EMS372

GCU/3AS

Genset Controller

User Manual

This document applies to:	9001-0104
Build version	3600-0168
Firmware Version	5000-0046 (V3.G.3D)

Version History:

S. No.	Version No.	Changes Made	Date Modified	Modified By	Approved By
1					
2					
3					

www.ems.gen.nz

EMS
FUTURE ELECTRONICS LIMITED
PHONE: +6498184726, ADDRESS: 5C, WESTECH PLACE, KELSTON AUCKLAND – 0602, NEW ZEALAND

Contents

EMS372
Genset Controller

1. Introduction

The EMS372 is a custom designed controller gensets sold in the private market segment.

The unit incorporates both manual ,autostart and AMF(Automatic Mains Failure) initiated start and stop sequencing, monitors engine and alternator operating parameters and provides both engine and alternator protection, in a single integrated package.

The genset operating parameters are shown by scrolling screens on a backlit 16 Character by 2 line LCD. Alarms and warning are also shown on the LCD and supplemented by an alarm LED and Hooter output. The unit has provided Passwords for security purposes.

The unit provides comprehensive monitoring of the engine and generator operating parameters and provides automatic shutdown of the set in the event of damaging conditions. In addition to the usual engine safety protections the unit monitors water level, fuel level, engine temperature, canopy temperature, oil pressure its supports perheat and generator loading to provide even more comprehensive protection.

The unit incorporates an Event Log (20 events)and a Stop Alarm Log (40 events) to give the field service engineer the operational history and alarm history for easier diagnostics.

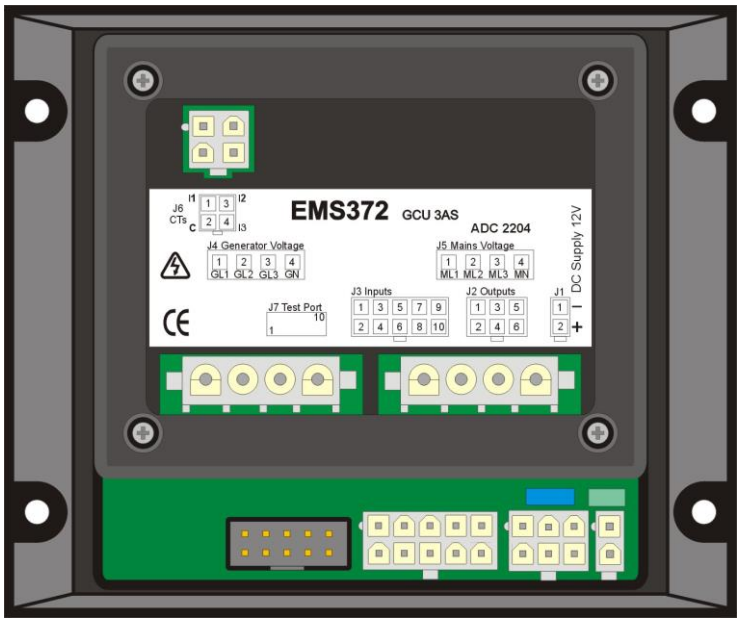
In the factory environment, the unit is configured by cloning through a PC system. Field specific parameters can be adjusted by using the front panel buttons and an inbuilt menu system.

2. Benefits

- Reduces system cost:
    - Integrates engine gauges and AC metering into one unit.
    - Minimises control panel wiring offering reduced material and labour costs.
- Reduces warranty costs by providing comprehensive engine and generator protection and a maintenance due timer.
- Flexible, the unit can be customised by PC cloning for individual genset model characteristics and fitments.
- Includes communications port for remote monitoring applications or dual station operation.

3. Physical Form

Front View



Back View

4. Functions

4.1 System

Function	Description
Protection Shutdown	Automatic preventative engine and genset shutdown in the event of abnormal operating conditions with optional configuration parameters and clear LCD status messages
Manual Start	In response to the front panel pushbutton performs a fully sequenced engine start with optional configuration parameters and clear LCD status messages
Manual Stop	In response to the front panel pushbutton performs a fully sequenced engine stop with optional configuration parameters and clear LCD status messages
Auto Start	In response to a digital input performs a fully sequenced engine start with optional configuration parameters and clear LCD status messages
Auto Stop	In response to a digital input performs a fully sequenced engine cool down then stop with optional configuration parameters and clear LCD status messages
AMF Start	In response to a mains failure event performs a fully sequenced engine start with optional configuration parameters and clear LCD status messages
AMF Stop	In response to a mains restored event performs a fully sequenced engine stop with optional configuration parameters and clear LCD status messages
Manual Transfer Control	Manually initiated and automatically sequenced A and B contactor control with optional configuration parameters and clear LCD status messages
Emergency Stop	In response to a digital input performs a fully sequenced engine stop with optional configuration parameters and clear LCD status messages
Automatic Transfer Control	Automatically initiated and sequenced A and B contactor control with optional configuration parameters and clear LCD status messages

4.2 Engine Monitoring

Function	Description
Lubrication Oil Pressure	Monitors engine oil pressure with optional configuration parameters and clear LCD status messages this ensures the oil

	pressure remains within configured limits. Exceeding these limits will result in automatic engine shutdown to prevent damage.
Oil Temperature	Monitors engine oil temperature with optional configuration parameters and clear LCD status messages this ensures the engine temperature remains within configured limits. Exceeding these limits will result in automatic engine shutdown to prevent damage.
Engine Temperature	Monitors engine temperature with optional configuration parameters and clear LCD status messages this ensures the engine temperature remains within configured limits. Exceeding these limits will result in automatic engine shutdown to prevent damage.
Battery Voltage	Monitors engine battery voltage with optional configuration parameters and clear LCD status messages this ensures the battery voltage remains within configured limits.
Battery Charging	Monitors engine battery charging status and clear LCD status messages this ensures the battery is charged when the engine is running.
Radiator Water Level	Monitors engine radiator water minimum level with clear LCD status messages this ensures the radiator water level remains sufficient. Low water will result in automatic engine shutdown to prevent damage.
Fuel Level	Monitors engine fuel level with clear LCD status messages. Low fuel level will result in automatic engine shutdown to prevent damage.
Canopy Temperature	Monitors engine canopy temperature with optional configuration parameters and clear LCD status messages this ensures the engine canopy temperature remains within configured limits. Exceeding these limits will result in automatic engine shutdown to prevent damage.
Running Hours	Records engine run hours with clear LCD status messages.

4.3 Generator AC Monitoring

Function	Description
AC Phase Voltage	Monitors 1, 2 or 3 phases of AC voltage with optional configuration parameters and clear LCD status messages.
AC Phase Current	Monitors 1, 2 or 3 phases of AC current with optional configuration parameters and clear LCD status messages. ***Uses externally uses shunts.***
AC Phase Frequency	Monitors 1, 2 or 3 phases of AC Frequency with optional

	configuration parameters and clear LCD status messages.
AC Phase Reversal	Monitors Genset AC for Phase reversal with optional configuration parameters and clear LCD status messages.
AC Loading	Monitors AC load as a percentage of full load with optional configuration parameters and clear LCD status messages.
AC Power Metering	Monitors AC power output (KW, KVA, KVAR, KWH) with optional configuration parameters and clear LCD status messages.

4.4 Mains AC Monitoring

Function	Description
AC Phase Voltage	Monitors 1, 2 or 3 phases of AC voltage with optional configuration parameters and clear LCD status messages
AC Phase Frequency	Monitors 1, 2 or 3 phases of AC frequency with optional configuration parameters and clear LCD status messages
AC Phase Reversal	Monitors Mains AC for Phase reversal with optional configuration parameters and clear LCD status messages
Automatic Mains Failure (AMF)	Monitors AC failure with optional configuration parameters and clear LCD status messages

4.5 System LED Indications

Function	Description
Alarm	Red LED indication of system alarm.

4.6 System LCD Displays

Function	Description
Setup menu	System configuration menus
Start Up	Clear step-by-step start up sequencing messages
Shutdown	Clear step-by-step shutdown sequencing messages
Transfer	Clear step-by-step load transfer messages

4.7 Engine LCD Displays

Function	Description
Low oil pressure	Engine oil pressure low

High oil temperature	Engine oil temperature high
High engine temperature	Engine temperature high
Low coolant level	Radiator water level low
Low fuel level	Engine fuel level low
High canopy temperature	Engine canopy temperature high
Engine Hours	Total Engine Hours Total Engine Starts

4.8 Genset LCD Displays

Function	Description
Phase Voltages	Phase 1, 2 and 3 Voltages
Phase Currents	Phase 1,2 and 3 Currents
Phase Frequencies	Phase 1,2 and 3 Frequencies
Phase Reversal	Phase 1,2 or 3 Reversed
AC Power Metering	Monitors AC power output (KW, KVA, KVAR, PF. KWH) with optional configuration parameters and clear LCD status messages.
Overload	Genset overloaded

4.9 Mains AC LCD Displays

Function	Description
Phase Voltages	Phase 1, 2 and 3 Voltages and L1-L2, L2-L3, L3-L1
Phase Frequencies	Phase 1, 2 and 3 Frequencies

4.10 AC Inputs

Function	Description
3 Phase Genset AC Voltage	Genset AC voltages.
3 Phase Genset Current	Genset AC currents via external shunts.
3 Phase Mains AC Voltage	Mains AC voltages.

