0	0			Invalid input voltage configuration
				0	1			120 AC input
				1	0			208 3-phase input
				1	1			240 VAC input
0						0		No affect
0						1		No affect
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 4-1 ECM switch configurations

(Switch settings shown below are for a Telecom CE-3X2 with 120 VAC input and 48VDC output.)



**\*NOTE:** Programming parameters that affect the Autotest feature via Status Monitoring will override this switch setting.

## 4. ECM Configuration and System Interface

### 4.2 ECM Configuration, *continued*

#### 4.2.1 Switch Settings, *continued*

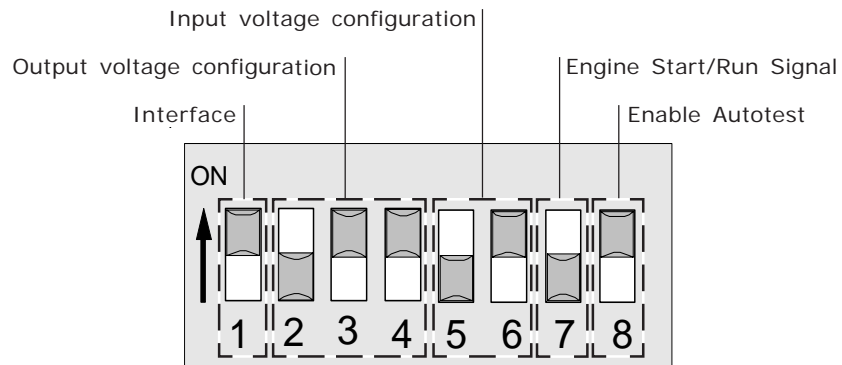


Fig. 4-2 SW5, ECM PCBA (Alpha p/n 704-630-xx-xxx)

To reset Factory Defaults, turn ALL dipswitches off, briefly power up the ECM (plug in AC line sense) for 10 seconds, de-power, then re-set dipswitches appropriately.

## 4. ECM Configuration and System Interface

### 4.2 ECM Configuration, *continued*

#### 4.2.2 Default Settings

---

Telecom Defaults (set with JP13 stuffed)

---

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



## 4. ECM Configuration and System Interface

### 4.4 ECM Input Voltage and Line Sense Configurations

The ECM has 120/240VAC **input voltage** and **line sense** capabilities, which must be configured **separately**. The ECM PCBA part number 704-630-XX must be configured for 120/208/240VAC **line sense** via DIP Switch SW5-5 and SW5-6 as shown in Table 4-1. The default setting is 120VAC. The logic transformer (T1) located on the GRI power board part number 704-634-XX, 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 as shown in Fig. 4-4. 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. In other words, 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 SW-5 is set correctly, the ECM will properly scale the voltage for status monitoring purposes.



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

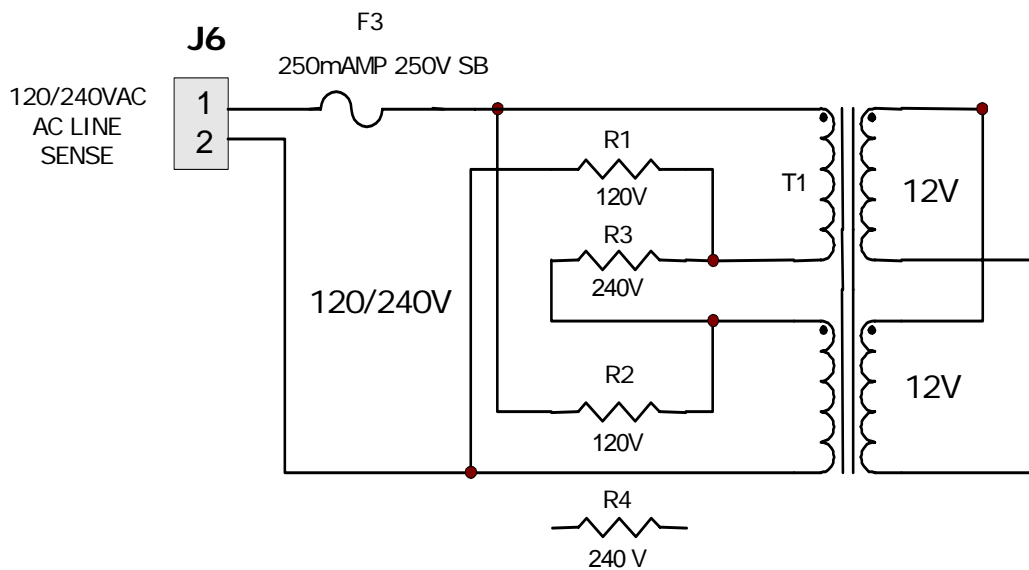


Fig. 4-4 ECM Power Board (p/n 704-634-XX)

## 4. ECM Configuration and System Interface

### 4.5 ECM System Parameters

The following is a listing of programmable parameters used by the ECM. They may be changed via the Telecom Power Monitor (TPM). Refer to the Telecom Power Monitor Technical Manual (p/n 744-781-B0) for additional information.

