Operation and Maintenance Manual For

PowerCom Controller

Power Generation

BULLETIN NO. 0914-0101-00

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SECTION - 1 : INTRODUCTION

About the Manual

This manual contains information needed to correctly operate and maintain the PowerCom provided on your engine. Additional service literature (Shop Manual, Troubleshooting and Repair Manual) can be ordered from Authorized Dealers.

This manual contains information needed to understand, correctly operate and maintain the **PowerCom** as recommended by Cummins India Limited.

This manual does **not** cover base engine maintenance procedures. Refer to the Operation and Maintenance Manual, Bulletin No. 3243773-03 for the specific engine information. Any base engine specific changes in the Software Calibration Features will be covered in separate bulletins for that particular Engine / Rating.

This manual does **not** cover generator equipment maintenance or repair procedures. Consult the generator equipment manufacturer for specific maintenance and repair recommendations. Both metric and U.S. customary values are listed in this manual. The metric value is listed first, followed by the U.S. customary in brackets.

To The Owner and Operator

Preventive maintenance is the easiest and least expensive type of maintenance. Follow the maintenance schedule recommendations outlined in Maintenance Guidelines.

Keep records of regularly scheduled maintenance.

Use the correct fuel, oil and coolant in your engine as specified in Specifications

and Torque Values. Cummins India Ltd. uses the latest technology and the highest quality components to produce its engines. Cummins recommends using only genuine Cummins parts and ReCon exchange parts.

Personnel at Cummins Authorized Repair Locations have been trained to provide expert service and parts support. If you have a problem that cannot be resolved by a Cummins Authorized Repair Location, follow the steps outlined in the Service Assistance.

NOTE: Discharge of oil or oily waste into or upon water is a direct violation of today's laws. Violators are subject to a penalty of various monetary charges. Dispose off these substances properly.

General Safety Instructions

WARNING

Read and understand all the safety precautions and warnings before repair. This list contains general safety precautions that **must** be followed to provide personal safety. Special safety precautions are included in the procedures when they apply.

- Make sure the work area surrounding the product is safe. Be aware of hazardous conditions that can exist.
- **Always wear** protective glasses and protective shoes when working.
- **Do not** wear loose-fitting or torn clothing. Remove all jewelry when working.
- Disconnect the battery and discharge any capacitors before beginning any repair work. Disconnect the air starting motor if equipped to prevent accidental engine starting. Put a “Do **Not** Operate” tag in the operator’s compartment or on the controls.
- Use ONLY the proper engine barring techniques for manually rotating the crankshaft.
- Do **not** attempt to rotate the crankshaft by pulling or prying on the fan. This practice can cause serious personal injury, property damage, or damage to the fan blade(s) causing premature fan failure. If an engine has been operating and the coolant is hot, allow the engine to cool before you slowly loosen the filler cap and relieve the pressure from the cooling system.
- Do not work on anything that is supported ONLY by lifting jacks or a hoist.
- Always use blocks or proper stands to support the product before performing any service work.
- Relieve all pressure in the air, oil, and the cooling systems before any lines, fittings, or related items are removed or disconnected. Be alert for possible pressure when disconnecting any device from a system that utilizes pressure.
- Do **not** check for pressure leaks with your hand. High pressure oil or fuel can cause personal injury. To avoid personal injury, use a hoist or get assistance when lifting components that weigh 23 kg [50 lb] or more. Make sure all lifting devices such as chains, hooks, or slings are in good condition and are of the correct capacity. Make sure hooks are positioned correctly.
- **Always** use a spreader bar when necessary. The lifting hooks **must not** be side-loaded. Corrosion inhibitor contains alkali.
- Do **not** swallow internally.
- Do **not** get the substance in your eyes. Avoid prolonged or repeated contact with skin. In case of contact, immediately wash skin with soap and water. In case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. IMMEDIATELY CALL A PHYSICIAN. KEEP OUT OF REACH OF CHILDREN. Naptha and Methyl Ethyl Ketone (MEK) are flammable materials and **must** be used with caution. Follow the manufacturer’s instructions to provide complete safety when using these materials. KEEP OUT OF REACH OF CHILDREN.
- To avoid burns, be alert for hot parts on products that have just been turned **OFF,** and hot fluids in lines, tubes, and compartments.
- **Always** use tools that are in good condition. Make sure you understand how to use them before performing any service work. Use ONLY genuine Cummins or Cummins Recon® replacement parts.
- **Always** use the same fastener part number (or equivalent) when replacing fasteners. Do **not** use a fastener of less quality if replacements are necessary.

General Repair Instructions:

This engine incorporates the latest diesel technology; yet, it is designed to be repaired using normal repair practices performed to quality standards.

Cummins India Ltd., does not recommend or authorize any modifications or repairs to engines or components except for those detailed in Cummins Service Information. In particular, un-authorized repair to safety-related components can cause personal injury. Below is a partial listing of components classified as safety-related:

1. Air Compressor
2. Cooling Fan
3. Fan Hub Assembly
4. Fan Mounting Bracket(s)
5. Fan Mounting Capscrews
6. Fan Hub Spindle
7. Flywheel
8. Flywheel Crankshaft Adapter
9. Flywheel Mounting Capscrews
10. Fuel Shutoff Assemblies
11. Fuel Supply Tubes
12. Lifting Brackets
13. Throttle Controls
14. Turbocharger Compressor Casing
15. Turbocharger Oil Drain Line(s)
16. Turbocharger Oil Supply Line(s)
17. Turbocharger Turbine Casing
18. Vibration Damper Mounting Capscrews

- Follow All Safety Instructions Noted in the Procedures.
  - Follow the manufacturer's recommendations for cleaning solvents and other substances used during the repair of the engine. **Always** use good safety practices with tools and equipment.
- Provide a Clean Environment and Follow the Cleaning Instructions Specified in the Procedures
  - The engine and its components **must** be kept clean during any repair. Contamination of the engine and components will cause premature wear.
- Perform the Inspections Specified in the Procedures.
- Replace all Components or Assemblies which are damaged worn beyond the specifications
- Use genuine Cummins new or ReCon Service Parts and Assemblies.
  - The assembly instructions have been written to use again as many components and assemblies as possible. When it is necessary to replace a component or assembly, the procedure is based on the use of new Cummins India Ltd. or Cummins ReCon® components. All of the repair services described in this manual are available from all Cummins Distributors and most Dealer locations.
- Follow the specified Disassembly and Assembly Procedures to avoid damage to the components.

Complete rebuild instructions are available in the shop manual which can be ordered or purchased from a Cummins Authorized Repair Location.

PowerCom DO'S AND DONT'S

DON'Ts

1. DO NOT remove the PowerCom connectors A, B and C when +24V supply is connected to the controller.
2. DO NOT attempt to open the PowerCom enclosure.
3. DO NOT attempt to remove or repair any of the PowerCom electronic parts (components, cables etc.). There are no user serviceable parts inside PowerCom.
4. Precaution during welding:
   i) DO NOT connect ground cable of welding machine to PowerCom
   ii) Do not perform welding on the chassis or any part of engine / chassis when PowerCom is powered up.
5. DO NOT expose PowerCom to sunlight, humidity, heat, water while in operation.
6. Servicing of PowerCom is to be done by **Authorized Cummins Personnel Only.**

DO's

1. Precautions during welding :
   i) First, disconnect battery cables from battery terminals.
   ii) Then, disconnect the connectors A, B, C from the PowerCom
2. Contact authorized service personnel in case of PowerCom failure.

Graphic Symbols

The following symbols have been used in this manual to help communicate the intent of the instructions. When one of the symbols appears, it conveys the meaning defined below :

WARNING - Serious personal injury or extensive property damage can result if the warning instructions are not followed.

CAUTION - Minor personal injury can result or a part, an assembly, or the engine can be damaged if the caution instructions are **not** followed.

Indicates a **REMOVAL or DISASSEMBLY** step.

Indicates an **INSTALLATION or ASSEMBLY** step.

INSPECTION is required.

CLEAN the part or assembly.

PERFORM a mechanical or time **MEASUREMENT.**

LUBRICATE the part or assembly.

Indicates that a **WRENCH or TOOL SIZE** will be given.

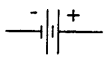
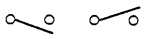
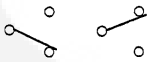
TIGHTEN to a specific torque.

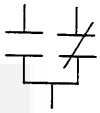
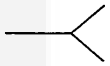
PERFORM an electrical **MEASUREMENT.**

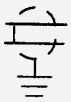
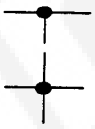
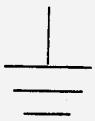
Refer to another location in this manual or another publication for additional information.

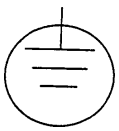
The component weight 23 kg [50 lb] or more. To avoid personal injury, use a hoist or get assistance to lift the component.

Electrical Symbols

Name	Symbol
Battery	
Alternator (Frequency Source)	
Resistor	
Variable Resistor (Potentiometer) — 3 Terminal Device	
Variable Resistor (Potentiometer) — 2 Terminal Device	
Terminal Strip	
Switches :	
(N.O.) Normally Open	
(N.C.) Normally Closed	
Transfer	
Transfer 3 position	
Relay Contact :	
(N.O.) Normally Open	
(N.C.) Normally Closed	

Name	Symbol
Transfer	
Capacitor	
Fuse	
Circuit Breaker	
Jumper Wire	
Coil	
Magnetic Core	
Transformer	
Variable Reluctance Magnetic Pickup	
Female Contact	
Male Contact	

Name	Symbol
Shields:	
Shielded Wire	
Shielded Pair	
Crossing of Conductors (wires) not Connected	
Junction of Connected Conductors (wires)	
Grounded	
Chassis or Frame Connection	
Conducting connection to a chassis or frame, or equivalent chassis connection of a printed wiring board. The chassis or frame (or equivalent chassis connection of a printed wiring board) may be at a different potential than the earth or structure in which this chassis or frame (or printed wiring board) is mounted.	
Direct Conducting Connection to Circuit Return.	
Conducting connection to a structure that services a function similar to that of an earth ground (that is, a structure such as a frame of an air, space or land vehicle that is not conductively connected to earth.)	

Name	Symbol
Earth Safety Ground	
** This symbol may be used in place of symbol for direct conducting connection to circuit return to indicate a ground connection having a specified protective function (e.g., for protection against electrical shock in case of a fault). ** Ref. Electrical and Electronics Graphic Symbols and abbreviated names.	

Foreword

This manual contains information for the correct operation and maintenance of your Cummins engine. It also includes important safety information, engine and systems specifications, troubleshooting guidelines.

Keep this manual with the equipment. If the equipment is traded or sold, give the manual to the new owner. The information, specifications, and recommended maintenance guidelines in this manual are based on information in effect at the time of printing. Cummins India Limited reserves the right to make changes at any time without obligation. If you find differences between your engine and the information in this manual, contact your local Cummins Authorized Dealer.

The latest technology and the highest quality components were used to produce this engine. When replacement parts are needed, we recommend using only genuine Cummins or ReCon® exchange parts. These parts can be identified by the following trademarks:

Important Reference Numbers

Fill in the part name and number in the blank spaces provided below. This will give you a reference whenever service or maintenance is required.

PowerCom Sr. No. _____

Engine Model _____

Engine Serial Number _____

Engine Control Parts List (CPL) Number _____

Engine Oil Type and Viscosity _____

Fuel Pump Part Number _____

Filter Part Numbers:

- Air Cleaner Element _____
- Coolant _____
- Lubricating Oil _____
- Fuel _____

Belt Part Number (Alternator) _____

Boot loader calibration no. _____

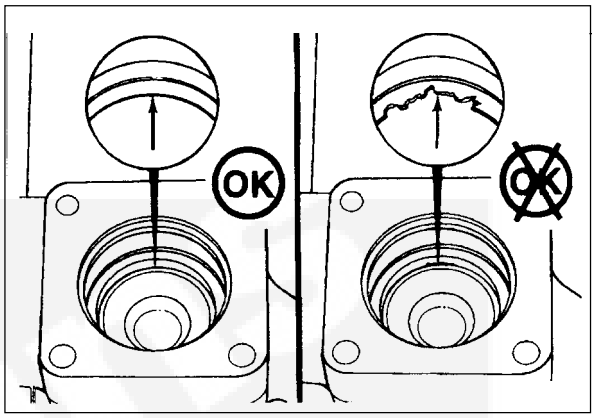
Base calibration no. _____

Fuel pump code. _____

Engine Hours _____

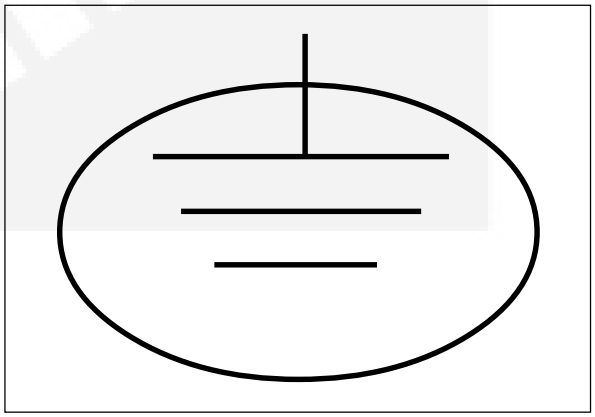
Illustrations

Some of the illustrations throughout this manual are generic and will **not** look exactly like the engine or parts used in your application. The illustrations can contain symbols to indicate an action required and an acceptable or **not** acceptable condition.

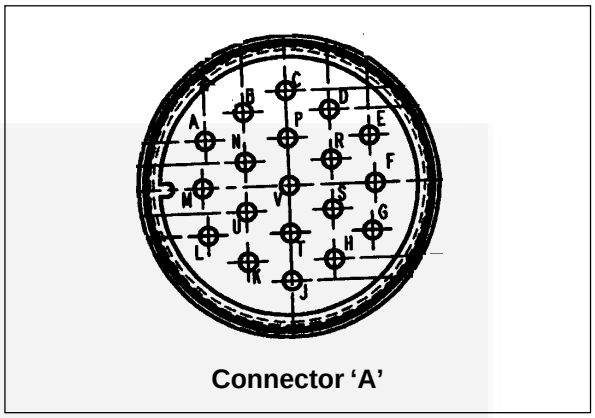


The illustrations included in this manual are intended to illustrate procedures performed or location of particular items.

The procedure performed or location of the item described will be the same even though the illustrations may vary.

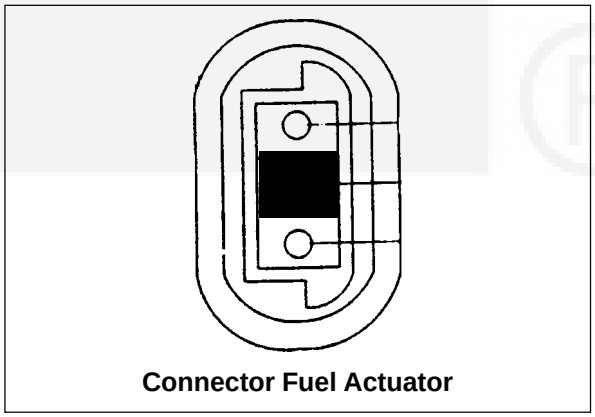


Illustrations showing connector contact positions for connections to the PowerCom are shown as viewed looking at the connector on the PowerCom, not the interfacing connector of the wiring harness.



Connector 'A'

Illustrations showing connector contact positions for connections to the in-line connectors of the wiring harnesses are viewed looking at the corresponding connector on the factory supplied engine or extension wiring harness, not the connector of the interfacing harness.



Connector Fuel Actuator

NOTES

SECTION 2： PowerCom General Information

1.0 System Overview

The PowerCom is a microprocessor based integrated G-drive controller. It provides engine governing & complete generator set monitoring and protection.

1.1 Description

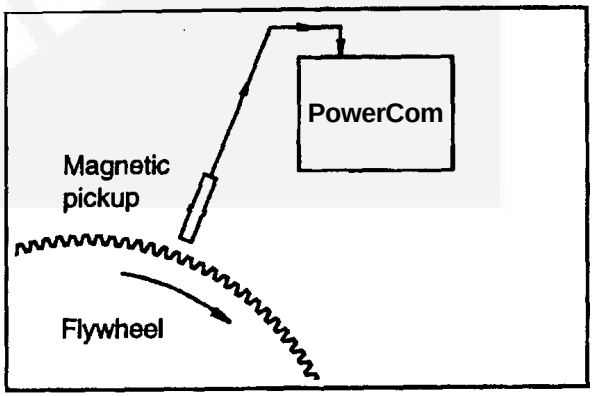
PowerCom is used as the standard control panel for genset applications for domestic markets in the range of 320kVA to 625kVA.

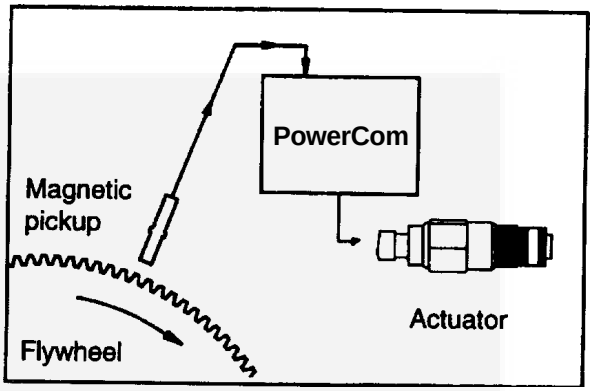
The primary function of PowerCom is to govern the engine, monitor and protect the engine and the alternator.

The PowerCom consists of engine control board, alternator control module and LED board with display.

The features available in PowerCom are as follows:

- Engine Parameters monitoring
- Alternator Parameters monitoring
- Engine Protection
- Alternator Protection
- Engine Control (Isochronous governing)
- Engine Paralleling Feature (Speed bias and Raise / Lower inputs)
- Trims Adjustment Feature (Limited engine trim adjustments using display interface and alternator parameter trimming using display interface.)
- Remote Monitoring compatibility
- Model specific calibration generation feature using display interface.
- Engineering tool / Manufacturing tool/service tool compatibility with existing tools.
- 6 configurable discrete outputs
- Fault indication on front panel display using fault LEDs.
- Remote start / stop.





1.2 Theory of operation

Engine Control: Refer fig. 1.0, Pg. 17

The magnetic pickup senses the engine speed at the flywheel ring gear and generates an AC voltage with its frequency proportional to the engine speed. The signal is sensed by the PowerCom and is used as a speed feedback. The actuator mounted in the actuator housing is used to control the fuel flow from the fuel pump to the injectors. Actuator valve (with no current flowing in the actuator coil) is normally closed. Actuator opens depending upon the current through the actuator coil.

The PowerCom compares the electrical signal from the magnetic pickup with a preset speed reference point (for e.g. 1500 RPM). If there is a difference in the two signals, the controller will change the amount of current flowing through the actuator coil. A change in the amount of current to the actuator coil makes the actuator shaft to linearly open/ close the fuel outlet port, and controls the

amount of fuel flow to the engine. This in turn controls the engine speed.

The PowerCom controls the engine speed at the set reference speed (for e.g. 1500 RPM) from No load to Full load (For Isochronous operation). It also provides programmable speed droop function. It requires no special settings as the software in the PowerCom controls the engine speed.

Alternator Monitoring: Refer fig 1.0

The PowerCom monitors the alternator parameters such as:

- Frequency
- LL Voltage (L1, L2,L3, Average)
- LN Voltage (L1, L2,L3, Average)
- Current (L1,L2,L3, Average)
- PF (L1,L2,L3, Average)
- kVA (L1,L2,L3, Total)
- kW (L1,L2,L3, Total)

The controller also recognizes alternator fault parameters such as:

- Over Voltage Shutdown
- Under Voltage Shutdown
- Over Frequency Shutdown
- Under Frequency Warning
- Over Current Warning

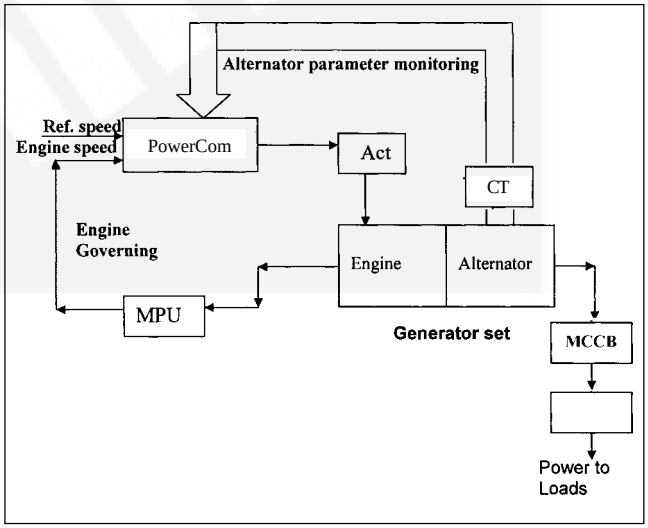


Fig. 1.0 Block Diagram of operation of PowerCom

Interfacing PowerCom with a PC : Refer fig. 1.1

The datalink connector is 9 pin 'D' type connector interfacing with PC based service tool. The data link is intended to be used to connect single or multiple PowerCom to a host computer acting as a supervisor for facilitating data acquisition and logging using a PC based service tool.

There are many features of the PowerCom that are configured using the service tool. Electronic service tool is a packaged software application that installs on an IBM compatible PC. The Service Tool is available as a Kit

(Part No. 4105287) on a CD. The Service PC, running the PowerCom Tool is connected to the PowerCom via a RS-232 serial communication cable. The data link uses two wire RS-485 serial communication standard. A RS- 485 to RS-232 converter kit (Part No. 4071717) is required for connecting the data link to a PC's RS-232 serial communication port. The configurable features will be discussed in this manual, however, all functions of Service Tool are not covered. Refer to the Service Tool manual (Part No. 3243816) for more detailed information about using Service Tool.

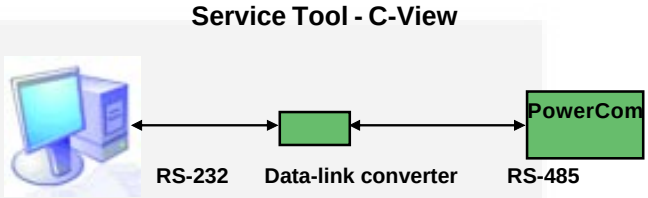


Fig. 1.1

Note that the service tool ' C-View ' software should be installed. This requires a separate service cable to communicate with the PowerCom through the RS-485 service data converter.

SECTION 3 : Front Panel Description

1.0 PowerCom Front panel description:

1.0.1 Display:

This 128 * 64 LCD display is used to view menus of the menu-driven operating system and faults.

The following 6 menus are displayed on the menu screen

- Engine – This menu monitors engine parameters.
- Alternator – This menu monitors alternator parameters.
- Information – This provides important data-plate information and allows changing of engine serial number.
- Discrete inputs / outputs – This provides status of discrete inputs & outputs.
- Fault – This provides fault codes & fault description.
- Scroll – This provides information on engine and alternator parameters. (The parameters are scanned one by one).

1.0.2 Display menu selection keys:

6 membrane keys-3 on each side of the display are used to step through the different menu options and to adjust parameters.

The [>>] and [<<] keys are used to scroll as Previous & Next menus. The individual screen provides the guidance for key operations.

1.0.3 Indicator Description:

Genset Running: This green LED is lit whenever the genset is running at rated rpm.

Remote Start: This green LED is lit whenever the genset is remotely started.

Charging Failure: This red LED is lit when the battery fails to charge.

Low oil pressure warning: This orange LED is lit whenever the oil pressure is lower than the normal operation.

Overspeed shutdown: This red LED indicates that engine has shutdown because of excessive speed.

High coolant temperature warning: This orange LED is lit whenever the coolant temperature reaches above normal range of operation.

Low coolant level shutdown: This red LED indicates that the engine has shutdown because of low coolant level.

Warning: This orange LED is lit whenever the controller detects a warning signal.

Shutdown: This red LED is lit whenever the controller detects any shutdown fault.