4.11 Analog Inputs

Function	Description

Lubrication Oil Pressure	Engine oil pressure.
Engine Temperature	Engine coolant temperature (Air or Water).
Radiator Water Level	Engine radiator water level.
Fuel Level	Engine fuel level.
Oil Temperature	Engine oil Temperature
Canopy Temperature	Engine canopy temperature.

4.12 Digital Inputs

Function	Description
Auto Start / Stop Input	Auto start.
Emergency Stop Input	Emergency engine stop.
Oil Switch Input	Oil Pressure Switch sensor.
User Input	User Defined Input.

4.13 Special Inputs

Function	Description
Battery Voltage	Internal measurement of incoming DC supply.
Excitation Voltage	Internal measurement of battery charging alternator excitation voltage.
Low Water Level	Oscillating, AC coupled, Zero net current flow.

4.14 Digital Outputs

Function	Description
Excitation Output	Alternator excitation control and feedback.
Fuel Output	Open drain fuel solenoid control.
Crank Output	Open drain engine crank control.
Configurable OP2	Configurable from the menu item Refer to section of Setup items for available options
Configurable OP3	
Configurable OP1	

5. Operation

Front Layout

5.1 Buttons

Button	Function Description
	**Start button / Menu Previous** Used to initiate generator start sequence Used as system menu previous or value down button
	**Stop button / Menu Next** Used to initiate generator stop sequence Used as system menu next or value up button
	**Up button / Menu Up** Used as system menu scroll up button
	**Down button / Menu Down** Used as system menu scroll down button

5.2 LEDs

Button	Function Description
Alarm 	**Alarm** Indicates system alarm

5.3 Password Access

The unit requires a password before allowing the user to access Setup Menu items. There are different passwords for Installation, Servicing and Factory level.

5.4 Initial Power Up

On power up, the unit displays Logo.

The unit then displays the Serial number, Application Code and Firmware version.

After the initialisation process is complete, the unit waits for a Start request (Start Button or Auto Start Input), during which time it will display 'READY'.

5.4.1 Ready

When the unit is in READY all measuring systems and display systems are turned on. The unit remains on for 1 minute and if the genset is not started in that time the unit goes into sleep mode to conserve battery power. In this mode the unit wakes periodically to check for any unusual conditions and if it finds none it goes back to sleep, otherwise it alarms accordingly.

Any activity on the buttons immediately wakes the unit and the appropriate action is taken.

Pressing the STOP button while the unit is asleep immediately wakes the unit and scrolls all engine and generator parameter screens. This allows reading of battery voltage, fuel level, and run hours KWH etc.

5.4.2 Mode Selection

When the unit is in READY the user can select one of 3 modes can be selected by pressing the UP button

- **Manual :** Only the Front panel Start and stop buttons can start and stop the engine
  - The Auto Start input is ignored
- **Auto:** Only the Auto Start input can start the Engine
  - The Manual Start and Stop buttons are ignored
- **Test :** Then engine is started simular to Manual mode but the contactors are not changed

In any mode the engine can be stopped with the Stop button.

5.5 Manual Operation

5.5.1 To start the genset

When the display is showing READY, press the start button momentarily to start the genset. The READY state implies the engine and generator parameters are as expected for a stationary genset. If the conditions are not as expected, an appropriate warning or alarm is displayed on the LCD. The warning or alarm condition must be cleared before the genset can be started.

The unit will perform the starting sequence as follows:

- PREHEAT

- If PREHEAT is selected then the PREHEAT Output will activate for the time specified

- FUEL-ON.
  - If ETR (Energise To Run) fuel control is configured, the unit will control the fuel output and display FUEL ON and the proceeds to the CRANK state.
  - For ETS (Energise To Stop) the sequence does not activate the output but proceeds immediately to the CRANK state.

- CRANK.
  - The crank output is activated and the display shows 'Cranking' with a count down time.
  - The crank output is deactivated when the unit has detected a speed signal above the crank disconnect speed specified in the settings, or has detected oil pressure above the minimum oil pressure specified in the settings or Excitation is present
  - If the genset does not start, the LCD will show 'Stopping', control the Fuel and Crank outputs accordingly, and return to READY. No retries are done.
  - If the unit looses power due to battery voltage drop during cranking, and the engine fires, then on regaining adequate battery voltage, the unit will continue to allow the engine to run.

- RUN UP.
  - When the engine starts, the display shows 'Run Up' with a count down in seconds. This allows the engine measurement system to stabilise. Over speed and loss of speed signal are the only parameters checked during Run Up.

- WARM UP
  - Allows the engine to stabilise at full speed before going on load. Oil pressure and Over-speed are monitored. The display shows 'Warm Up' with a countdown time.

- RUNNING
  - The display shows 'RUNNING'. Operating parameters are scrolled onto the display.

5.5.2 To stop the genset

Push the stop button briefly.

The unit will perform a stopping sequence as follows:

- STOPPING
  - The display will show 'Stopping' with a countdown time.
  - If ETR fuel control has been selected the Fuel output will be de-energised.

- If ETS fuel control has been selected then the Fuel output will be energised for the Max Fuel Time or until the engine stops. The stopping process will retry if the engine fails to stop the first time. During the 'ETS Rest period' the Fuel output is deactivated.
- The fuel output is controlled until the engine stops rotating and oil pressure decays. If the Oil Pressure has not decayed by the end of the 'Max Fuel Time', the fuel output is deactivated and the controller waits until the oil pressure has decayed, or for the remainder of the 'Stop Time'. The speed must remain at zero and the oil pressure must be below the alarm set point for the 'Stop Rest Time' before the engine is considered stopped.
- If the genset does not stop then the alarm output is activated and 'STOP FAIL' is displayed on the LCD.

- READY
  - The engine has stopped and is ready to start again as required.

6. Automatic Operation

If the Autostart input is activated, the unit will initiate an Autostart sequence. The sequence is similar to the manual start and stop sequences above with the following additions.

- An adjustable Start Delay follows the Autostart input activation. This is usually configured to avoid nuisance starting. The Display shows "Starting" with a countdown value. For long start delays, the start time units may be set to minutes. If the autostart restores for more than the Start Restore time, then the start sequence is aborted.
- The unit cranks the engine for the crank time or until the engine fires. If the engine does not fire after the crank time, then the unit will repeat the crank procedure after waiting for the crank rest time. This cycle is repeated for the "Crank Retries" and if the engine has not started after the last cycle, a "Fail to Start" alarm is generated.
- The Start sequence now follows the manual starting sequence until the engine is running.
- During an Autostart run the LCD displays Auto in the top left of the display.

The stopping sequence is initiated by deactivation of the autostart input. The engine does not stop immediately as there are three additional states in the Auto stopping sequence.

- "Run On" follows "Running" and is a provided as an adjustable delay to reduce nuisance stopping. The Contactor A & B Outputs remain activated and the Display shows "Run On" with a countdown value. If the autostart input is re-activated during "Run On" the unit returns to normal "Running" until the Autostart input is deactivated.

- "Cool Down" follows "Run On" and allows the engine and/or generator to cool down before stopping. The cool time is adjustable. At the start of "Cool Down" the Contactor A & B Outputs are deactivated, transferring the load to the mains. The display shows "Cool Down" with a countdown. If the autostart input is re-activated during "Run On" the unit returns to normal "Running" and Contactor A and B are activated.

Pressing the Stop button in auto mode stops the engine immediately, deactivates the Contactor A & B Outputs, and changes the mode of the unit to Manual.

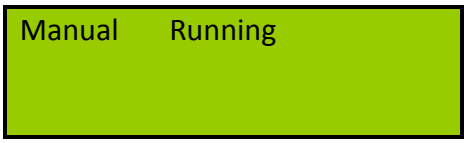
7. Display Operation

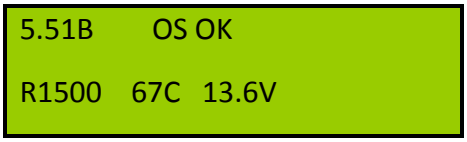
7.1 When the genset is ready

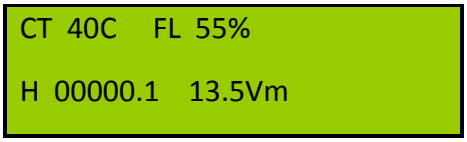
7.2 When the genset is running

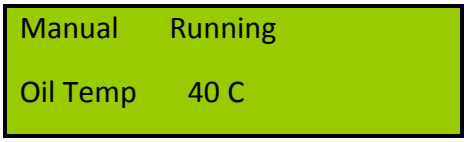
When the genset is starting and stopping, the display shows the state of the sequence together with the time remaining before the next state will commence.

