EMS827

AMF Genset Controller

User Manual

This document applies to Product	9001-xxxx
Build Version	3600-xxxx
Firmware Version	5000-xxxx

Version History:

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

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EMS

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Contents

EMS827
AMF Controller for
30KVA to 160KVA Gensets

1. Introduction

The unit is a controller for mid-engine Gensets with Automatic Mains Failure (AMF) functionality sold in the private market segment.

The unit incorporates Manual, Autostart Start and AMF 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 Mains and Alternator status and operating parameters are shown by scrolling screens on a backlit Graphics LCD. Alarms and warning are also shown on the LCD and supplemented by status LEDs and a sounder output.

The unit provides comprehensive monitoring of the engine operating parameters and provides automatic shutdown of the set in the event of damaging conditions. In addition to standard engine safety protections the unit monitors battery voltage, battery status, charging conditions, coolant level and temperature, fuel level, canopy temperature, oil pressure and temperature, engine speed and operating hours.

On the Alternator side, the unit monitors and displays 1 or 3 phase voltages, for L-N and L-L. It monitors the operating frequency, 3 individual phase currents, Average PF, KVA, KVAr for each phase and Alternator total. It maintains 3 phase Power meter functions which comprise, Total Mains KWH, Total Alternator KWH and Total Alternator KVArH,

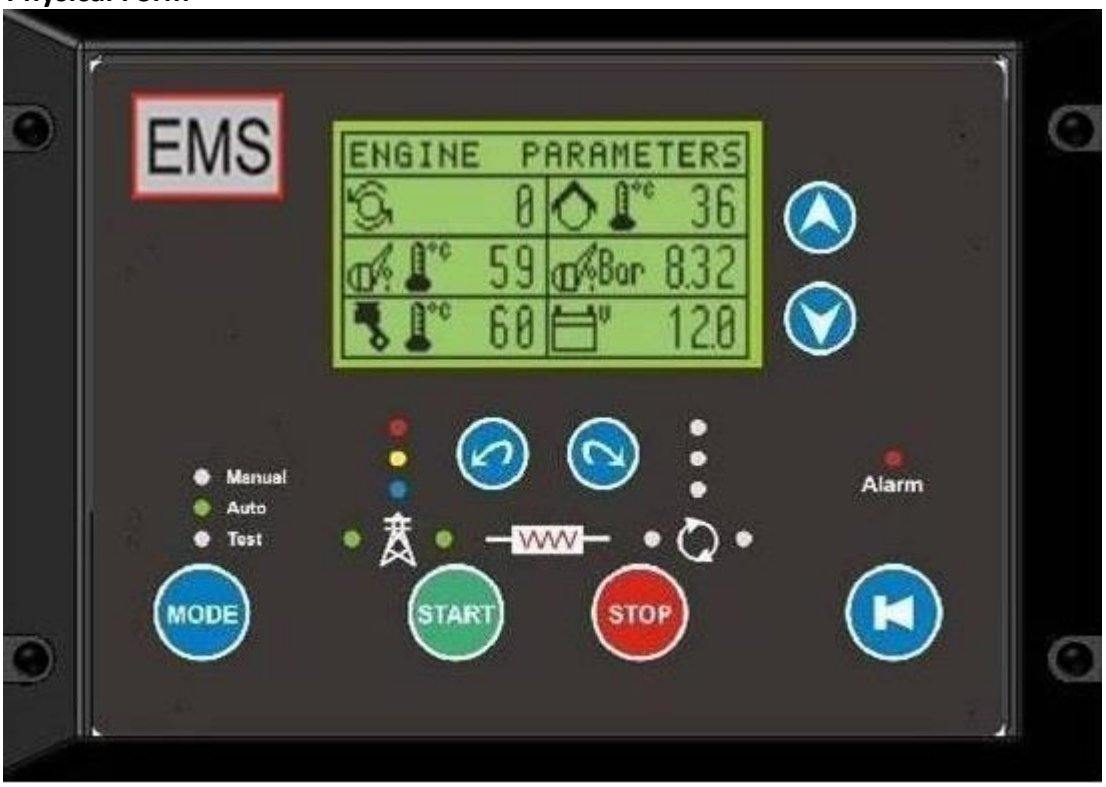
The alternator incorporates several protection features which include Over-load, Over-current, Load imbalance, and IDMT protection.

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

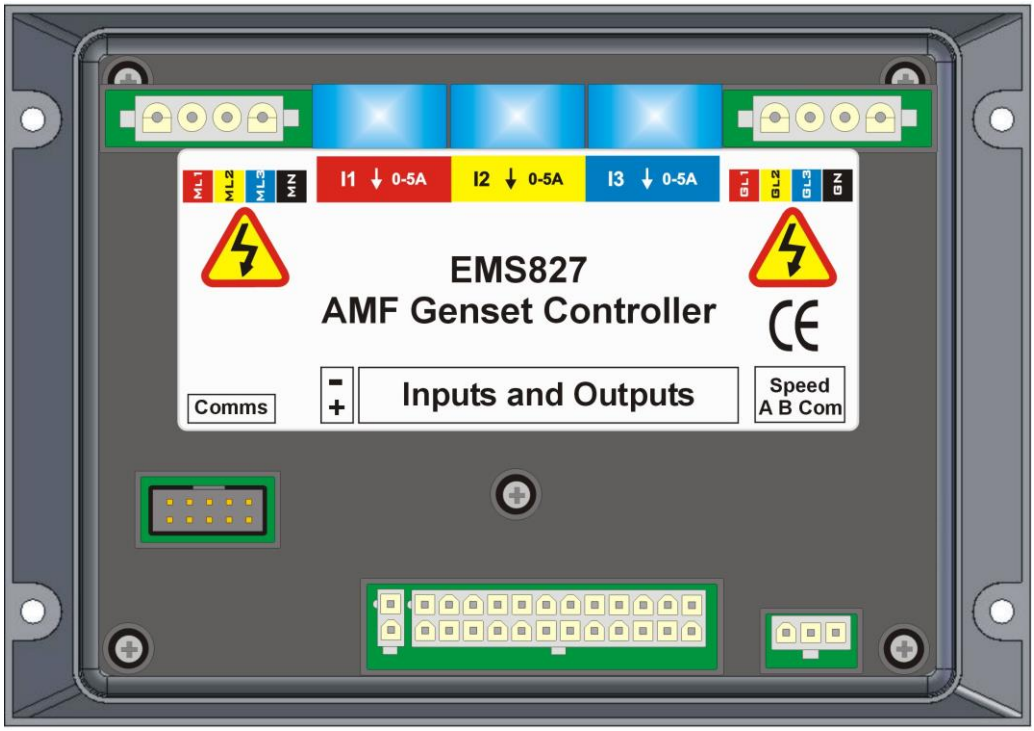
2. Benefits

- 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.
- Flexibility, the unit can be customised by PC cloning for individual genset model characteristics and fitments.
- Includes communications port for remote monitoring applications, dual station operation and companion auxiliary units.
- Inbuilt data logs provide operating history in the event of engine or alternator failure.

3. Physical Form



Front View



Rear 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, the unit performs a fully sequenced engine start with optional configuration parameters and clear LCD status messages
Manual Stop	In response to the front panel pushbutton, the unit performs a fully sequenced engine stop with optional configuration parameters and clear LCD status messages
Auto Start / Auto Stop	In response to a digital input, the unit performs a fully sequenced engine start or stop with optional configuration parameters and clear LCD status messages.
AMF Start	In response to a mains failure event, the unit performs a fully sequenced engine start with optional configuration parameters and clear LCD status messages
AMF Stop	In response to a mains restored event, the unit performs a fully sequenced engine stop with optional configuration parameters and clear LCD status messages
Emergency Stop	In response to a digital input, the unit 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
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
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.

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 pressure monitoring can be from an oil pressure switch, or a resistive oil pressure sensor, or both.
Lubrication Oil Temperature	Monitors engine oil temperature with optional configuration parameters and clear LCD status messages this ensures the oil temperature remains within configured limits. Exceeding these limits will result in automatic engine shutdown to prevent damage.
Coolant Temperature	Monitors coolant temperature with optional configuration parameters and clear LCD status messages this ensures the coolant temperature remains within configured limits. Exceeding these limits will result in automatic engine shutdown to prevent damage.
Coolant Level	Monitors radiator water level and provides clear LCD status messages. Automatic engine shutdown if radiator water is low.
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 during standby and operation and shows the status with clear LCD status messages. Warnings are given if charging is under or over charging.
Fuel Level	Monitors engine fuel level with clear LCD status messages. Low fuel level will result in automatic engine shutdown to prevent damage. A fuel loss warning and event log are included.
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.
Service Timer	A service timer is incorporated to ensure proper service schedules are maintained. The service message is displayed on the LCD at the pre-programmed times. An event log is maintained for service due and service taken.