3-way selector key switch: The 3 positions are:

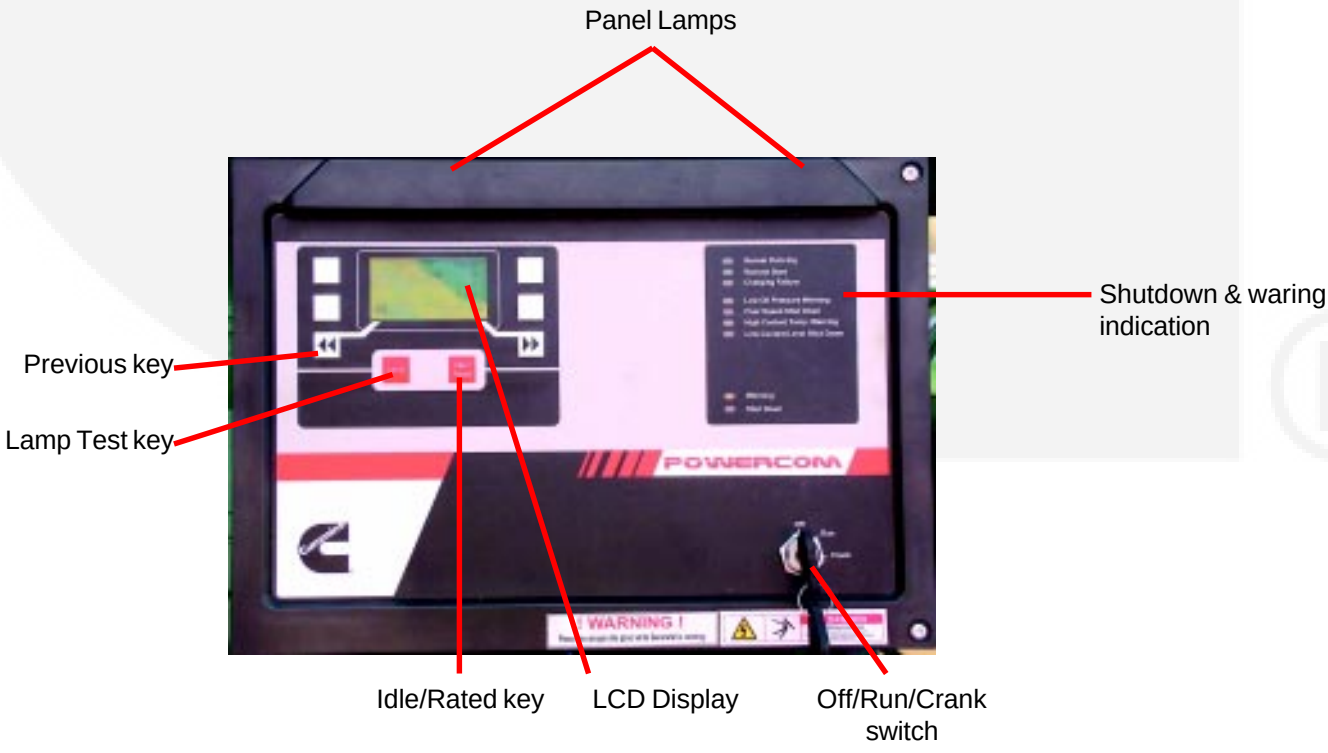
Off: This prevents the engine from starting.

Run: This keeps the engine in the ready position so that once a start command is received, the generator set starts.

Crank: This key is used to crank the generator set.

Lamp key: Press this button to test all front panel LEDs.

Idle & Rated key: This key is used to run the generator set at idle or rated speed. The state toggles with every press. This key is deactivated when the set is running on high idle in loaded condition or engine is remotely started.



1.1 Inputs & Outputs:

PowerCom measures the input signals from various sensors which are described in the later section. The inputs & outputs are listed below.

Inputs

Analog input - engine

- Coolant Temperature
- Lube Oil Pressure
- Intake Manifold Temperature*
- Solid State Potentiometer
- Battery Voltage
- Magnetic Pickup (MPU)
- Lube Oil Temperature

Discrete input

- Remote Start
- Remote Stop
- Raise
- Lower
- Discrete Input 1
- Discrete Input 2
- Lamp
- Idle / Rated
- Low coolant level
- Key switch input - OFF/RUN/CRANK

Analog input - Alternator

- LN Voltage (L1, L2,L3)
- Current (L1,L2,L3)

Discrete Outputs - engine

- Shut Down
- Starter
- Actuator

Note : * Optional and available on selective models.
** Configurable only for pin K of connector A.

Discrete output – Fault indication

- Remote Start indication
- Engine Running indication
- Common Warning
- Common Shutdown
- High Coolant Temp Warning
- Low Lube Oil Pressure Warning
- Low Coolant level Shutdown
- Over Speed Shutdown
- Charging Failure indication

Discrete outputs - configurable

- Discrete Output 1
- Discrete Output 2
- Discrete Output 3
- Discrete Output 4
- Discrete Output 5
- Discrete Output 6 (for pin K of connector A)

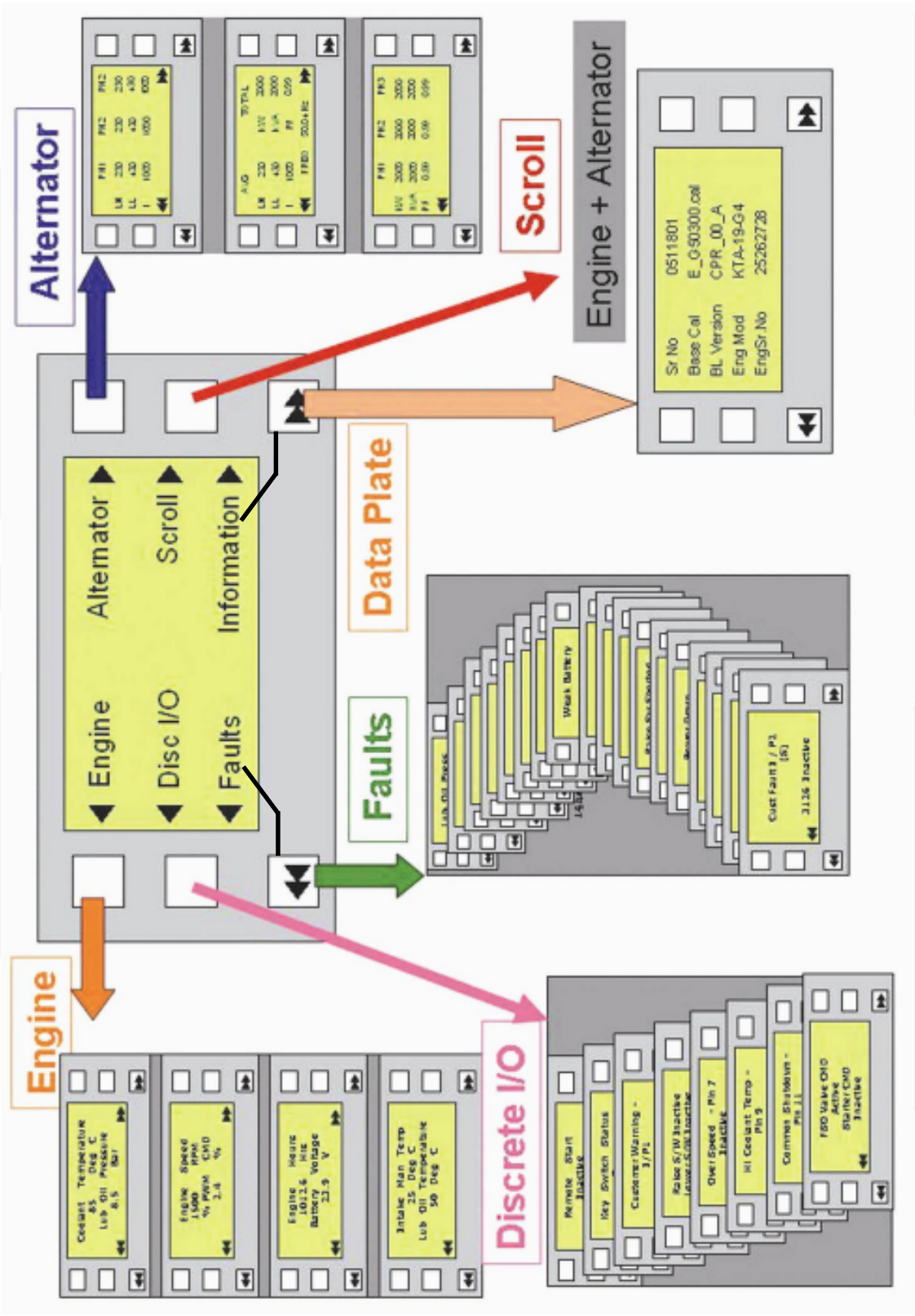
Each Discrete output can be configured as:

- Common Warning
- Common Shut Down
- Engine Running
- Engine Not Ready To Start
- High Coolant Temperature
- Low Lube Oil Pressure
- Over Voltage
- Under Voltage
- Over Frequency
- Under Frequency
- Over Current
- High Oil Temperature
- Data Link Start **

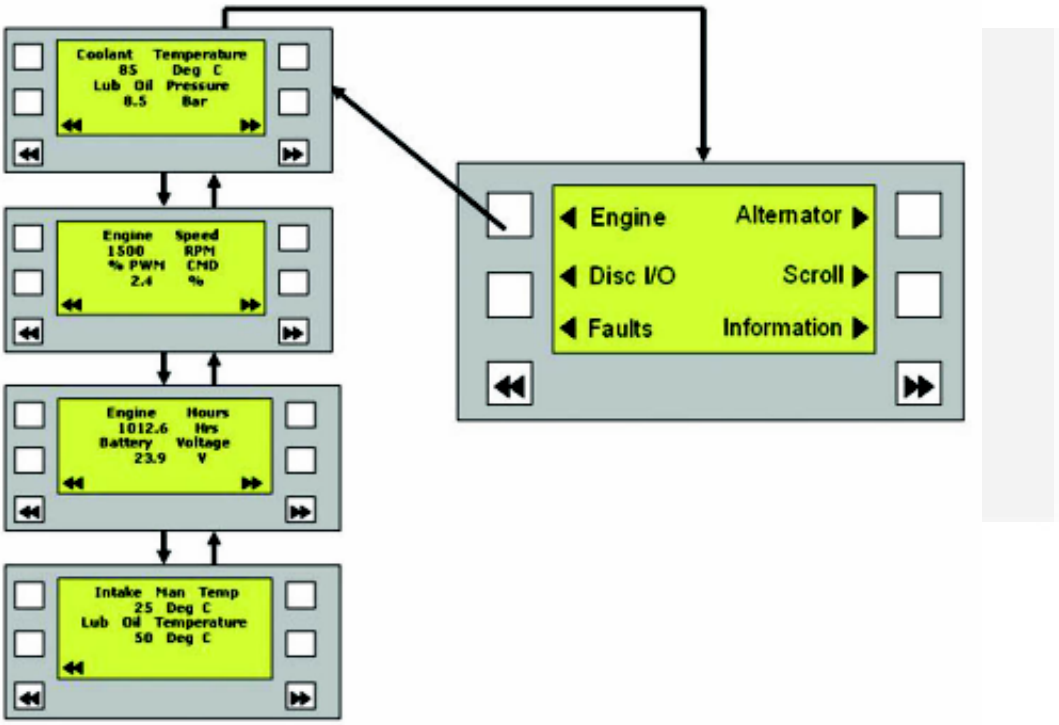
NOTES

SECTION 4 : Menu Description

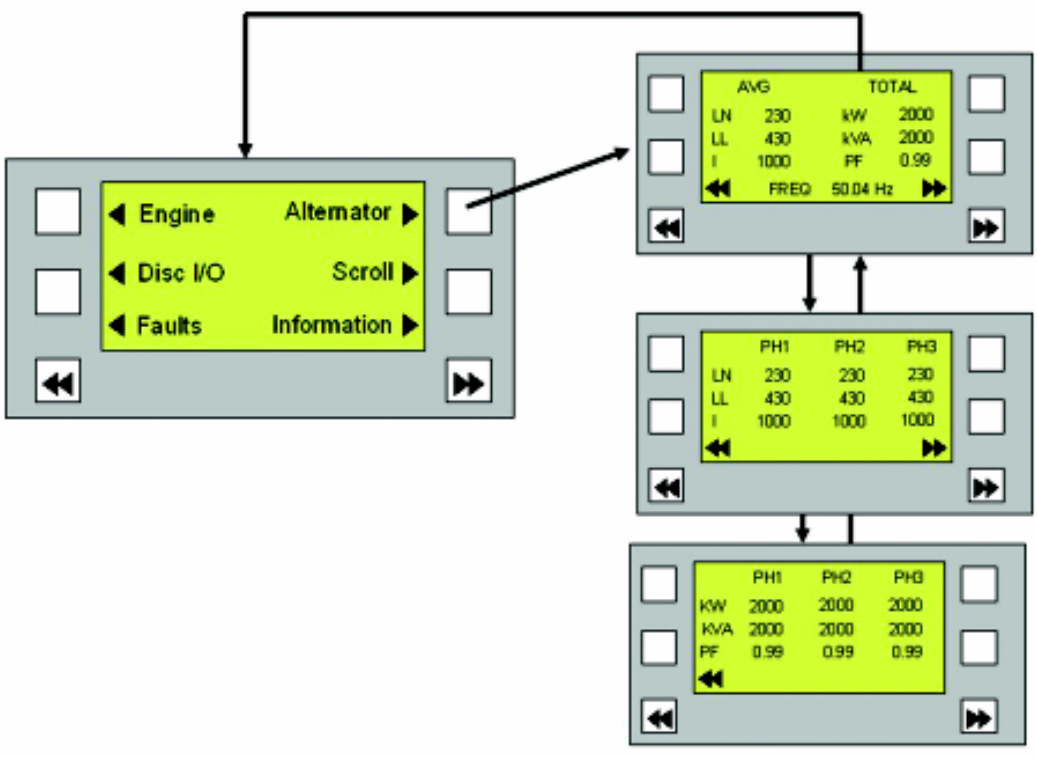
PowerCom Display Interface



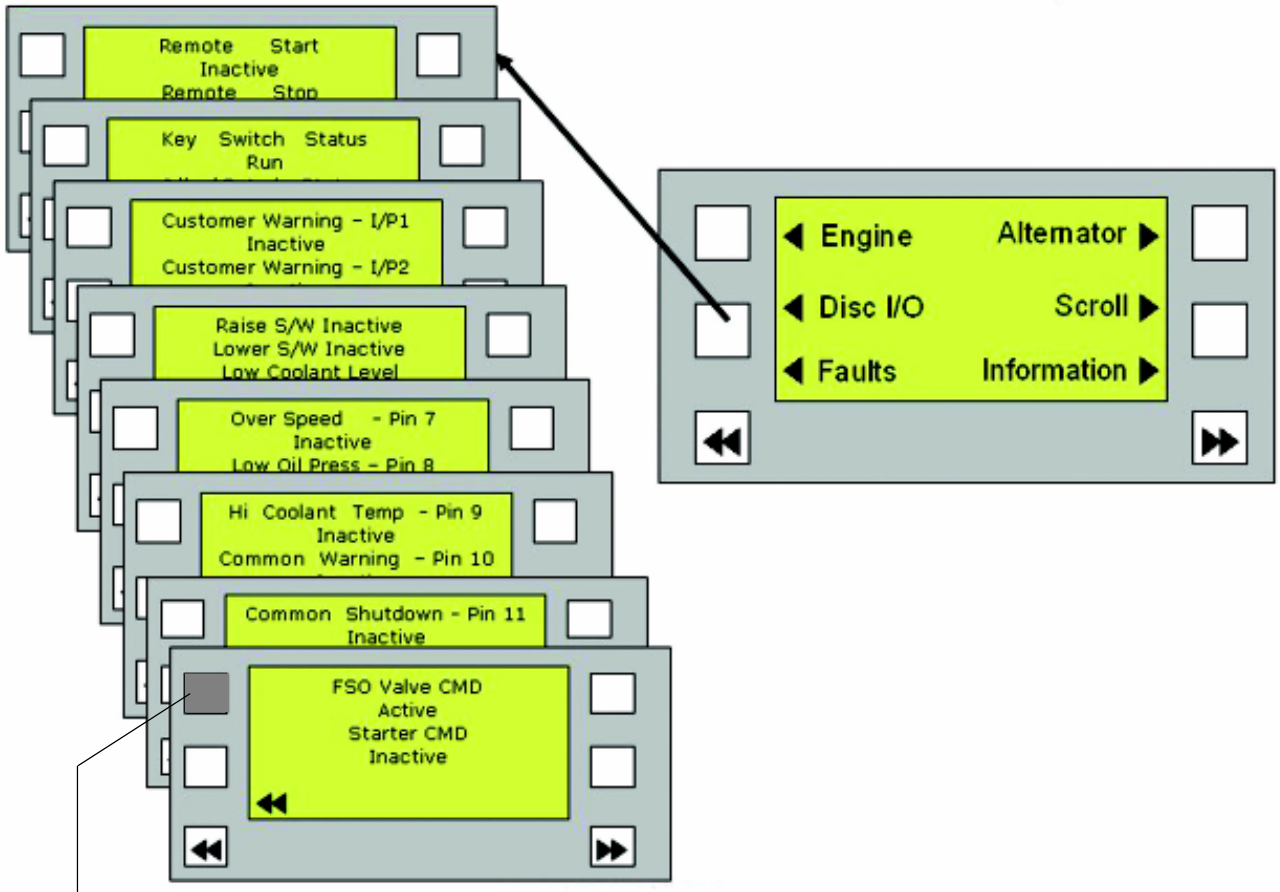
Screens for Engine Parameters



Screens for Alternator Parameters

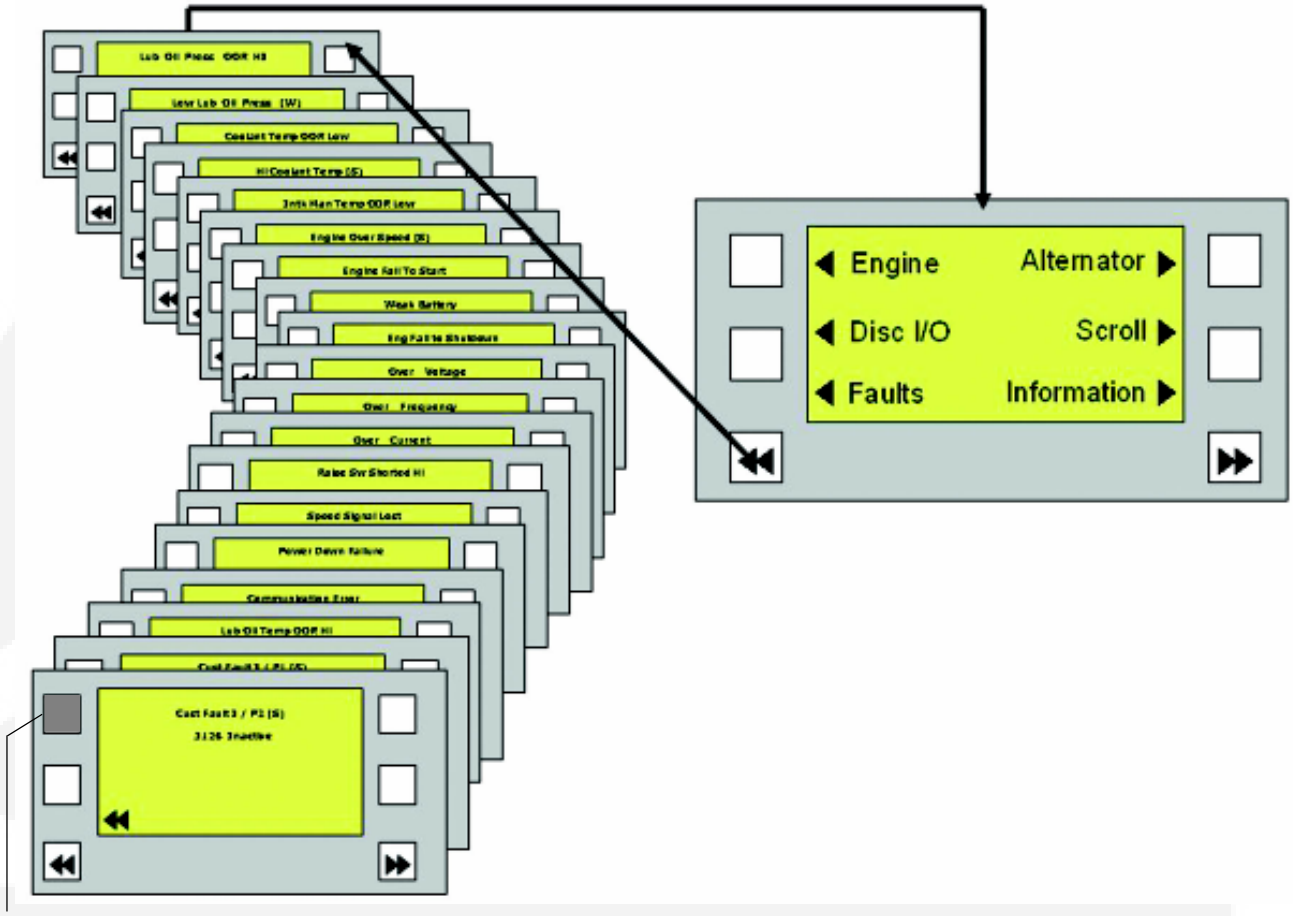


Screens for Discrete I/O



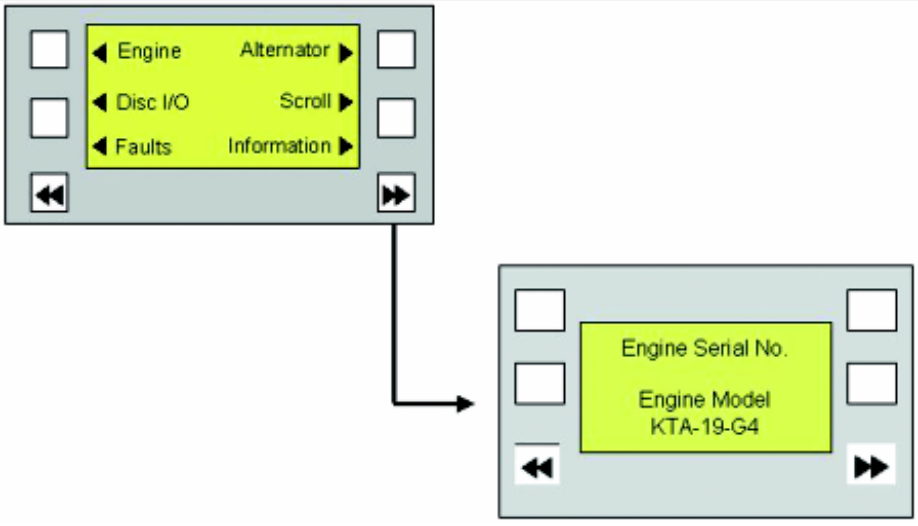
Return to main menu

Screens for Faults



Return to main menu

Screens for Information Menu



1.0 Menu Display and Keys:

Display:

This 128 * 64 LCD display is used to view menus of the menu-driven operating system. This display is also used to show shutdown & warning messages.
Refer to menu trees later in the section.

Display menu selection keys:

4 membrane keys-2 on each side of the display are used to step through the different menu options and to adjust parameters.

The [>>] and [<<] keys are used to scroll as Next & Previous menus respectively.

The key is active when a text adjacent to the key is displayed.

Figure 2.0 shows the front panel with LCD, various menus and keys for operation. The upper left hand side key is also used as RETURN TO THE MAIN MENU KEY from any page.

2.0 Main Menu Description:

The figure below shows the major menus that are available to the user.

Press the key adjacent to the option for observing the parameters. i.e. if the key adjacent to Engine is pressed, you will be able to observe all the engine parameters.

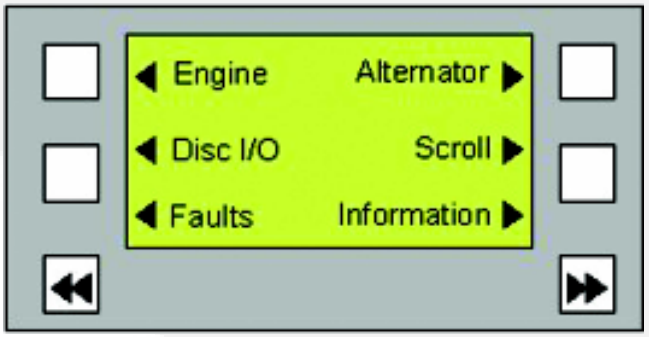


Fig 2.0 Engine Menu selection

2.1 Engine Menu:

Figures below show a block representation of the engine menu. As shown, the engine menu has 8 submenus. The submenus are as follows:

Coolant Temperature submenu: This submenu displays the engine coolant temperature in degrees centigrade.

Intake manifold temperature: This submenu displays the intake manifold temperature in degrees centigrade.

Lube Oil temperature: This submenu displays the oil temperature in degrees centigrade 0 to 140°C.

Lube oil pressure: This submenu displays the engine lube oil pressure in Bar.

Battery Voltage: This submenu displays the battery voltage in volts.

Speed: This submenu displays the engine speed in rpm.

Hours: This submenu displays the no. of hours the engine runs.

Fuel Actuator: This submenu displays the actuator opening in percentage.