#### 4.5.1 Low DC Bus Level

Description: If the power system battery voltage goes below this threshold voltage for a certain period of time, the ECM will start the generator.

Range: 0V to 127VDC

Default setting: 49V

#### 4.5.2 High DC Bus Level

Description: If the power system battery voltage goes above this threshold voltage for a certain period of time (duration is programmable; default = 5 seconds), the ECM will shut down the generator.

Range: 0V to 127VDC

Default setting: 57V

#### 4.5.3 Service Interval

Description: Number of engine run hours between required services.

Range: 0 to 65535 hours

Default setting: 100 hours

#### 4.5.4 Service Countdown

Description: The number of engine run hours remaining until the next periodic maintenance is required. This parameter is reset to *Service Interval* when the service timer reset button is depressed for at least five seconds. Run time since last service is simply *Service Interval* minus *Service Countdown*.

Range: 0 to 65535 hours

Default setting: N/A

#### 4.5.5 Total Engine Runtime

Description: This counter keeps track of total in-service hours on the generator set. It can be programmed to an initial value that matches a mechanical hour-meter that is often found on the generator's prime mover or it can be used in place of such a meter.

Range: 0 to 6553.5 hours

Default setting: N/A

## 4. ECM Configuration and System Interface

### 4.5 ECM System Parameters, *continued*

#### 4.5.6 Auto-test Interval

Description: Interval between automatic self tests in days. *Auto-test Countdown* is reset to this value (multiplied by 24 hours) when this parameter is written or upon completion of an automatic self test. Setting this value to zero will disable the automatic self-test.

Range: 0 to 65535 days

Default setting: 0 days (automatic self tests disabled)

#### 4.5.7 Auto-test Countdown

Description: The number of hours remaining until the next automatic self-test. This parameter is an indicator but also can be used to program the time of the next automatic self-test. Subsequent tests will occur *Auto-test Interval* days later at the same time of the day (if a real time clock is installed in the ECM).

Range: 0 to 65535 hours

Default setting: N/A

#### 4.5.8 Auto-test Duration

Description: The number of minutes that the engine will run when a test is requested.

Range: 0 to 65535 minutes

Default setting: 10 minutes

#### 4.5.9 Start Delay

Description: The period of time between detection of utility failure and start of the engine - generator. If utility power returns before the start delay timer expires (counts down to 0), the timer will start to count up after 30 minutes and continue to increment 1 count per minute until it returns to the *Start Delay* value.

Range: 0 to 65535 seconds

Default setting: 180 (3 minutes)

#### 4.5.10 Shutdown Delay

Description: Cool-down period between determination by the ECM that the generator can be shutdown and the time actual shutdown occurs.

Range: 0 to 65535 seconds

Default setting: 720 (12 minutes)

## 4. ECM Configuration and System Interface

### 4.5 ECM System Parameters, *continued*

#### 4.5.11 Error Code

Description: ECM hardware error code. Self-diagnostic information is available via the error code; this includes problems detected in the operation of the micro-controller and system configuration faults. Since only one code can be reported, the oldest one will be kept unless the associated condition clears. This datum can only be written to 0. Resetting factory defaults also clears the error code.

Range: 0 to 65535 codes

Default setting: 0

Error Codes	Description
1	Computer Operation Properly timeout.
2	Micro-controller clock failure.
3	Illegal op-code detected.
4	Jumps to unassigned interrupt vector.
101	EEPROM fault.
102	ECM output configuration switch setting undefined.
103	ECM input configuration switch setting undefined.
104	ECM factory test failed.

Timer / Counter notes:

The real time data may be updated via serial communications when a real time clock is not installed on the ECM. The ECM's microprocessor will then maintain real time using its internal clock between updates from an external communications device.

#### 4.5.12 Over-Voltage Duration

Description: Over-voltage period between determination by the ECM that the generator can be shutdown and the time actual shutdown occurs.

Range: 0 to 255

Default setting: 5 (seconds)

### 5.1 Self-Test

Generator testing can be initiated in four 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*.

Generator testing consists of starting and running the generator for a programmable period of time (the default test duration is 10 minutes). 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 asserted, or the engine is already running.