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. Measurements include L-N and L-L.
AC Phase Current	Monitors 1 or 3 Delta 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 Alternator 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, KVArH and Avg PF) 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. Measurements include L-N and L-L.
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.
Mains Failure	Monitors AC failure with optional configuration parameters and clear LCD status messages. Includes Under and Over Voltage, Under and Over Frequency,

4.5 System LED Indications

Function	Description
Alarm	Red LED indication of system alarm.
Manual Mode	Green LED indication that the unit is in Manual Start Mode.

Function	Description
Auto Mode	Green LED indication that the unit is in Automatic Start Mode
Test Mode	Green LED indication that the unit is in Test Mode

4.6 Transfer Control LED Indications

Function	Description
Alternator Phase 1 Available	Red LED indication that the Alternator phase 1 voltage is available.
Alternator Phase 2 Available	Yellow LED indication that the Alternator phase 2 voltage is available.
Alternator Phase 3 Available	Blue LED indication that the Alternator phase 3 voltage is available.
Alternator Available	Green LED indication that the Alternator is available for the load.
Alternator on Load	Green LED indication that the Alternator is on load.
Mains AC Phase 1 Available	Red LED indication that the mains phase 1 voltage is available.
Mains AC Phase 2 Available	Yellow LED indication that the mains phase 2 voltage is available.
Mains AC Phase 3 Available	Blue LED indication that the mains phase 3 voltage is available.
Mains AC Available	Green LED indication that the mains is available for load.
Mains AC on Load	Green LED indication that the mains is on load.

4.7 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

4.8 AC Inputs

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

4.9 Analog Inputs

Function	Description
Speed	Engine speed from MPU or battery charging alternator.
Lubrication Oil Pressure	Engine oil pressure. Exciting current approx 13mA
Lubrication Oil Temperature	Engine oil temperature. Exciting Current approx 5mA
Coolant Temperature	Engine coolant temperature (Air or Water). Exciting current approx 5mA
Fuel Level	Engine fuel level. Exciting current approx 13mA
Canopy Temperature	Engine canopy temperature. Exciting Current approx 5mA
Coolant Level	Engine Radiator level. Exciting frequency 500Hz
Battery Voltage (Internal)	Battery Voltage is measured internally from DC supply point.

4.10 Digital Inputs

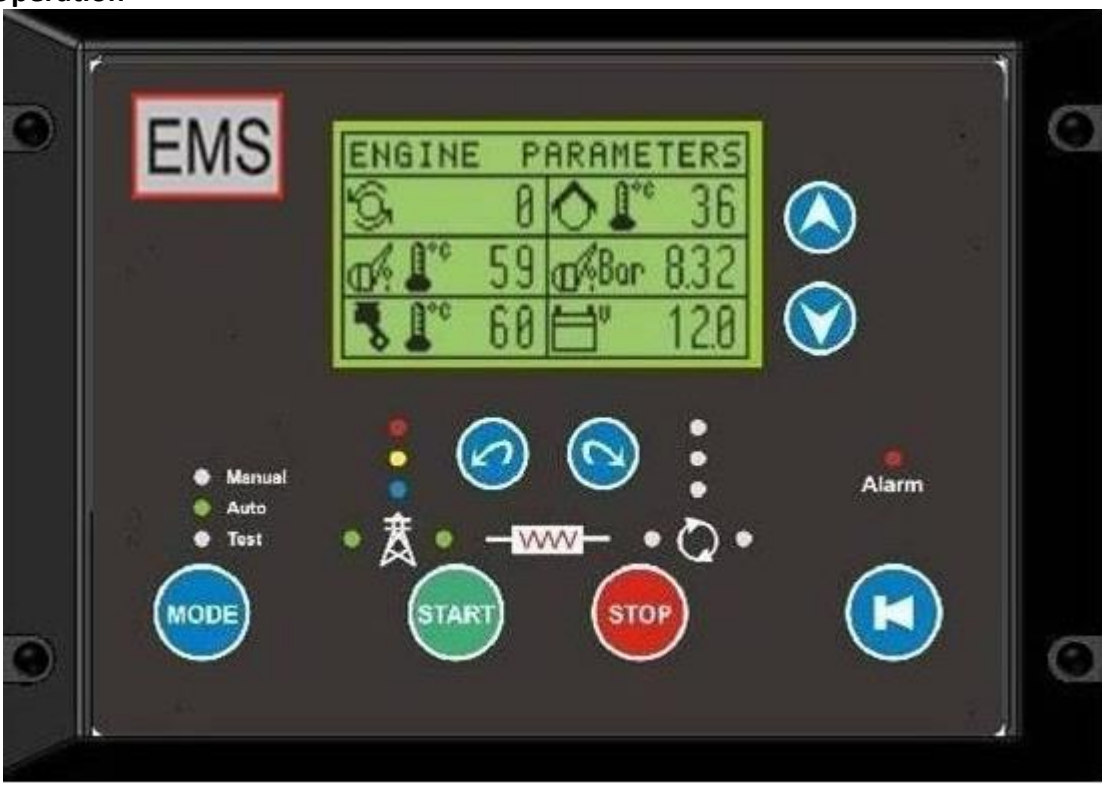
Function	Description
Auto Start / Stop Input	Auto start. Close to common. Current limited 10mA at 10V
Emergency Stop Input	Emergency engine stop. Selectable Open or Close to common. Current limited 10mA at 10V
Oil Switch Input	Oil Pressure Switch sensor. Close to common. Current limited 10mA at 10V
Digital Input 1	Configurable. Default = Bypass. No logic control but full instrumentation available.
Digital Input 2	Configurable. Default = Canopy door open.

Function	Description
	Close to common. Current limited 10mA at 10V
Digital Input 3	Configurable. Default = Fire. Shutdown genset and open both contactors. Close to common. Current limited 10mA at 10V
Digital Input 4	Configurable. Status, Warning, Alarm, PC programmed message. Close to common. Current limited 10mA at 10V

4.11 Outputs

Function	Description
Excitation Output	Alternator excitation control and feedback. 200mA Pulsed
Preheat Output	Open drain engine preheat control. Open Drain 300mA /36V DC
Fuel Output	Open drain fuel solenoid control. Open Drain 300mA /36V DC
Crank Output	Open drain engine crank control. Open Drain 300mA /36V DC
Idle Output	Open drain engine idle control. Open Drain 300mA /36V DC
Hooter Output	Open drain audible sounder control. Open Drain 300mA /36V DC
Common Alarm Output	Open drain audible sounder control. Open Drain 300mA /36V DC
Contactor A Output	Open drain transfer contactor A control. Open Drain 300mA /36V DC
Contactor B Output	Open drain transfer contactor B control. Open Drain 300mA /36V DC

5. Operation



Front Layout

5.1 Buttons

Button	Function Description
MODE	**Mode button** Used to change mode between manual, auto and test
START	**Start button / Menu Previous** 1. Used to initiate generator start sequence 2. Used as system menu previous button
STOP	**Stop button / Menu Next** 1. Used to initiate generator stop sequence 2. Used as system menu next button
	Accept button / Setup Menu Entry 1. Used to accept system events and silence the sounder 2. Used to enter the Setup mode

Button	Function Description
	**Mains Transfer Button** Used to start transfer sequence of load from genset to mains
	**Genset Transfer Button** Used to start transfer sequence of load from mains to genset
	**Screen Scroll up / Setup menu up Button** 1. Screen Scroll up Button 2. Used as the system menu up and value increment button
	**Screen Scroll down / Setup menu down Button** 1. Screen Scroll up 2. Used as the system menu down and value decrement button

5.2 LEDs

Button	Function Description
	**Alarm** Indicates system alarm
	**Genset Available** Indicates that the genset is available to go on load
	**Genset On Load** Indicates that the genset is currently on load
	**Alternator Phase Status** Indicates the phases which are available from the genset 1. Red – Phase 1 2. Yellow – Phase 2 3. Blue – Phase 3
	**Mains Available** Indicates that the mains supply is available to go on load
	**Mains On Load** Indicates that the mains supply is currently on load

Button	Function Description
	**Mains Supply Phase Status** Indicates the phases which are available from the mains 1. Red – Phase 1 2. Yellow – Phase 2 3. Blue – Phase 3
	**Manual Mode** Indicates that the system is in manual mode
	**Auto Mode** Indicates that the system is in automatic mode
	**Test Mode** Indicates that the system is in test mode

5.3 Initial Power Up

On power up, the unit displays the 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, AMF failure 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. Where 'awake' mode has been selected the system parameters are continuously scrolled.

