EMS326

Basic Genset Controller

User Manual

This document applies to:	9001-0050
Build version	3600-0130
Firmware Version	5000-0045 (V2.2.5)

Version History:

S. No.	Version No.	Changes Made	Date Modified	Modified By	Approved By
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Level 1
Genset Controller

1. Introduction

The EMS326 is a custom designed controller for small gensets sold in the private market segment.

The unit incorporates both manually and autostart 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 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 coolant level, fuel level, canopy temperature and generator loading to provide even more comprehensive protection.

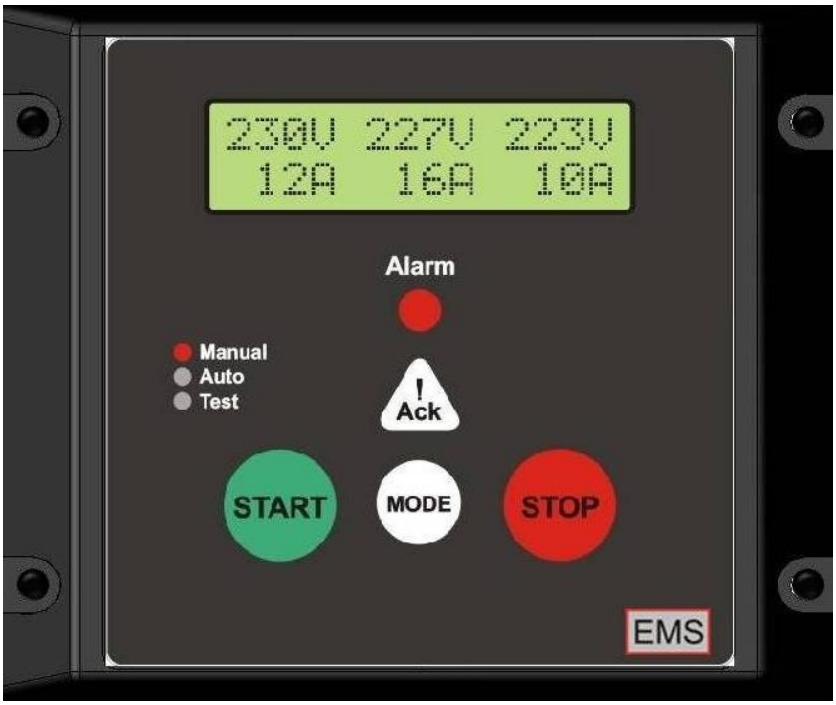
The unit incorporates an Event Log (20 events)and a Stop Alarm Log (40 events) to give the field service engineer the operational history and alarm history for easier diagnostics.

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.

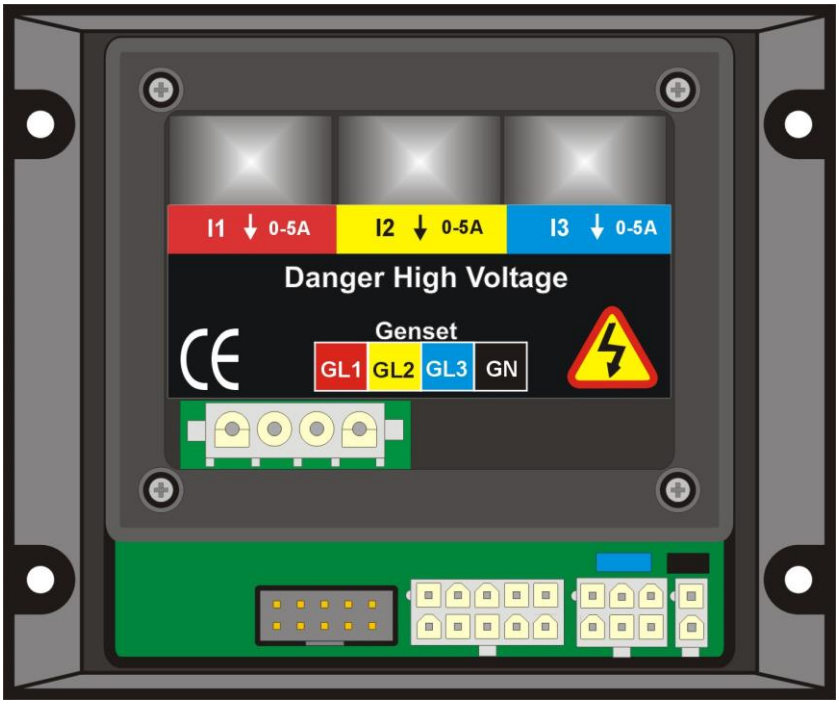
2. Benefits

- 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
Emergency Stop	In response to a digital input performs a fully sequenced engine stop with optional configuration parameters and clear LCD status messages