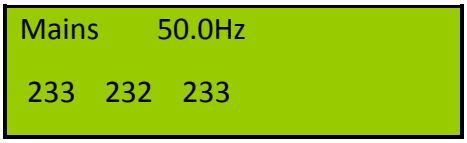
Once the genset is fully running or if the genset is stopped and in 'READY', the running parameters are displayed. This includes generator and engine parameters simultaneously on separate displays. The unit sequentially scrolls through screens as shown below:

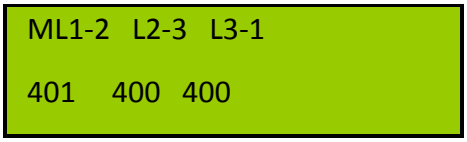


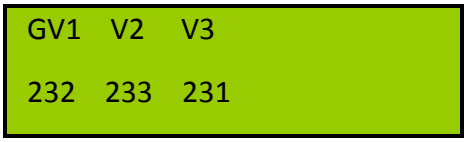


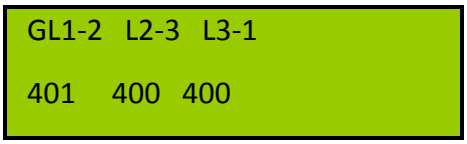


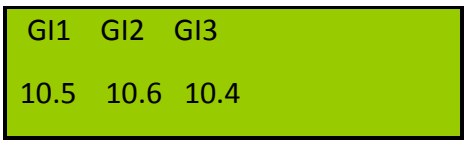


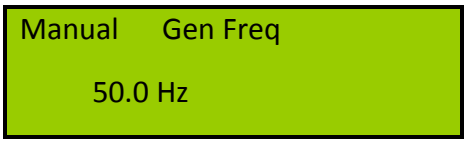

Mains 50.0Hz
233 232 233

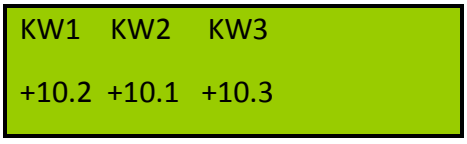

ML1-2 L2-3 L3-1
401 400 400

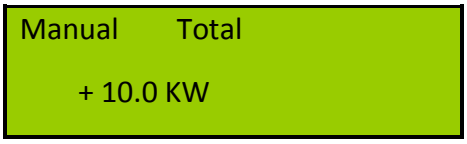

GV1 V2 V3
232 233 231

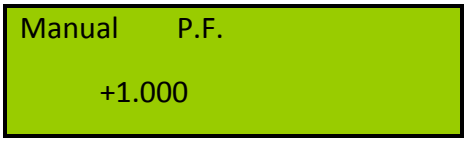

GL1-2 L2-3 L3-1
401 400 400

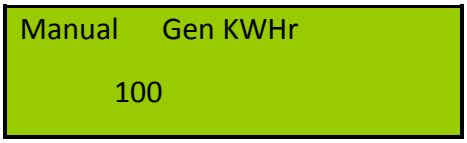

GI1 GI2 GI3
10.5 10.6 10.4

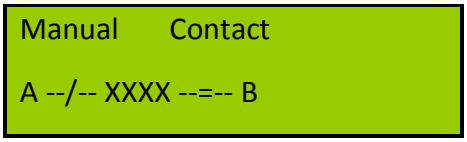

Manual Gen Freq
50.0 Hz


KW1 KW2 KW3
+10.2 +10.1 +10.3


Manual Total
+ 10.0 KW


Manual P.F.
+1.000





Then Returns to the first screen

If warnings are present, the associated messages are included in the scroll list, and are interleaved with each status display. A typical Warning will display is as follows:

OR

8. Alarms and Warnings

In the event of abnormal operating conditions the unit will issue a warning or an alarm and shut the genset down as required. The LCD shows an appropriate message indicating the nature of the condition. To draw operator attention to the condition the flashing general alarm LED is used.

In most cases, Warnings do not stop the genset and are self-resetting. Alarms will normally stop the genset and require the operator to clear the alarm by pressing the Stop or Accept button. The genset cannot be started if an alarm exists.

Warnings are indicated by slow flashing of the alarm LED and displaying the appropriate message on the LCD as follows.

Message	Function description
Oil Pressure Low	The oil pressure is below the warning setpoint
Engine Temp High	The engine temperature is above the warning setpoint
Canopy Temp High	The canopy temperature is above the warning setpoint
Low Fuel	The Fuel Level is below the warning setpoint
Battery Volts Low	The battery volts are below the warning setpoint
Battery Volts High	The battery volts are above the warning setpoint
Battery Charge Fail	The battery is not being charged correctly
Auto Start On	The Autostart input is active when the unit is not in auto mode
Maintenance	Engine maintenance is due. The engine has run for longer than the maintenance time. A message is also displayed every 5 seconds on the

	LCD. Once the maintenance timer has expired, pressing the ⚠ button for 30 seconds will reset it.
Minus Current Lx	Minus current indicates that the current measured on Lx (x being 1,2 or 3) is reversed. This is probably due to reversed CT wiring or importing power.
Overload Active	The overload output is active.

Alarms are indicated by fast flashing of the alarm LED and displaying the appropriate message on the LCD.

Message	Function description
Oil Pressure Low	The oil pressure went below the alarm setpoint while running. Check oil level and replenish. Check for blocked oil filter.
Engine Oil Temp High	The engine oil temperature went above the alarm setpoint while the engine was running. Check for over loading. Check cooling air flows, Check coolant level.
Engine Temp High	The engine temperature went above the alarm setpoint while the engine was running. Check for over loading. Check cooling air flows, Check coolant level.
Canopy Temp High	The Canopy Temperature went above the alarm setpoint. Check cooling air flows. Check for overloading.
Fuel Level Low	The Fuel Level is below the alarm setpoint. The engine is stopped to prevent air and dirt infiltration to the engine. Replenish the fuel.
Battery Voltage High	The battery voltage went above the setpoint. High battery voltage usually indicates that the battery charging alternator has failed and it is producing a voltage which might damage the battery, control relays or the controller. Engine shutdown is recommended to minimise the risk of damage and fire.
Hirev Alarm	The speed signal indicates the engine is grossly over speed. Check Governor system.
Coolant Level Low	The radiator water level is below the required level. The water level needs topping up.
Start Fail	The engine has failed to start. Check Fuel supply, check battery condition, check air filters.

Stop Fail	The engine has failed to stop. Check stop solenoid, check rack operation.
Oil-P Fault	The Oil Pressure sensor system is not functioning as expected. Check oil pressure sensor and associated wiring.
Eng-T Fault	The Engine Temperature Sensor is not functioning as expected. Check engine temperature sensor and associated wiring.
Can-T Fault	The Canopy Temperature Sensor is not functioning as expected. Check the canopy temperature sensor and associated wiring.
Fuel-L Fault	The Fuel Level Sensor is not functioning as expected. Check the Fuel Level Sensor and associated wiring.
Oil Detected	Oil Pressure is unexpectedly present. Check the Oil Pressure Sensors and associated wiring. Check the Oil filter system is not blocked. Check the engine is not running with a failed speed sensing system.
E-S Lock-out	The emergency stop input has been activated. Deactivate the emergency stop input, then press the stop button to clear this alarm.
A-S Lock-out	If the Stop button is pressed while running, it is considered an emergency stop and the unit will stop the engine and enter the Autostart Lockout state. This prevents the engine from starting again, while the Autostart input remains activated. The Autostart Lockout state is self resetting upon deactivation of the Autostart input. If the engine was stopped for a real emergency, then the emergency stop switch should also be activated to ensure the engine will not start inadvertently. If the unit is in the Autostart Lockout state, the engine can be restarted by pressing the Start button. This is not considered a manual start but rather a release from the Autostart Lockout condition. The contactors will be controlled in the appropriate way.
Phase Reversal	The generator has a phase reversal or the wiring is incorrect
Low V1 Volts	Voltage on genset Phase V1 is Low
Low V2 Volts	Voltage on genset Phase V2 is Low
Low V3 Volts	Voltage on genset Phase V3 is Low
High V1 Volts	Voltage on genset Phase V1 is High
High V2 Volts	Voltage on genset Phase V2 is High

High V3 Volts	Voltage on genset Phase V3 is High
High Frequency	Genset frequency is high
Low Frequency	Genset frequency is low

Alarms are indicated by fast flashing of the alarm LED and displaying the appropriate message on the LCD.