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, Test or Stop modes. The mode is selected by pressing the mode button. The mode is indicated on the LCD and the LED associated with the mode buttons.

The engine can be stopped with the Stop button in MANUAL, AUTO or TEST modes.

In MANUAL mode the unit responds only to the manual push button and may control A and B contactors if these options have been enabled.

In the AUTO mode, the unit responds to the autostart input 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

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 after a short delay 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. This typically ONLY happens with ETS fuel systems.
- 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.

5.5 Autostart Engine Control

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.

- "Idle down" follows "Cool Down". The engine runs at idle speed for the idle down time. If the autostart input re-activated during Idle Down, then the unit returns to the Warm Up state and continues its starting sequence from there in the normal manner.

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.

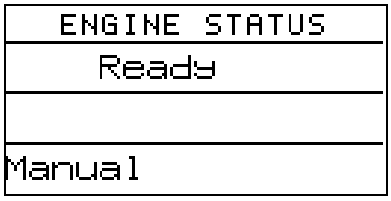
6. Display Operation

6.1 When the genset is running

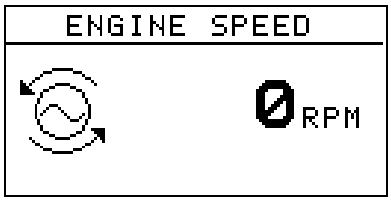
When the genset is starting and stopping, the display shows the state of the sequence together with the time remaining before the next state will commence.

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:

Screen – 1



Screen – 2



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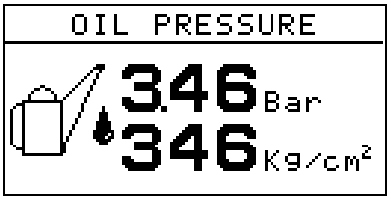
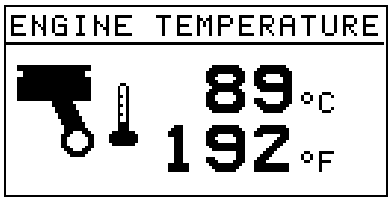
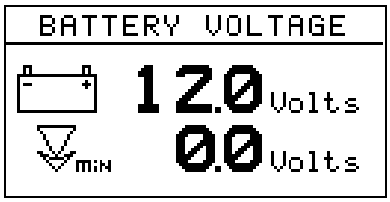


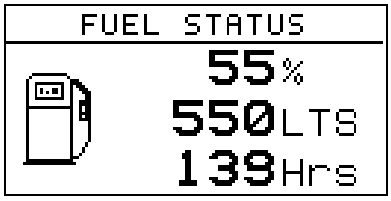
Screen – 4



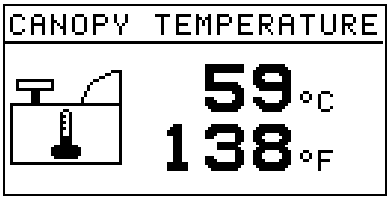
Screen – 5



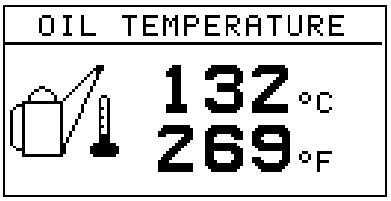
Screen – 6



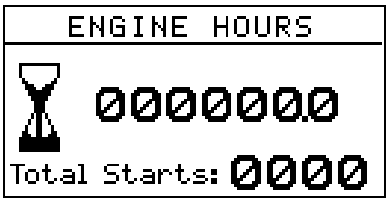
Screen – 7



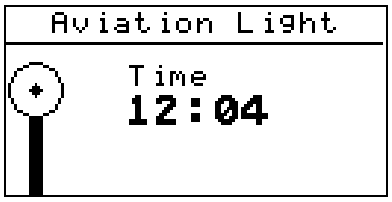
Screen – 8



Screen – 9



Screen – 10



Screen – 11

MAIN	VOLTS	L to L	
R	0	-Y	0
Y	0	-B	0
B	0	-R	0

Screen – 12

MAIN		Hertz
R		0.0
Y		0.0
B		0.0

Screen – 13

GEN	VOLTS	L to L	
R	0	-Y	0
Y	0	-B	0
B	0	-R	0

Screen – 14

GEN	AMPS	Hertz
R	0.0	0.0
Y	0.0	0.0
B	0.0	0.0

Screen – 15

GEN	KW	KVA
R	+ 0.0	0.0
Y	+ 0.0	0.0
B	+ 0.0	0.0

Screen – 16

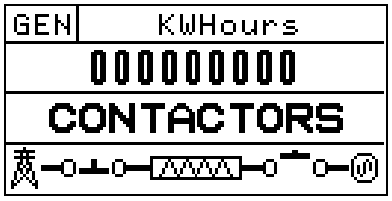
GEN	KVAR	PF
R	+ 0.0	+1.0
Y	+ 0.0	+1.0
B	+ 0.0	+1.0

Screen – 17

GEN		Total
	KW	+ 0.0
	KVA	+ 0.0
	KVAR	+ 0.0

Screen – 18

GEN	AVG	P.F.
L→N	0	+1.0
L→L	0	Accumulated
Amp	0.0	



Screen – 19

Then returns to start scroll

If Warnings or Alarms are present, the associated messages are included in the LCD scroll list, and are shown after the last screen has been displayed.

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 can not 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.

Alarms are indicated by fast flashing of the ALARM LED and displaying the appropriate message on the bottom 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.
Oil Temperature High	The oil temperature went above the alarm setpoint while the engine was running. Check for over loading. Check cooling air flows, check coolant and oil level.
Engine Temp High Coolant Temp High	The Engine / Coolant temperature went above the alarm setpoint while the genset 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.

Message	Function description
	Replenish the fuel.
Fuel Loss	The Fuel Level is unexpectedly going down while the genset is not running
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 setpoint. Check for overloading. Check fuel system.
Over Speed	The engine was running above the setpoint. Check governor system. Check power takeoff couplings.
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.
Belt Broken	If the belt break detector has been activated. Check the belts
Oil-P Fault	The Oil Pressure sensor system is not functioning as expected. Check oil pressure sensor and associated wiring.
Oil-T Fault	The Oil Temperature sensor system is not functioning as expected. Check oil temperature 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.

Message	Function description
	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.
Can Door	The canopy door input has been activated and the canopy door unexpectedly open
Fire Alarm	The Fire Alarm input has been activated. The genset will be shutdown as an emergency stop. Investigate the source of the alarm then press the stop button to clear this alarm

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.
Oil Temperature High	The oil temperature went above the alarm setpoint while the engine was running. Check for over loading. Check cooling air flows, check coolant and oil level.
Engine Temp High	The engine temperature went above the alarm setpoint while the engine was running.

Message	Function description
	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 setpoint. Check for overloading. Check fuel system.
Over Speed	The engine was running above the setpoint. Check governor system. Check power takeoff 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, 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.
Oil-T Fault	The Oil Temperature sensor system is not functioning as expected. Check oil temperature 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.

Message	Function description
	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.
Fire Alarm	The Fire Alarm input has been activated. The genset will be shutdown as an emergency stop. Investigate the source of the alarm then press the stop button to clear this alarm
A-S Lock-out	If the Stop button is pressed while running in auto mode, 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.