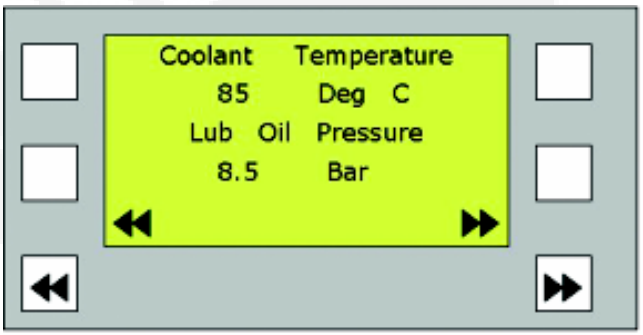


Fig 2.1 Engine parameters

Press the 'Next' key to view the next page on the display.

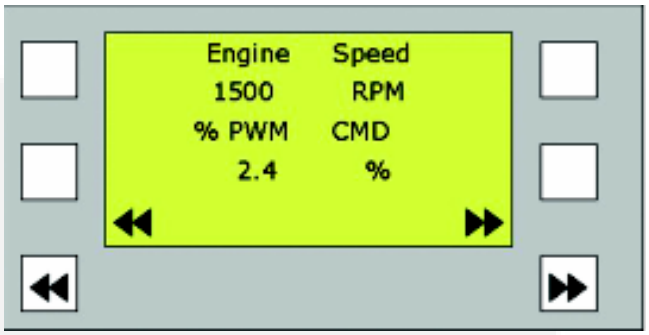


Fig 2.2 Engine parameters

Fig 2.3 Engine parameters

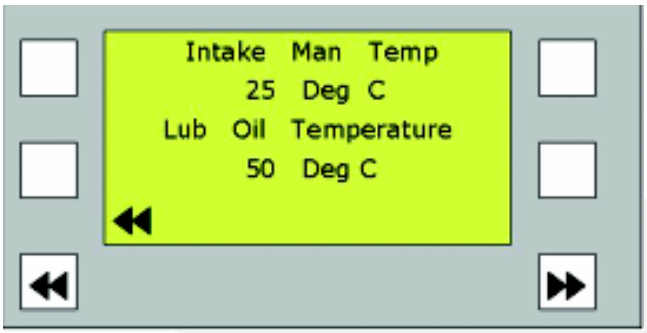


Fig 2.4 Engine parameters

After observing all the engine parameters, continue pressing 'Prev' key till Main Menu screen is displayed.

3.0 Alternator Menu:

Fig. below shows a block representation of the alternator menu. If you press the key next to the word "Alternator" in the display, the alternator submenus are displayed. The submenus are as follows:

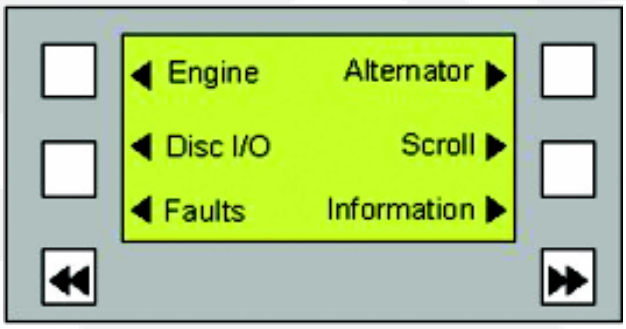


Fig 3.0 Alternator screens

Line-to-Neutral submenu: Line to neutral voltage is displayed in this submenu. ie. Line1 wrt Neutral, Line2 wrt Neutral & Line3 wrt Neutral.

Average Line-to-neutral submenu: This submenu displays the average line to neutral voltage in volts.

Current: This submenu displays the line currents for all 3 phases in amperes.

Average current: This displays the average of all three current values.

Line-to-Line voltage submenu: This displays the voltage between L1 to L2, L2 to L3 and L3 to L1 in volts.

Average line to line: This submenu displays the average value of all the 3 line to line voltages.

Power factor: This displays the power factor values of all the 3 phases.

Average pf: This displays the average value of all three pf values.

Apparent Power (kVA): This displays the amount of apparent power output for L1, L2 and L3 in kVA.

Total apparent power (kVA): This displays the total amount of apparent power.

Real Power: This displays the amount of real power output for L1, L2 and L3 in kW.

Total Real Power: This displays the total amount of real power in kW.

Frequency: This displays the generator set output frequency.

CT ratio: This displays the CT ratio values. Standard value = 2000 : 5.

Fig. 3.0 Key next to "alternator" is pressed to enter the menu.

Press the 'Next' key for viewing the next page.

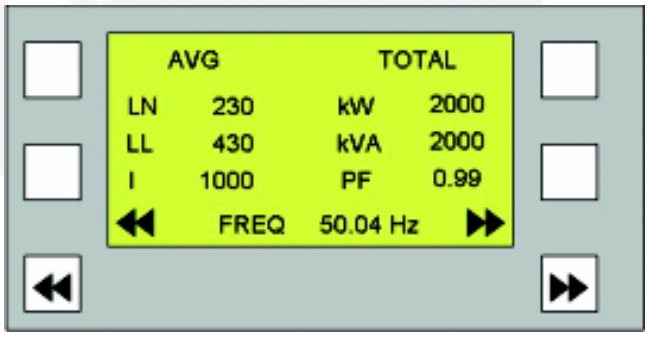


Fig 3.1 Alternator parameters

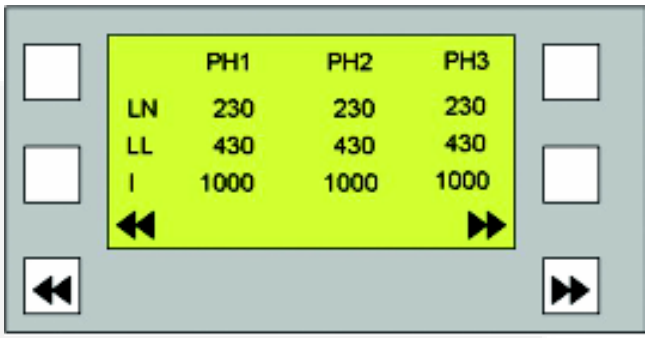


Fig 3.2 Alternator parameters

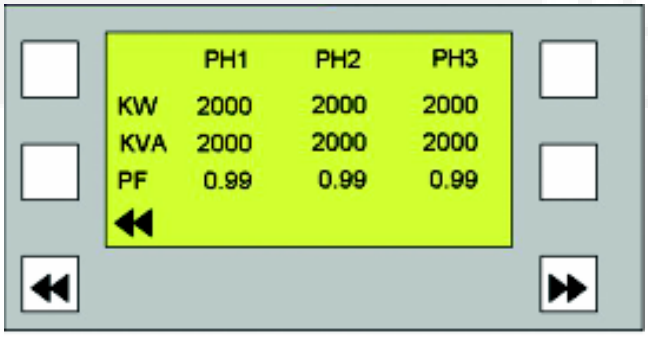


Fig 3.3 Alternator parameters

4.0 Fault Menu:

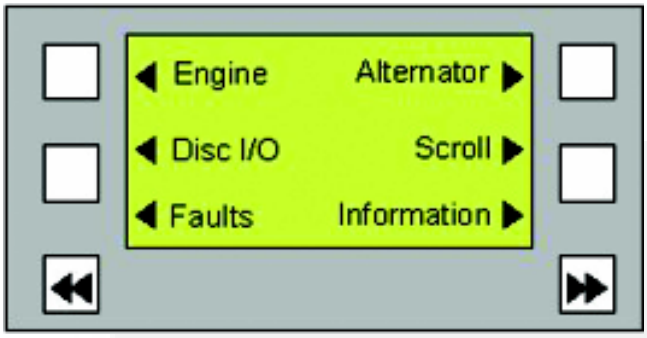


Fig 4.0 Fault Menu

To view the fault menu, key adjacent to it should be pressed Fig 4.0. This menu displays the various fault codes and their status. If a fault has occurred, **Active** will be displayed against the fault code, else **Inactive** will be displayed.

'Next' key press will lead to the next set of fault list, whereas, 'Prev' key press will lead to the Main menu page.

Fig 4.1 Faults screen

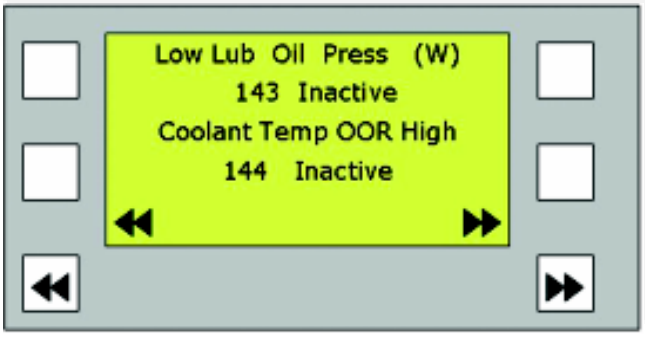


Fig 4.2 Faults screen

5.0 Discrete I/Os:

This menu indicates the status of various inputs & outputs. This menu has 18 submenus. Press the key adjacent to the Discrete I/Os to enter the submenus.

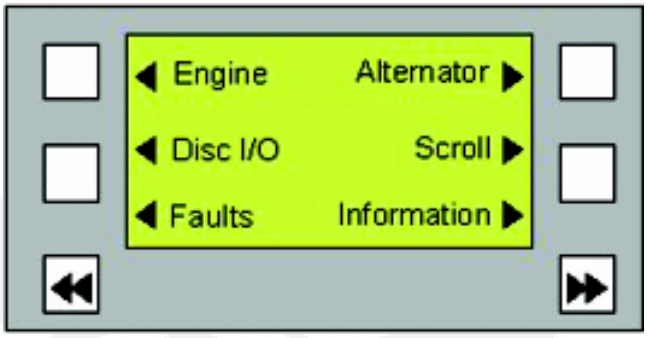


Fig 5.0 Discrete I/O Menu

Pressing the 'Next' key thereafter will display the submenus. The submenus are as follows:

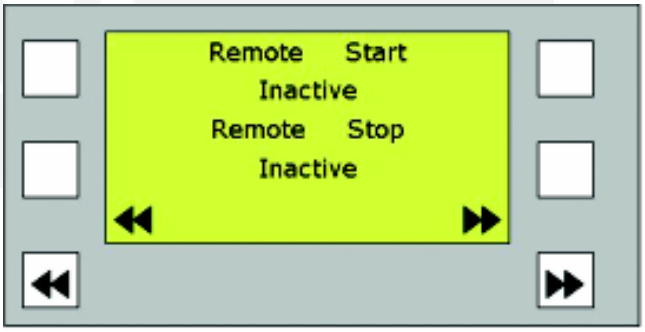


Fig 5.1 Discrete I/O screen

Fig 5.2 Discrete I/O screen

I/P1 & I/P2: Configurable digital inputs.

Idle/Rated: This submenu displays the type of speed at which the engine has been set to run. ie. either Idle speed or Rated speed.

Remote Start: Indicates remote start input status.

Remote Stop: Indicates remote stop input status.

Key switch: Displays the key switch status; On/Off/Run condition

Raise: Active or inactive status of this input.

Lower: Active or inactive status of this input.

Low Coolant level: Indicates the status of the low coolant level sensor.

This will be active if the coolant level is low else it is inactive.

Outputs 1 through 6: These are configurable outputs. The status is high or low depending on the configuration.

Fuel Shutoff valve: This output is On/Off depending on the condition of the FSO valve.

Starter: Indicates the starter status; whether active or inactive.

Go back to the main menu using the "Prev" key.

6.0 Information Menu:

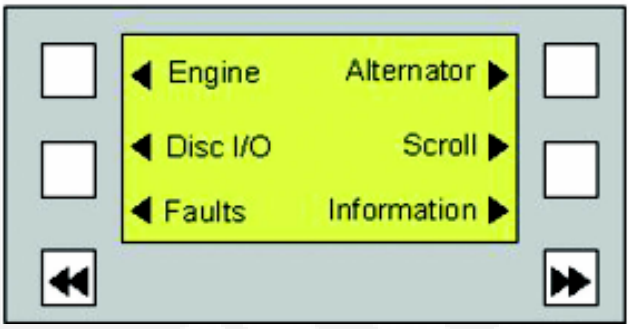


Fig. 6.0 Information menu

This menu gives you the information about the generator set. This menu can be displayed by pressing the key adjacent to the 'Information' word on the display.

The following parameters are observed:

Serial Number: This is 7 digit value which corresponds to the controller. Every controller will have a different Sr. number.

Base Calibration: This displays the base calibration value.

Boot Loader version: This displays the boot loader version.

Engine model: Displays the model of the engine.

Engine Serial No. - Displays the Serial No. of the engine.

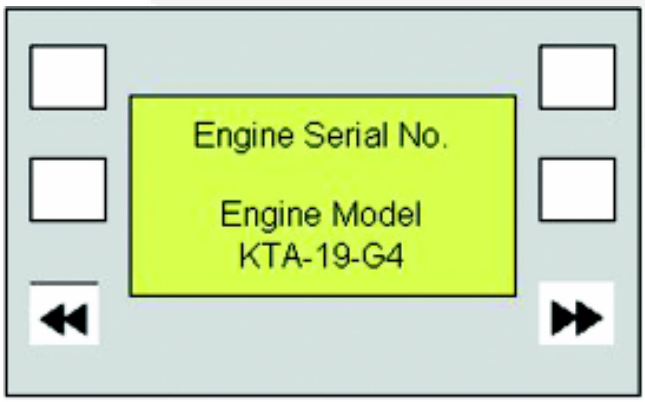


Fig. 6.1 Information screen

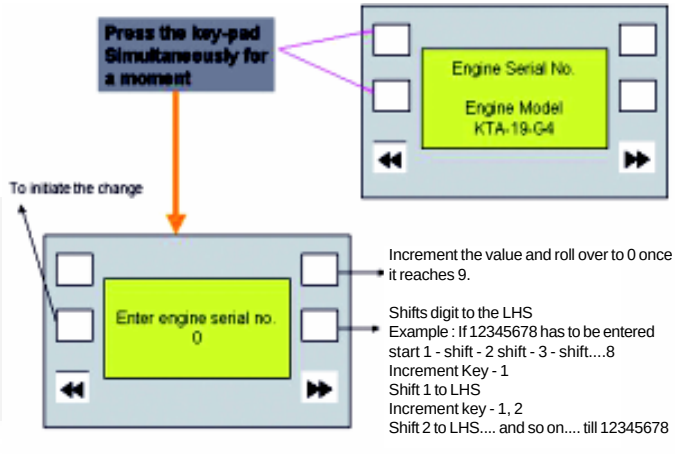


Fig. 6.2 Engine serial number enter

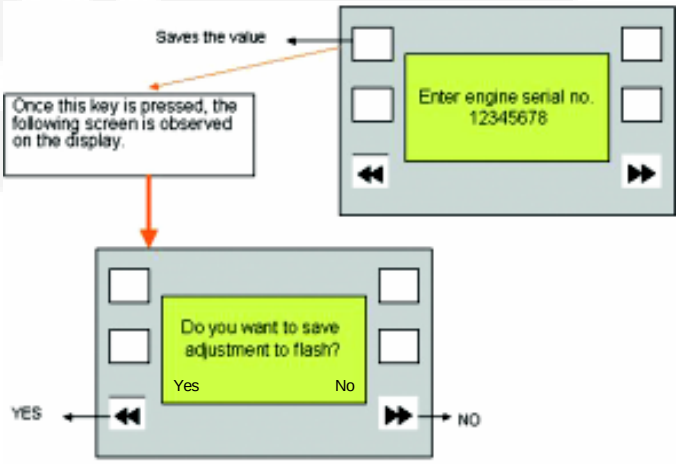


Fig. 6.3 Engine serial number enter

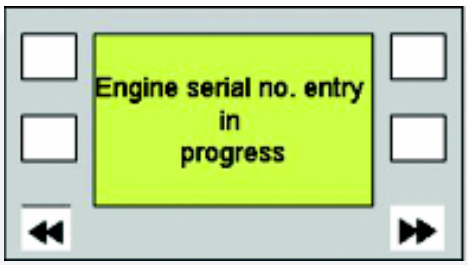


Fig. 6.4 Engine serial number enter

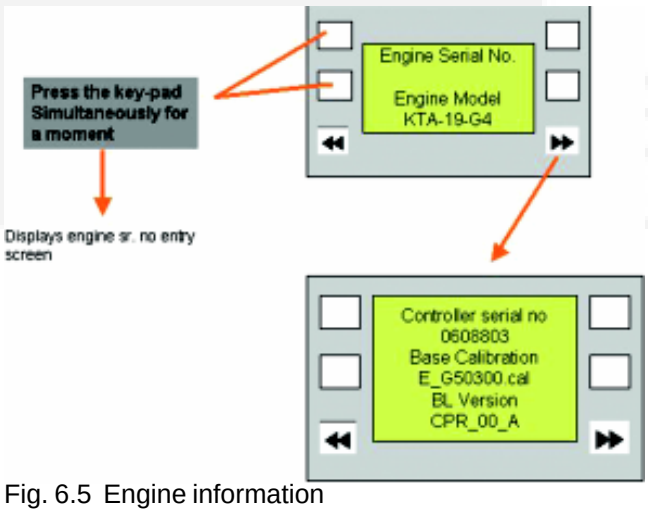


Fig. 6.5 Engine information

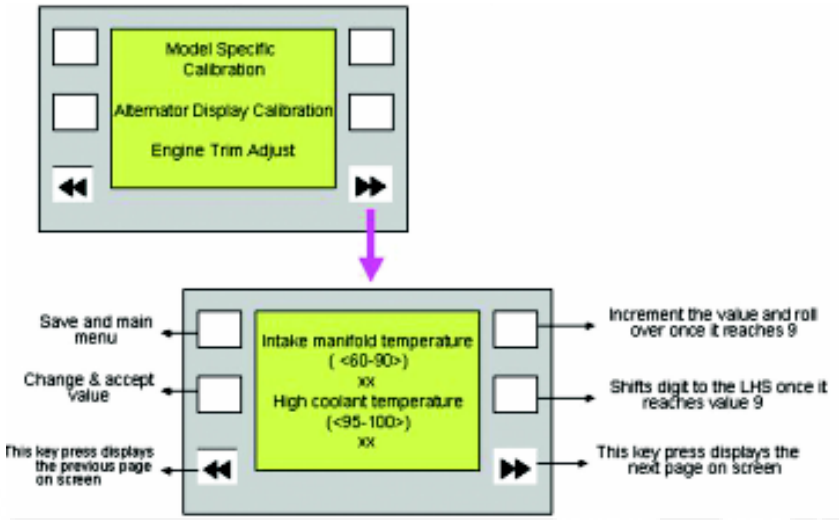


Fig. 6.6 Engine Trim Adjustment

Engine Trim Adjustment

If the user tries to enter out of range values, the controller restores back the original values.

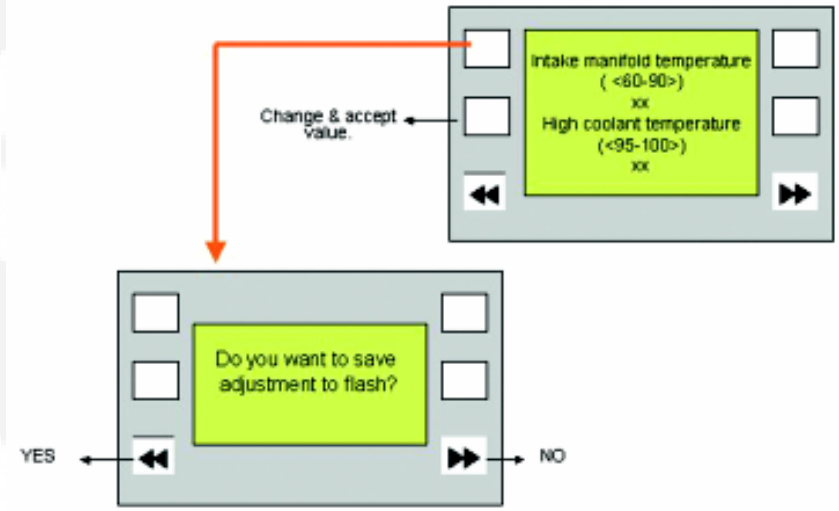


Fig. 6.7 Engine Trim Adjustment

Fig. 6.8 Engine Trim Adjustment

7.0 Scroll Menu:

This menu scrolls the above described engine, alternator parameters and the discrete I/Os.

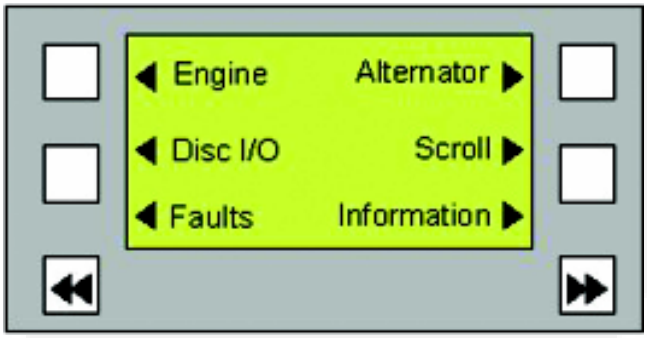
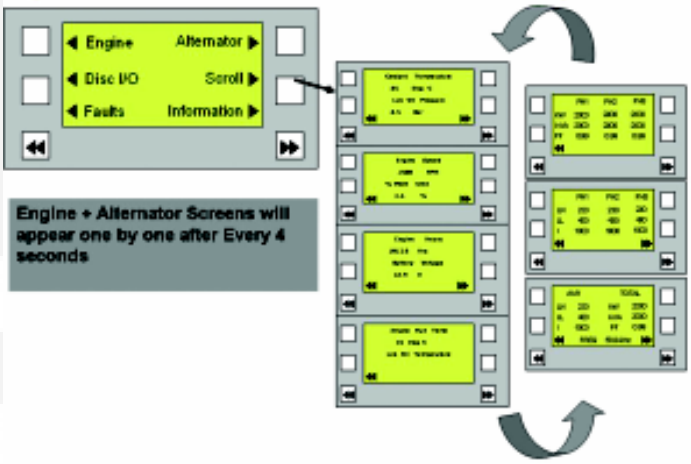


Fig. 7.0 Scroll



8.0 Settings & Calibration:

This page can be selected by pressing the upper two LHS keys simultaneously.

8.1 Model Specific Calibration:

This option can be selected by pressing the upper LHS & upper RHS keys simultaneously. This is used for configuring the model specific calibration file. The model ID can be selected by incrementing or decrementing the ID values. This value can also be saved.

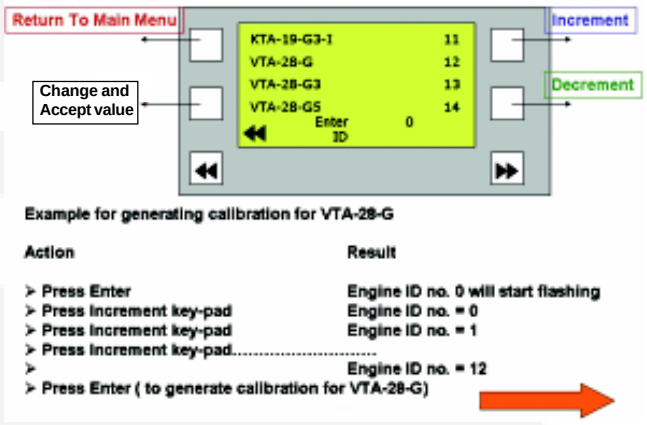


Fig. 8.1 Model specific calibration

8.2 Alternator Trim Adjustments:

The phase voltage can be adjusted in this option. The variation is +/-5% of the actual value. The trim value can be changed by incrementing or decrementing the values. This value can be saved.

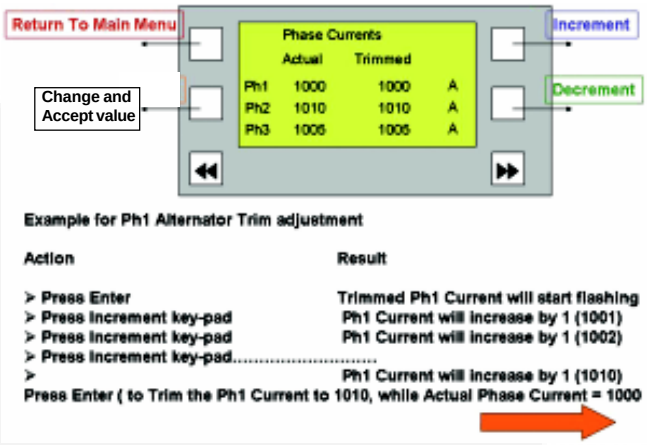


Fig. 8.2 Alternator Trim Adjustments

Note: This setting changes only the display value of this parameter and not the real alternator output value.

NOTES

SECTION 5 : Sensors Description

SENSORS

1.1 Magnetic pickup

The magnetic pickup is an electromagnetic device. It is mounted on the flywheel housing. It senses the engine speed at the flywheel ring gear and generates AC voltage with its frequency proportional to the engine speed. A two pin MS connector is provided to connect the magnetic pick up to the engine harness.

The magnetic pickup is connected between pin 'B' (RPM –) and 'T' (RPM +) of Connector A through engine harness.