AGF(Automatic Genset Failure)

When the Con B is closed meanwhile the Mains get stable, it checks Mains and opens the Con B in order to protect the load....

Message	Function description
AGF Phase Reversal	The generator has a phase reversal or the wiring is incorrect
AGF Loss V1 Volts	Voltage on Alternator Phase V1 was lost
AGF Loss V2 Volts	Voltage on Alternator Phase V2 was lost
AGF Loss V3 Volts	Voltage on Alternator Phase V3 was lost
AGF Low V1 Volts	Voltage on Alternator Phase V1 is Low
AGF Low V2 Volts	Voltage on Alternator Phase V2 is Low
AGF Low V3 Volts	Voltage on Alternator Phase V3 is Low
AGF High V1 Volts	Voltage on Alternator Phase V1 is High
AGF High V2 Volts	Voltage on Alternator Phase V2 is High
AGF High V3 Volts	Voltage on Alternator Phase V3 is High
AGF High Frequency	Alternator frequency is high
AGF Low Frequency	Alternator frequency is low

8.1 Inputs Electrical Specification

Input	Type	Comment
Battery + Volts	Power	Nominal 12VDC or 24VDC or Station Battery Supply Max 6-36VDC
0V Common	Power	0VDC, Common
Fuel Level Sensor	Analog/Digital	Suitable for either resistive or switch C.O.F senders Current limited exciting voltage 10V at 10mA approx
Engine Oil Temperature	Analog/Digital	Suitable for either resistive or switch C.O.F. senders

Sensor		Current limited exciting voltage 10V at 10mA approx
Engine Temperature Sensor	Analog/Digital	Suitable for either resistive or switch C.O.F. senders Current limited exciting voltage 10V at 10mA approx
Canopy Temperature	Analog/Digital	Suitable for analog use with EMS08 temperature sensor or switch C.O.F input Current limited exciting voltage 10V at 10mA approx
Oil Pressure Sensor	Analog	Suitable for either resistive or switch senders. Optionally for protection or display only. Current limited exciting voltage 10V at 10mA approx
Low Water Level	Digital	Suitable for probe or switch input. Open Circuit = Active Frequency output 500Hz. Galvanically isolated.
Autostart	Digital	Suitable for switch input. Connect to 0V = Active Current limited exciting voltage 10V at 10mA approx
Emergency Stop	Digital	Suitable for switch input. Connect to 0V = Active Current limited exciting voltage 10V at 10mA approx
Oil Pressure Switch	Digital	Used for backup Oil Pressure protection. Configurable for N.O or N.C. operation. Current limited exciting voltage 10V at 10mA approx
User	Digital	Yet to be defined. Connect to 0V = Active Current limited exciting voltage 10V at 10mA approx
Excitation	Internal	High Impedance
Battery Voltage	Internal	High Impedance
GL1	Voltage	Generator Phase 1 Volts Max 350VRMS
GL2	Voltage	Generator Phase 2 Volts Max 350VRMS
GL3	Voltage	Generator Phase 3 Volts Max 350VRMS
GN	Voltage	Generator Neutral Max 350VRMS
ML1	Voltage	Main Phase 1 Volts Max 230VRMS

ML2	Voltage	Main Phase 2 Volts Max 230VRMS
ML3	Voltage	Main Phase 3 Volts Max 230VRMS
MN	Voltage	Main Phase Neutral Volts Max 230VRMS
I1	Amps	Phase 1 Amps CT Loop 5A RMS Continuous. 6.25A Peak
I2	Amps	Phase 2 Amps CT Loop 5A RMS Continuous. 6.25A Peak
I3	Amps	Phase 3 Amps CT Loop 5A RMS Continuous. 6.25A Peak

8.2 Outputs Electrical Specification

Output	Type	Comment
Excitation	Current	200mA burst mode pulsed current controlled output.
Fuel Solenoid	Open Drain	300mA Open Drain protected coil drive. Max 36VDC This output is used to maintain the fuel solenoid activated for running or stopping duty.
Crank	Open Drain	300mA Open Drain protected coil drive. Max 36VDC This output is used to control the crank relay coil. The crank relay should be sized for the crank contactor current. It is recommended that the crank relay is located in the wiring loom near to the starter motor. This position removes the need for high current wiring to the control box and thus leads to lower cost.
Config O/P1	Open Drain	User Selectable options Refer to Setup and configuration section for available outputs and their functions Open drain 300mA overload protected
Config O/P2		
Config O/P3		

9. Load Transfer and Contactor Operation

The unit provides for both Mains and Generator contactor control even though in many applications this function will not be used, instead an MCB is used to switch the generator

to and from the load. Contactor outputs are controlled in both Manual and Auto operating modes.

The Mains contactor output is controlled to deactivate the Mains contactor when the start button is pressed or the autostart input is activated. The time of opening can be selected to respond immediately on an autostart input or a start button press. It can also be delayed or when the genset is running and able to take load.

The unit has a special feature autostart inhibit, which can inbihit the mains contactor output even when the mains get failed.

The Generator contactor output will activate only after the Mains contactor has opened and only when the genset able to take load. The timing is controlled by the XFR DELAY configuration setting.

If the genset was started by activating the Autostart input, then deactivating the input will move the sequence to the "Cool Down" state. During cool down the Generator contactor output is deactivated and after a delay the Mains Contactor output is controlled to re-activate the Mains contactor.

9.1 Battery Charging Alternator Excitation

The battery charging alternator excitation system is implemented using a burst mode pulse system. This ensures reliable self-excitation while managing current consumption during standby, heat dissipation during fault conditions, and pulsing the battery-charging alternator prior to cranking for improved speed signal output.

During standby and Ready, the alternator excitation is pulsed once per minute to maintain some level of residual magnetism in the alternator but still maintaining minimum power consumption. On receiving a start signal, the unit pulses the alternator excitation input with a burst of 200mA pulses. The pulse width is dependent on the battery voltage. This pulse burst establishes a definite magnetic field in the battery-charging alternator prior to cranking. This ensures a significant speed-sensing signal is generated for crank disconnect sensing. The alternator excitation is turned off and the engine is cranked without the usual alternator burden loading the cranking process. This aids easier starting. When the engine has fired and is running, more 200mA pulse bursts are applied. Given the alternator is rotating at more than the 3000RPM the alternator will achieve self-excitation.

If self-excitation is not achieved this process will repeat for a few seconds before the excitation failed warning is given.

Alternator excitation may also be used as a secondary crank disconnect signal for the case where the speed signal has failed immediately the engine starts to run. This feature can be disabled if not required by setting "Excite Dis" to NO.

For systems where a battery-charging alternator is not fitted, turning off the excitation warning will disable the excitation system.

9.2 Battery Voltage Monitoring and Charging Detection

A battery is considered charged if (assuming a 12V system. x2 for 24V) its terminal voltage is above 13.1Volts. Typically a fully charged battery has a terminal voltage of 13.6V, above

this and the battery is being overcharged. During cranking the large discharge current will reduce the battery terminal voltage below 12.5V and the battery cannot increase the terminal voltage again without the assistance of a charger. This sequence provides a useful mechanism to determine if a battery is being actively charged.

Many applications have a current meter to show charging current. Such meters provide very limited value as a good battery will recover its terminal voltage very quickly and then be maintained with a very low level of trickle current. This trickle current is usually too small a percentage of the current meters range to provide any useful information.

The unit constantly measures the battery terminal voltage and can detect proper charging and discharging performance. Voltage readings are taken and compared against an inbuilt voltage profile. If the battery terminal voltage falls outside the critical voltages for each action then a battery warning is indicated.

During standby, and particularly where an on line charger is not available, monitoring the health of the battery is vital. The unit regularly wakes and measures the battery voltage, if it falls below the set point a warning is issued to ensure the operator is aware of the need for battery recharging.

10. Set-up

In the factory environment the unit can be setup by the EMS Cloning Utility or by the EMS Windows setup utility. In the field, adjustments to the unit can be made using the buttons on the front panel.

The EMS Windows setup utility and the EMS Cloning options are detailed elsewhere and only the field adjustment method is discussed here.

To enter set-up, when the unit is showing “Ready”, press and hold UP button for 20 seconds. When the unit enters set-up mode the LCD will show “Setup” and optionally request a PIN number if this option is enabled. Before any items can be changed a PIN number must be entered.

10.1 Navigating in the setup menu

The setup menu comprises a range of columns where each column comprises of a list of items and each item has a range of settable values.

Column Headings are as follows

Syste m	Engin e	Timer s	Con A	Start Stp	AC Setup	AMF Setup	AGF Setup	I/O Confg	Com ms	Exit

The STOP button is used to select the next column, or to increment a value.