Message	Function description
AGF Phase Reversal	The generator has a phase reversal or the wiring is incorrect
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

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
Coolant Temperature Sensor	Analog/Digital	Suitable for either resistive or switch C.O.F. senders
Canopy Temperature	Analog/Digital	Suitable for analog use with EMS08 temperature sensor or switch C.O.F input
Oil Pressure Sensor	Analog	Suitable for either resistive or switch senders. Optionally for protection or display only.
Oil Temperature Sensor	Analog/Digital	Suitable for either resistive or switch C.O.F senders
Low Water Level	Digital	Suitable for probe or switch input. Open Circuit = Active
Autostart	Digital	Suitable for switch input. Connect to 0V = Active
Emergency Stop	Digital	Suitable for switch input. Connect to 0V = Active
Oil Pressure Switch	Digital	Used for backup Oil Pressure protection. Configurable for N.O or N.C. operation

Input	Type	Comment
Digital Input 1	Digital	Suitable for switch input. Connect to 0V = Active
Digital Input 2	Digital	Suitable for switch input. Connect to 0V = Active
Digital Input 3	Digital	Suitable for switch input. Connect to 0V = Active
Digital Input 4	Digital	Suitable for switch input. Connect to 0V = Active
Excitation	Internal	High Impedance input
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 Max 5A peak
I2	Amps	Phase 2 Amps CT Loop Max 5A peak
I3	Amps	Phase 3 Amps CT Loop Max 5A peak
I Com		Common CT connection for S1 terminals.
ML1	Voltage	Mains Phase 1 Volts Max 350VRMS
ML2	Voltage	Mains Phase 2 Volts Max 350VRMS
ML3	Voltage	Mains Phase 3 Volts Max 350VRMS
MN	Voltage	Mains Neutral Max 350VRMS

Input	Type	Comment
SPA	Voltage	Speed A magnetic pickup input 3V – 70V peak at >500 to 10KHz Speed A Battery Alternator input 2V to 70V peak at 20Hz to 1KHz
SPB	Voltage	Speed B magnetic pickup input 3V – 70V peak at >500 to 0KHz Speed B Battery Alternator input. Connect to common.
SPCom	Voltage	Speed Common 0VDC

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.
Hooter	Open Drain	300mA Open Drain protected coil drive. Max 36VDC This output is used for an external sounder or horn.
Common Alarm	Open Drain	300mA Open Drain protected coil drive. Max 36VDC
Spare	Open Drain	300mA Open Drain protected coil drive. Max 36VDC

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.

Load transfer can also be initiated with the use of the 'Mains Transfer' and 'Genset Transfer' buttons which will initiate a transfer sequence in accordance with configuration parameters.

9. Speed Sensing

The unit can obtain speed information from one of four sources.

- Magnetic pickup unit
- Battery charging flywheel magneto
- Generator output 50/60Hz if used for genset control
- Battery charging alternator

9.1 MPU

The magnetic pickup unit usually counts teeth on the flywheel and is mounted in the bell housing. It is important to ensure the gap between the MPU face and the teeth is 1mm to 2mm, as this distance greatly affects the output of the MPU. The unit requires a minimum of 3VRMS at low speed to ensure proper crank disconnect. Setup requires calculating the number pulses per 10 revolutions and the calculated number is then entered into the menu system "Cal Value".

Calculate: Number of Teeth x 10 = Speed Pulses Per 10 Revolutions.
Eg: 125 teeth x 10 = 1250.
Enter the number 1250.

9.2 Magneto

Battery charging flywheel magneto is similar to the MPU in that there is a fixed relationship between the engine speed and the number of pulses per revolution. The number of pulses per 10 revolutions must be calculated and entered into the menu system "Cal Value".

Calculate: Measure frequency at some standard RPM and Calculate as follows:

Cal Value = (Freq x 600) / RPM.
Eg: (100Hz x 600) / 1500 = 40
Enter the number 40

9.3 Generator

If the unit is used in a genset application the speed source can be the generator 50/60 Hz output and is connected internally within the unit from the AC input connectors. AC should not be connected directly to the speed MPU / Magneto input. For correct crank disconnect the generator must be providing a detectable output at low speed and therefore the voltage at 300 RPM must be greater than 40VRMS. This can be affected by the AVR and must be confirmed to provide suitable signals and timing for proper crank disconnect.

For setup the number of pulses per 10 revolutions must be calculated and entered into the menu system “Cal Value”. The generator output frequency and standard RPM must be known.

Calculate Speed Calibration value as follows:
Cal Value = (Freq x 600) / RPM.
Eg: (50Hz x 600) / 1500 = 20
Enter the number 20.

9.4 Battery Charging Alternator

A low cost speed source can be derived from the battery-charging alternator if fitted. It unfortunately is also the most troublesome, and not recommended for reliable and repeatable long-term service. The difficulties arise from the in-exact relationship of alternator output frequency and engine RPM. As a result of slippage and variable mechanical coupling both calibration and long-term stability are compromised.

The ratio of crank pulley to alternator pulley is indeterminate, as it depends very significantly on where the coupling belt rides in the V grove. Belt tension plays a very significant role, as does belt wear and instantaneous belt loading.

Immediately after starting an engine the alternator is required to re-charge the partially discharged battery. The loading on the alternator is very high and belt slippage is common as is belt set low in the V groove. The output frequency may be lower than expected. If speed calibration is performed at this time, the speed representation will be too low and subsequently as the load reduces on the alternator, the engine speed will appear to erroneously increase.

The battery charging alternator output frequency and current RPM must be known. This is achieved by independently running the engine, and measuring the battery charging alternator frequency on the W (sometimes D+) terminal. Excitation must also be provided to ensure self-excitation and an adequate output signal. Some small variation in reported speed may result but this can be calibrated out later during engine commissioning. For setup the number of pulses per 10 revolutions must be calculated and entered into the menu system “Cal Value”.

Calculate Speed Calibration value as follows:
Cal Value = (Freq x 600) / RPM.
Eg: (257Hz x 600) / 1500 = 102.8.
Enter the number 103.

10. 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 disconnects 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.

11. 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.

12. 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  button for 20 seconds. When the unit enters set-up mode the bottom LCD will show "Setup" and optionally request a PIN number if this option is enabled.

12.1 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.

System	Engine	Timers	Con A	Start/Stp	AC Setup	AMF Setup
AGF Setup	Testing	Manual	Room Temp	Aviation Light	I/O Config	Comms
Log Viewer						

The  button is used to select the previous column, Item, or to increment a value.

The  button is used to select the next column, item, or to decrement a value.

The 

button changes from Column to item to value editor.

The 

button changes from Item to column and exit setup mode.

The  button is used to accept value changes.

Setup mode automatically terminates if no button in pressed for 60 seconds, or when you press the 

button with the column headers list visible.

12.2 System Column

Item	Range	Default	Description
Contrast	0 - 13	6	LCD Contrast
Disp Update	OFF 2 – 60 sec	3	Display Cycle Time, sets frequency of display update. If set to Off, display scrolling is disabled. For manual scrolling press the ▲ for the previous measurement screen and the ▼ next measurement screen.
Disp Hold	5 – 60 sec	30	Display holds time. Sets the duration of display hold when the alarm button is pressed to halt the scrolling
PowerUp	Manual Last	Manual	PowerUp mode restores. On power restore places the unit in either Manual or the last used mode.
Sleep Time	0 – 720 min	0	The interval when the unit will power up and check inputs for alarms etc. When set to 0, the unit will never enter sleep mode.
Backlight	Off On	Off	The LCD Backlight can be ON continuously or turned OFF during sleep. ***WARNING: Leaving the Backlight ON will dramatically shorter it's lifespan.***
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	NO YES	NO	Setting to Yes will load all configuration items to their factory default values. Note: Engine calibration will be lost.

12.3 Engine Column

Item	Range	Default	Description
Crank Rel	100 – 1000 Hz	300	Crank Disconnect Frequency
Cal Value	1 – 2500	20	RPM Calibration Value (Refer to Speed Sensing section)

Item	Range	Default	Description
U Spd Wrn	OFF 400 – 3600 rpm	OFF	Warning threshold for slow engine speed
U Spd Alm	OFF 400 – 3600 rpm	OFF	Alarm threshold for slow engine speed
O Spd Wrn	OFF 400 – 4000 rpm	1600	Warning threshold for high engine speed
O Spd Alm	OFF 400 – 4000 rpm	1650	Alarm threshold for high engine speed
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 Time	5 – 600 sec	15	Note: This item is only displayed when Fuel Select = ETS (See Above) Maximum fuel solenoid activation time
FuelLitreHr	1 – 600 Litre	4	Genset fuel consumption. Used to calculate the number of runtime hours remaining for current fuel level.
FuelTotal	50 – 30000 Litre	1000	Total fuel tank volume. Used to calculate the number of runtime hours remaining for current fuel level.
Fuel Type	COF 0 – 90 10 – 180	0 – 90	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.