4.2 Engine Monitoring

Function	Description
Over / Under Speed	Monitors engine speed with optional configuration parameters and clear LCD status messages this ensures the engine speed remains within configured limits. Exceeding these limits will result in automatic engine shutdown to prevent damage.
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.
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 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 fitted 5A CTs.***
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 System LED Indications

Function	Description

Alarm	Red LED indication of system alarm.

4.5 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

4.6 Engine LCD Displays

Function	Description
Low oil pressure	Engine oil pressure low
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

4.7 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
Overload	Genset overloaded

4.8 AC Inputs

Function	Description
3 Phase Genset AC Voltage	Genset AC voltages.
3 Phase Genset Current	Genset AC currents via external 5A CTs.

4.9 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.
Canopy Temperature	Engine canopy temperature.

4.10 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.

4.11 Outputs

Function	Description
Excitation Output	Alternator excitation control and feedback.
Fuel Output	Open drain fuel solenoid control.
Crank Output	Open drain engine crank control.
Contactor A Output	Open drain transfer contactor A control.
Contactor B Output	Open drain transfer contactor B control.
Sounder Output	Open drain audible sounder control.

5. Operation

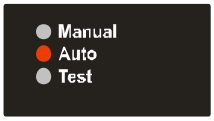
Front Layout

5.1 Buttons

Button	Function Description
START	**Start button / Menu Previous** 1. Used to initiate generator start sequence 2. Used as system menu previous or value down button
STOP	**Stop button / Menu Next** 1. Used to initiate generator stop sequence 2. Used as system menu next or value up button
Ack	**Accept button / Menu Up** 1. Used to accept system events and silence the sounder 2. Used as system menu scroll up button
MODE	**Mode button** Used as a system menu down button As a mode button it selects one of the following operating modes: Manual =. The DG can only be started and stopped manually. Auto = The DG is started and stopped by using the Auto Start Input. Test = The DG is started manually but the contactors do not change.

5.2 LEDs

Button	Function Description

Alarm 	**Alarm** Indicates system alarm
	Manual =. The DG can only be started and stopped manually. Auto = The DG is started and stopped by using the Auto Start Input. Test = The DG is started manually but the contactors do not change.

5.3 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'.

5.3.1 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.

5.3.2 Mode Selection

The unit may be operated in Auto, Manual or Test modes**.**

In Manual mode the unit responds only to the manual push button and may control A and B contactors if this option has been enabled.

In the Auto mode, the unit responds to the autostart input, Scheduler or Remote Starts and controls A and B contactors.

In Test mode the engine responds only to the manual start button and runs for a preset test time if configured. Contactors are not controlled.

In all three modes the engine can be stopped with the Stop button.

The operating mode of the unit is selected by pressing the mode button. For each press of the button the mode of the unit is cycled round to the next mode. As the modes change the display shows the new mode and the appropriate mode LED is lit.

5.4 Manual Operation

5.4.1 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:

- 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.

5.4.2 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.

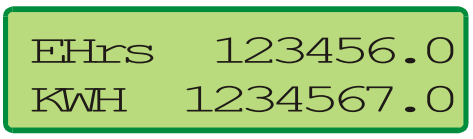
6. Display Operation

6.1 When the genset is ready

6.2 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:



Then

Then

Then

Then

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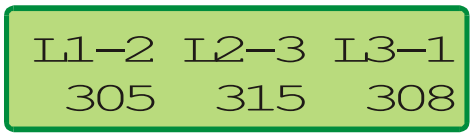
Then



Then

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

7. 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
Under Speed Warning	The engine speed is below the warning setpoint
Over Speed Warning	The engine speed is over 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 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.
Under Speed	The engine was running below the under speed set point. Check for overloading. Check fuel system.
Over Speed	The engine was running above the set point. Check governor system. Check power take-off couplings.
Hirev Alarm	The speed signal indicates the engine is grossly over speed. Check Governor system.
Water 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, and 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.
Speed Fault	The Speed Sensing system is not working as expected. Check the associated speed sensor wiring and external influences such as poorly operating battery chargers and poorly filtered UPS systems connect to the load.
Speed Detected	Speed signal is unexpectedly present. Check the associated speed sensor wiring and external influences such as poorly operating battery chargers and poorly filtered UPS systems connected to the load. Check electrical safety earthing systems. Check associated communications networks are isolated and not part of an unexpected earth loop.
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