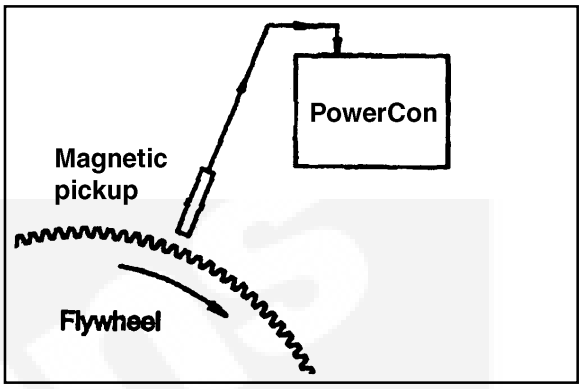


Fig. 1.0

1.2 Coolant temperature sensor

A coolant temperature sensor is mounted on the thermostat housing. The sensor is fitted in an adapter. A two-pin connector is provided to connect the coolant temperature sensor to the engine harness. The sensor is connected between pin 'P' and 'N' of Connector 'A' through the engine harness.

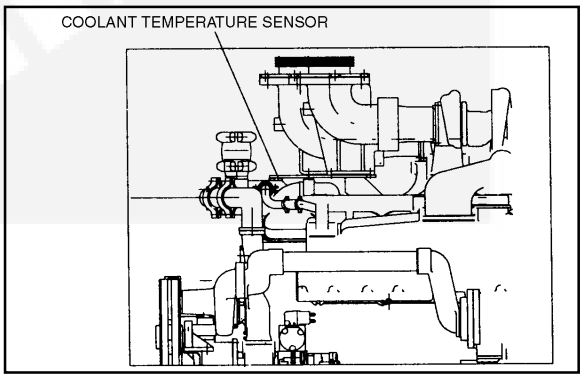


Fig. 2.0

1.3 Intake Manifold temperature sensor

The intake air temperature sensor is used to monitor the low temperature aftercooler performance for two-pump two-loop system only. The intake air temperature sensor is mounted on the aftercooler housing for the KTA –38-G5 and KTA-50-G8 engines. A two-pin connector is provided to connect the intake air temperature sensor to the engine harness. The sensor is connected between Pin 'S' and 'U' of Connector 'A' through the engine harness.

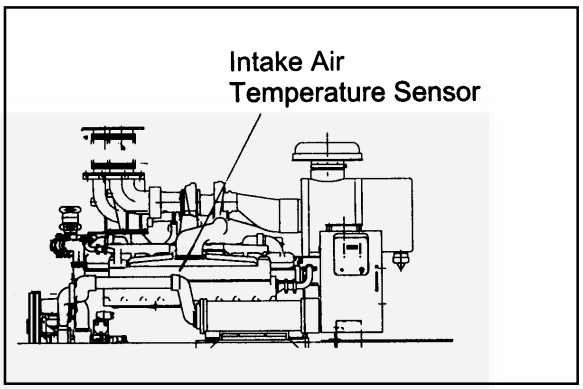


Fig. 3.0

1.4 Lube oil pressure sensor

Lube oil pressure sensor is mounted on the engine block oil gallery. A three-pin connector is provided to connect lube oil pressure sensor to the engine harness.

The sensor is connected between pin 'J', Pin 'G' and Pin 'H' of Connector 'A' through the engine harness.

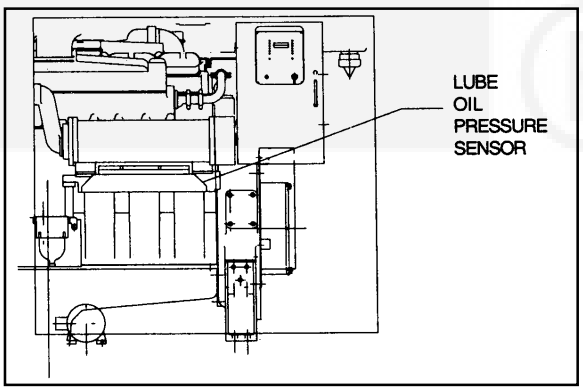


Fig. 4.0

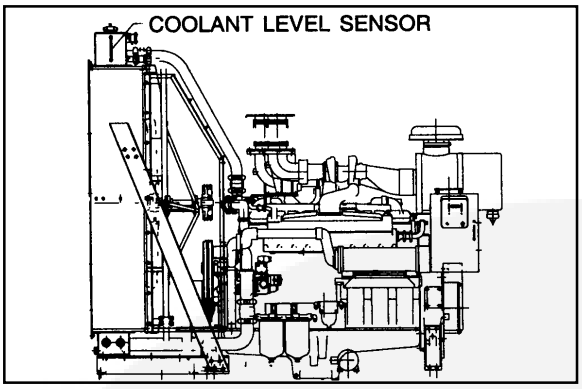


Fig. 5.0

1.5 Coolant level sensor

The coolant level sensor is a switch type sensor. It is used to detect the coolant level of the engine. The sensor is connected at Pin-R of Connector 'A' to the engine harness.

Note : The sensor locations shown in the figures are of VTA-28 engine as an example.

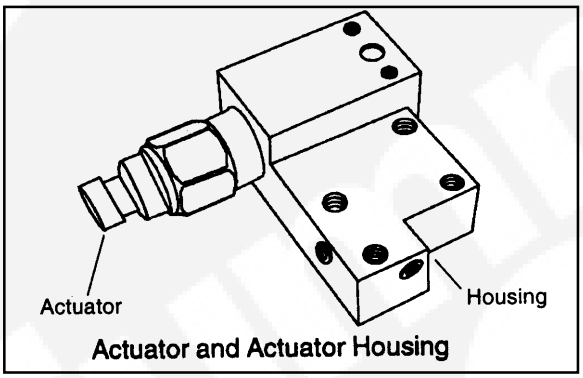


Fig. 6.0

1.6 Actuator and actuator housing

The actuator is a linear proportional valve. The actuator is housed in the aluminum housing. This assembly is used as a valve for controlling the speed and horsepower of the engine by controlling the fuel flow. The actuator is connected between Pin-F and Pin-M of Connector 'A' to the engine harness.

Actuator is closed when no current is flowing through the actuator coil. When current is passed through the actuator coil, the actuator port opens proportional to the actuator current.

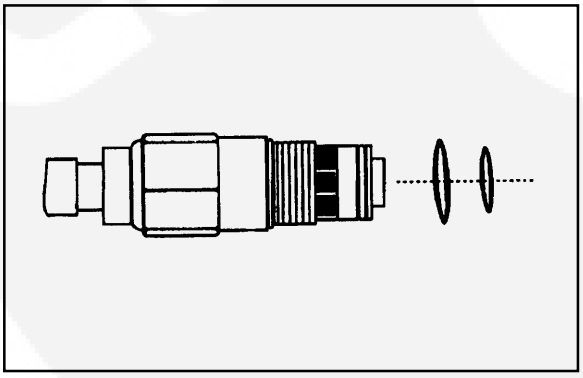


Fig. 6.1

NOTES

SECTION 6 - Connector details

CONNECTOR DETAILS

1.0 Description:

The controller consists of three different hardware boards combined as one – Engine Control Board (ECB), Alternator Control Module with Display (ACMD) and the LED Board. Hence there are two internal interfaces : ECB- ACMD and ACMD – LED Board. The controller has the following external interfaces:

- Engine Interface – Engine, OEM and Optional Connector
- Alternator Interface – PT CT Connector
- Data Link Interface – Data Link Connector

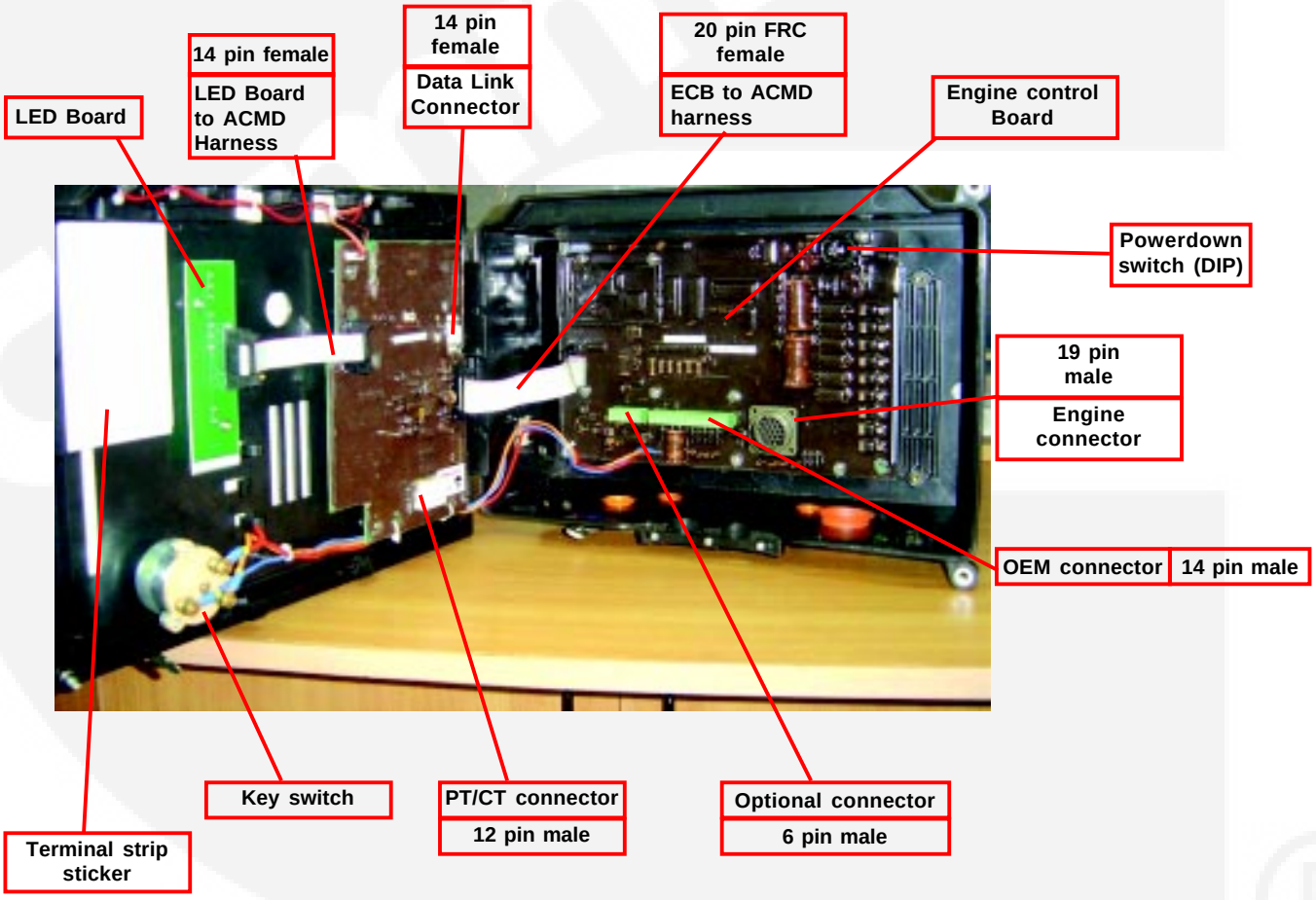


Fig. 1.0 PowerCom Connectors

2.0 Connectors:

2.1 Engine Interface:

2.1.1 Engine Connector (Connector A) – 19 Pin male MS Connector (MS 3102R-22-14P)

All the engine sensors are connected to this connector.

Sr. No.	Pin No.	Description
1	A	24 Volt Negative
2	B	Speed Signal Return
3	C	Not Connected
4	D	Shutdown Positive
5	E	Starter Solenoid Positive
6	F	Actuator Positive
7	G	Lube Oil Pressure Sensor Supply Positive
8	H	Lube Oil Pressure Sensor Output Signal
9	J	Lube Oil Pressure Sensor Supply Negative
10	K	Data Link Start
11	L	24 Volt Positive
12	M	Actuator Return
13	N	Coolant Temperature Sensor Signal
14	P	Coolant Temperature Sensor Return
15	R	Coolant Level Switch Signal
16	S	Intake Manifold Temperature Sensor Signal*
17	T	RPM Signal
18	U	Intake Manifold Temperature Sensor Return*
19	V	'W' Point (Alternator)

* Note : Optional and available only on selective models.

2.1.2 OEM Connector (Connector B) – 14 Pin male connector

All the discrete I/Os are connected to this connector.

Sr. No.	Pin No.	Description
1	1B	Supply Return
2	2B	Raise Switch Signal
3	3B	Lower Switch Signal
4	4B	Remote Start Signal
5	5B	Remote Stop Signal
6	6B	Speed Bias Signal
7	7B	Configurable Discrete Output 1
8	8B	Configurable Discrete Output 2
9	9B	Configurable Discrete Output 3
10	10B	Configurable Discrete Output 4
11	11B	Configurable Discrete Output 5
12	12B	Not Connected
13	13B	Discrete Input 1
14	14B	Discrete Input 2

2.1.3 Optional Connector(Connector C) – 6 Pin male Connector - usage of this connector depends on customer requirement.

Sr. No.	Pin No.	Description
1	1C	Reserved
2	2C	Reserved
3	3C	Reserved
4	4C	Free
5	5C	Lube Oil Temperature Sensor Signal
6	6C	Lube Oil Temperature Sensor Return

Note : Do not connect to reserved pins.

2.2 Alternator Interface (PT CT Connector) – 12 Pin male Molex Connector
This connector carries all the alternator signals.

Sr. No.	Pin No.	Description
1	1	Neutral
2	2	Line B Voltage Input
3	3	Line Y Voltage Input
4	4	Line R Voltage Input
5	5	Free
6	6	Line B Current Input (CT1)
7	7	Line B Current Input (CT2)
8	8	Line R Current Input (CT1)
9	9	Line R Current Input (CT2)
10	10	Line Y Current Input (CT1)
11	11	Line Y Current Input (CT2)
12	12	Free

2.3 Data Link Interface – DB9 female connector (RS-485 Communication)
This connector is used for serial communication.

Sr. No.	Pin No.	Description
1	1	Data Link Positive
2	2	Data Link Negative
3	3	Not Connected
4	4	Not Connected
5	5	Not Connected
6	6	Not Connected
7	7	Not Connected
8	8	Not Connected
9	9	Not Connected

2.4 Internal Interfaces:

2.4.1 ECB – ACMD Harness connection details
(20 pin FRC female-female harness with mating connectors on both the boards)

Sr. No.	Pin No.	Description
1	1	Unswitched Supply Positive (24 V)
2	2	Unswitched Supply Positive (24 V)
3	3	Unswitched Supply Positive (24 V)
4	4	Unswitched Supply Positive (24 V)
5	5	Not Connected
6	6	Not Connected
7	7	Supply Return
8	8	Supply Return
9	9	Supply Return
10	10	Supply Return
11	11	Data Link Positive
12	12	Data Link Negative
13	13	Data Link Positive
14	14	Data Link Negative
15	15	Not Connected
16	16	Not Connected
17	17	+ 5 V Control Pin
18	18	Idle / Rated Switch Signal
19	19	Charging Failure LED Signal
20	20	Supply Return

2.4.2 LED Board – ACMD Harness connection details
(14 pin female-female harness with mating connectors on both the boards)

Sr. No.	Pin No.	Description
1	1	Genset Running LED Signal
2	2	Remote Start LED Signal
3	3	Charging Failure LED Signal
4	4	Charging Failure LED Return
5	5	Low Lube Oil Pressure Warning LED Signal
6	6	Over Speed Shut Down LED Signal
7	7	High Coolant Temperature Shut Down LED Signal
8	8	Low Coolant Level Shut Down LED Signal
9	9	Common Warning LED Signal
10	10	Common Shut Down LED Signal
11	11	LED Board Supply Positive (+3.3 V)
12	12	Not Connected
13	13	Not Connected
14	14	Not Connected

NOTES

SECTION 7 - PowerCom Features

PowerCom FEATURES

1.0 Power down mode

Unswitched 24 VDC volts is connected to the PowerCom through Connector A.

When the key switch is turned to Run position controller wakes up from sleep mode and executes hardware check where the LEDs and Displays are checked. Controller then enters into all parameters scan mode and is ready to start the engine. When the key switch is in 'run position' and the engine is not running, controller will not turn off immediately, but the power down mode will be enabled. Controller will turn OFF after the set power down time (10 seconds), thus minimizing the battery drain during engine off condition. Power down mode can be disabled by a 2 pin DIP switch which is mounted on the ECB.

2.0 Key switch and starter protection

The key switch on the front panel is used to turn on or off the 24 volts DC battery supply to the controller. The key switch is a three-position switch which controls the three modes as OFF, RUN, START.

i) OFF mode:

The key switch in off mode disconnects the supply to the FSOV and fuel actuator, resulting in engine shut down. It also transits the controller to "power down" mode.

ii) RUN mode:

When the key switch is turned to "Run" position, the controller wakes up. Carries out self check and is ready to start the engine.

iii) START mode:

Turn and hold the key switch to "Start" position, for controller to energize the starter magnetic switch. A built in software mechanism disengages the

supply to the starter magnetic switch after six seconds and prevents the starter from damage. The controller also ramps up the engine speed from crank to idle/rated mode in a predetermined time period.

3.0 Starter Protection

When the key switch is held in Start position, the starter magnetic switch will turn on, causing the starter to engage with the flywheel ring gear teeth and rotate the engine. As the engine picks up speed (upto 330 rpm), the starter magnetic switch is de-activated by the controller automatically. This disengages the starter from the flywheel ring gear, preventing the starter from Over cranking. As long as the engine is running, taking the key switch to Start position will not activate the starter key switch. This prevents starter damage that can be caused by an attempt to engage the starter with flywheel ring gear when an engine is already running.

Overcranking Prevention

There is a built in timer mechanism which prevents starter damage due to over cranking. After six seconds from the instant the key switch is turned to Start position, the starter magnetic switch will automatically de activate and remain de activated for six more seconds even if the key is in start position. The starter protection is based on engine speed and not on lubricating oil pressure. Releasing the key switch from Start position will reset the starter engage/disengage time.

4.0 Idle / Rated Mode Selection

The idle / rated switch is used to select the base running speed of the engine. When the idle / rated switch is in Idle Position, Idle speed is selected. Whereas Rated speed is selected if the switch is in Rated Position.

When engine is started using key switch, the engine goes to idle mode. i.e. the key switch status is 'Idle'. On pressing this key, the status toggles to 'Rated' and the engine goes to rated speed. To bring back the engine to idle speed, the key should be pressed again.

However, if the engine is started remotely, the key is deactivated by the controller switch and the engine directly goes to Rated Speed.

For e.g.

Idle speed = 1100 rpm (Idle position)
Rated speed = 1500 rpm (Rated position)

Note : For AMF application, Idle/Rated switch should always be in 'RATED' position so that on Remote Start, engine goes to rated speed. Also, Idle mode cannot be selected when engine is on load.

5.0 Fuel shutoff supply / Fuel actuator command

The percentage duty cycle of the actuator PWM command is indicated on the front display. This fuel actuator command is proportional to the current flowing through the actuator.

The supply to the fuel shut off valve is turned ON, the moment the key switch is set to "Run" position, and remains ON continuously till the engine trips because of a fault condition or the user stops the engine manually or the controller receives a Remote Stop command.

6.0 Alarm Relay Drivers

Relays can be connected to Discrete outputs of the OEM harness for alarm indication.

7.0 Remote start

Applying +24 volts DC (with respect to engine battery negative) through an external contact at Pin 4B of the

Connector B, would start the engine with this remote start command. +24 volts DC should be applied continuously at this input, till engine starts. Note that the Starter magnetic switches (2 Nos. in case of KV engines) draw current from this 24 V source. The cables and the contact must therefore be appropriately rated. Recommend 10 amps capability. It also includes starter protection and over cranking prevention.

Note: Use 'potential free contact' for this input.

8.0 Remote stop

On applying 24 volts DC momentarily to pin 5B of the Connector B, the supply to the fuel shut off valve is removed and fuel actuator is closed and the engine is shut down remotely.

Note: Applying +24 volts DC to Remote Start and Remote Stop inputs at the same time shall not start the engine. Simultaneous use of Remote start & stop is invalid

Note : Use 'potential free contact' for this input.

CAUTION

Do not connect '+24V' from battery to pin 1B (ground) of OEM connector.

9.0 Battery voltage

A 24V battery is connected to power up the controller. This battery voltage is measured and displayed on the digital LCD display.

10.0 Battery Charging Indication

With no charging current flowing to the battery from the charging alternator, the charging failure LED glows. Hence this LED glows when the engine is not running. As the engine starts running and the charging alternator starts supplying charging current to the batteries, the LED turns OFF. If this LED glows when the engine is running, it indicates that the charging alternator is not generating voltage.

11.0 Non-metallic enclosure

Better performance and no corrosion.

12.0 Engine control

Engine governing facility is provided in this controller. The governing lies in the G2 class according to ISO 8528-5.

13.0 Engine and alternator parameters

Controller also monitors engine & alternator parameters.

14.0 Raise & lower setpoint

Raise and lower setpoint input is used for incrementing and decrementing the engine speed during parallel operation.

15.0 Datalink start & stop facility is provided.

Controller when interfaced with PC for communication. The service tool used is C-View. User can start/stop the controller using C-View.

16.0 PowerCom controller is designed for a 0-60^{o}C ambient temperature range.

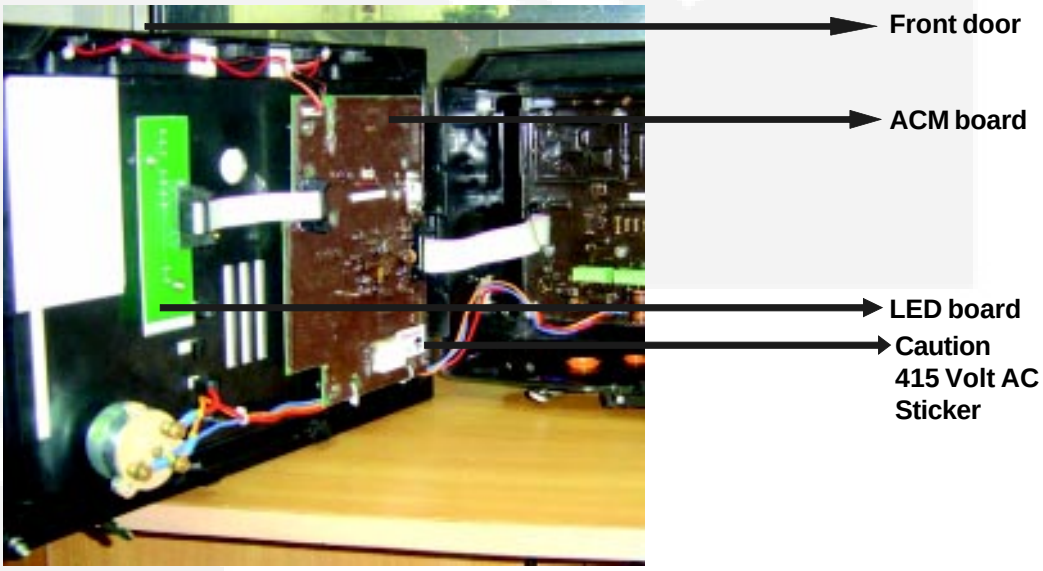
NOTES

SECTION 8 - Alternator Control Module

Alternator Control Module System:

1.0 The ACM provides alternator protection against Over voltage, Under Voltage, Over Frequency, Under Frequency and Over Current.

The ACM fetches the engine parameters from ECB (engine control board) and monitors AC metering parameters and status of alternator protection flags to the ECB. The communication between the ACM & the ECB is through RS-485 2-wire interface.



2.0 Features:

ACM displays engine as well as alternator parameters.

Display provides functionality to select model and give information to ECB for model specific calibration.

Display provides functionality to adjust the trims of ECB and give the information to ECB for trim adjustment.

The ACM provides pass through capability for the external RS485 communication for the existing ECB PC Tools called as 'C View Tool'.

The ACM accepts the calibration download command through C-View Tools.

The ACM accepts the recalibration download command through C-View Tools.

The ACM allows PC tool to adjust the trims variables of ECB.

The ACM provides feature to adjust pre-selected trims through Display interface.

2.1 Alternator signals:

ACM provides analog inputs, Discrete Inputs and Discrete output signals.

2.1.1 Analog inputs:

The analog inputs required for the ACM are:

- Line voltage: L1/L2/L3 which range from 0-500volts.
- Line current: obtained from CT1/CT2/CT3 which range from 0-2000A

2.1.2 Discrete inputs:

The ACM accepts 6 key pad inputs for display interface for screen operations and 2 key pad inputs for Idle Rated switch and Lamp on front panel door.

2.1.3 Discrete outputs:

The ACM Control provides 8 different discrete outputs for Fault indication.