Item	Range	Default	Description
Oil Type	0 – 90 10 – 180	0 – 90	Selects type of oil sensor being used. Dual station sensors can be used on same analog input.
Oil Range	5, 7.5, 10 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.
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.
LowWaterEn	OFF ON	ON	Enables the Radiator Water Level Alarm. Must be disabled if the Water level is not monitored.
ETemp Delay	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 system	Water Air	Water	Engine Cooling Temperature Source Water = Water monitoring Air = Engine monitoring

Item	Range	Default	Description
ETemp Type	COF TS120 TS150 TS200	TS150	Selects Engine temperature sensor type. COF = Switch: Close on Fault TS120 = Sensor with FSD of 120ºC 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.
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 30 – 95 ºC	60	High canopy temperature alarm shutdown set point. Alarm output activates and engine is shutdown.
CTemp Warn	OFF 30 – 95 ºC	55	High canopy temperature warning set point and engine continues to run.
OTemp Type	OFF COF TS150 TS200	TS150	Selects Oil temperature sensor type. COF = Switch: Close on Fault TS150 = Sensor with FSD of 150ºC TS200 = Sender with FSD of 200ºC
OTemp Alarm	70 – 200 ºC	98	High Engine temperature alarm shutdown set point. Alarm output activates and engine is shutdown.
OTemp Warn	70 – ETALM ºC	95	High Engine temperature warning setpoint. Engine continues to run.
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 the Oil temperature goes above 50 ºC

Item	Range	Default	Description
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.
Charge Min	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.
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.
Fpump On	10 – 90 OFF %	OFF	Transfer fuel pump control. Off or starts the transfer fuel pump until target % reached OR Fpump Time expires.
Fpump Off	10 – 99 %	90	Transfer fuel pump control. Stops the transfer fuel pump when target % reached OR Fpump Time expires.
FPump Time	1 – 999 Min	5	Transfer fuel pump control. Maximum timed pumping.

Item	Range	Default	Description
Stop on Alarm	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.** **This option is only settable using the EMS Windows setup utility**.

12.4 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 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
Sounder 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

12.5 Contactor A Column

Item	Range	Default	Description
Unload	Imedt Delay Run	Imedt	Contactor A unload mode. Imedt = 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) Run = 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 A Contactor control for manual running and when the Autostart input is active.

12.6 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.

12.7 AC Setup Column

Item	Range	Default	Description
VPhases	1 – 3	3	1: = 1 Phase Alternator system. 2: = 2 Phase Alternator system. 3: = 3 Phase Alternator system.
Amp Phases	1,3	3	Selects the number of CTs used. When the load is balanced between phases, and cost minimisation is important, a single CT for phase 1 may be used.
CT Ratio	1 – 2000	12	Selects the CT ratio
PhaseRevse	None Mains Gen Both	Mains	Enables phase reversal activation of the alarm output.

12.8 AMF Setup Column

Item	Range	Default	Description
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.

12.9 AGF Setup Column

Item	Range	Default	Description
Low Volt Trip	60 – 240 Volts	180	The minimum voltage below which the Genset is shut down
Low 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	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.

Item	Range	Default	Description
CapType	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. Based on IDMT curves.
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.
Load Bal	Off On	Off	If the balance between phases is more than 30% for 30 minutes a warning is given.

12.10 Testing Column

Item	Range	Default	Description
ConAProt	ON OFF	OFF	Enables protection of Contactor A in test mode.

12.11 Manual Column

Item	Range	Default	Description
ConAProt	ON OFF	OFF	Enables protection of Contactor A in manual mode.
ConBProt	ON OFF	OFF	Enables protection of Contactor B in manual mode.

12.12 Room Temp Column

Item	Range	Default	Description
Enable	ON OFF	OFF	Enables room temperature control.
Trip	1 - 60 °C	30	Room temperature trip level.
Restore	1 - 60 °C	25	Room temperature restore level.

12.13 Aviation Light Column (Not protected against prolonged power loss)

Item	Range	Default	Description
Enable	ON OFF	OFF	Enables room aviation light control.
Hour Of Day	0 – 23 Hours	12	Hour to set light
Minute Of Day	0 – 59 Minutes	0	Minute to set light
On Start	0 – 22 Hours	18	Hour to turn light on
On End	0 – 22 Hours	6	Hour to turn light off

12.14 I/O Config Column

Item	Range	Default	Description
I/P1	OFF BeltBreak FireAlarm Door Bypass	BeltBreak	Selectable Digital Input Function from one of the following: Belt Break = Stop the engine when sensor is activated

Item	Range	Default	Description
I/P2	OFF BeltBreak FireAlarm Door Bypass	FireAlarm	Fire Alarm = Stop the engine when sensor is activated Door = Alarm when door is opened, engine is not stopped Bypass = Inhibit all engine start and stop sequencing ***NB: While the Bypass input is active the unit is unable to protect the engine and generator from damage due to abnormal operation. This input should be used with great caution and only on manned and monitored engines.***
I/P3	OFF BeltBreak FireAlarm Door Bypass	Door	
I/P4	OFF BeltBreak FireAlarm Door Bypass	OFF	

12.15 Comms (Communications) Setup Column

Item	Range	Default	Description
Comms ID	1 - 240	117	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	None	RS232 Handshaking Mode None = No RTS/CTS control. 3 wire connection. Modem = Uses RTS/CTS flow control. 5 wire connection.
Modem Dial	OFF 1 - 5	Off	Allocates the phone number for alarm dial out

12.16 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
Fault History Log	-	-	This option is used to display the most recent 50 events 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 hour's value.
Operating Parameter Log			This log captures operating parameters every 30 minutes and build a log of 200 screens. The parameters are indexed to the run hour's value.

Fuel Log			These logs captures fuel replenishments by start and finish % values. The values are indexed to the run hour's value. Logging occurs on fuel reduction when the engine is not running and fuel increase at all times.

13. Communications

The unit is fitted with a fully functional communications port, which communicates using Modbus ASCII and RTU protocols. 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. There are additional modules for Fibre Optic, Ethernet and TCP/IP.

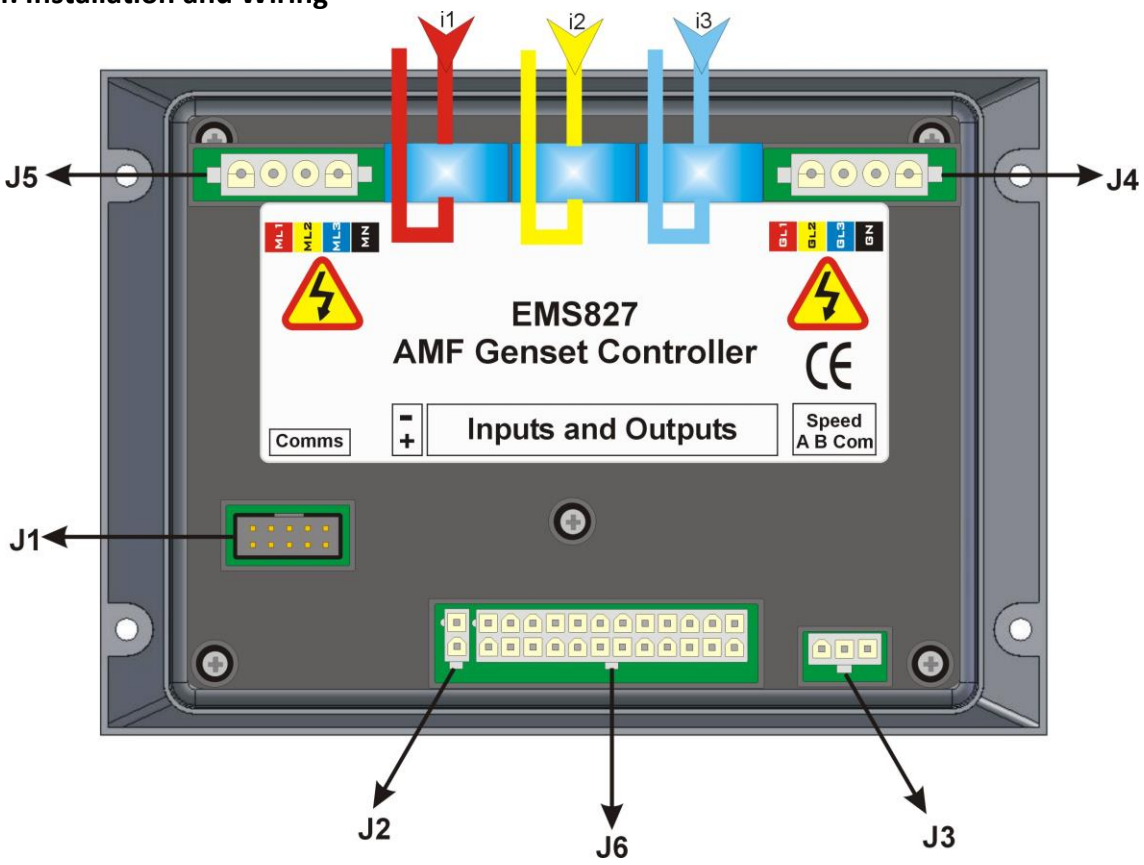
13.1 Unit General Specifications

Feature	Specification
Overall Dimensions	180 x 126 x 51mm
Mounting Hole	155 x 117mm
IP rating	IP56 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 < 10mA Running 70mA
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 362VDC max. Short Circuit protected.