The START button is used to select the previous column, or to decrement a value.

The UP button scrolls up the item list.

The Down button scrolls down the item list.

Once the bottom of the column has been reached, the unit displays “Top Press Stop”. Pressing the STOP button takes the user to the top of the column.

Setup mode automatically terminates if no button in pressed for 60 seconds, or when the exit item is accessed.

10.2 System Column

Item	Range	Default	Description
Contrast	0 - 13	7	LCD Contrast
Disp Update	OFF 2 – 99 sec	3	Display Cycle Time, sets frequency of display update. If set to Off, display scrolling is disabled. For manual scrolling press the ACK button for up and the hidden button for down.
Disp Hold	5 – 60 sec	30	Display hold time. Sets the duration of display hold when the alarm button is pressed to halt the scrolling
Sleep Time	0 – 720 min	0	The unit will wakes up after this interval time and checks for alarms etc. When set to 0, the unit will never enter sleep mode.
Show Hz	Yes / No	Yes	Shows or hides the display for Hz
Show Cust Logo	Yes	Yes	Show or hide the Customer Logo
Show KWHr	Yes / No	Yes	Shows or hides the display for KWHr
Show KW	Yes / No	Yes	Shows or hides the display for KW
Show PF	Yes / No	Yes	Shows or hides the display for PF
Site ID	0 – 30000	0	Site Identifier. May also be used for asset numbering.
Defaults	YES / NO	NO	Setting to Yes will load all configuration items to their factory default values. Note: Engine calibration will be lost.

10.3 Engine Column

Item	Range	Default	Description
CrankDis Hz	15 – 30 Hz	20	Crank Disconnect Frequency
RPM Type	2P / 4P	4P	Used to select the number of poles in the alternator.
Fuel Select	ETR ETS	ETR	Fuel Solenoid Type ETR (Energize To Run) ETS (Energize To Stop)

Item	Range	Default	Description
ETS Tries	1 - 2	2	Note: This item is only displayed when Fuel Select = ETS (See Above) Maximum Stop Retries for ETS Fuel Control
ETS Rest	5 – 60 sec	5	Note: This item is only displayed when Fuel Select = ETS (See Above) Stop Retry Pause time for ETS Fuel Control
FuelMax Tm	5 – 600 sec	15	Note: This item is only displayed when Fuel Select = ETS (See Above) Maximum fuel solenoid activation time
Fuel Type	OFF COF Kohler	Kohler	Fuel level sensor type.
Fuel Alarm	OFF 1 – 50 % %	50	Fuel level alarm setpoint. Alarm output activates and engine is shutdown. When low fuel alarm is active engine start is inhibited.
Fuel Warn	5 – 55 %	55	Fuel level warning setpoint.
Oil Type	OFF 10 – 180	10 – 180	Selects type of oil sensor being used. Dual station sensors can be used on same analog input.
Oil Range	5.0, 7.5, 10.0 Bar	5	Used to select the oil sensor full scale in Bar
Oil Alarm	0.2 - 3.0 Bar	1.0	Low oil pressure alarm shutdown set point. Alarm output activates and engine is shutdown.
Oil Warn	0.2 - OALM Bar	1.5	Low oil pressure warning set point and engine continues to run.
ETemp Type	COF TS150	TS150	Selects Engine temperature sensor type. COF = Switch: Close on Fault TS150 = Sensor with FSD of 150ºC
ETemp Alarm	70 – 200 ºC	98	High Engine temperature alarm shutdown set point. Alarm output activates. Engine is shutdown.
ETemp Warn	70 – ETALM ºC	95	High Engine temperature warning set point. Engine continues to run.

Item	Range	Default	Description
CTemp Type	OFF COF EMS08	EMS08	Selects Canopy temperature sensor type. COF = Switch: Close on Fault EMS08 = EMS08 temperature sensor with an FSD of 100ºC
CTemp Alarm	OFF 45 – 85 ºC	60	High canopy temperature alarm shutdown set point. Alarm output activates and engine is shutdown.
CTemp Warn	OFF 40 – 85 ºC	55	High canopy temperature warning set point and engine continues to run.
OTemp Type	OFF COF TS150	OFF	Selects Oil temperature sensor type. COF = Switch: Close on Fault TS150 = Sensor with FSD of 150ºC
OTemp Alarm	70 – 200 ºC	95	High Engine temperature alarm shutdown set point. Alarm output activates and engine is shutdown.
OTemp Warn	70 – ETALM ºC	90	High Engine temperature warning setpoint. Engine continues to run.
Lo Battery	OFF 9.5 – 24 Volts	10.0	Low Battery voltage level warning
Hi Battery	12 – 32 OFF Volts	15.0	High Battery voltage level warning
MaxBat Vlt	12.0 – 38.0 OFF Volts	18.0	Maximum Battery Voltage. If the Battery voltage exceeds this level then the engine is shut down. This is used to protect the battery from a failed alternator.
Chg Min V	OFF 10 – 28 Volts	13.1	The minimum battery voltage below which a “Low Charge Volts” warning is activated when the engine is running. This generally indicates an excitation failure or broken alternator belt.
OTempDelay	1 – 300 sec	30	Monitoring Delay time from engine starting before monitoring for high oil temperature. This is to allow the starting of a hot engine. This delay will be truncated once

Item	Range	Default	Description
			the Oil temperature goes above 50 ºC
Oil Prot	Switch Sender Both	Switch	Oil protection sensor mode. Switch = Protection from switch input only Sender = Protection from analog input only Both = Combined protection
Oil Check	YES NO	YES	Checks for oil pressure prior to cranking.
Oil Dis	YES NO	YES	Yes = Uses the digital Oil Pressure input to disconnect the crank. This may be used as an auxiliary mechanism to disconnect the crank quickly when the speed source is slow to establish. No = Switch is only used for alarm if enabled (Oil Prot)
Oil Dis Delay	OFF ON	OFF	Oil Pressure Disconnect delay. Used to delay the effect of the oil disconnect switch by 1 second for cold climatic conditions. Only configurable via the PC configuration Software.
LowWater En	OFF ON	ON	Enables the Radiator Water Level Alarm. Must be disabled if the Water level is not monitored.
FanOnTemp	OFF 30 - 80 ºC	60 ºC	Controls the temperature at which the Fan output is turned on
ETempMon Dly	1 – 300 sec	30	Monitoring Delay time from engine starting before monitoring for high engine temperature. This is to allow the starting of a hot engine. This delay will be truncated once the Engine temperature goes above 50 ºC
ETemp Sys	Water Engine	Water	Engine Temperature Source Water = Water monitoring Engine = Engine air temperature monitoring
Excite Warn	YES NO	YES	Yes = charging alternator excitation failure warning enabled. No = charging alternator excitation failure warning disabled.
Excite Dis	YES NO	YES	Yes = uses successful charging alternator excitation as a secondary crank disconnect signal to prevent over cranking. No = Excitation Disconnect function disabled.

Item	Range	Default	Description
Stop on Alm	OFF ON	ON	On = Engine protection functions are enabled. (Normal setting) Off = All protection shutdown mechanisms for the engine are disabled. Warnings and Alarms continue to be indicated. Off should only be chosen for mission critical applications when shutdown is not permitted and the engine can run to destruction. Only configurable via the PC configuration Software.

10.4 Timers Column

Item	Range	Default	Description
PreHeat Time	0 – 60 sec	0	Time to turn on the PreHeating output prior to cranking 0 = Skip Preheat delay
Crank Time	1 – 30 sec	10	Maximum cranking time
Crank Rest	3 – 50 sec	10	Delay between cranking retries
Crank Tries	1 - 10	3	Crank retries. Manual start sequencing will not retry.
Run Up	2 – 60 sec	3	Oil pressure, Temperature, Underspeed, and Overspeed, checking is disabled to allow these to stabilize during the starting process. Hirev is active to protect against a jammed governor.
Warm Up	2 – 60 sec	10	Time for the engine to warm prior to stepping to full speed. Under speed is not monitored.
Stop Time	3 – 600 sec	15	Time to allow large engines to completely stop rotating and oil pressure decline when stopping. During this time if Energize to Stop option is chosen, the fuel solenoid will activate up to the Fuel Max Time.
Stop Rest	2 – 20 sec	4	The time that oil pressure and speed signals are absent for before the unit considers the engine to be stopped.