ACM controls the following Fault LEDs

- Engine Running
- Remote Start
- High Coolant Temperature Warning
- Low Lube Oil Pressure Warning
- Low Coolant Level Shutdown
- Over Speed Shutdown
- Common Warning
- Common Shutdown

2.1.4 Alternator Parameters monitored by ACM are as follows:

- Line1 to Neutral AC Voltage
- Line2 to Neutral AC Voltage
- Line3 to Neutral AC Voltage
- Line1 to Line2 AC Voltage
- Line2 to Line3 AC Voltage
- Line1 to Line3 AC Voltage
- Line1 Current
- Line2 Current
- Line3 Current
- Line1 Power Factor Phase
- Line2 Power Factor Phase
- Line3 Power Factor Phase
- Line1 kVA
- Line2 kVA
- Line3 kVA
- Line1 kW
- Line2 kW
- Line3 kW
- Voltage Line to Line Average
- Voltage Line to Neutral Average
- Average Alternating Current
- Total kVA
- Total kW
- Power Factor
- Frequency

3.0 Alternator control has the following fault outputs:

- Over frequency fault
- Under frequency fault
- Over voltage fault
- Under voltage fault
- Over current fault

The above also act as the alternator protection parameters.

3.1 The ACM fault and fault response are shown in the table below:

Fault	Fault response
Over Frequency Fault	Shutdown
Under Frequency Fault	Warning
Under Voltage Fault	Shutdown
Over Voltage Fault	Shutdown
Over Current Fault	Warning

4.0 The parameters that are displayed by the ACM are in the following ranges:

Screen	Parameter to be displayed	Range	Unit
Main Menu	Menu Displayed: Engine Alternator Discrete Input-Output Faults Scroll (screen scrolling) Information		
Engine	Coolant Temperature	0 to 150	Deg C
	Intake Manifold Temperature	0 to 150	Deg C
	Oil Temperature	0 to 150	Deg C
	Lube Oil Pressure	0 to 10	Bar
	Fuel Actuator Command	0 to 100	%
	Engine Speed	0 to 5000	RPM
	Engine Running Hours	0 to 99999.9	Hour
	Battery Voltage	0 to 40	Volt

Screen	Parameter to be displayed	Range	Unit
Discrete Input-Output	Customer Input 1	Active, Inactive	-
	Customer Input 2	Active, Inactive	-
	Idle / Rated	Idle , Rated	-
	Remote Start	Active, Inactive	-
	Remote Stop	Active, Inactive	-
	Key Switch	Off, Run, Start	-
	Raise	Active, Inactive	-
	Lower	Active, Inactive	-
	Low Coolant Level	Active, Inactive	-
	Configurable xxx Output pin 7	Active, Inactive	-
	Configurable xxxx Output pin 8	Active, Inactive	-
	Configurable xxxx Output pin 9	Active, Inactive	-
	Configurable xxxx Output pin 10	Active, Inactive	
	Configurable xxxx Output pin 11	Active, Inactive	
	Configurable xxxx Output pin 12	Active, Inactive	-
	Fuel Shut Off	Active, Inactive	-
	Starter	Active, Inactive	
Faults	Fault Code Number	-	-
	Fault Status and Description	Active, Inactive	-
Alternator	Line 1 Voltage	0 to 500	Volt
	Line 2 Voltage	0 to 500	Volt
	Line 3 Voltage	0 to 500	Volt
	Line 1 Current	0 to 2000	Ampere
	Line 2 Current	0 to 2000	Ampere
	Line 3 Current	0 to 2000	Ampere
	Line 1-3 Voltage	0 to 500	Volt
	Line 2-3 Voltage	0 to 500	Volt
	Line 3-1 Voltage	0 to 500	Volt
	Line 1 kVA	0 to 2000	kVA
	Line 2 kVA	0 to 2000	kVA
	Line 3 kVA	0 to 2000	kVA
	Line 1 kW	0 to 2000	kW
	Line 2 kW	0 to 2000	kW
	Line 3 kW	0 to 2000	kW
	Line 1 PF	0 to 1	-
	Line 2 PF	0 to 1	-
	Line 3 PF	0 to 1	-
	Average Line Voltage	0 to 500	Volt
	Average Line Current	0 to 2000	Ampere
	Average Line to Line Voltage	0 to 500	Volt
	Average kVA	0 to 2000	kVA
	Average kW	0 to 2000	kW
	Average PF	0 to 1	-

Screen	Parameter to be displayed	Range	Unit
	Frequency	0 to 80	Hz
Information	ECB Serial No. Base Cal Version Boot loader Version Engine Serial No. Engine Model	- - - - -	- - - - -
Scroll	Scroll the above screen with four seconds between transitions of screens.	-	-

5.0 Model specific calibration:

The display supports the functionality for changing the engine model. The activation of this menu is from the membrane keys. The following condition is checked for allowing the change in the engine model:

System Mode = “Ready” i.e. the Genset not running (Engine Speed = 0 RPM)

With the above condition satisfied, the display shall display the list of engine models read from the ACM flash (Written during PowerCom calibration).

The display scrolls through the models using the membrane keys. The model is accepted using the membrane key.

ACM gives the model specific trims from ACM flash to ECB for model specific calibration generation.

6.0 Trim adjustment:

The display supports the functionality for changing the engine parameters. The activation of this menu is made from the membrane keys. The following condition shall be checked for allowing to change the trims:

System Mode = “Ready” i.e. the Genset not running (Engine Speed = 0 RPM)

With the above condition satisfied, the display shall display the list trims read from the ECB.

The display scrolls through the trims using the membrane keys. The keys used for this functionality are used for scrolling through the trims, selecting the trim to be changed, incrementing the trim value, decrementing the trim value, cursor left, cursor right and accepting the changed value. (As described on page 33).

SECTION 9 - Engine Startup And Adjustments

ENGINE STARTUP AND ADJUSTMENTS

Introduction

This section explains various field adjustments provided by controller. Field adjustments allow the user to tune or select certain parameter options specific to customer requirements. Field adjustments can be performed with the help of controller Service Tool. This document explains the function of all the field adjustments and the effect each field adjustable has on the operation of controller.

1. Adjustments for Engine Start-up

1.1 Start to Idle Time

Tool Feature: Engine Crank

Description: This is the time required by the engine to reach the Idle Speed after cranking it. The user has a choice of selecting the time in which the engine is expected to ramp up to the Idle Speed after cranking.

Example: If the Start To Idle Time is set to **10 seconds**, then the engine shall ramp to Idle Speed (E.g. 1100 RPM) in 10 seconds after cranking it.

1.2 Start to Rated Time

Tool Feature: Engine Crank

Description: This is the time required by the engine to reach the Rated Speed after cranking it. The user has a choice of selecting the time in which the engine is expected to ramp up to the Rated Speed after cranking. This time can be set to a minimum value (E.g. 0 seconds) in case of AMF application, where it is critical to get the engine to rated speed as fast as possible.

Note: Setting Start to Rated Time to **0 seconds**, does not mean that the engine goes to rated speed in 0 seconds, but it means that, the ramping of the speed shall be disabled and the engine speed ramp up shall only be limited by the engine inertia and not controlled by controller.

Example: If the Start To Rated Time is set to **10 seconds**, then the engine shall ramp to Rated Speed (E.g. 1500 RPM for 50 Hz application) in 10 seconds after cranking it.

2.0 Frequency Adjustments

2.1 Speed Adjust Source

- **Tool Feature:** Reference Speed
- **Description:** controller provides the user with 2 options for frequency adjustment. The user can select “Raise-Lower Switches”, “Speed Bias Analog Input” or “None” as a source for providing the frequency adjustment. If the user doesn’t want to adjust the engine speed then the “Speed Adjust Source” shall be set to “None”.

2.2 Raise-Lower Switches:

Two switch inputs called as “Speed Raise” and “Speed Lower” are provided on the connector B to adjust the generator set frequency. The frequency is adjusted within +/- 4 Hz of the rated operating frequency.

The customer can implement the frequency adjust feature by connecting the speed raise / speed lower push buttons on connector B to +24 Volts.

The engine speed will increase by 1 RPM if the “Speed Raise” button is momentarily pressed and released. If the “Speed Raise” button is pressed and held in that position then the engine speed will increase at a programmable rate (e.g. 2 RPM/ second).

The engine speed will decrease by 1 RPM if the “Speed Lower” button is momentarily pressed and released. If the “Speed Lower” button is pressed and held in that position then the engine speed will decrease at a programmable rate (e.g. 2 RPM/ second).

Note: Use potential free contacts for these inputs.

2.3 Raise Lower Switch Ramp Rate

Tool Feature: Reference Speed

Description: This parameter sets the rate at which the engine speed will change (increase in case of “Speed Raise” button and decrease in case of “Speed Lower” button) if either the Speed Raise / Speed Lower button is pressed and held in that position.

Example: If the Raise Lower Switch Ramp Rate is set to 2 RPM/second then the engine speed will change by 2 RPM every second if either “Speed Raise” or “Speed Lower” button is pressed and held in that position.

2.4 Speed Bias Analog Input:

The speed bias input can be implemented by connecting a 0-5 Volt analog input to connector B - pin I with reference to engine battery negative when “speed adjust source” is selected as “speed bias analog Input”.

Note

The speed bias signal and the signal return conductors must be protected from EMI by using

a twisted, shielded cable. One end of the shield must be connected at connector B - pin A at the controller **end and the other end should be left open.**

∆ Caution ∆

The voltage input must not exceed +5 Volt DC for the speed bias input. Improper configuration or adjustment of speed bias input feature can cause unstable engine operation. The user is responsible for performing the necessary system tests to ensure that the feature is properly configured.

The parameters related to the frequency adjustment feature are described below.

2.5 ***Speed Bias Input Connected***

- **Tool Feature:** Analog Inputs
- **Description:** If the user wants to select the "Speed Bias Analog Input" as the frequency adjust source, then the user first needs to enable the speed bias analog input by selecting "Connected" option through Service Tool. Also the "Speed Adjust Source" parameter needs to be configured to select "Speed Bias Analog Input" as the source for frequency adjustment.

3.0 Adjustments for Engine Speed Governing

Controller offers a number of adjustments for Engine Speed Governing. Note that the factory set default values for all the governor parameters are already tuned specific to engine models, so in normal circumstances, the user should not be required to perform any adjustments for engine speed governing. If at all the adjustments are required to be performed then, the adjustments shall be performed in the following order;

- If steady state speed instability or engine hunting is observed then adjust the "Governor Gain Adjust" parameter first.
- If steady state speed instability or engine hunting is observed at specific load on the engine then, adjust the "Governor Gain Load Multiplier Table" parameter, which allows the user to adjust the speed governor response at specific load points.
- If steady state instability or engine hunting is observed during cold engine conditions, then adjust the "Governor Gain Temperature Multiplier" parameter, which allows the user to adjust the speed governor response when the engine is cold.

3.1 ***Governor Gain Adjust***

- **Tool Feature:** Governor
- **Description:** The overall engine speed governor response can be tuned with the help of this parameter.

∆ Caution ∆

Improper configuration or adjustment of governor gain adjust parameter can cause unstable engine operation. The user is responsible for performing the necessary system tests to ensure that the feature is properly configured.)

- **Example:** If the Governor Gain Adjust parameter is set to **0.7**, then the governor proportional gain will get scaled by **0.7**. If the Governor Gain Adjust parameter is set to **1.2**, then the governor proportional gain will get scaled by **1.2**.

3.2 ***Governor Load Scheduling Enable***

- **Tool Feature:** Governor
- **Description:** The user can enable or disable the engine load based governor gain-scheduling feature using this parameter. If enabled, the governor gains will get scaled by a multiplier as explained in the description for "Governor Gain Load Multiplier Table" parameter.

3.3 ***Governor Gain Load Multiplier Table***

- **Tool Feature:** Governor
- **Description:** This feature provides flexibility to the engine speed governor in a way that the user can have different speed governor response based on engine load. By configuring this feature, the users can optimise the speed governor feature within controller for all conditions like engine no load to engine full load.

  This parameter is a 2-D table of Engine Load vs. Gain Multiplier. The engine load is divided into four regions viz. 0% to 24%, 25% to 49%, 50% to 74% and 75% and above. The user can have different gain multipliers depending on the engine load.

Note

Since this feature is based on Engine Load measured by controller, the user must perform the load calibration as mentioned in the description for "Load Mapping Table".

∆ **Caution** ∆

Improper configuration or adjustment of governor gain adjust parameter can cause unstable engine operation. The customer is responsible for performing the necessary system tests to ensure that the feature is properly configured.

- **Example:** The user can configure the Governor Gain Load Multiplier Table as follows;

Engine Load (%)	Multiplier
0	0.900
25	0.945
50	1.000
100	1.000

For the above settings, the governor gains will be scaled by **0.900** if the engine load is between 0% and 24%. The governor gains will be scaled by **0.945** if the engine load is between 25% and 49% and so on.

3.4 *Governor Gain Scheduling Temperature Threshold*

- **Tool Feature:** Governor
- **Description:** This feature provides flexibility to the engine speed governor in a way that the governor response can be tuned for various engine temperatures. By configuring this feature, the users can optimise the speed governor feature within **controller** for cold engine as well as warm engine conditions.

  The way this feature works is that, the user can tune “Governor Gain Temperature Multiplier”, which scales the governor gains. This gain multiplier scales the governor gains only if the engine coolant temperature is less than value indicated by “Governor Gain Scheduling Temperature Threshold”.

  Thus the user can program both the temperature threshold below which gain multiplier scales the governor gains as well as the value of the gain multiplier.

∆ **Caution** ∆

Improper configuration or adjustment of governor gain adjust parameter can cause unstable engine operation. The customer is responsible for performing the necessary system tests to ensure that the feature is properly configured.

- **Example:** If the value of “Governor Gain Scheduling Temperature Threshold” is set to **40 °C** and the “Governor Gain Temperature Multiplier” is set to **0.75**, then the governor gains will get scaled by **0.75** as long as the engine temperature is less than **40 °C**.

  As soon as the engine temperature exceeds beyond the temperature indicated by “Governor Gain Scheduling Temperature Threshold” (40 °C for this example), the “Governor Gain Temperature Multiplier” will have no effect on the governor gains.

3.5 *Governor Gain Temperature Multiplier*

- **Tool Feature:** Governor
- **Description:** This feature provides flexibility to the engine speed governor in a way that the governor response can be tuned for various engine temperatures. By configuring this feature, the users can optimise the speed governor feature within CONTROLLER for cold engine as well as warm engine conditions.

  The way this feature works is that, the user can tune “Governor Gain Temperature Multiplier”, which scales the governor gains. This gain multiplier scales the governor gains only if the engine coolant temperature is less than value indicated by “Governor Gain Scheduling Temperature Threshold”.

  Thus the user can program both the temperature threshold below which gain multiplier scales the governor gains as well as the value of the gain multiplier.

∆ **Caution** ∆

Improper configuration or adjustment of governor gain adjust parameter can cause unstable engine operation. The user is responsible for performing the necessary system tests to ensure that the feature is properly configured.

- **Example:** If the value of “Governor Gain Scheduling Temperature Threshold” is set to **40 °C** and the “Governor Gain Temperature Multiplier” is set to **0.75**, then the governor gains will get scaled by **0.75** as long as the engine temperature is less than **40 °C**.

  As soon as the engine temperature exceeds beyond the temperature indicated by “Governor Gain Scheduling Temperature Threshold” (40 °C

for this example), the "Governor Gain Temperature Multiplier" will have no effect on the governor gains.

3.6 *Idle Speed*

- **Tool Feature:** Reference Speed
- **Description:** The user can set the low idle speed of the engine using this parameter.
- **Example:** If the value for "Idle Speed" is set to **1100 RPM**, then after start-up, the engine will run at 1100 RPM if Idle/Rated switch is in **Idle** position.

  If the value for "Idle Speed" is set to **900 RPM**, then after start-up, the engine will run at 900 RPM if Idle/Rated switch is in **Idle** position.

3.7 *Idle to Rated Time*

- **Tool Feature:** Reference Speed
- **Description:** This parameter sets the time it takes for the engine to ramp up or ramp down from idle to rated mode and vice versa.
- **Example:** If the value for "Idle to Rated Time" is set to **10 seconds**, then the engine will ramp up from idle speed (e.g. 1100 RPM) to rated speed (e.g. 1500 RPM for 50 Hz application) in 10 seconds. Similarly it will ramp down from rated speed (e.g. 1500 RPM for 50 Hz application) to idle speed (e.g. 1100 RPM) in 10 seconds.

4.0 Adjustments for Droop

4.1 *Droop*

- **Tool Feature:** Reference Speed
- **Description:** Droop is typically expressed in percentage of speed and can be calculated using the formula;

$$\%\ Droop = \left(\frac{No\ Load\ Speed - Full\ Load\ Speed}{Full\ Load\ Speed} \right) \times 100$$

E.g. If the No Load Speed = **1545 RPM**, Full Load Speed = **1500 RPM**, then % Droop using the formula above would be equal to **3%.**

The engine speed at any given load would then be calculated using the following formula;

$$S = \left[NLS - \left(\frac{Available\ kW\ Load}{Rated\ kW\ Load} \times (NLS - FLS) \right) \right]$$

Where;

S = Speed at available load;
NLS = No Load Speed (Same as high idle speed);
FLS = Full Load Speed (Rated Speed, e.g. 1500 RPM for 50 Hz application).

Isochronous Mode: For Isochronous speed mode operation, the droop setting needs to be set to **0%**.

Note

The default % Droop is factory set to 3%. If the Droop value is changed, then the effect of new Droop value will take place only after user performs "Save Adjustments" using C-View and turns off the CONTROLLER by using the "Forced Power Down " feature or waits till CONTROLLER Power Down. The procedure for "Forced Power Down" of CONTROLLER is explained in description for 0 - Power Down Control**.**

∆ Caution ∆

Improper configuration or adjustment of governor gain adjust parameter can cause unstable engine operation. The user is responsible for performing the necessary system tests to ensure that the feature is properly configured.

Example: For Droop = **3%**,
NLS = **1545 RPM**,
FLS = **1500 RPM**.

If for a given generator set, Rated kW Load = **400 kW**, then

For available kW Load = **200 kW**, the engine speed can be calculated from the above formula and it would be equal to **1522.5 RPM.**

4.2 Adjustments for Load Management (Load Mapping)

Load Offset Table

- **Tool Feature:** Load Management

  Description: CONTROLLER supports Droop over a range of 0 to 6%. When the Droop is set to 0%, it is called as "Isochronous" operation where the engine speed does not change with the engine load. In this case Load mapping / Load management is not required.

  For any value other than 0% of Droop, the engine speed shall change within a certain band with reference to engine load.

  I.e. e.g. For Droop = 3%,
  $(Engine\ Speed)_{No\text{-}Load} = 1545$
  $(Engine\ Speed)_{50\%\text{-}Load} = 1522.5$
  $(Engine\ Speed)_{100\%\text{-}Load} = 1500$

  In order for CONTROLLER to calculate the correct speed at which the engine should run based on engine load, CONTROLLER calculates percent engine load based on the

actuator current. It does so with the help of a table, which relates the actuator current to % engine load. This table is part of the CONTROLLER calibration and cannot be changed in the field. On top of this table, there is another table, which relates % engine load to % engine load offset. This table is field adjustable.

% Engine Load	% Load Offset
0	0
25	0
50	0
75	0
100	0

This table is provided to compensate for any differences between the actual percent load and the percent load calculated by CONTROLLER.

E.g. If the actual percent load (in % kW), on the engine is equal to 20% and the percent load calculated by CONTROLLER is equal to 17%, then the difference of 3%, required by CONTROLLER to match the actual load, shall be entered in the "% Load Offset" column in front of 0% engine load.

Conversely, if the actual load on the engine is equal to 40% and the load calculated by CONTROLLER is equal to 44%, then the difference of -4%, required by CONTROLLER to match the actual load, shall be entered in the "% Load Offset" column in front of 25% engine load.

Similarly, the load offsets across the entire load range can be compensated for with the help of this table.

Note

This is a one-time activity to be performed while commissioning CONTROLLER generating sets for paralleling operation. This activity needs to be repeated if any of the engine components like fuel pump, actuator are replaced. Please ensure that the kW meter in the Generator Set panel is calibrated.

A) Example: Procedure for calibrating the CONTROLLER for Load Measurement is as follows:

1) Start the generating set as a single set.

2) Connect the CONTROLLER Service Tool to CONTROLLER and continuously monitor **Engine Load.**

3) Run the engine at no load.

4) Observe the parameter **Engine Load** in the CONTROLLER Service Tool Monitor window.

5) If the parameter **Engine Load** is same as the actual load in % kW on the engine, then go to the next step. If not then enter the difference **(Actual Load (%) - Load Calculated by CONTROLLER (%))** in the second column and first row of the table **Load Offset Table**.

6) Run the engine at various load points. One load point shall be used for each load segment viz. 0, 25, 50 and 75. I.e. For the segment 25%, the engine can be run at 30% or 40% or which ever is available at the customer site.

7) Repeat steps **4** and **5** for all the load segments mentioned in step **6**.

8) Stop the engine and perform a **Save Adjustments** operation using the CONTROLLER Service Tool so that the above readings are permanently stored in CONTROLLER.

5. Faults

CONTROLLER has the following attributes for any Fault

- **Fault Code:** This is a unique number that identifies a particular fault.
- **Fault Response:** A Fault Response can either be **Warning** or **Shutdown** and are field adjustable. Faults with response as shutdown will trip the engine on the occurrence of the fault where as faults with response as warning will not trip the engine but only indicate the warning condition.
- **Fault Status (Active & Inactive faults):** This attribute indicates whether a fault is present or not at any given instance of time. If a fault is live then the fault status will be "Active" and if the fault has occurred in the past but is not live then the fault status will be "Inactive".
- **No of Occurrences:** This attribute indicates how many times a fault has occurred. This is a non-resettable attribute. It can only be viewed.
- **Time of Last Occurrence:** This is the time at which the fault has last occurred. It is in terms of Engine Hours. For e.g. if a particular fault has occurred 5 times then the time stored would be the time for the fault when it occurred for the fifth time.
- **Snapshot:** Snapshot consists of a list of pre-defined parameters. Every time a fault occurs,

the values for these pre-defined parameters would be stored in the memory. For every fault occurrence, there would be a set of two values for each parameter in the snapshot. One set of value would be just before the fault occurred and the other set of value would be just after the fault occurred. This would help in diagnosing any issues by providing this additional information. Limited number of snapshot records can be stored in memory and when the memory allocated for snapshot is full, then any new snapshot entry would overwrite the oldest snapshot entry. CONTROLLER Service Tool can read this snapshot memory and after reading this memory, it can be cleared using the CONTROLLER Service Tool.

5.1 *Fault Information List*

- **Tool Feature:** Fault Handler
- **Description:** This is a table of Fault Codes and default response of that Fault Code. The user can configure this Fault Response. A fault response of "Warning" is considered "less severe" and the fault response of "Shutdown" is considered to be "more severe".

∆ Caution ∆

The user can change the response of a particular fault from "less severe" to "more severe". A "more severe" response cannot be changed back to "less severe", i.e. for a fault with a default response as "Warning", the response can be changed to "Shutdown". But for a fault with a default response as "Shutdown", the response cannot be changed to "Warning". This way the user cannot disable critical faults like engine protection faults.

If the user wants to revert back the fault response of a fault from "more severe" to "less severe", i.e. from "Shutdown" to "Warning", then it can only be done by re-calibrating the controller. This way the default response of the faults would be restored back.

- **Example:**

E.g. 1

For fault code **145** (Coolant Temperature Sensor shorted high), the default response is "Warning". It means that if the coolant temperature sensor is out of range, then the controller will only issue a warning and the engine would not trip.

If a particular customer prefers to trip the engine in case the coolant temperature sensor goes out of range, then the user can change the default response for this fault from "Warning" to "Shutdown".

E.g. 2

For fault code **234** (Engine Overspeed), the default response is "Shutdown". It means that if the controller detects that the engine speed has exceeded the overspeed threshold, then the controller will trip the engine as it is potentially dangerous to run the engine in such situation. Since this fault is critical and the engine needs to shutdown immediately, the user cannot change the fault response of this fault from "Shutdown" to "Warning". This way the controller would ensure that the critical faults are not disabled.

5.2 *Clear Snapshot Type 1 Buffer*

- **Tool Feature:** Fault Handler
- **Description:** The user can clear the snapshot memory within the controller by this parameter. Even if the snapshot memory is not cleared, the controller will overwrite the memory with new snapshot information if this memory becomes full.

6. Annunciation

Customer Output

- **Tool Feature:** Discrete Outputs
- **Description:** CONTROLLER gives the user an option of having one free configurable output. The user can configure this output by choosing one of the options available, which are mentioned in the table.