## 5. System Self-test and Maintenance

### 5.1 Self-Test, *continued*

If AC line should fail during a test, the test will terminate normally but the engine will continue to run until line returns. If the test fails because the DC Bus alarm activates, the test will terminate, the self-test fail alarm will activate but the generator will continue to run 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.

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

#### **Auto-Test Interval**

This feature represents the number of days between automatic tests. Programming this variable to 0 disables the automatic test feature.

#### **Auto-Test Countdown**

This countdown timer is monitored by the ECM to determine when the next automatic test should be initiated. Although this timer is normally used as a status indicator, it can be used to set the start time for the next autotest. For example, if the user wants to start the automatic test sequence at 12:30pm and it is presently 10:15am, they can wait until 10:30 and program Auto-Test Countdown to 2 hours. Subsequent tests will begin at nearly the same time of day so long as the ECM doesn't lose power in the interim. The ECM sets Auto-Test Countdown whenever the Auto-Test Interval is changed. Thus, if the Auto-Test Interval is programmed to 10 days, the ECM will set Auto-Test Countdown to 240 hours.

#### **Auto-Test Duration**

The length of each Auto-test is measured in minutes. The default test duration is 10 minutes. The test duration may be set between 10 and 120 minutes.

### 5.1 Self-Test, *continued*

#### **Manually enabling the Autotest feature**

Switch SW5-8 is used 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, place switch SW5-8 in the OFF position and restart the ECM. It is important to understand that upon power up, the ECM looks for a **change** in the switch position before it changes the test control parameters. (*Please refer to Fig. 4-2*)

Procedure to set the self test to a specific time of day without a Telecom Power Monitor (TPM) if SW5-8 was in **ON** position.

1. Go to the site at 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 only 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.

## 5. System Self-test and Maintenance

### 5.2 System Maintenance

The ECM monitors time between periodic maintenance of the engine-generator. The *Service Interval* internal ECM variable represents the number of hours of engine-run-time between periodic services. When the engine runs for a number of hours equal to *Service Interval*, the ECM sets the *Service Required Alarm* and turns on the amber notification LED. The default value of *Service Interval* is 100 hours but it can be programmed from 0 to 250.

*Service Due* represents the number of engine run time hours before the next periodic maintenance will be required. Pressing and holding the service-reset switch for 5 seconds resets the service counter and *Service Due* is updated with the current value of the service interval.

An exception to the standard *Service Interval* occurs when the engine is new. At 25 hours of *Engine Run Time*, the ECM will set the *Service Required* flag. 25 hours represents the break-in period of the engine, which should be serviced at this point. Note that if a service-reset is performed before the *Engine Run Time* counter reaches 20 hours, the *Service Required* flag will still be set at 25 hours. If, on the other hand, a service-reset is issued when the engine more than 20 hours, the *Service Countdown* will be set to *Service Interval*.



**NOTE:** Telecom 3.5kW/5.0kW APUs are shipped with synthetic oil which does not require changing after the initial 25 operational hours. The oil should be changed after each 72- to 100-hour period of continuous operation in accordance with the generator manufacturer's owners manual. Exact times will vary as a function of temperature and operating conditions.

## Engine Control Module Alarm Table

Alarms are indicated in three ways: ECM LEDs, RS-485 communications and alarm contact closures on ECM transponder interface. Alarm indication via 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 figures show 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		●	●	●		●		●	●	

Fig. 3-1 Major, Minor Alarm Indications, and Notifications (LEDs as displayed on the ECM)

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

Legend:

- \* = Latching Alarm
- \*\* = Notifications
- \*\*\* = Alarm "latches" after 5 activations

Remove page and use for quick reference



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#### **CANADA**

Alpha Technologies  
7033 Antrim Ave.  
Burnaby, B.C. V5J 4M5  
Tel: (604) 430-1476  
Fax: (604) 430-8908

#### **UNITED KINGDOM**

Alpha Technologies  
Cartel Business Estate  
Edinburgh Way  
Harlow, Essex CM20 2DU  
Tel: +44-1279-422110  
Fax: +44-1279-423355

#### **GERMANY**

Alpha Technologies  
Hansastraße 8  
D-91126 Schwabach  
Tel: +49-9122-997303  
Fax: +49-9122-997321

#### **MIDDLE EAST**

Alphatec  
P.O. Box 6468  
3307 Limassol, Cyprus  
Tel: +357-5-375675  
Fax: +357-5-359595

#### **AUSTRALIA**

Alpha Technologies  
8 Anella Ave., Unit 6  
Castle Hill, NSW 2154  
Tel: +61 (0)2 9894-7866  
Fax: +61 (0)2 9894-0234