Item	Range	Default	Description
Test Time	0 – 740 minutes	0	Duration that the Test Mode will run before the Genset is shut down. 0 = Run until user presses the manual Stop button.
Maintenance	OFF 50 – 1000 hrs	250	Hours between Maintenance Requests

10.5 Contactor A Column

Item	Range	Default	Description
Unload	Immediate Delay Running	Immediate	Contactor A unload mode. Immediate = Unloads contactor A at the beginning of the Start Delay Delay = Unloads contactor A after a delay (see next item) or when the genset is ready for load, (whichever is the sooner) Running = Unloads contactor A when the genset is ready for load
Unload Dly	3 – 999 sec	5	Note: Only displayed if Unload is set to Delay Delay for Delayed Unload mode (see above)
Xfr Delay	0 – 10 sec	5	Delay time between break and make operations for A to B and B to A contactor control.
Over I Trip	5-99.9V	24	Maximum current above which generator trips to protect ConA
Over I Dly T	0-180S	10	Maximum time before which the generator trips to protect ConA

10.6 Start/Stop Column

Item	Range	Default	Description
Start Delay	0 – 600	2	Autostart Delay Time. The time between the detection of an Autostart activation and the initiation of starting. Start time units are set in the next item.
Start Units	SEC MIN	SEC	Units for the Autostart delay time Sec = Seconds

Item	Range	Default	Description
			Min = Minutes
StartRestor	1 – 600 sec	5	Selects the time for which the Autostart has to be restored before the start delay timer is reset and starting aborted.
Start Warn	0 – 30 sec	2	Prestart warning time. If an output has been assigned to a Start Warning function, then it will turn on for this time period before a start occurs.
Run On	0 – 3600 sec	60	Run On Time. During run on reactivation of Autostart input will return the engine to running state. The generator remains on load.
Cool Down	0 – 3600 sec	60	Cool Down Time. Used to cool the turbo and alternator as required. The generator is off load.

10.7 AC Setup Column

Item	Range	Default	Description
VPhases	1 – 3	3	1: = 1 Phase Genset system. 2: = 2 Phase Genset system. 3: = 3 Phase Genset system.
CT Ratio	1 – 2000	12	Selects the load CT ratio
PhaseRev	ON OFF	ON	Enables test for correct generator phase sequence.

10.8 AMF Setup Column

Item	Range	Default	Description
AMF Start	No Yes	No	No = Engine is NOT started when Mains Fails Yes = Engine is started when Mains Failes
Low Volt Trip	60 – 240 Volts	185	The minimum voltage below which the Genset is started
Hi Volt Trip	110 – 300 Volts	270	The maximum voltage above which the Genset is started
Lo Hz Trip	40 – 60 Hz	47	The minimum frequency below which the Genset is started.

Hi Hz Trip	50 – 70 Hz	55	The maximum frequency above which the Genset is started.

10.9 AGF Setup Column

Item	Range	Default	Description
Lo Volt Trip	60 – 240 Volts	180	The minimum voltage below which the Genset is shut down
Lo Volt Dly	0 – 30 sec	3	Time before the alarm will react to Low voltage
Hi Volt Trip	110 – 300 Volts	275	The maximum voltage above which the Genset is shut down
Hi Volt Dly	0 – 30 sec	3	Time before the alarm will react to high voltage
Lo Hz Trip	Off 30 – 60 Hz	44	The minimum frequency below which the Genset is shut down. This is only checked while the engine is Running on load.
Lo Hz Dly	0 – 30 sec	3	Time before the alarm will react to low frequency.
Hi Hz Trip	50 – 70 Hz	56	The maximum frequency above which the Genset is shut down.
Hi Hz Dly	0 – 30 Secs	3	Time before the alarm will react to high frequency.
O/Load KW	5-6553	30	Maximum KW above which the Genset will shut down
O/Load KW Tm	5– 60 sec	10	Time before the alarm will react to KW Overloading.
O/Load Amp	5-6553	50	Maximum KW above which the Genset will shut down.
O/Load Amp Tm	5 – 60 Min	10	Time before the alarm will react to Amps Overloading
LO L-LV Trip	110-420	318	The minimum line to line genset voltage below which Generator shutdown

Item	Range	Default	Description
Hi L-LV Trip	195-530	477	The maximum line to line genset voltage above which Generator shutdown

10.10 I/O Setup Column

Item	Range	Default	Description
O/P1	OFF Running Fan ConA ConB Hooter PreHeat	Hooter	Selectable Digital Output Function from one of the following: Running = On while engine is Running Fan = Used to control the Fan ConA = Contactor A Control ConB = Contactor B Control Hooter = Enables on fault PreHeat = Control Preheater prior to cranking
O/P2		Running	
O/P3		Fan	
I/P1	OFF Belt Break Earth Fault EngineFault AltntrFault Fan MInhibit	MInhibit	Selectable Digital Input. Alarm shutdown function on input activation with specific LCD message. Belt Break = Shut down engine for Broken Belt Earth Fault = Shut down engine for Earth Fault AltntrFault = Shut down engine for Alternator Fault Fan = Fan Control MInhibit = Prevent starting of the Engine when active AutoStart = Start the Engine while active
I/P2		AutoStart	

10.11 Comms (Communications) Setup Column

Item	Range	Default	Description
Comms ID	1 - 240	116	Comms Address. Required for remote communications

Item	Range	Default	Description
Baud Rate	1200 2400 4800 9600 19200 38400 57600	9600	Comms Port Baud Rate
Data Bits	7 – 9	8	Number of Data Bits
Parity	Even Odd None	None	Parity Select
Stop Bits	1 or 2	1	Number of Stop Bits
UART Mode	None Modem LAN	None	RS232 Handshaking Mode None = No RTS/CTS Control. 3 Wire connection Modem = Uses RTS/CTS flow control. 5 wire connection. LAN = Uses RTS Line to control Direction on an RS485 LAN adapter (EMS18)

11. Communications

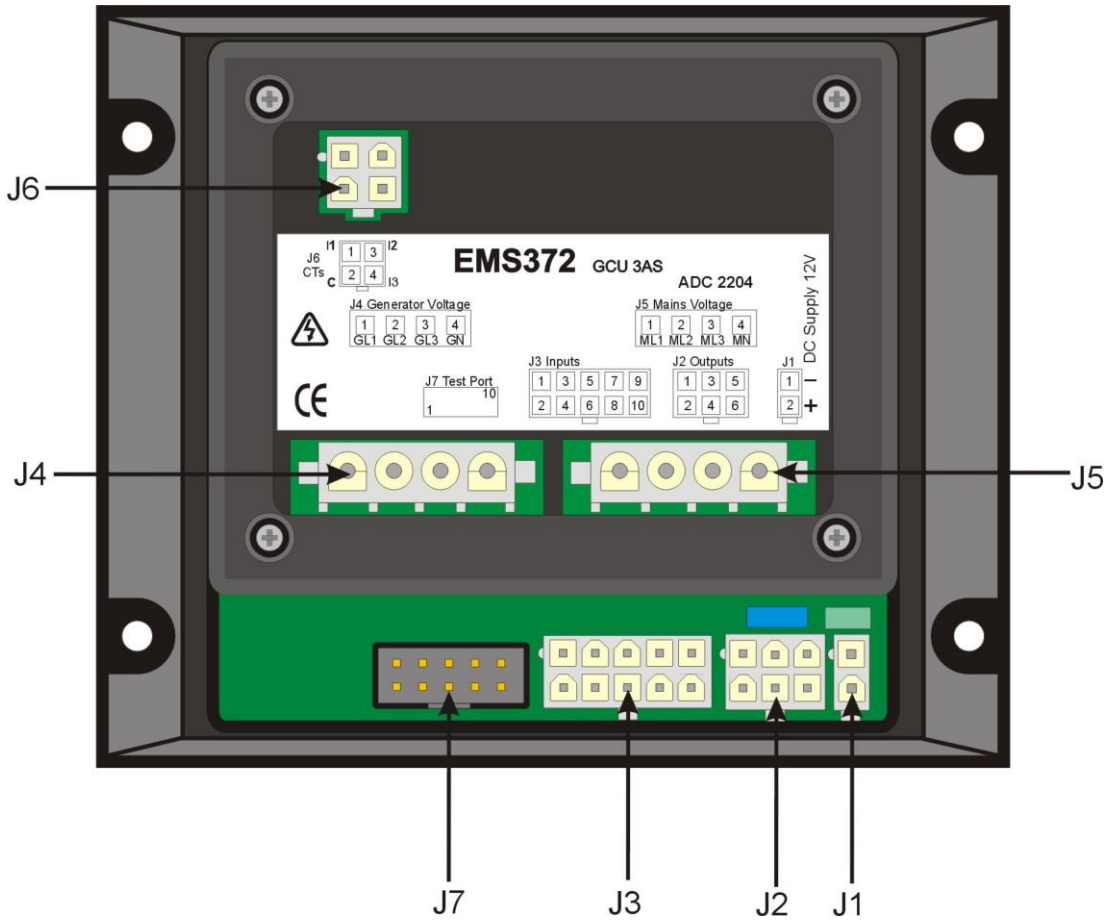
The unit is fitted with a fully functional communications port, which communicates using Modbus ASCII protocol. This port may be plugged into RS232 or RS485 communication adaptors and through these to a modem, a multi-drop network or auxiliary units such as the EMS930 telecom expander.