No	Option	If this is the selected Option then
1	Common Warning	Customer output (+24 volts on Pin no H of connector B) shall be active if one or more faults within CONTROLLER with response as "Warning" are present.
2	Common Shutdown	Customer output (+24 volts on Pin no H of connector B) shall be active if one or more faults within CONTROLLER with response as "Shutdown" are present.
3	Engine Running	Customer output (+24 volts on Pin no H of connector B) shall be active if the engine is running at rated speed.
4	Engine Not Ready to Start	Customer output (+24 volts on Pin no H of connector B) shall be active if Key Switch is in "OFF" position and/or the Idle/Rated Switch is in "Idle" position. This indicates that the engine cannot be started using Remote Start Input as used in AMF Applications. Thus to enable the engine to start remotely Key Switch should "always" be in "RUN" position and Idle/Rated switch should be in "Rated" position.

7. Power Down Control

Power Down Control

- **Tool Feature:** System Mode
- **Description:** CONTROLLER has a Powerdown feature, which automatically powers down the controller after a pre-set time (factory set default value is 10 minutes) if the engine is not running irrespective of the key switch position. This feature allows the user to configure the Controller Power Down by choosing one of the options available in the table mentioned below.

No	Option	If this is the selected Option then
1.	Disable Powerdown	The powerdown feature is disabled temporarily and the CONTROLLER will not powerdown. This option is suitable in situations where the user wants to perform some diagnostics without running the engine and wants the controller to be ON. "Power Down Control" feature will default back "Enable Powerdown" once the engine is started. This option cannot be stored permanently in CONTROLLER memory.
2.	Enable Powerdown	The powerdown feature is enabled and CONTROLLER will powerdown if the engine is not started and CONTROLLER is ON for pre-set time duration.
3.	Force Powerdown	The CONTROLLER skips the pre-set power down time and powers down immediately. This option is suitable in situations where the user has performed "Save Adjustments" using the CONTROLLER Service Tool and wants to cycle power to CONTROLLER. **Note** **This is the only recommended way of forcefully powering down the CONTROLLER instead of removing the CONTROLLER connectors or removing power from the battery terminals.**

8. Engine Hours

Engine Hours Since Reset

- **Tool Feature:** Hour Meter
- **Description:** CONTROLLER keeps track of engine running hours using two parameters. One parameter is non-resettable and one is resettable. The non-resettable parameter indicates the number of hours the engine has run with a particular CONTROLLER. Whereas the ressetable parameter allows the user to store the cumulative engine running hours in case multiple CONTROLLER's have been used on that particular engine.

  The engine running hours that are displayed on the CONTROLLER digital display indicates the cumulative hours the engine has run. In normal case the "Engine Hours" and "Ressetable Engine Hours" would both indicate the same value. But in case if an CONTROLLER is changed in the field and a new CONTROLLER is fitted, then the user needs to assign the hours clocked by the earlier CONTROLLER (the one which was replaced) to the "Engine Hours Since Reset" parameter in the new CONTROLLER. The example given below is self-explanatory.

- **Example:** If a particular engine has run for **3000 hours** without replacing the CONTROLLER for the entire duration of 3000 hours then "Engine Hours" would be equal to **3000 Hours** and "Engine Hours Since Reset" would also be equal to **3000 Hours**.

  After 3000 Hours, if for some reason the CONTROLLER is replaced, and a new CONTROLLER is fitted on the same engine, the "Engine Hours" parameter for the new CONTROLLER shall start recording the hours from **zero (0 Hours)**. In order for the new CONTROLLER to show the cumulative engine running hours, the user needs to set the "Engine Hours Since Reset" parameter equal to the hours clocked by the previous CONTROLLER, i.e. for this example, it would be **3000 Hours**. Thus the new CONTROLLER now would be able to track the cumulative engine run hours and the same will be displayed on its digital display.

9. Manual Overrides

The Manual Overrides are provided for diagnostics purpose. With the help of these overrides, the user can force a particular output/input to have a specific value to verify whether that particular output/input is functioning properly. The way these overrides work is that for a particular parameter override, two parameters are used. One is the override value itself and another parameter to enable or disable the override mode. The user can configure these overrides temporarily by putting the values of their choice and then enabling the override switch. The override switch values restore to default on the next power-up, the default option being "Inactive". The override parameters do not retain their values in memory.

∆ Caution ∆

Manual Overrides are provided for diagnostic purpose only. Since these values override normal parameter values, it is not advisable to

run the engine with the manual override values as it might potentially cause severe damage to the engine or result in severe injury to the operator.

9.1 *Fuel Actuator Cmd Override*

- **Tool Feature:** Fuel System
- **Description:** This is the override provided for Fuel Actuator Command. With this the user can set a forced value for the Fuel Actuator Command. It is very useful to diagnose the fuel actuator for typical actuator issues like actuator sticky. Use of this override is strongly recommended to diagnose the actuator instead of conventional methods like applying external voltage to the actuator.

  For this override to function the engine should be stopped and then the user can enter a specific value in % for this parameter.
- **Example:** If "Fuel Actuator Cmd Override" = 35%, then the actuator would be driven by a 35% PWM signal.

If "Fuel Actuator Cmd Override" = 50%, then the actuator would be driven by a 50% PWM signal.

9.2 *Fuel Actuator Cmd Override Enable*

- **Tool Feature:** Fuel System
- **Description:** This is the override switch provided to Enable or Disable the Fuel Actuator Command Override. When this parameter is set to "Enable" the "Fuel Actuator Cmd Override" parameter drives the fuel actuator.

Speed Override

- **Tool Feature:** Engine Speed

  Description: This is the override provided for Engine Speed. With this the user can run the engine at a specific speed.

  Δ Caution Δ

  Running the engine at an excessively high speed can cause potential damage to the engine as well as can cause severe injury to the operator.
- **Example:** If "Speed Override" is set to **1300 RPM**, then the engine would run at 1300 RPM.

If the "Speed Override" is set to **1600 RPM**, then the engine would run at 1600 RPM.

9.3 *Speed Override Enable*

- **Tool Feature:** Engine Speed
- **Description:** This is the override switch provided to Enable or Disable the Engine Speed Override. When this parameter is set to "Enable" the engine is run at the speed specified by "Speed Override" parameter.

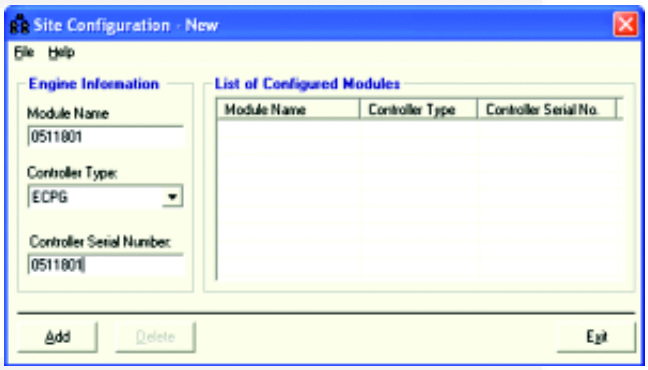
10.0 Calibration Procedure:

PowerCom can be calibrated in 2 ways:
1: Through C-View
2: Through controller panel.

Through controller panel: Refer to the model specific calibration.

Connect the controller to the PC using the data link connector and RS232-RS485 converter. Follow the given steps for calibration.

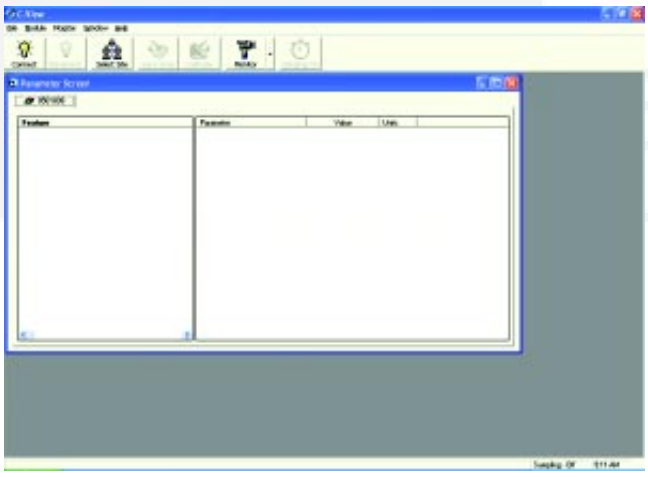
10.1 Go the Tool setup utility for setting of PowerCom serial number.



Enter the engine control board serial number and select the type of controller used. Refer to the above fig. Click ADD to save the *.cfg file.

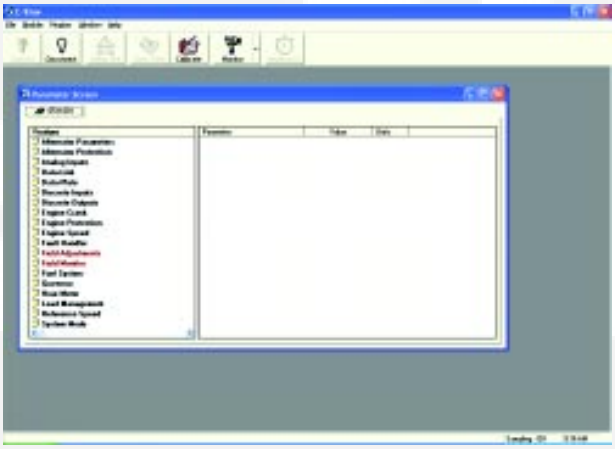
10.2 Open Cview to select the site & identify the controller.

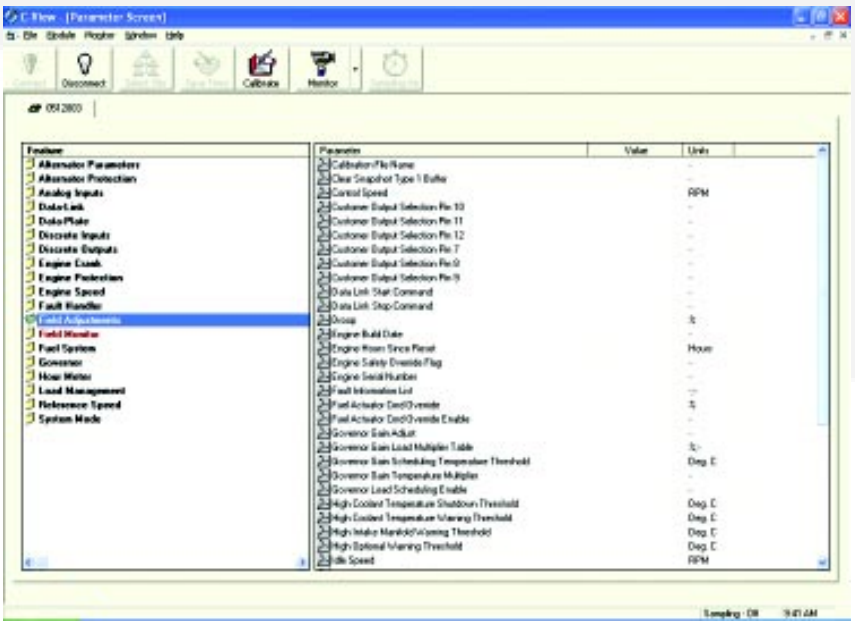
Refer to the fig. given below.



10.3 " Click on " Connect " to start calibration.
Refer to the fig. shown below.

10.4 After connecting to PowerCom, the following screen is observed with various adjustable & observable parameters.
Click on 'calibrate' for calibration of the controller.

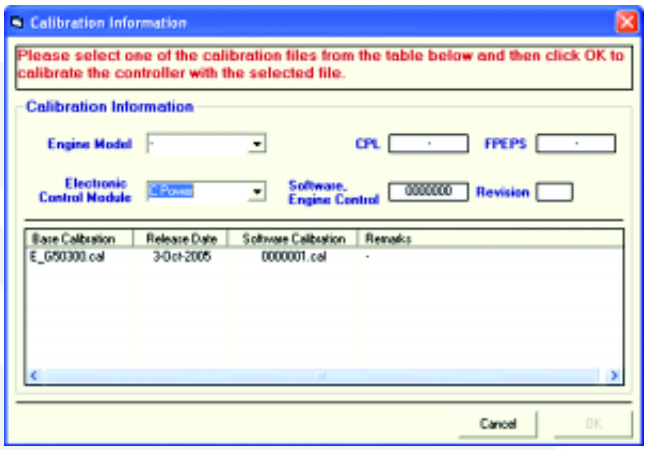




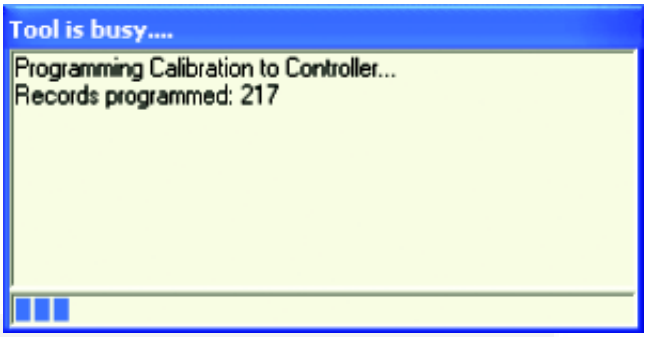
These are various engine & alternator parameters that are adjusted & monitored.

10.5 Observe the following screen.

Select the type of controller. Select *.cal file & press OK for calibration.



10.6 Following screen is observed on the PC when the controller is calibrating itself.
Also, it takes about 20 mins for calibration.



10.7 Following screen is observed when the controller is successfully calibrated.

Note : Disconnect the C-View after calibration.

If the user wants to use C-View, he will have to reconnect it to the controller

11.0 GUIDELINES FOR CURRENT TRANSFORMERS

All current transformers (CTs) used with PowerCom control must confirm to the following specifications.

- Continuous rated full load secondary output current: 5 amps at 50 or 60Hz
- Total burden VA rating: at least 2.5 VA
- Output terminals between which current is drawn in high and low ranges on tapped CTs.
- Maximum allowable ratio error at rated output: +/–1%
- Maximum allowable phase angle error at rated output: +/–1%
- 10 second overload output current in rated metering load: 10 Amps
- Maximum allowable ratio error at overload output: +/–1%
- Ambient temperature rating: –40 to 176 Deg F (–40 to +80 Deg C)
- System voltage rating – 600VAC

Current Transformer Selection

Current transformers (CTs) used in PowerCom control applications are ideally sized to produce rated CT secondary amps at twice rated generator (full 200% range) output amperes. In other words, when the generator is producing 100% output amperes, the secondary current of the CTs is 2.5 amperes per phase. This requirement determines a lower bound of the CT ratio. An upper bound is determined by requiring that at 100% rated output current the CTs secondary current is at least 1 ampere. The purpose of this is to maintain sufficient metering resolution. The lower and upper bound of the CT limits are prescribed by the following two formulas.

$$\textit{Minimum CT Ratio} = \frac{(2) * (\text{Genset Rated Current})}{5}$$

$$\textit{Maximum CT Ratio} = \frac{(5) * (\text{Genset Rated Current})}{5}$$

Formula for CT Sizing

We find the genset rated current in each phase for each output voltage. This is done using the following formula:

$$\text{Current} = \frac{\text{Power (VA)}}{\sqrt{3} * \text{Voltage}}$$

OR

$$\text{Current} = \frac{\text{Power (W)}}{\sqrt{3} * \text{Voltage} * \text{Power factor}}$$

Refer to the figure below for mounting methods of the CT.

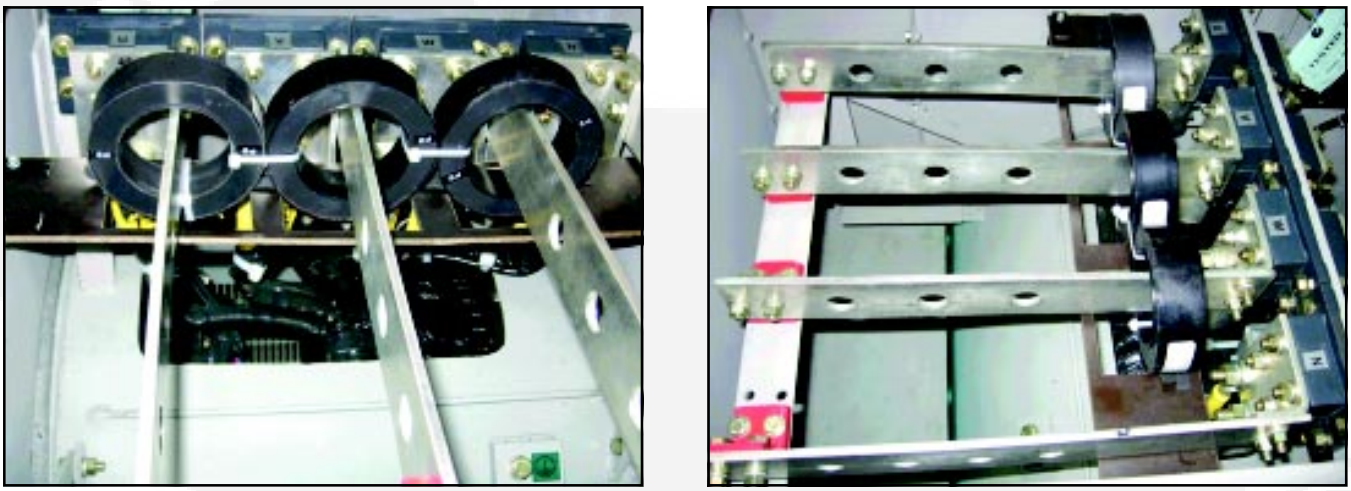


Fig. 11.0 Mounting of CT.

Note: P1 side of CT is towards the alternator.

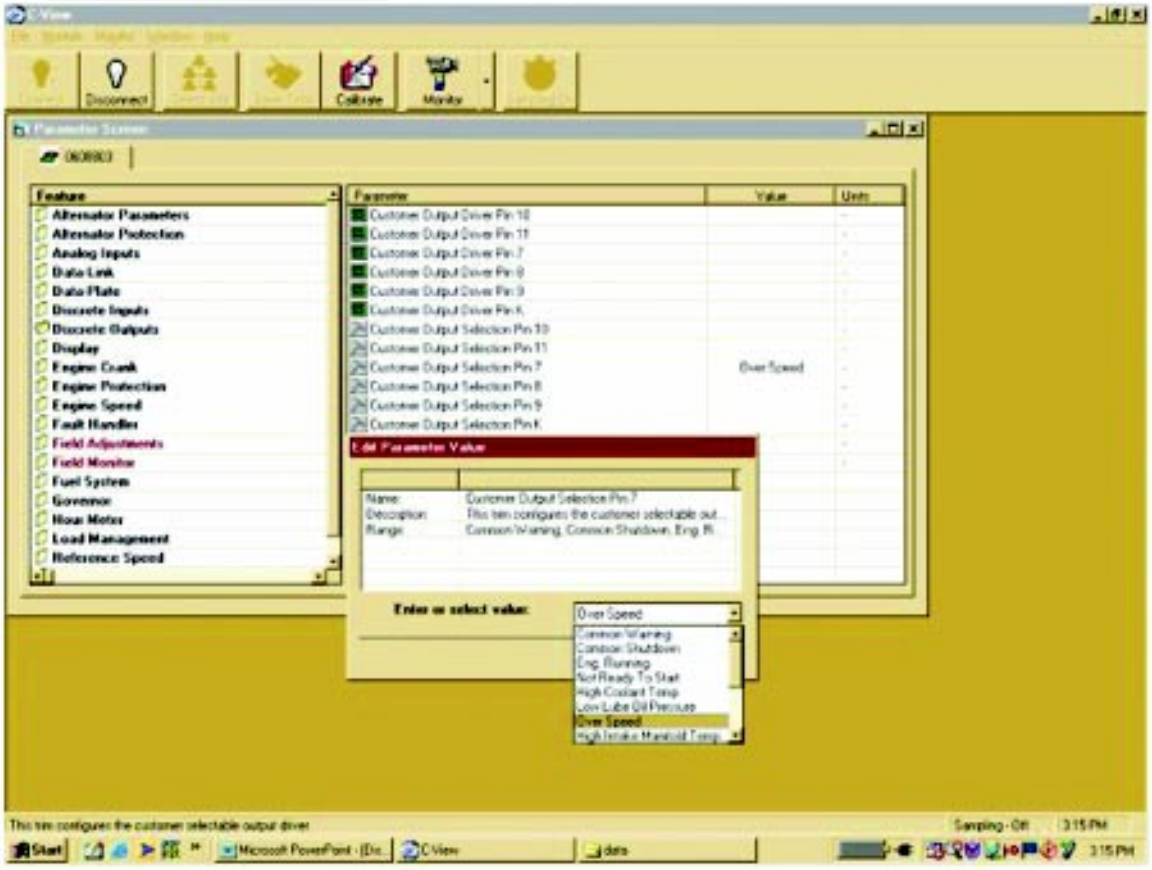
12.0 Configuration of Customer Faults

These two faults can be enabled as warning or shutdown.

For fault options, please refer page 21.

The below figurres show the setting of customer faults using C-View.


Disconnect
Calibrate
Monitor
Feature
Parameter
Value
Unit
Alternator Parameters
Alternator Protection
Analog Inputs
Data Link
Data Plate
Discrete Inputs
Discrete Outputs
Display
Engine Crank
Engine Protection
Engine Speed
Fault Handler
Field Adjustments
Field Monitor
Fuel System
Governor
Hour Meter
Load Management
Reference Speed
Edit Parameter Value
Name: Customer Configuration Fault Input 1
Description: Customer Configuration Fault Input 1
Range: Customer Warning, Customer Shutdown
Enter or select value:
Customer Warning
Customer Shutdown
Cancel
OK
Customer Configuration Fault Input 1
Start
Microsoft PowerPoint - [Do...
C-View
data
3:15 PM


Disconnect
Calibrate
Monitor
Feature
Parameter
Value
Unit
Alternator Parameters
Alternator Protection
Analog Inputs
Data Link
Data Plate
Discrete Inputs
Discrete Outputs
Display
Engine Crank
Engine Protection
Engine Speed
Fault Handler
Field Adjustments
Field Monitor
Fuel System
Governor
Hour Meter
Load Management
Reference Speed
Edit Parameter Value
Name: Customer Output Selection Pin 7
Description: This item configures the customer selectable out...
Range: Common Warning, Common Shutdown, Eng R...
Enter or select value:
Over Speed
Common Warning
Common Shutdown
Eng Running
Not Ready To Start
High Coolant Temp
Low Lube Oil Pressure
Over Speed
This item configures the customer selectable output driver
Start
Microsoft PowerPoint - [Do...
C-View
data
3:15 PM

NOTES

SECTION 10 - ENGINE PROTECTION & FAULTS

1.0 ENGINE PROTECTION

The engine protection parameters shown on the right can be configured within preset limits using the service tool. The service tool does not allow the values of the parameter to be set beyond the minimum and maximum limits.

1.1 Fault Diagnosis

The following are the fault and warning indications that are visible on the display panel. These indications light up red whenever a fault or a warning occurs.

Common Warning
Common Shutdown
High Coolant Temp Warning
Low Lube Oil Pressure Warning
Low Coolant level Shutdown
Over Speed Shutdown
Charging Failure indication

Note: Only active faults are displayed on PowerCom panel. PowerCom service tool shall be used to view all active as well as inactive faults.

1.2 Fault Codes

The PowerCom can record and report certain detectable diagnostic conditions. These conditions are recorded as fault codes. These can be used to assist in troubleshooting engine and controller failure. Refer to the fault code list and troubleshooting tree in the manual for further details.

Fault codes recorded in the PowerCom can be accessed in following way:

– PowerCom Front Panel: When a fault is detected by the controller, the red LED on the right hand side ie. “Common warning or Common shutdown” lights up or any fault that is displayed on the front panel lights up, depending on the fault condition.

The user can use the key which is adjacent to the “Fault” on the display to view the active faults along with the respective code detected by the controller.

The codes and the respective faults are as follows:

1.2.1 Fault Code Information :

Fault Code	Engine Protection/ system Fault	Default fault response	Fault Description	Effect (only when fault is active)
135	System	Warning	Oil Pressure Sensor Signal is shorted High	No engine protection for lube oil pressure. No effect on engine performance.
141	System	Warning	Oil Pressure Sensor Signal is shorted Low	No engine protection for lube oil pressure. No effect on engine performance.
143	Engine Protection	Warning	Low oil pressure	Low lube oil pressure warning. No effect on engine performance.
144	System	Warning	Coolant temp. sensor signal is shorted high	No engine protection for coolant temp. No effect on engine performance.
145	System	Warning	Coolant temp. sensor signal is shorted low	No engine protection for coolant temp. No effect on engine performance.
146	Engine Protection	Warning	High Coolant temperature.	High coolant temperature warning relay is energized. No effect on engine performance.
151	Engine Protection	Shutdown	High coolant temperature	Shutdown of the engine
153	System	Warning	High intake manifold temperature.	No effect on engine performance.