Feature	Specification
Digital Input Rating	Opto-coupler isolated. Whetting current 10mA at 12 V DC. DC input protection for +/- 30V DC Transient Protected.
Analog Input Rating	Current limited outputs approx 15mA or less as required by sensors/ Short circuit and reverse voltage protected.
Input Reference	0V Common
Displayed Speed Range	0 – 4000 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 (VDO/Datcon)
Oil Pressure Range	500, 750, 1000 KPa
Engine Temperature Sensor Type	Switch: Close on fault Resistive (NTC)
Engine Temperature Range	VDO 120ºC, VDO 150ºC, VDO 200ºC
Canopy Temperature Sensor Type	Switch: Close on fault Resistive (NTC)
Canopy Temperature Range	EMS08 0-100 ºC
Oil Temperature	Switch: Close on fault Resistive (NTC)
Oil Temperature Range	40ºC-150ºC
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	8 to 36 Volts
Set-up and Adjustment	All features may be adjusted using set-up buttons and LCD menu or via a PC Windows based utility

Feature	Specification
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

14. Installation and Wiring



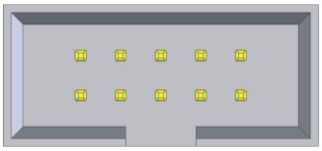
NB: The unit is a complex electronic device and caution should be taken to ensure correct wiring before power is applied.

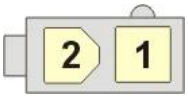
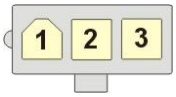
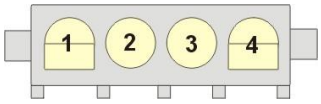
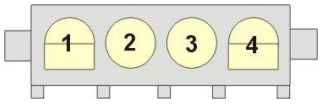
The unit is fitted with 2, 3, 8 and 14 way Molex Minifit or equivalent socket connectors for which mating plugs can be selected from the Amp PE, or TPK range.

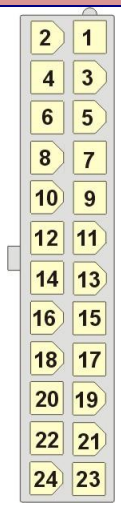
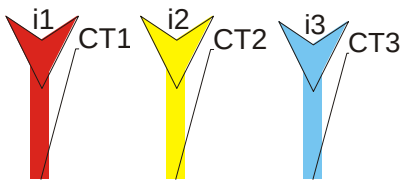
The unit is also fitted with 4 way Mate-N-Lok or equivalent socket connectors for which mating plugs supplied by Tyco Electronics or equivalent can be used.

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.

14.1 Connector Detail

Connector Assignment	Connection Information
J1: Data Port 	Programming and Auxiliary Unit data port. **NB: Connect ONLY manufacturer approved equipment to this port**

Connector Assignment	Connection Information	
J2: DC Power Supply 	**Pin**	**Connection**
	1	Common –ve. ***(Note 1)***
	2	Battery +ve. ***(Note 2)***
J3: Speed Input 	**Pin**	**Connection**
	1	Speed Input A
	2	Speed Input B
	3	Speed Common
J4: Alternator AC Input 	**Pin**	**Connection**
	1	Alternator AC Phase 1 (Red)
	2	Alternator AC Phase 2 (Yellow)
	3	Alternator AC Phase 3 (Blue)
	4	Alternator AC Neutral
J5: Mains AC Input 	**Pin**	**Connection**
	1	Mains AC Phase 1 (Red)
	2	Mains AC Phase 2 (Yellow)
	3	Mains AC Phase 3 (Blue)
	4	Mains AC Neutral
J6: I/O	**Pin**	**Connection**
	1	Water Level Input
	2	Fuel Level Input
	3	Engine Temperature Input
	4	Canopy Temperature Input

Connector Assignment	Connection Information	
	5	Oil Pressure Input
	6	Oil Temperature Input
	7	Auto Start Input
	8	Emergency Stop Input
	9	Oil Pressure Switch Input
	10	I/P1 VBelt Input
	11	I/P2 Bypass Input
	12	I/P4 Canopy Door Input
	13	I/P3 Fire Alarm Input
	14	I/P5 User Definable Input
	15	Inputs Common (0V)
	16	Preheat Output
	17	Fuel Solenoid Output
	18	Crank Output
	19	Idle Output
	20	Contactor A Output
	21	Contactor B Output
	22	Sounder Output
	23	Excitation Output
	24	Outputs Common (0V)
CT1, CT2 & CT3: **Current Transformers** 	**CT**	**Use**
	1	Phase 1 Current (Red) *(Note 3)*
	2	Phase 2 Current (Yellow) *(Note 3)*
	3	Phase 3 Current (Blue) *(Note 3)*

Notes:

1. *This connection must be made directly to the engine crankcase for lowest electrical noise. This connection must not have currents other than the controller currents flowing and must be used exclusively for the controller.*

2. *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.*

3. *Wire must be passed through the CT in the direction of the arrow.*

15. 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. The hooter can be silenced with the Hooter 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 High Water Temp	Engine temperature has exceeded the high temperature set point. The temperature icon turns on. Either message may also be shown 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.
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.

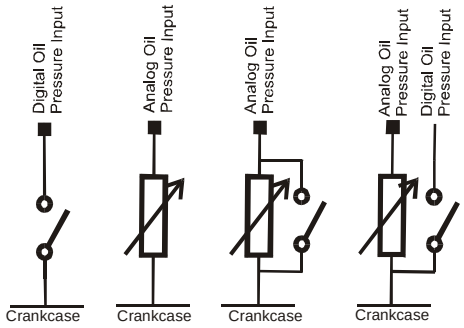
Engine Temp Flt	The unit has detected that the engine temperature has not risen to 50 degrees within the first 5 minutes of running or the temperature sensor has shorted to common. Normally this indicates a faulty temperature sender or broken wiring.
Oil Temp Flt	The unit has detected that the Oil temperature sender has become open circuit.
High Canopy Temp	The unit has detected a high canopy temperature.

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.

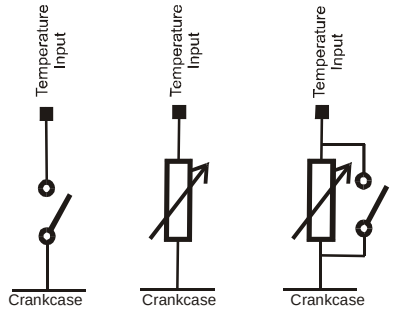
Message	Cause
No Excitation	Excitation voltage is low when engine is running. This indicates a probable charging fault or the alternator belt has broken.
Low Charge Volts	Battery Voltage is below the charging voltage setpoint when the engine is running. Indicates that the alternator is not charging the 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.
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 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 after the Temperature monitoring delay has expired.
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  button for 30 seconds. If the engine maintenance is carried out prior to the timer expiring, pressing the  button for 60 seconds will reset the timer.