11.1 Unit General Specifications

Feature	Specification
Overall Dimensions	100 x 120 x 60mm
Mounting Hole	92 x 92mm
IP rating	IP55 front, IP20 rear
Supply Voltage	8 V to 36V DC Nominal Automotive
Operating Temperature	-20 to +70°C
Storage Temperature	-20 to +70°C

Relative Humidity	95% non-condensing
Supply Current	Standby < 7mA Running 50mA
AC Voltage Range	L-N = 350VRMS.
AC Frequency Range	40 – 70Hz
CT current range	0 – 5A + 25% Overload
Overall Accuracy	Class 1
Digital Output Rating	Open Drain Relay Coil Driver. 300mA 32VDC max.
Input Reference	0V Common
Engine Hours	0 – 99999.9 Hours
Kilo Watt Hours	0 – 999999.9 KWH
Oil Pressure Sensor Type	Switch: Close on fault Resistive 10 to 180 Ohms
Oil Pressure Range	500, 750, 1000 KPa
Engine Temperature Sensor Type	Switch: Close on fault Resistive (NTC)
Engine Temperature Range	120ºC, 150ºC, 200ºC
Canopy Temperature Sensor Type	Switch: Close on fault Resistive (NTC) EMS08 Sensor
Canopy Temperature Range	EMS08 0-100 ºC
Fuel Level Sensor Type	Switch: Close to fault Resistive 0 to 90 Ohms Resistive 10 to 180 Ohms Resistive 180 to 10 Ohms
Battery Volts Measurement	6 to 40 Volts
Set-up and Adjustment	All features may be adjusted using set-up buttons and LCD menu or via a PC Windows based utility
Terminations	Amp DUAC / Molex Mini Fit JNR
Testing	Environmental Tests: IEC68 Part2 EMC Compliance: EN50081-1, EN50081-2, IEC6100-4-3 Electrical Safety AS 3100 and AS 3260

12. Installation and Wiring



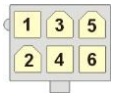
NB: The unit is a complex electronic device and caution should be taken to ensure correct wiring before power is applied.

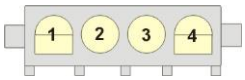
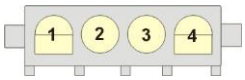
The unit is fitted with 2, 6 ,4 and 10 way Molex Minifit or equivalent socket connectors for which mating plugs can be selected from the Amp PE, or TPK range.

The UNIT is also fitted with two 4 way Mate-N-Lok or equivalent socket connectors for which mating plugs can be selected from the Molex or Tyco range and a 4pin.

The majority of UNIT wiring is low current for which 0.75mm^2 wire is sufficient. This excludes the CT wires (i1, i2 and i3) for which 1.5mm^2 wire should be used.

12.1 Connector Detail

Connector Assignment	Connection Information	
J7: Data Port 	Programming and Auxiliary Unit data port. **NB: Connect ONLY manufacturer approved equipment to this port**	
J1: DC Power Supply 	**Pin**	**Connection**
	1	Common –ve. This connection must be made directly to the engine block for lowest electrical noise. This connection must not have currents other than the controller currents flowing and must be exclusively for the controller.
	2	Battery +ve This connection must be made directly to the positive terminal of the battery for best performance. Do not make this connection to the positive terminal on the Starting Motor.
J3: Inputs 	**Pin**	**Connection**
	1	Fuel Level Input
	2	Coolant Temperature Input
	3	Canopy Temperature Input
	4	Oil Pressure Input
	5	Water Level Sensor
	6	Not Used
	7	Auto Start Input
	8	Emergency Stop Input
	9	Oil Pressure Switch Input
	10	I/P1 User Defined Input
J2 = Outputs 	**Pin**	**Connection**
	1	Fuel Output
	2	Crank Output
	3	Sounder Output

Connector Assignment	Connection Information	
	4	Contactor A Output
	5	Contactor B Output
	6	Excitation Output
J4 = AC Inputs for Genset 	**Pin**	**Connection**
	1	Gen AC Phase 1
	2	Gen AC Phase 2
	3	Gen AC Phase 3
	4	Gen AC Neutral
J5 = AC Inputs for Mains 	**Pin**	**Connection**
	1	Main AC Phase 1
	2	Main AC Phase 2
	3	Main AC Phase 3
	4	Main AC Neutral
J6 = Current to Shunts 	**Pin**	**Connection**
	1	Phase 1 Current
	2	CT Common – Connect L2 of all CTs to here
	3	Phase 2 Current
	4	Phase 3 Current

13. Trouble shooting

The unit displays the following messages when an alarm occurs. Alarms shut down the engine, set the alarm output and flash the alarm indicator. The alarm indications can be cleared after the genset has stopped, by pressing the stop button.

Message	Cause
Low Oil Pressure	Oil pressure has not reached the Oil Alarm set point (Oil Alarm) at the end of the run up time or has dropped below this value when the engine is running.
Low Fuel Level	Fuel level is less than the minimum value set point.

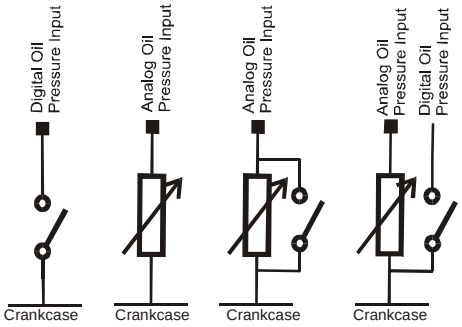
Message	Cause
High Engine Temp	Engine temperature has exceeded the high temperature set point. The temperature icon turns on. This message may also be shown as "High Water Temperature" depending on temperature system setup.
High Oil Temperature	Oil temperature has exceeded the high temperature set point. The oil pressure icon turns on.
Low Water Level	Water Level is below the water level very low level.
High Rev	Engine has exceeded safe operating speed.
Start Failure	The engine has failed to start.
Stop Failure	The engine has failed to stop.
E-S Lock out	The emergency stop input has stopped the engine.
Oil Pressure Flt	The unit has detected that the Oil Pressure sender has become open circuit. Normally this indicates a faulty sender or broken wiring. This will only shut down when the Oil System is set to Sender.
Engine Temp Flt	The unit has detected that the engine temperature has not risen to 50 degrees within the first 5 minutes of running or the temperature sensor has shorted to common. Normally this indicates a faulty temperature sender or broken wiring.
Oil Temp Flt	The unit has detected that the Oil temperature sender has become open circuit.
High Canopy Temp	The unit has detected a high canopy temperature.
Belt Broken	The unit has detected a broken belt.

The following warning messages indicate potential problems. When a warning occurs, the message associated with the warning is displayed. Warnings clear automatically when the warning condition is cleared.

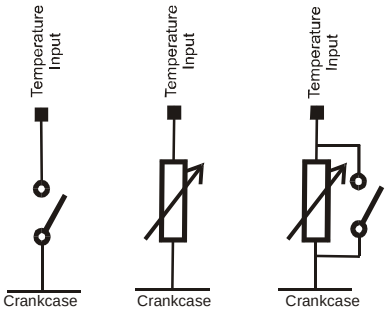
Message	Cause
No Excitation	Excitation voltage is low when engine is running. This indicates a probable charging fault or broken belt.
Low Charge Volts	Battery Voltage is below the charging voltage setpoint when the engine is running. Indicates that the alternator is not charging the battery.
Under Voltage	Battery Voltage is below the low battery setpoint.
Over Voltage	Battery Voltage is above the high battery volts setpoint. This may be due to a faulty regulator or battery charger.

Message	Cause
Oil Lock Out	The unit has detected that the oil pressure is above the oil pressure alarm setpoint with the engine not running. This warning prevents the engine from attempting to crank with the engine potentially running. This may be due to a faulty oil sender or a very tight engine. This warning is disabled if Oil Pressure Check before Cranking is set to Off.
Tacho Lock Out	The unit has detected that a speed signal is present with the engine not running. This warning prevents the engine from attempting to crank with the engine potentially running. This warning can sometimes be caused by ripple generated by mains powered battery chargers.
Excite Lock Out	The unit has detected that a Excitation is present with the engine not running. This warning prevents the engine from attempting to crank with the engine potentially running. This warning can sometimes be caused by ripple generated by mains powered battery chargers.
AutoStart On	The unit has detected an Autostart signal when not in auto mode, indicating the engine needs to be started in Auto mode.
Low Oil Pressure	The Oil Pressure has dropped below the Oil Pressure Warning set point while the engine is running. The Oil Pressure Icon is lit.
High Engine Temp	Engine temperature has exceeded the high temperature warning set point.
High Canopy Temp	Canopy Temperature has exceeded the high canopy temperature setpoint after the Temperature monitoring delay has expired.
Low Fuel Level	Fuel level is less than the warning set point.
Fuel Level Flt	The unit has detected that the fuel sender is open circuit. This is only a warning, and will not shut down the engine
Can Temp Flt	The unit has detected that the canopy temperature sender is open circuit or has shorted to common.
Maintenance	The time since the last maintenance has exceeded the maintenance time. The alarm output is not activated for this warning. The warning is cleared by pressing and holding the ACK button for 30 seconds. If the engine maintenance is carried out prior to the timer expiring, pressing the ACK button for 60 seconds will reset the timer.