Fault Code	Engine Protection/ system Fault	Default fault response	Fault Description	Effect (only when fault is active)
154	System	Warning	Low intake manifold temperature.	No effect on engine performance.
155	Engine Protection	Warning	High auxiliary temp.	No effect on engine performance.
234	Engine speed	Shutdown	Overspeed shutdown	Engine shuts down when controller detects this fault.
235	Engine Protection	Shutdown	Low coolant level shutdown	Engine shuts down when controller detects this fault.
359	Engine crank	Shutdown	Engine fail to start	This fault occurs when the engine fails to start after a set time.
415	Engine Protection	Shutdown	Low oil pressure	Engine shuts down after the detection of this fault.
441	System	Warning	Weak battery detected	Controller has detected a weak battery. Engine may not crank.
1411	System	Warning	Speed bias analog i/p signal is shorted high.	No effect on engine performance.
1416	System mode	Shutdown	Engine fails to shutdown	Engine fails to stop even though it receives a stop command. No engine protection feature.
1438	Engine crank	Shutdown	Engine fails to crank	No effect on engine performance.
3111	System	Warning	Speed bias analog i/p signal is shorted low.	No effect on engine performance.
3112	System	Warning	Speed/load raise switch is shorted high	No effect on engine performance.
3113	System	Warning	Speed/load raise switch is shorted low	No effect on engine performance.
3115	Engine speed	Shutdown	No engine speed signal is detected.	Engine speed is not detected by the controller causing shutdown of the engine.
3116	Fuel system	Shutdown	Fuel actuator stuck	Actuator does not respond to i/p signal. Engine is shutdown.
3118	System	Warning	Power down failure fault	Controller will not powerdown causing battery drain. No effect on engine performance.
1446	Alternator Protection	Shutdown	Over voltage fault	Engine stop due to over voltage fault.

Fault Code	Engine Protection/ system Fault	Default fault response	Fault Description	Effect (only when fault is active)
1447	Alternator Protection	Shutdown	Under voltage fault	Engine stop due to under voltage fault.
1448	Alternator Protection	Shutdown	Over frequency fault	Engine stop due to over frequency fault.
1449	Alternator Protection	Warning	Under frequency fault	No effect on engine performance
1471	Alternator Protection	Warning	Over current fault	No effect on engine performance
3123	Customer Input 1	Warning	—	No effect on engine performance.
3124	Customer Input 1	Shutdown	—	Engine stops due to customer fault.
3125	Customer Input 2	Warning	—	No effect on engine performance.
3126	Customer Input 2	Shutdown	—	Engine stops due to customer fault.

1.3 PowerCom Fault Response Threshold:

Engine Parameter	Fault Response	Threshold Time	Threshold values
Engine Overspeed	Shutdown	5 sec	110% of rated RPM for 1500 & 1800 rated RPM
High coolant temp. warning	Warning	5 sec	93^0C (199^0F)
High coolant temp. shutdown	Shutdown	5 sec	96^0C (205^0F)
High intake manifold temp. warning	Warning	5 sec	75^0C (167^0F)
Low lube oil press. Warning	Warning	5 sec	**RPM threshold (bar)** 0 0 500 0.5 1100 1.0 1500 2.1
Low lube oil press. Shutdown	Shutdown	5 sec	**RPM threshold (bar)** 0 0 500 0.3 1100 0.6 1500 2.4
Low coolant level	Shutdown	5 sec	
Under voltage	Shutdown	5 sec	85% rated
Over voltage	Shutdown	5 sec	115% rated
Over frequency	Shutdown	5 sec	110% rated
Under frequency	Warning	10 sec	85% rated
Over current	Warning	5 sec	120% rated

NOTES

SECTION 11 – TROUBLESHOOTING

1.0 Warning & Shutdown codes with their corrective actions:

Fault Code	Corrective Action
135 Oil press. Sensor is shorted high Warning	• Inspect the sensor for damaged pins, if found damaged, replace the sensor. Also, inspect the sensor for dirt. • Check lube oil sensor spec. & if found not as per spec, replace the sensor. • Check engine harness for continuity if no supply is observed between pins G & J of engine harness.
141 Oil press. Sensor is shorted low Warning	• Indicates that the controller has sensed that the engine oil press. sender signal is shorted low. Check sensor / connector / wires. • Check for engine harness connectivity.
143 Low lube oil pressure	• Indicates that the engine oil pressure has dropped to an unacceptable level. • Check dipstick calibration and oil level in the engine. OR • Check for mounting location of the sensor on the engine. OR • Check for oil contamination. OR • If lube oil suction tube broken, replace it. • If oil pump is malfunctioning, replace it.
144 Coolant temperature sensor is shorted high.	• Check coolant sensor resistance as per specification. OR • Replace the engine harness is short circuit is observed.
145 Coolant temperature sensor is shorted low.	• Check sensor specification. OR • If coolant sensor is shorted to ground, replace the engine harness.
146 High coolant temperature.	• Check coolant level, add coolant if necessary. OR • If intake air temp. is too high, check for air-circulation from radiator entering air cleaner. OR • If radiator/Heat Exchanger fins are damaged, replace them. OR • Check pipe coupling or hose.

Fault Code	Corrective Action
151 High coolant temp. shutdown.	• Add coolant if level is low. OR • If intake air temp. is too high, check for air circulation from radiator. OR • Check for radiator/Heat Exchanger fins.
153 High intake manifold temp.	• Check specifications of the sensor. • Check whether the sensor is shorted to 12 VDC. Replace engine harness if so.
154 Low intake manifold temp.	• Check specifications of the sensor. • Check whether the sensor is shorted to ground. Replace engine harness if so.
155 High intake temperature	• Check whether the sensor is shorted to ground. Replace engine harness if so.
234 Engine over speed shutdown	• Check whether the engine over speed limit is calibrated at a sufficiently higher value than the rated engine speed. OR • Replace the fuel actuator if it is stuck in the open position. OR • If fuel actuator is getting +24 VDC supply continuously, replace the engine harness.
235 Low coolant level shutdown	• If the coolant level is low, add coolant. • If coolant level sensor is faulty, replace it. OR • If +24 V is obtained at pin “R” of the engine harness, replace it.
359 Engine fail to start	• Add fuel in the tank if the level is low.OR • Replace the filter if it is choked. OR • Tighten the fuel line connections if there is air in the fuel. • Check the harness for open or short connection in the fuel shutoff valve. • Check the engine harness for actuator supply.
415 Low lube oil pressure shutdown	• Check oil level. • Check sensor location. • Check for contamination in the oil. • Replace oil filter if the flow is blocked. • Remove oil sump if the suction tube is broken or tube seals are leaking.

Fault Code	Corrective Action
	• Check sensor supply voltage at pin “G and J” of the harness. • Check the continuity between connector “A” and harness. If no continuity is observed, replace it.
441 Weak battery	• Replace battery.
1411 Speed bias analog i/p signal is shorted high.	• Check OEM harness for short circuit ie. +5V or +24V battery supply. If short, replace the harness.
1416 Engine fail to shut down	• If FSO valve is permanently ON even if Switch is in OFF position, check the harness for +24V short to battery supply. If short is observed, replace the harness. • Check and be sure that the manual override screw on FSO valve is out to maximum travel. • Check that the FSO is turned off when 24V from PowerCom is removed by turning the key switch from Run position to Off position. • Check engine fuel drain line.
1438 Engine fail to crank	• Tighten the battery connections if they are loose. • Check electrolyte levels and specific gravity of battery cells. If low, charge or replace the battery. • If battery rating is low, replace the battery with correct rating. If engine starting circuit is malfunctioning, check if 24V supply appears at the starter magnetic switch during start. If +24V battery supply does not appear, check for engine harness continuity. **Check for continuity** : Check the continuity between Pin ‘E’ of Connector ‘A’ and starter magnetic switch connections. If no continuity is observed, repair the wires or replace the engine harness. If continuity is observed, and problem still persists, replace the controller. • If engine drive unit does not get engaged with the starter, then check whether the starter solenoid gets supply voltage. If not, change the starter magnetic switch. • Remove engine starting motor & check for damage. • If there is hydraulic lock in engine cylinder, then check intake or exhaust valve operation.

Fault Code	Corrective Action
3111 Speed bias analog input signal is shorted low	• Check if the OEM harness is shorted to ground, if yes, replace the harness.
3112 Speed/Load raise switch is shorted high.	• Check the speed raise switch on the AMF panel. If a short is observed, replace it. • Also check the harness for short.
3113 Speed/load low switch is shorted high	• Check the speed low switch on the AMF panel. If a short is observed, replace it. • Also check the harness for short.
3115 No engine speed signal is detected	• Check whether the MPU is connected correctly to the harness. • The MPU coil resistance should be as per sensor specification, else replace the MPU. • Check tip of the MPU for damage. • The gap between MPU tip & engine flywheel ring gear teeth should be as per engine specification. Check the continuity between Connector A (Pin 'B' and Pin 'T') and MPU connector. If no continuity is observed repair the wires or replace the engine harness. • Voltage should be more than 1.5V AC. • Perform MPU body test.
3116 Fuel Actuator stuck	• Check engine fuel supply & ensure that air lock has not occurred. • If fuel filters are choked, clean or replace them. • Replace or clean the actuator with diesel if it is sticky. • If actuator is not getting supply , Check the engine harness for short circuits or open circuits. For short circuits : If short or open circuits observed between Connector A and actuator connector, repair the wires that have short or open circuits or replace the engine harness. For open circuits : Check the continuity between Connector A (pin 'F' and pin 'M') and the fuel actuator connector. If no continuity is observed, repair the wires or replace the engine harness. • Check actuator coil resistance.

Fault Code	Corrective Action
3118 Power down failure	• Replace the controller
1446 Over voltage fault	• Check for AVR function • Verify proper alternator connections. • Verify that PowerCom control voltage selection matches alternator winding voltage selection. • Isolate the power output from the generator set by opening the generator main circuit breaker. • Check voltage on the output terminals. If incorrect voltage is displayed, troubleshoot voltage sensing harness & circuitry. • If correct voltage is displayed, but it is very high, verify that the generator set can operate at proper voltage when exciter is powered from a suitable external source. • If voltage is unbalanced, troubleshoot main stator. • If voltage is balanced but abnormal, troubleshoot exciter & main field windings.
1447 Undervoltage shutdown	• Check the load & correct for any overload. • Check operation by disconnecting the load & restarting the genset. • Verify proper alternator connections. • Verify that PowerCom control voltage selection matches alternator winding voltage selection. • Isolate the power output from the generator set by opening the generator main circuit breaker. • Check voltage on the output terminals. If incorrect voltage is displayed, troubleshoot voltage sensing harness & circuitry. • If correct voltage is displayed, but it is very high, verify that the generator set can operate at proper voltage when exciter is powered from a suitable external source. • If voltage is unbalanced, troubleshoot main stator. • If voltage is balanced but abnormal, troubleshoot exciter & main field windings.
1448 Over frequency shutdown	• Reset the threshold to the lowest allowable setting. • Check for fuel or air delivery problem.

Fault Code	Corrective Action
1449 Under frequency shutdown	• Check the load & correct for any overload. • Check operation by disconnecting the load & restarting the genset. • Reset the threshold to the lowest allowable setting. • Check for fuel or air delivery problem.
1471 Overcurrent warning	• Check load & load cables. Repair if necessary. • Check operation by disconnecting load & restarting generator set. • Check CT ratio & CT connections.
3123 Customer Input 1 Warning	• Check input as per customer selection
3124 Customer Input 1 Shutdown	• Check input as per customer selection
3125 Customer Input 2 Warning	• Check input as per customer selection
3126 Customer Input 2 Shutdown	• Check input as per customer selection

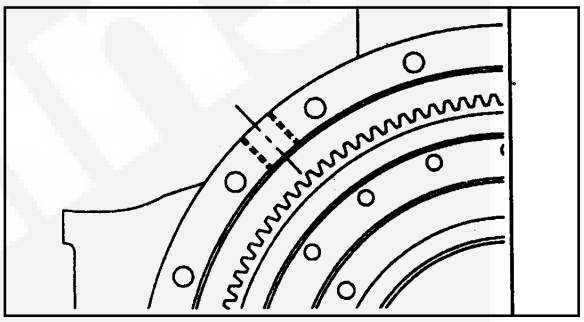
NOTES

SECTION 12 – INSTALLATION

1.0 Magnetic pick up

A magnetic pickup is an electromagnetic device. It is mounted on the flywheel housing so that the ring gear teeth are sensed by the pickup. Two pin MS connector is provided to connect the magnetic pick up to the engine harness.

The magnetic pickup is connected between pin 'B' and 'T' of engine connector through harness.



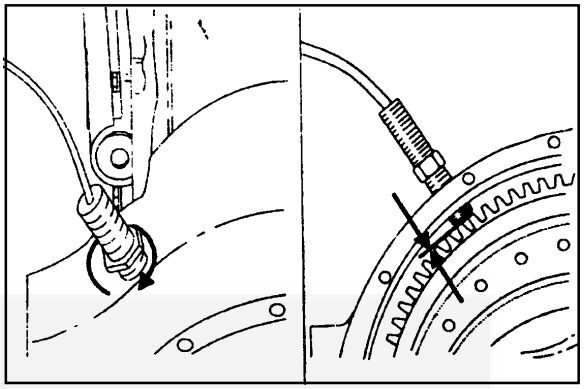
Installation:

1. Remove the magnetic pickup from the engine harness if connected. Then screw the magnetic pickup downwards till it comes in contact with a flywheel gear tooth. The tip should reach for the crest of the gear.

2. Unscrew the pickup by 1/2 - 3/4 of a turn to maintain a proper gap between pickup and flywheel tooth. Sensing distance should be between 0.71 to 1.07mm (0.028 - 0.042 inch) from the flywheel gear tooth.

   Screw the pickup all the way down until it contacts the flywheel gear tooth.

   The pickup will screw in very easy. Do not use excessive pressure to install the pickup.



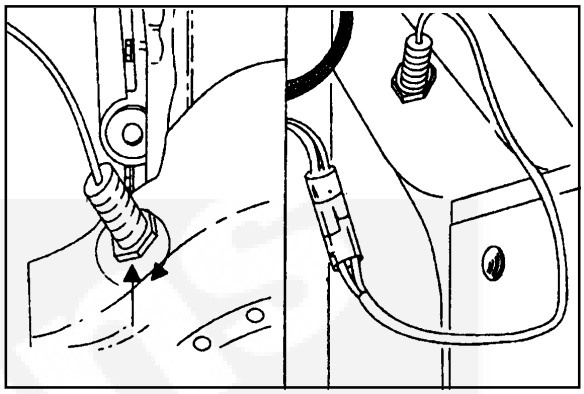
Note: If the pickup does not screw in with finger pressure, check the hole and the pickup threads. Tap the hole again, if required.

Back the pickup out 1/2 to 3/4 of a turn.

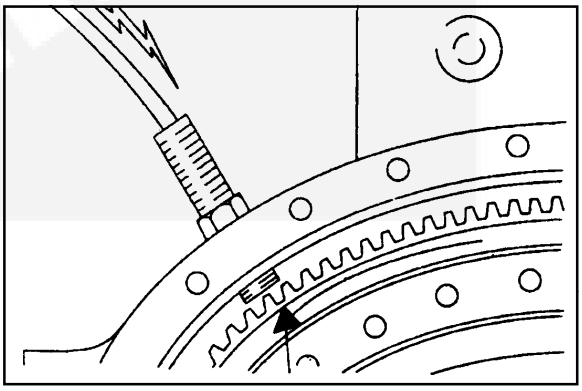
Cross check the installation with the feeler gauge between the magnetic pickup and the flywheel gear tooth, back the pickup out 0.71 to 1.07mm (0.028 to 0.042 inch) from the flywheel gear tooth.

Tighten the locknut down on the flywheel housing.

Plug the electrical connection into the Magnetic pick up connector, when required.

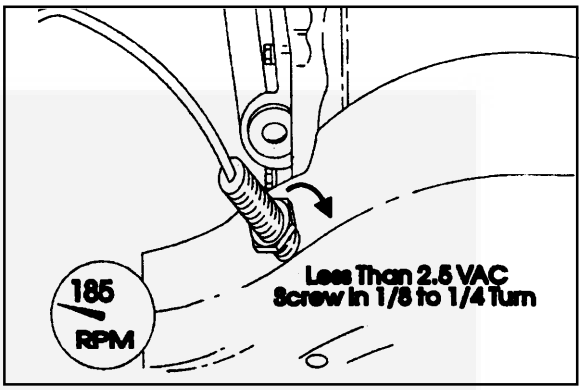


When the flywheel gear teeth pass the pickup, an A.C. voltage is induced. One cycle is induced for each gear tooth.



If the pickup signal is less than 1.5 volts A.C. when cranking the engine, screw the pickup in 1/8 to 1/4 turn.

Normally magnetic pickup, actuator housing, actuator, engine harness, PowerCom controller are mounted on the engine at the time of the shipment. However, the installation procedure for these parts is given below to aid retro fitting / replacement in field.

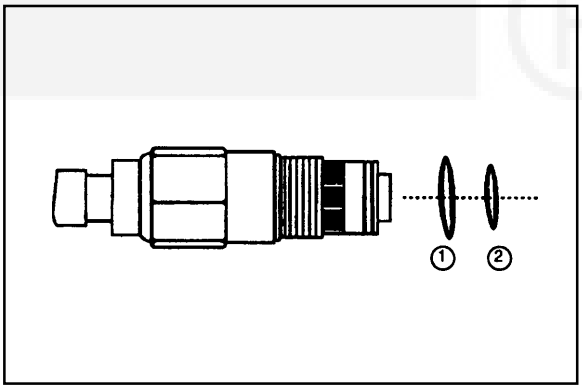


2.0 Actuator

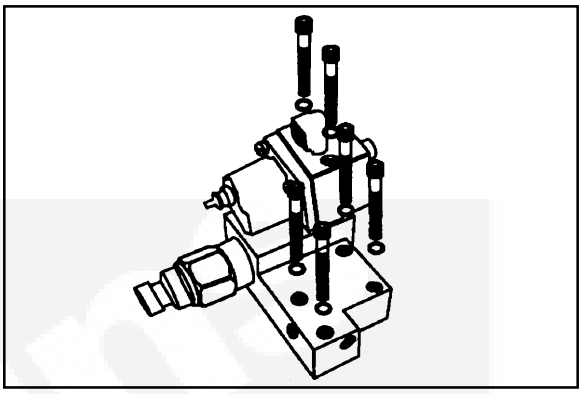
Two “O” rings are used for mounting the actuator in the housing.

1) Part number : 3865398 Seal “O” Ring

2) Part number : 3042542 Seal “O” Ring 1 2

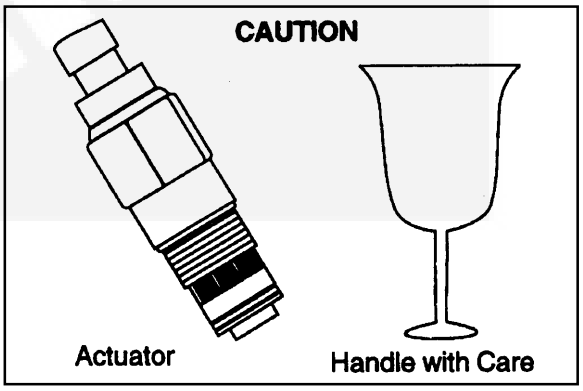


Two “O” rings and four Allen screws and washers are used to clamp the housing on the fuel pump. The actuator cable is used to connect actuator terminals to a connector in the engine harness at connector ‘A’ at pin ‘F’ & pin ‘M’.



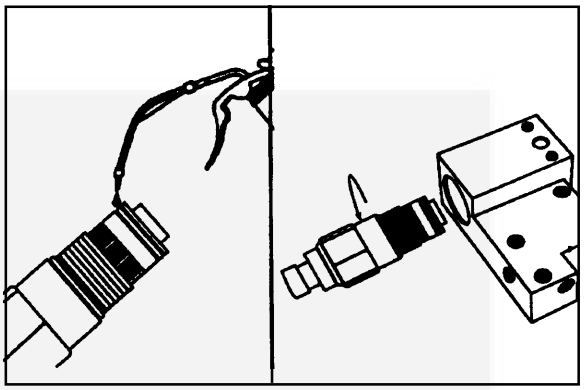
△ Caution △

Actuator is a delicate part and should be handled with care, while removing, cleaning or putting back in the housing.

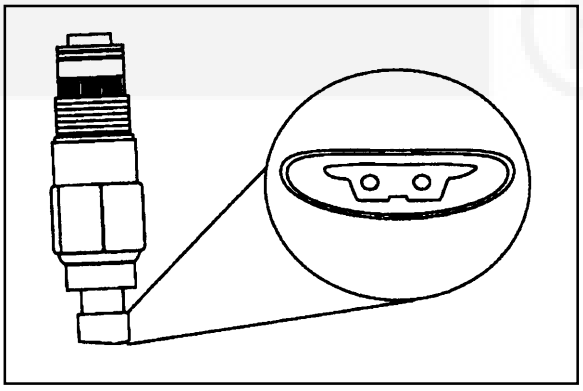


2.1 Installation

Lubricate the two-barrel “O” rings with clean engine oil. Insert the actuator in the housing and rotate it clockwise till it is inserted completely. Using a 1,1/4-inch spanner, tighten the actuator, (torque of 5.6 N•m).



Connect the connector to the actuator. The connector is “keyed”, so that it connects in one direction only.



2.4 Actuator removal from the housing

Actuator may be needed to be removed from the housing for cleaning the fuel filter, replacing or for diagnostic purpose. Remove the actuator connector. Using the 1.1/4" spanner, remove the actuator from the housing.

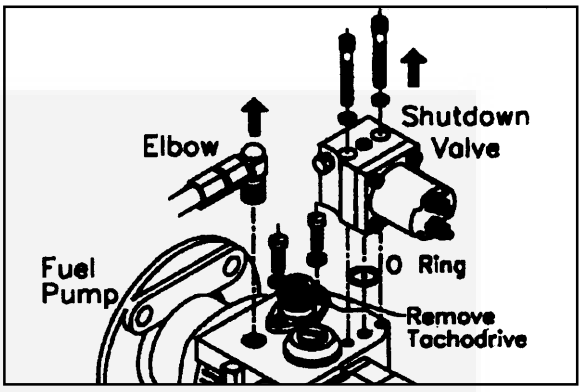
Note : Always shut off the supply to the POWERCOM by turning the key switch to “Off”, before servicing the actuator.

2.5 Cleaning the fuel Screen

There is a 10-micron fuel screen in the inlet side of the actuator; the filter screen should be periodically cleaned. Pull the two smallest fuel filter windows outwards. Hold the actuator in both the hands, with the connector pointed outwards. Pull the two fuel filter windows which are smallest outwards, the fuel filter screen opens. Clean the filter screen with shop air at pressure ~1Kg/cm2 (0.980 bar). Snap the filter back into place by pushing the filter windows together.

2.6 Actuator Housing

The actuator housing is mounted on the fuel pump as per following procedure:



Retrofitting preparation:

a) Remove the copper tube/rubber hose connecting the fuel shutoff valve to the injectors from the fuel shutdown valve side.

b) Remove the shutdown valve with the “O” ring.

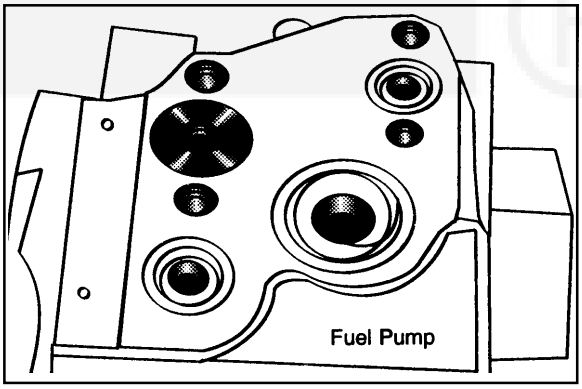
c) Remove the fuel pump return line along with the elbow, if used.

d) Remove the tacho drive, if it is on the top of the pump.

e) Plug it with an aluminum plug.

f) Clean the top of the fuel pump. The fuel pump is ready for mounting the actuator housing.

Note: In case of retrofitting, the fuel pump needs recalibration along with the actuator housing, using proper code for calibration.



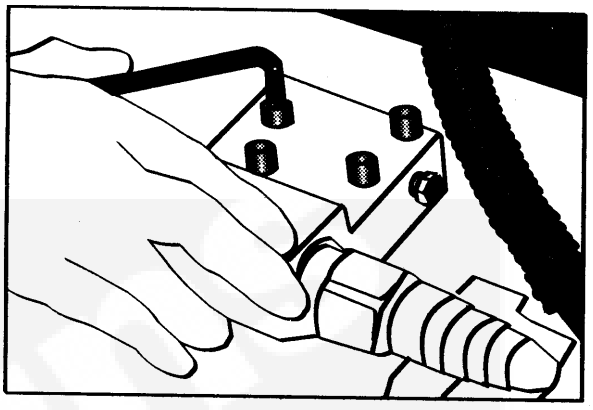
1. Place the actuator housing with two “O” rings, these “O” rings act as a face seal in fuel outlet and fuel return path respectively.