7.1 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 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
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

7.2 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.
Contactor A	Open Drain	300mA Open Drain protected coil drive. Max 36VDC This output is used to switch the load from the mains.
Contactor B	Open Drain	300mA Open Drain protected coil drive. Max 36VDC This output is used switch the load to the generator.
Alarm / Sounder	Open	300mA Open Drain protected coil drive. Max 36VDC

	Drain	This output is used for an external sounder or horn.

8. 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 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.

8.1 Speed Sensing

The unit obtains the speed information from the Generator output 50/60Hz

The actual speed input frequency may be displayed by setting the "Display Hz" option in the Engine column to "On". This allows the set up engineer to read the sensed frequency and derive the values required for the speed setting items below.

8.2 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.

8.3 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.

9. 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 the ACK 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.

9.1 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.

System	Engin e	Timer s	Con A	Start Stp	AC Setup	I/O Confi g	Com ms	Event Log	Stop Alm	Exit

Column Headings are as follows.

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 ACK button scrolls up the item list.

The MODE 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.

9.2 System Column

Item	Range	Default	Description
Contrast	0 - 13	6	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 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.
Security	ON / OFF	OFF	ON Prevents configuration editing.
PIN	OFF 1 – 9999	1	Unit PIN Number
Defaults	YES / NO	NO	Setting to Yes will load all configuration items to their factory default values. Note: Engine calibration will be lost.

9.3 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)
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
Oil Type	0 – 90 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 TS120 TS150	TS150	Selects Engine temperature sensor type. COF = Switch: Close on Fault TS120 = Sensor with FSD of 120ºC

Item	Range	Default	Description
	TS200		TS150 = Sensor with FSD of 150ºC TS200 = Sender with FSD of 200ºC
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.
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.
CTemp Type	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.
Fuel Type	COF 0 – 90 10 – 180 180 – 10	10 – 180	Fuel level sensor type.

Item	Range	Default	Description
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 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.
TempMonDly	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 Oil Engine	Water	Engine Temperature Source Water = Water monitoring Oil = Oil temperature monitoring Air = Engine air temperature monitoring
Excite Warn	YES NO	YES	Yes = charging alternator excitation failure warning enabled. No = charging alternator excitation failure warning disabled.

Item	Range	Default	Description
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.
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.

9.4 Timers Column

Item	Range	Default	Description
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	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
	sec		
Hooter Time	0 – 600 sec	0	0 = Sounder remains on indefinitely until acknowledged Value = Sounder maximum time is the value in seconds.
Maintenance	OFF 50 – 1000 hrs	250	Hours between Maintenance Requests

9.5 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.
Man Mode Ctl	NO YES	NO	Enables Contactor A control based on the status of the Autostart input while the unit is in the READY state. This feature allows the unit to be set to Manual mode and maintain load disconnection from the mains in the event of a mains failure. An LVM is usually connected to the Autostart input.

9.6 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.

Item	Range	Default	Description
Start Units	SEC MIN	SEC	Units for the Autostart delay time Sec = Seconds 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.

9.7 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.
Lo Volt Trip	60 – 240 Volts	180	The minimum generator voltage below which the Genset is shut down
Lo Volt Dly	0 – 30 sec	3	Time before the alarm will react to low generator voltage
Hi Volt Trip	110 – 300 Volts	275	The maximum generator voltage above which the Genset is shut down
Hi Volt Dly	0 – 30 sec	3	Time before the alarm will react to high generator voltage
Lo Hz Trip	30 – 60	44	The minimum generator frequency below which the Genset is shut down. This is only checked while the

Item	Range	Default	Description
	Hz		engine is Running on load.
Lo Hz Dly	0 – 30 sec	3	Time before the alarm will react to low generator frequency.
Hi Hz Trip	50 – 70 Hz	56	The maximum generator frequency above which the Genset is shut down.
Hi Hz Dly	0 – 30 Secs	3	Time before the alarm will react to high generator frequency.
Cap Type	AMPS KVA KW	KW	The type of capacity units used for the Genset.
Capacity	10 – 6553	20	Selects the full load capacity of the generator in units of CapType
O/Load Lvl	10 – 150 %	95	Selects the trip point for the overload contact as a percentage of the generator capacity
O/Load Time	0 – 60 sec	10	Time in seconds for which the overload condition is present before the overload trips.
O/Load RsLvl	10 – 99 %	85	Selects the restore point for the overload condition as a percentage of the generator capacity.
O/LoadRsTm	0 – 20 Min	5	Time in minutes for which the restore condition must be present before the overload condition is restored.