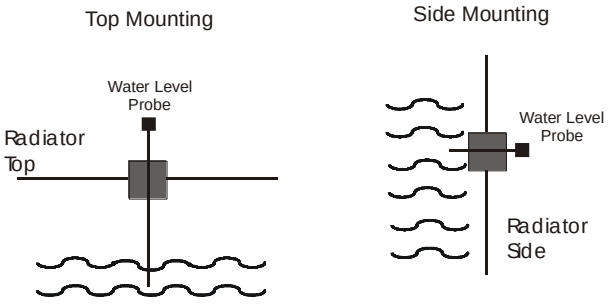
16. Wiring Options



Oil Pressure Sensing Options

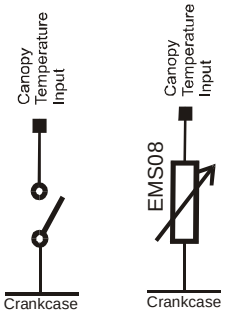


Temperature Sensing Options

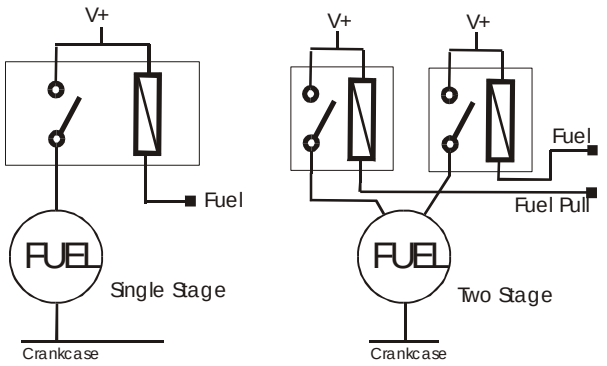


Note: The radiator must be electrically bonded to the crankcase common.

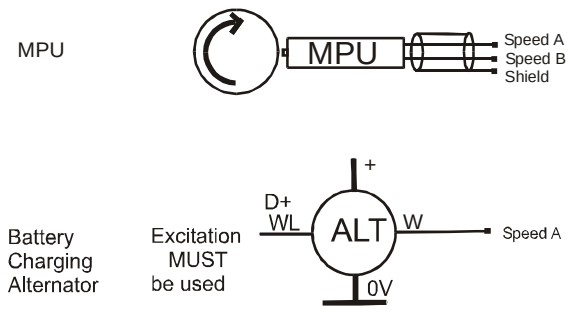
Water Level Wiring Options



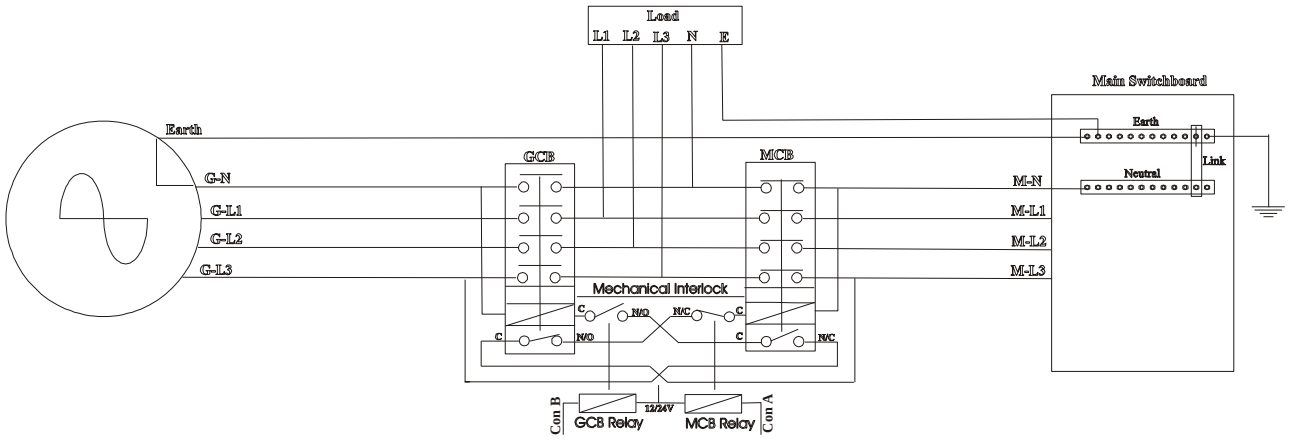
Canopy Temperature Wiring Options



Fuel Solenoid Wiring Options



Speed Detection Options

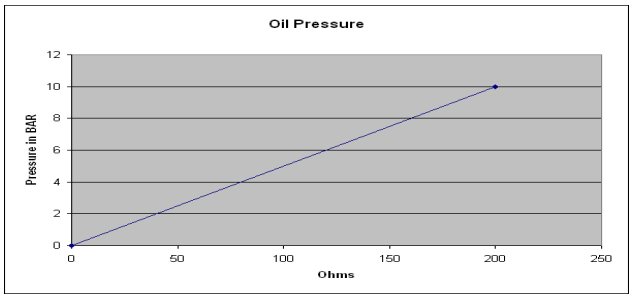


Typical Contactor Control

1. Engine Sensor Tables

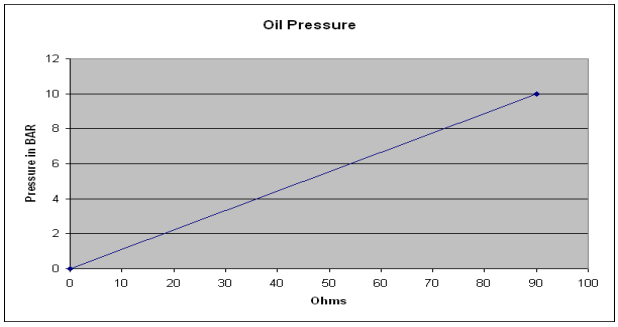
PowerTech Oil Pressure Sensor

Ohms	Pressure in BAR
0	0
200	10



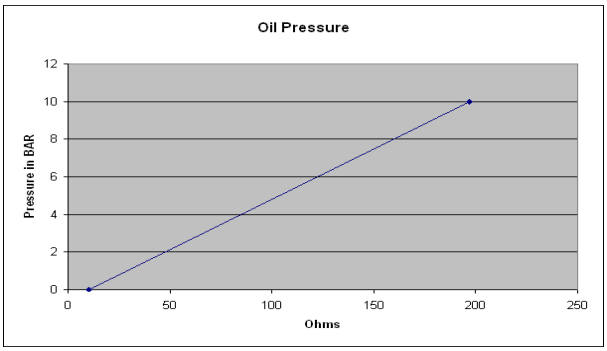
0-90 Oil Pressure Sensor

Ohms	Pressure in BAR
0	0
90	10



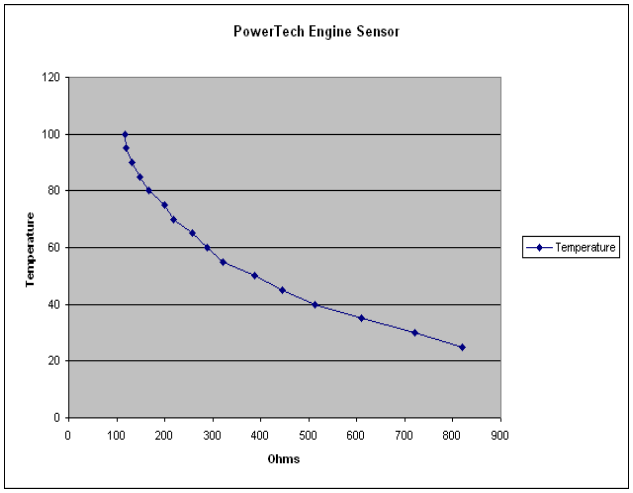
10-180 Oil Pressure Sensor

Ohms	Pressure in BAR
10	0
197	10



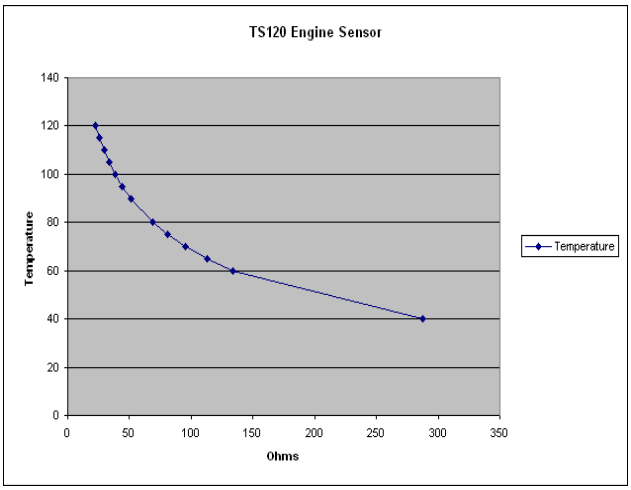
PowerTech Engine Temperature Sensor

Ohms	Temperature
820	25
720	30
609	35
513	40
445	45
388	50
321	55
289	60
257	65
219	70
199.2	75
166.6	80
149	85
132.5	90
119.7	95
116.6	100