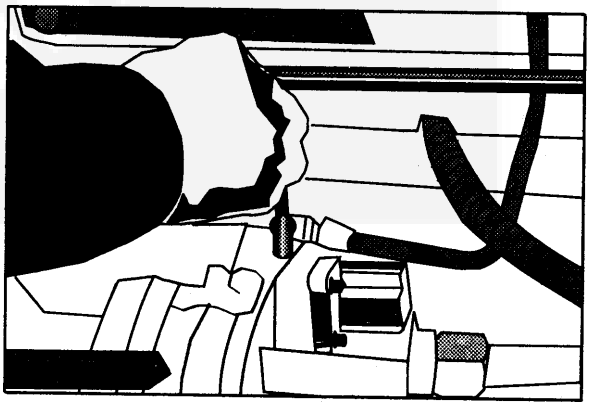
2. Clamp the housing on the fuel pump using four Allen screws. Torque of 5.6 N•m (50.4 in-lb) should be given.

3. Mount fuel shutoff valve on the actuator housing as per standard procedure.

4. Connect the fuel pump return line on the actuator housing.

5. Connect the copper tubing going to injectors from the fuel shut off valve.





3.0 PowerCom Controller

Normally all PowerCom controllers are mounted on a stand either inside or outside the acoustic enclosure.

The controller should be mounted such that the front and rear sides are accessible and convenient for any kind of adjustment and connections. The mounting place should be such that, the cable routing length is not more than the length of the extension cable provided.

The mounting location should be such that the controller is not directly exposed to Sun, heat, humidity, water while in operation.

The controller is mounted as shown in the figure.

⚠ Warning

To avoid personal injury, or death, it is important that all electrical equipment be properly bonded or grounded. All metallic parts that could become energized under abnormal conditions must also be properly bonded or grounded.

Section – 13 APPENDIX

APPENDIX - A

OPERATING, ELECTRICAL & ENVIRONMENTAL SPECIFICATIONS

Operation

Governor Mode	Isochronous to 6% Droop (G2 class of governing)
Governor Gain Adjust	0.9 to 1.1
Frequency Adjust Range	±4Hz

Power

Nominal Operating Voltage	+24VDC
Operating Voltage Range	+20 to +32VDC
Maximum Continuous Voltage	+32VDC
Ground Polarity	Negative Ground
Nominal Operating Current	1.5A @ +24VDC
Maximum Operating Current	4.5A @ +18VDC
Sleep Mode Operating Current	100mA (nominal)
Ready Mode Operating Current	850mA (nominal)

[PowerCom On & Engine Not Running]

Environmental

Ambient PowerCom Housing Operating Temp	0° to 60°C (0° to140°F)
Storage Temperature	0° to 60°C (0° to140°F)
Vibration Limits	20-100Hz, 93.6mm/sec:

Physical

Dimensions (Including Heat Sink)	267 mm (L) x 377 mm (H) x 157mm (D)
excluding mounting brackets)	(12.34 x 10.37 x 4/64”)
Weight	2.53 kg (5.596 lbs.)
Housing Enclosure	Glass Filled Plastic

Protection

Reverse Polarity Protection	+28VDC Maximum

Electrical Interface Characteristics

Lamp/Relay Driver Supply

Supply Voltage	+12VDC Nominal @ 80 mA

Analog (Adjustable) Inputs

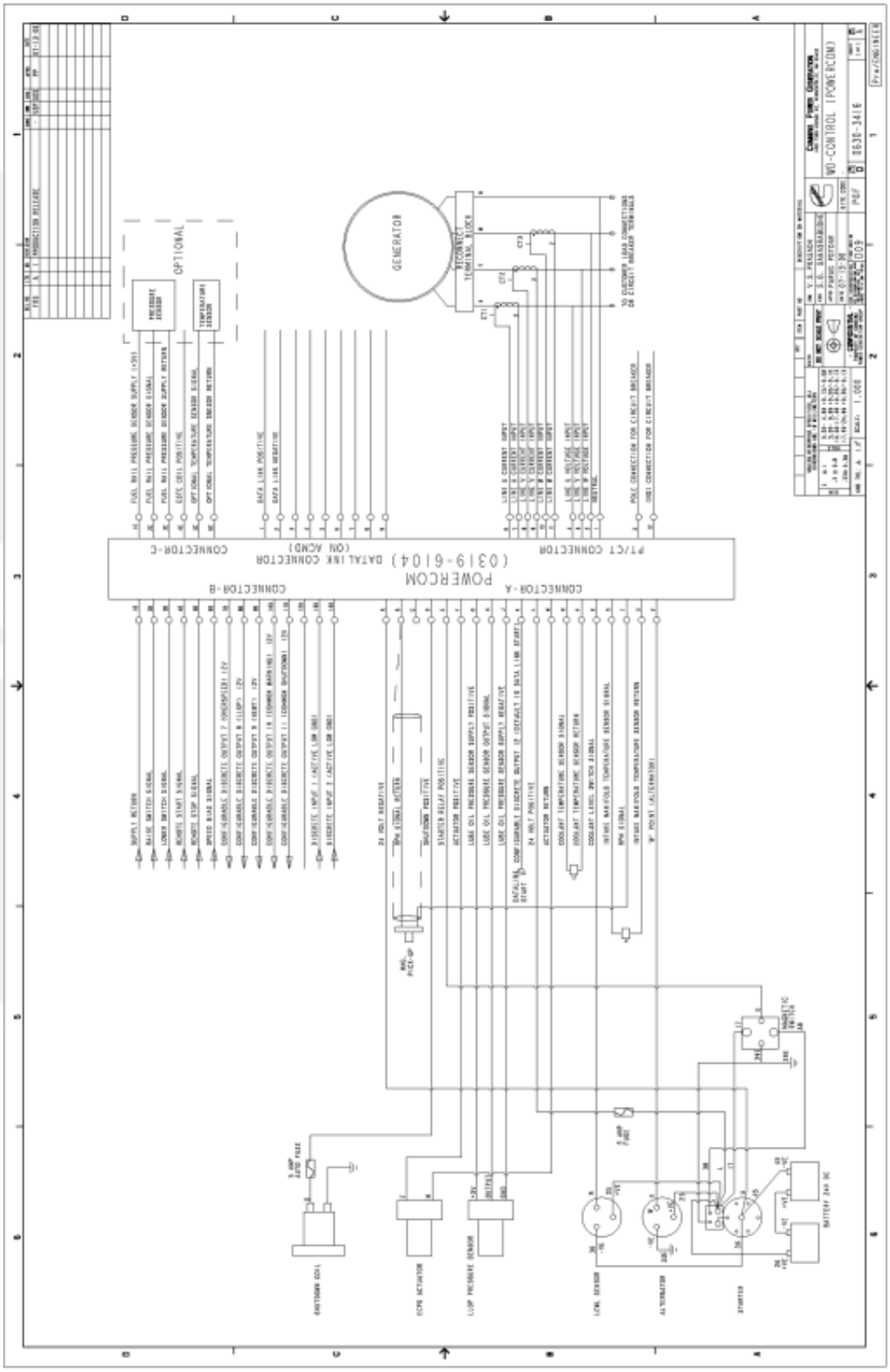
Nominal Input Voltage Adjustment Range	0-5VDC
Maximum Input Voltage	5VDC

Speed (Frequency) Bias Reference & Voltage Supply

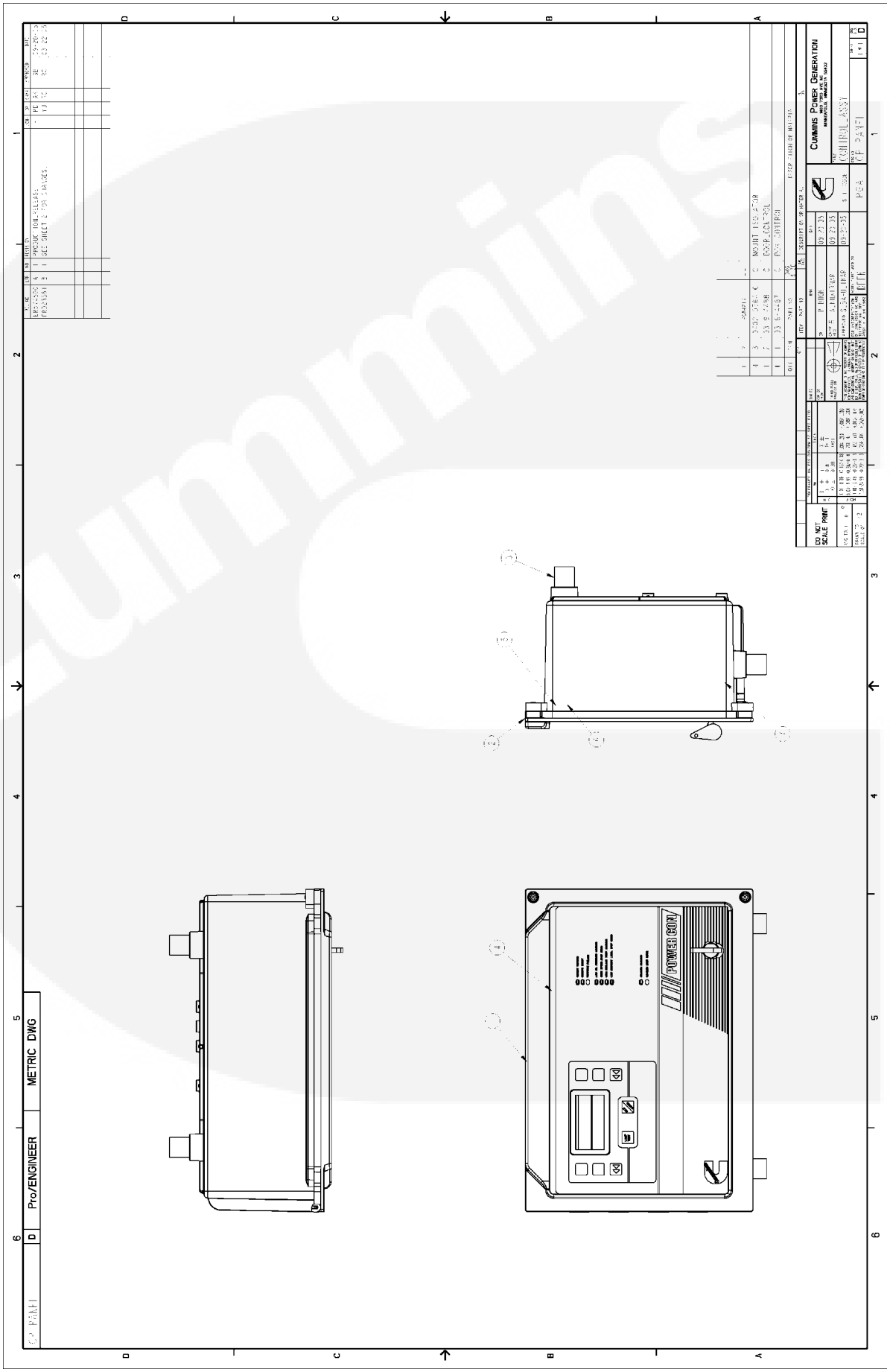
0-5 VDC Reference Voltage	+5VDC

APPENDIX-B

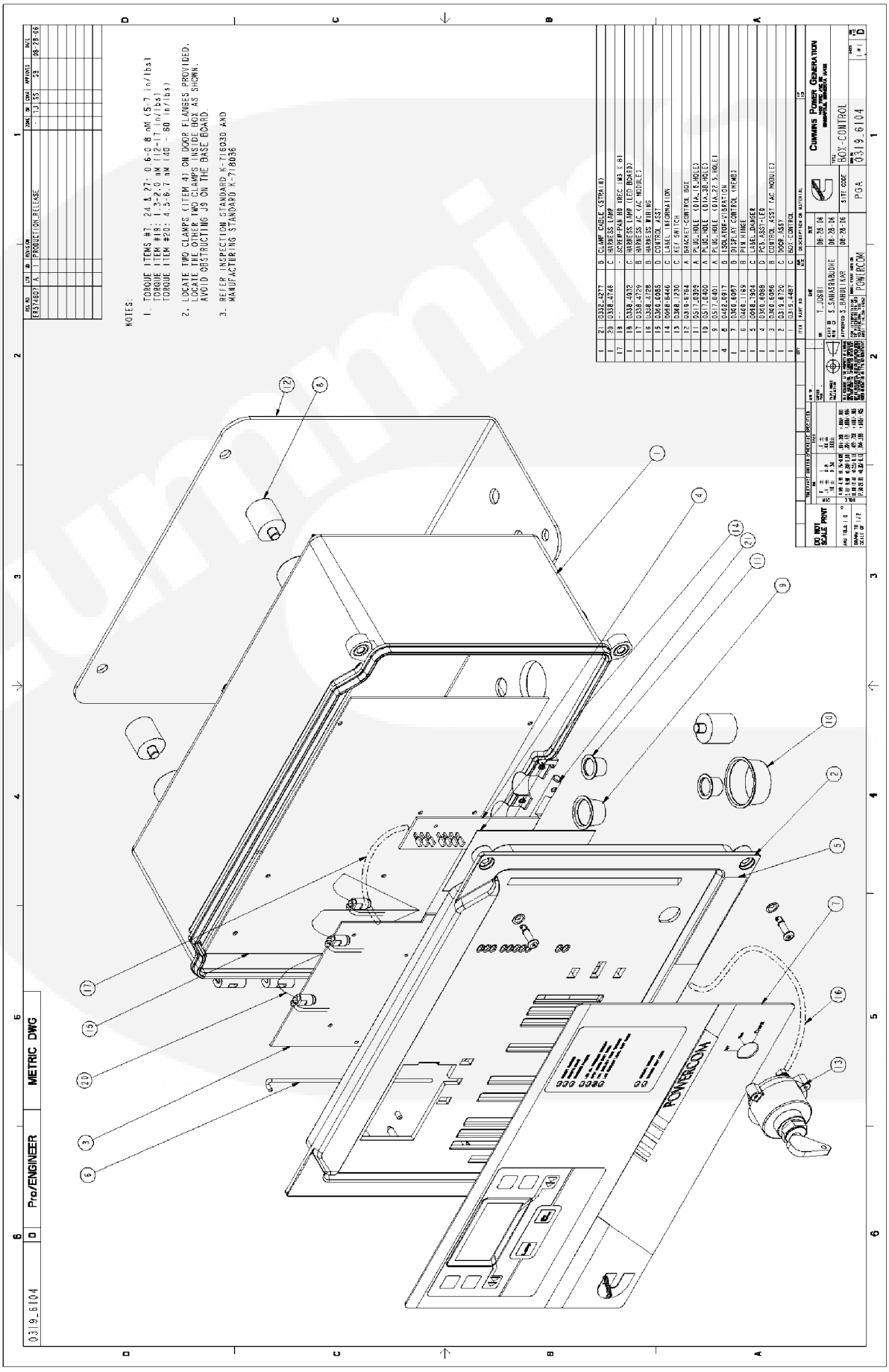
Electrical Wiring Diagram



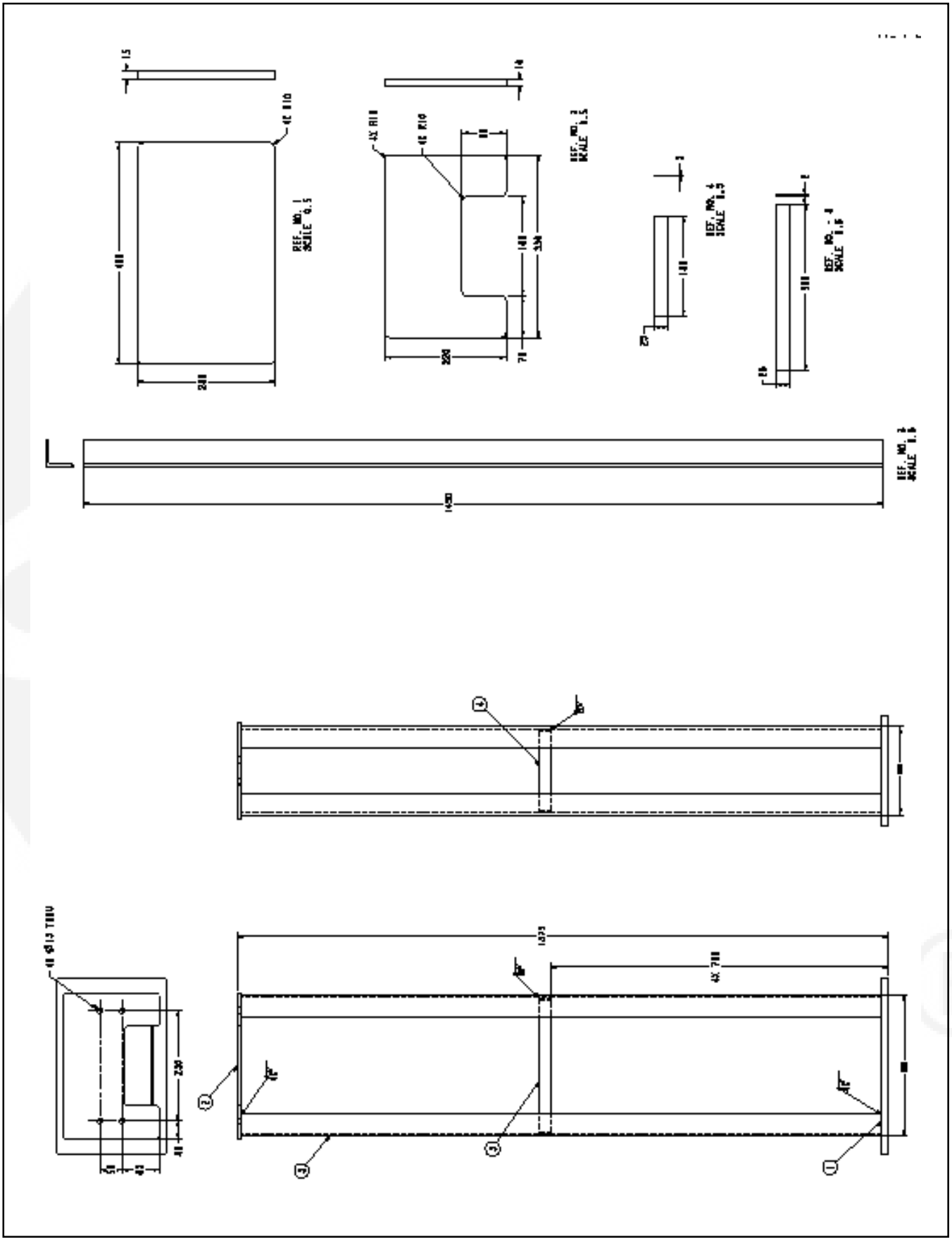
Overlay Diagram



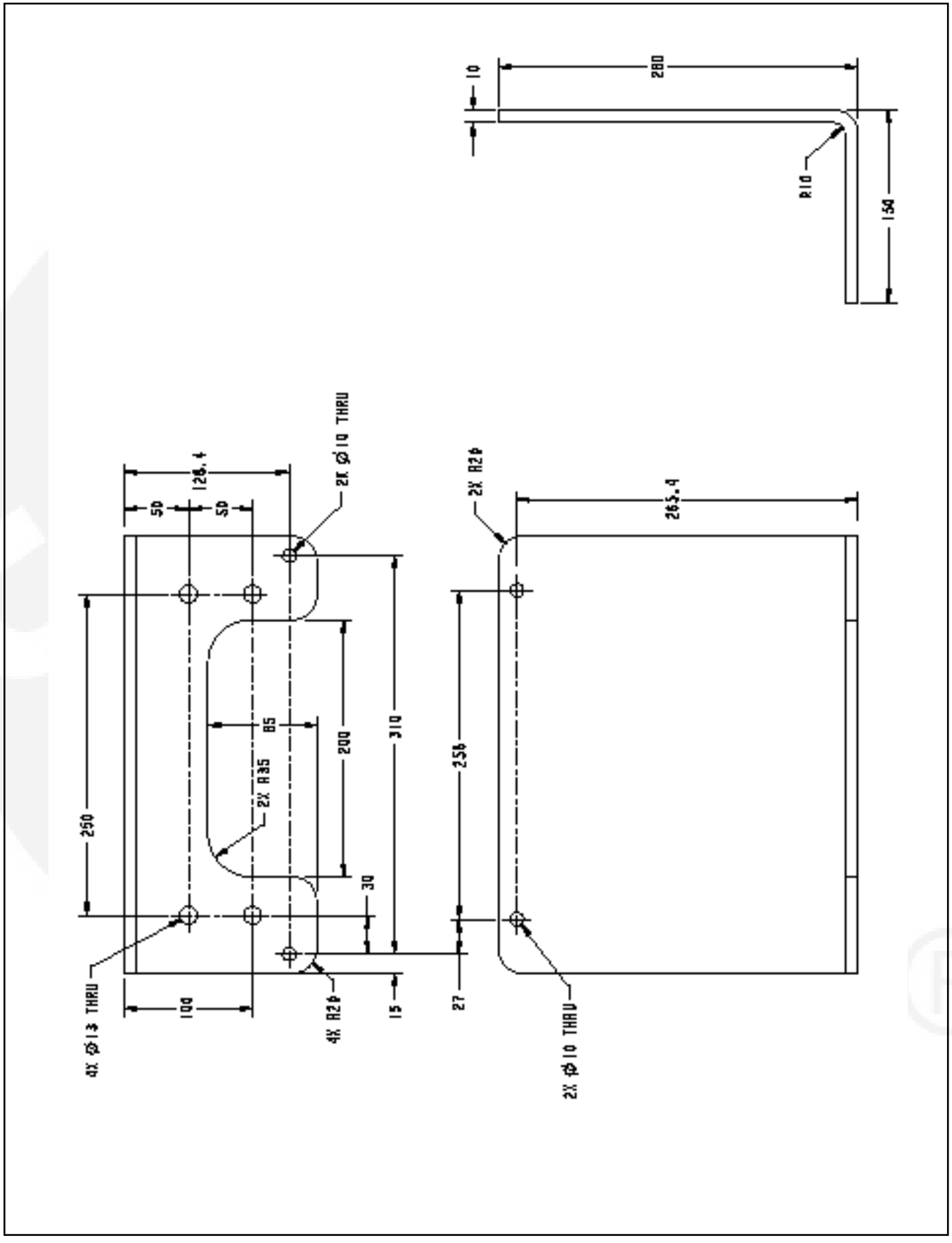
Panel Assembly Diagram



PowerCom Support Diagram



Panel Support Diagram



APPENDIX - C

SENSOR SPECIFICATIONS

Engine Speed Sensor
Torque = 34 to 47 N•m [25 to 35 ft-lb]
Coil Resistance = 750 to 1600 ohms

Oil pressure sensor
Torque = 14 N•m [124 in-lb]

Pressure (kPa)	Pressure [psia]	Voltage (VDC)
0	0	0.5
207	30	1.5
414	60	2.5
621	90	3.5
827	120	4.5

All Temperature Sensors
Torque = 15 N•m [133 in-lb]

Temperature (°C)	Temperature (°F)	Resistance (ohm)
0	32	30k to 36k
25	77	9k to 11k
50	122	3k to 4k
75	167	1350 to 1500
100	212	600 to 675

APPENDIX – D

List of replacement parts

Sr. No.	Part name	Part Number
Controller Assembly		
1	PowerCom Assembly	0319-6104
2	Key switch	504975
3	Vibration Isolator	0402-0764
4	Mounting stand	0319-6105
5	Base Board	0300-6085
6	Control-Assembly (AC Module)	0300-6086
7	Display-Control (LED Board)	0300-6088
8	C View Kit	4084236
9	Display Membrane	0300-6087
10	Harness-AC (AC Module)	0338-4729
Sensors		
1	Coolant temperature sensor	3865346
2	Intake manifold temperature sensor	3408345
3	Lube oil pressure sensor	3408560
4	Coolant level sensor	4072714
5	Adapter for Coolant temperature sensor	4053490
6	Adapter for Air intake temperature sensor	4053490
7	Magnetic pick up	3875360
8	Lube Oil Pressure sensor adaptor (V 28 engine)	4104562
9	Lube Oil Pressure sensor adaptor (495, 743, 855 series engines)	3814448
Actuator and Actuator housing		
1	Fuel Actuator with O ring	3330601
2	Fuel actuator housing	4071944
3	Fuel actuator filter screen	3867393
4	Fuel actuator ‘O’ rings (1)	3865398
5	Fuel actuator ‘O’ rings (2)	3042542

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Please check the appropriate boxes, add any suggestions or comments, and mail postage paid form.

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Is the information easy to understand ?	_____	_____
Does the information sufficiently cover the subject ?	_____	_____
Are subjects in the Index specific enough to locate in the manual ?	_____	_____
Are the important points sufficiently emphasized ?	_____	_____
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