9.8 I/O Setup Column

Item	Range	Default	Description
I/P1	OFF Belt Break Earth Fault	BeltBreak	Selectable Digital Input. Alarm shutdown function on input activation with specific LCD message. LCD message = Belt Break LCD message = Earth Fault

9.9 Comms (Communications) Setup Column

Item	Range	Default	Description

Item	Range	Default	Description
Comms ID	1 - 240	116	Comms Address. Required for remote communications
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 = The unit controls RS485 direction with the EMS18 or EMS19 for multidrop applications.
Alm DialOut	OFF 1 - 5	Off	Allocates the phone number for alarm dial out.

Item	Range	Default	Description
Alarm Description	-	-	This option is used to display the most recent 10 alarms. Alarms are displayed with the most recent at the top of the list. The list can be scrolled through like the other setup items.

9.10 Event Log

The event log capture starting and stopping events against the Engine hour meter. Additionally the start and stop fuel levels are also captured. This keeps a record of fuel consumption and running times.

The Event log items cannot be deleted or changed except by using the EMS Windows setup utility program.

Item	Range	Default	Description
Event Log Description	-	-	This option is used to display the most recent 20 start and stop events with an engine hours operating time stamp. Fuel levels are also recorded and can be used to verify replenishment and consumption rates. The Events are displayed with the most recent at the top of the list. The list can be scrolled through like the other setup items.

9.11 Fault History Log Viewer Column

Fault history log items cannot be deleted or changed except by using the EMS Windows setup utility program.

Item	Range	Default	Description
Stop Alarm Log	-	-	This option is used to display the most recent 50 stop alarms. Alarms are displayed with the most recent at the top of the list. The list can be scrolled through like the other setup items. The events are indexed to the run hours value at the time of the alarm. The LCD toggles between the Stop Alarm description and the Run Hours value.

Exit

Item	Range	Default	Description
Exit	-	-	Press the STOP button to Exit

10. 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.

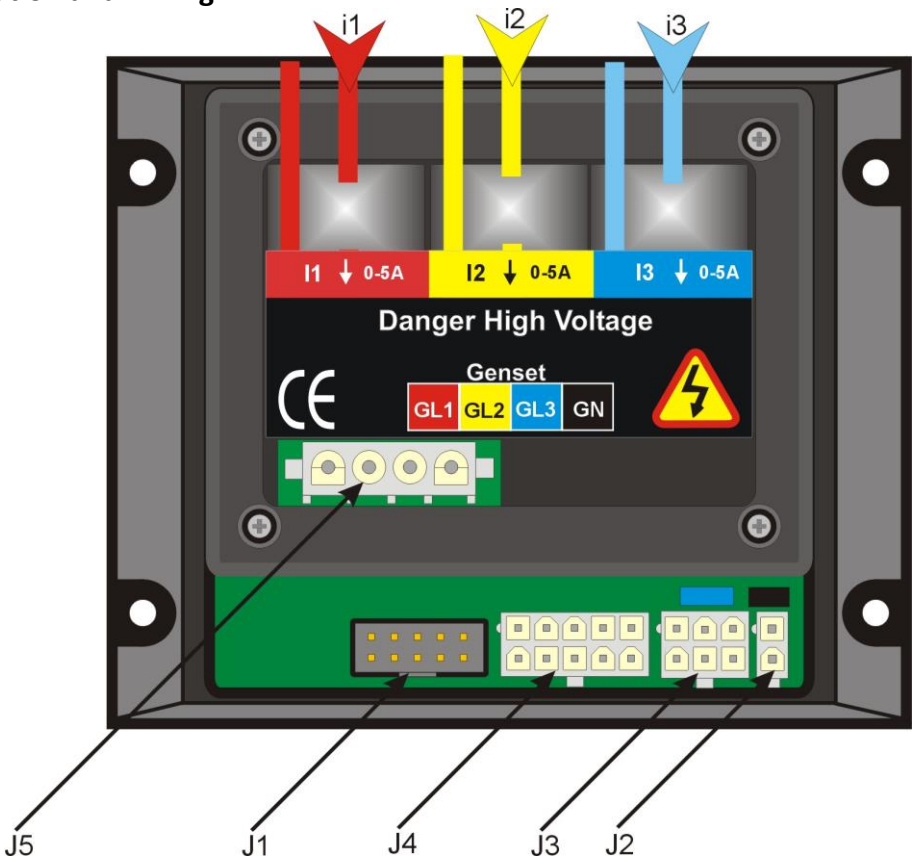
10.1 Unit General Specifications

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
Displayed Speed Range	0 – 5000 RPM
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