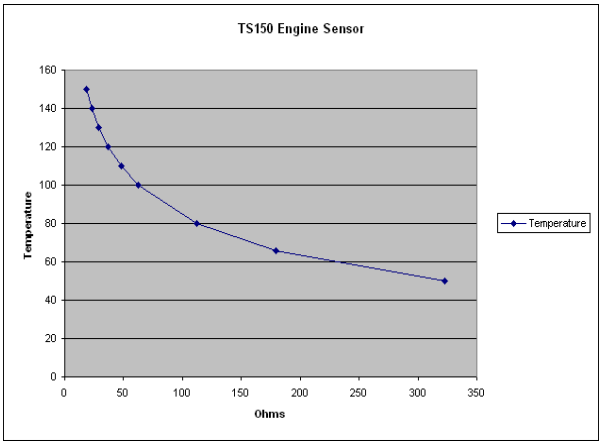
TS120 Engine Temperature Sensor

Ohms	Temperature
287.4	40
134	60
112.6	65
95.2	70
80.9	75
69.1	80
51.2	90
44.3	95
38.5	100
33.6	105
29.4	110
25.8	115
22.7	120



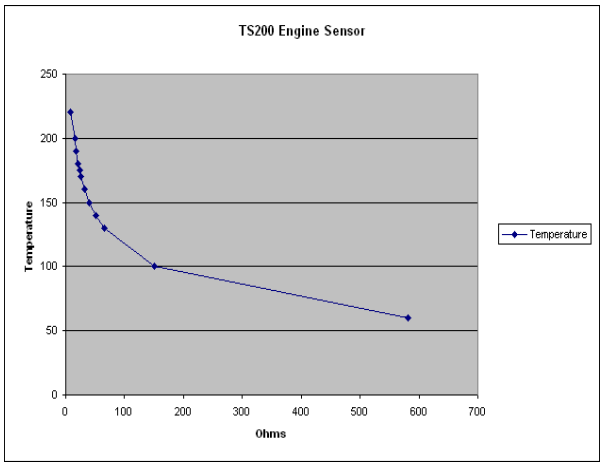
TS150 Engine Temperature Sensor

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



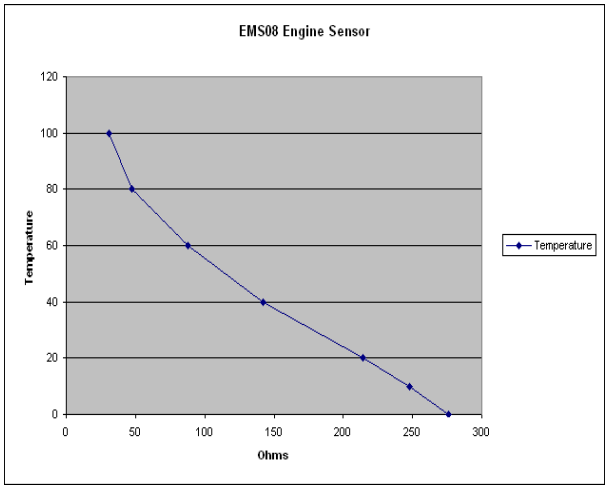
TS200 Engine Temperature Sensor

Ohms	Temperature
581	60
151.2	100
65.5	130
51.2	140
40.3	150
32.2	160
25.8	170
23.3	175
21.1	180
17.3	190
16.6	200
7.5	220



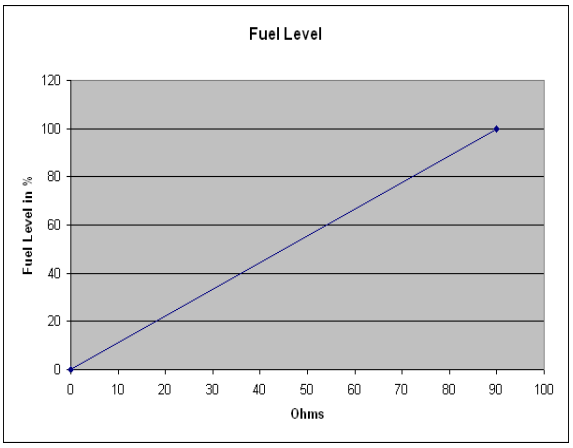
EMS08 Room Temperature Sensor

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



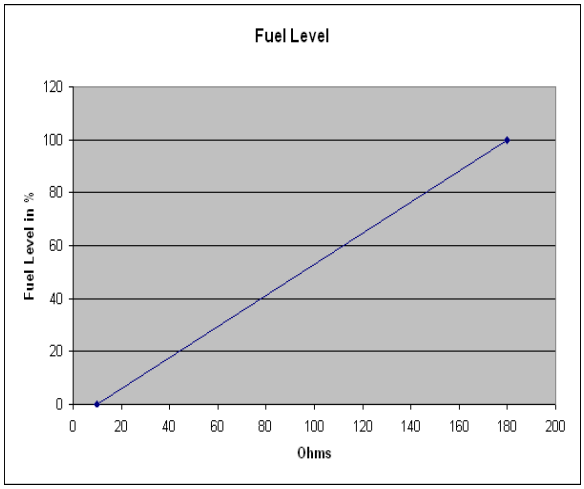
0-90 Fuel Level Sensor

Ohms	Fuel Level %
0	0
90	100



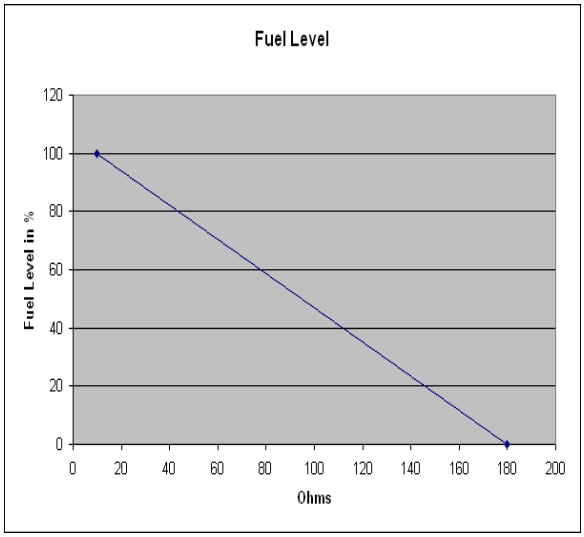
10-180 Fuel Level Sensor

Ohms	Fuel Level %
10	0
180	100



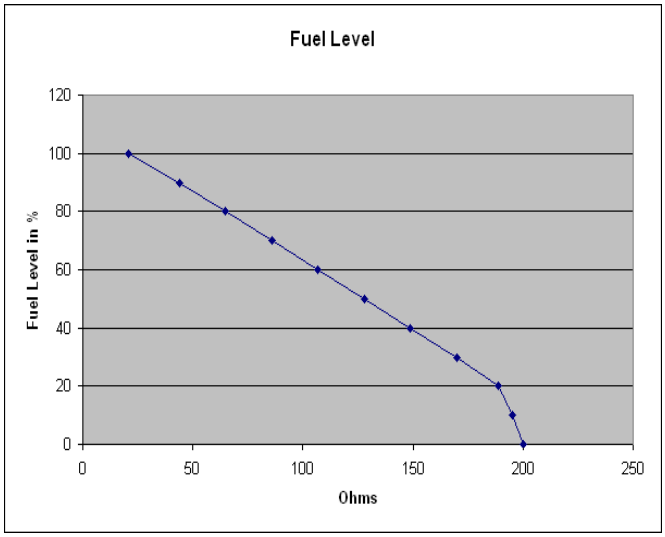
10-180 Fuel Level Sensor

Ohms	Fuel Level %
180	0
10	100



EMS820 Fuel Level Sensor

Ohms	Fuel Level %
200	0
195.2	10
188.6	20
170	30
148.5	40
127.8	50
106.8	60
86	70
64.8	80
43.8	90
20.9	100



Fuel Level in Setup Menu (Default values)

Ohms	Fuel Level %
16	0
33	10
62	20
92	30
121	40
142	50
159	60
170	70
174	80
178	90
182	100