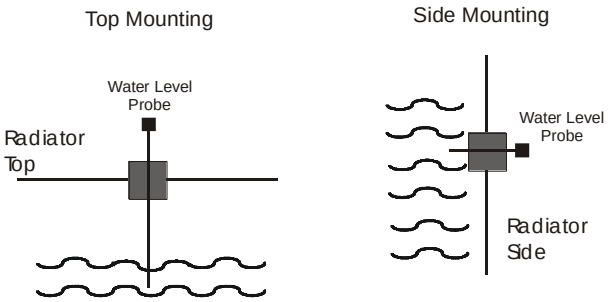
14. Wiring Options



Oil Pressure Sensing Options

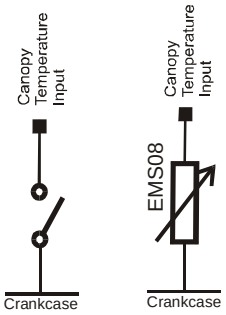


Temperature Sensing Options

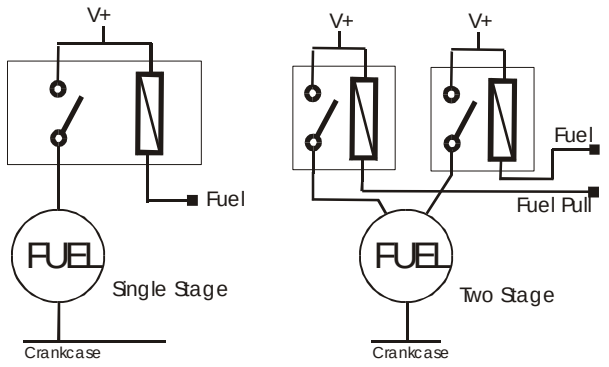


Note: The radiator must be electrically bonded to the crankcase common.

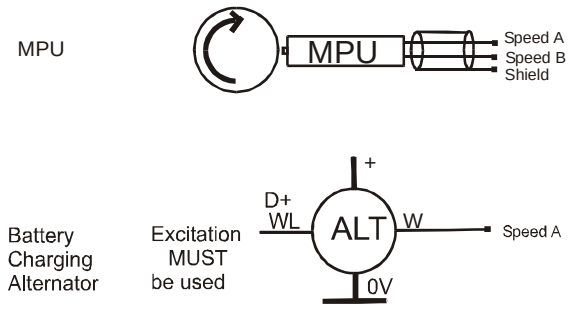
Water Level Wiring Options



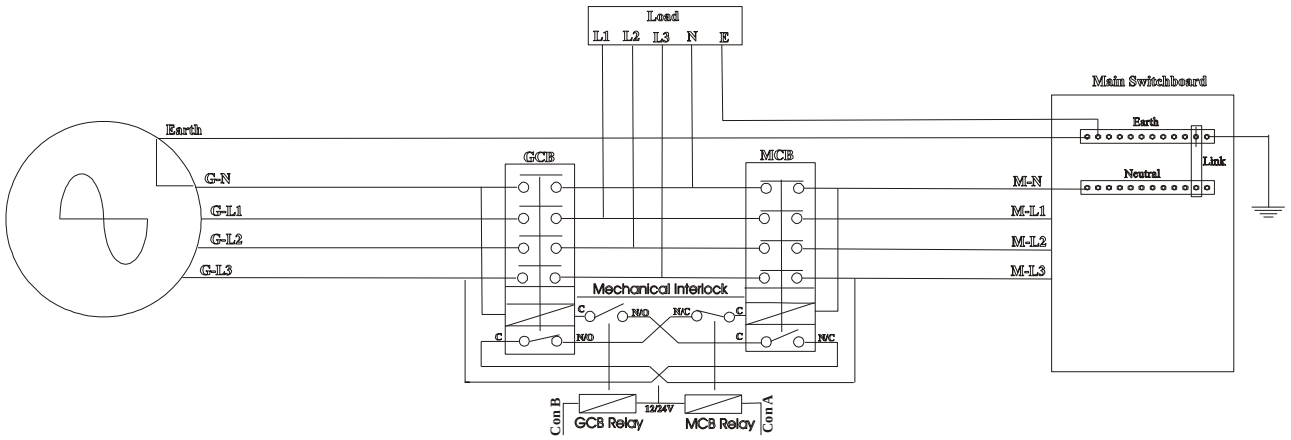
Canopy Temperature Wiring Options



Fuel Solenoid Wiring Options



Speed Detection Options

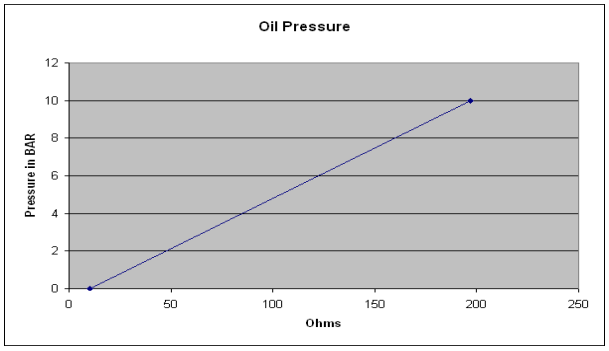


Typical Contactor Control

15. Engine Sensor Tables

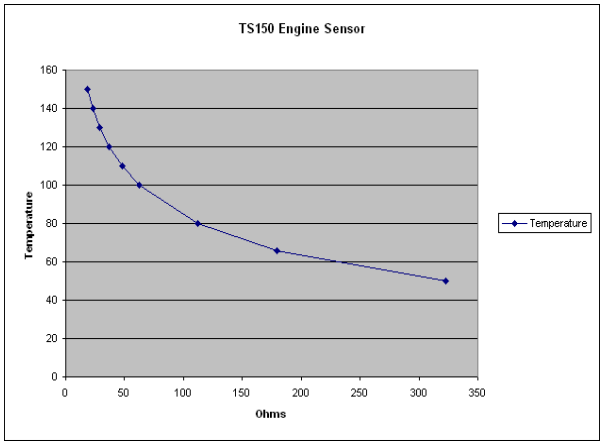
10-180 Oil Pressure Sensor

Ohms	Pressure in BAR
10	0
197	10



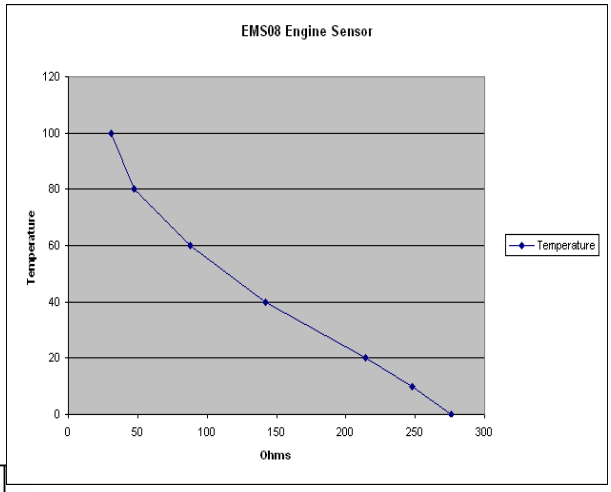
TS150 Engine Temperature Sensor

Ohms	Temperature
322.8	50
179.5	66
112.5	80
62.2	100
48.1	110
36.5	120
28.9	130
23.1	140
18.6	150



EMS08 Room Temperature Sensor

Ohms	Temperature
276.3	0
248.1	10
214.1	20
142.2	40
88	60
47.1	80
30.8	100



CONNETION DETAILS	LEVEL	RESISTANCE*
FUEL LEVEL INDICATOR 6 BLACK — BLACK 3	%	+/- 4 OHMS
	FULL	184
	70	170
MID LEVEL INDICATION - (MLI) - PFC 5 YELLOW — YELLOW 2	60	157
	50	135
	40	104
LOW LEVEL INDICATION - (LLI) - PFC 4 RED — RED 1	30	69
	20	37
WIRES 1 2 3 4 5 6	10	18
	EMPTY	14
	* THE READINGS ARE FROM FULL TO EMPTY (DOWN) ONLY	