11. Installation and Wiring



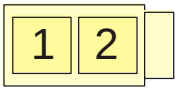
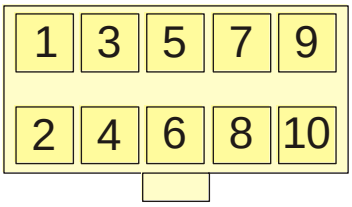
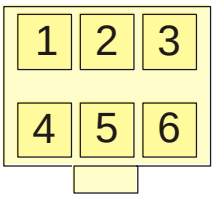
NB: The unit is a complex electronic device and caution should be taken to ensure correct wiring before power is applied.

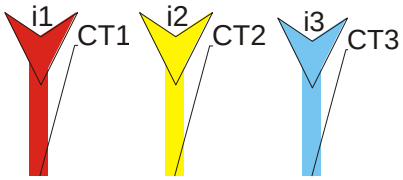
The unit is fitted with 2, 6 and 8 way Molex Minifit or equivalent socket connectors for which mating plugs can be selected from the Amp PE, or TPK range.

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

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.

11.1 Connector Detail

Connector Assignment	Connection Information	
J1: Data Port 	Programming and Auxiliary Unit data port. **NB: Connect ONLY manufacturer approved equipment to this port**	
J2: 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.
J4: 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
J3 = Outputs 	**Pin**	**Connection**
	1	Fuel Output
	2	Crank Output
	3	Sounder Output
	4	Contactor A Output

Connector Assignment	Connection Information	
	5	Contactor B Output
	6	Excitation Output
J5 = AC Inputs for Genset 	**Pin**	**Connection**
	1	Gen AC Phase 1 (Red)
	2	Gen AC Phase 2 (Yellow)
	3	Gen AC Phase 3 (Blue)
	4	Gen AC Neutral
Genset CT1, CT2 & CT3: **Current Transformers** 	**CT**	**Use**
	1	Gen Phase 1 Current (Red)
	2	Gen Phase 2 Current (Yellow)
	3	Gen Phase 3 Current (Blue)

12. 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.
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.
Under speed	Engine speed has dropped below the under speed set point.
Over speed	Engine speed has exceeded over speed set point.

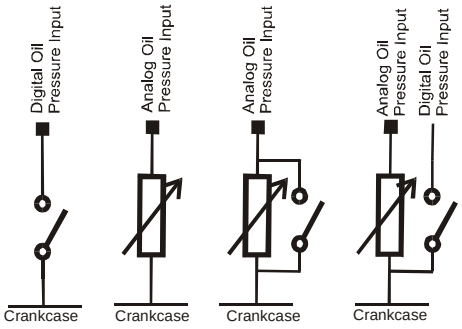
Message	Cause
High Rev	Engine has exceeded safe operating speed.
No Speed Signal	Engine has lost speed signals while running.
Start Failure	The engine has failed to start.
Stop Failure	The engine has failed to stop.
E-S Lock out	The emergency stop input has stopped the engine.
Oil Pressure Flt	The unit 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.

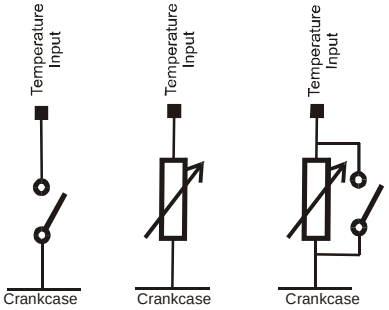
Message	Cause
No Excitation	Excitation voltage is low when engine is running. This indicates a probable charging fault or broken belt.
Low Charge Volts	Battery Voltage is below the charging voltage setpoint when the engine is running. Indicates that the alternator is not charging the battery.
Under Voltage	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.
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.

Message	Cause
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.
No Speed Signal	A speed signal could not be detected after the engine had started
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.

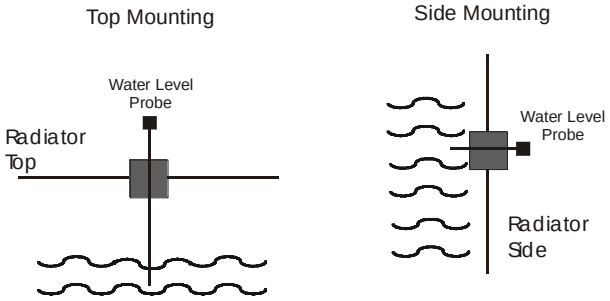
13. Wiring Options



Oil Pressure Sensing Options

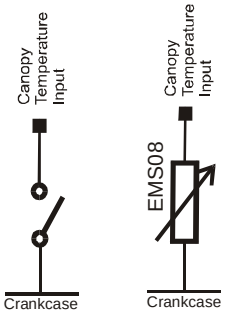


Temperature Sensing Options

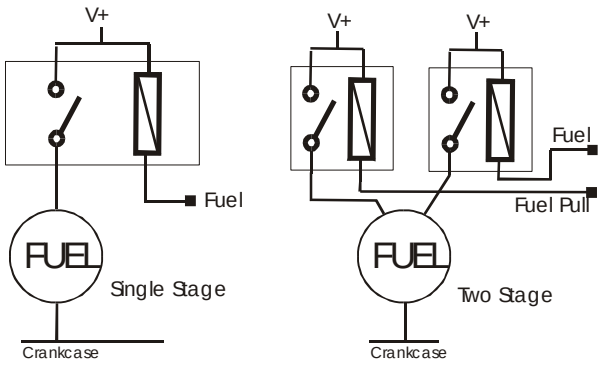


Note: The radiator must be electrically bonded to the crankcase common.

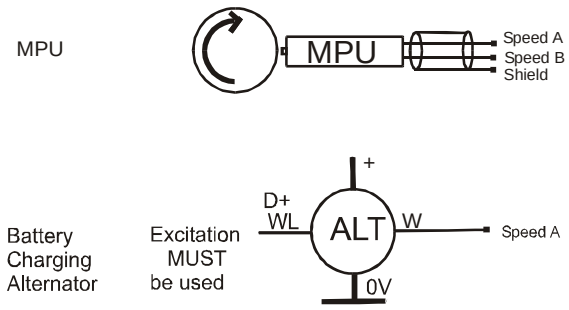
Water Level Wiring Options



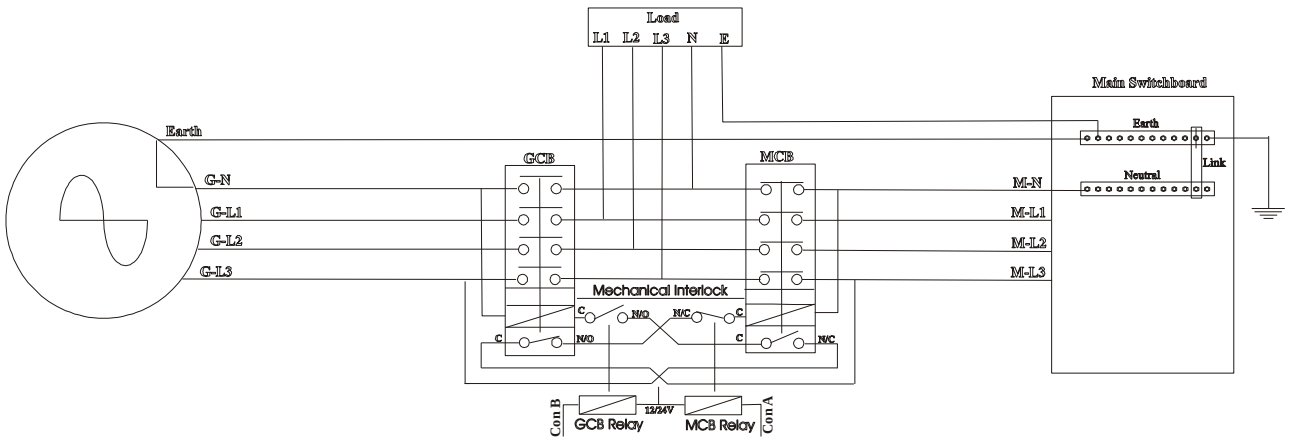
Canopy Temperature Wiring Options



Fuel Solenoid Wiring Options



Speed Detection Options



Typical Contactor Control