DEEP SEA ELECTRONICS

DSEG8600 Operator Manual

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DSEG8600 Operator Manual

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1 INTRODUCTION

NOTE: This entire manual must be carefully read before working on the DSEG8600 module.

This document details the installation and operation requirements of the DSEG8600 module and is part of the DSEGenset® range of products.

The manual forms part of the product and must be kept for the entire life of the product. If the product is passed or supplied to another party, ensure that this document is passed to them for reference purposes.
This is not a *controlled document.* DSE do not automatically inform on updates. Any future updates of this document are included on the DSE website at www.deepseaelectronics.com

The DSEG8600 series is designed to provide differing levels of functionality across a common platform. This allows the generator OEM greater flexibility in the choice of controller to use for a specific application.

The DSEG8600 module has been designed to allow the operator to start, stop and synchronise the generator, and if required, transfer the load to the generator either manually or automatically.

The DSEG8600 module contains two software applications, Multi Set (MS) and Single Set (SS). This allows to convert the DSEG8600 module into an Multi Set (MS) for multiple generator synchronising application, by selection in the Application menu. Detailed instructions are found in the *Multi Set (MS) & Single Set (SS) Application Selection Menu* in section 2 in this document.

Synchronising and Load Sharing features are included within the controller, along with the necessary protections for such a system. This provides the functionality to operate in parallel with the mains supply.

The DSEG8600 module monitors the engine, indicating the operational status and fault conditions, automatically shutting down the engine and giving a true first up fault condition of an engine failure by the text LCD display.

The powerful ARM microprocessor contained within the module allows for incorporation of a range of complex features:

- *Text based LCD display*
- *True RMS Voltage*
- *Current and Power monitoring*
- *USB, RS485 and Ethernet Communications*
- *Engine parameter monitoring.*
- *Mains (Utility) Supply monitoring.*
- *Fully configurable inputs for use as alarms or a range of different functions.*
- *Engine ECU interface to electronic engines including Tier 4 engines.*
- *Synchronising and load sharing with the Mains source*
- *Integral PLC to help provide customisation where required*
- *Fuel tank level monitoring to track fuel filling operations and detect fuel leak/theft*
- *Data Logging*
- *Direct connection to governor / AVR for synchronising and load sharing*
- *R.O.C.O.F. and vector shift protection for detection of mains failure when in parallel with the mains.*

The DSE Configuration Suite PC Software allows alteration of selected operational sequences, timers, alarms, and operational sequences. Additionally, the module's integral front panel configuration editor allows adjustment of this information.

Access to critical operational sequences and timers for use by qualified engineers, are protected by a security code. Module access is also be protected by a PIN code. Selected parameters are changed from the module's front panel.

The module is housed in a robust plastic case suitable for panel mounting. Connections to the module are via locking plug and sockets. Detailed instruction is found in the section entitled *Terminal Specification* elsewhere in this document.

1.1 CLARIFICATION OF NOTATION

Clarification of notation used within this publication.

NOTE:	**Highlights an essential element of a procedure to ensure correctness.**
CAUTION!	**Indicates a procedure or practice, which, if not strictly observed, may result in damage or destruction of equipment.**
WARNING!	**Indicates a procedure or practice, which may result in injury to personnel or loss of life if not followed correctly.**

1.2 GLOSSARY OF TERMS

Term	Description
AC	Alternating Current
AMSC	Advanced Multi-Set Communication
AVR	Automatic Voltage Regulator
BMS	Building Management System. A digital/computer-based control system for a building's infrastructure.
BUS	BUS is a communication system that transfers data between components inside a computer, or between computers.
CAN	Controller Area Network Vehicle standard to allow digital devices to communicate to one another.
CT	Current Transformer. An electrical device that takes a large AC current and scales it down by a fixed ratio to a smaller current.
DC	Direct Current
DEF	Diesel Exhaust Fluid (AdBlue). A liquid used as a consumable in the SCR process to lower nitric oxide and nitrogen dioxide concentration in engine exhaust emissions.
DHCP	DHCP (Dynamic Host Configuration Protocol) is a protocol that provides quick, automatic, and central management for the distribution of IP addresses within a network.
DM1	Diagnostic Message 1.A DTC that is currently active on the engine ECU.
DM2	Diagnostic Message 2.A DTC that was previously active on the engine ECU and has been stored in the ECU's internal memory.
DNS	Domain Name System.
DPF	Diesel Particulate Filter. A filter fitted to the exhaust of an engine to remove diesel particulate matter or soot from the exhaust gas.
DPTC	Diesel Particulate Temperature Controlled Filter. A filter fitted to the exhaust of an engine to remove diesel particulate matter or soot from the exhaust gas which is temperature controlled.
DTC	Diagnostic Trouble Code. The name for the entire fault code sent by an engine ECU.
ECU/ECM	Engine Control Unit/Management. An electronic device that monitors engine parameters and regulates the fuelling.
EMC	Electromagnetic Compatibility is the ability of electrical equipment and systems to function in their electromagnetic environment
FMI	Failure Mode Indicator. A part of DTC that indicates the type of failure, e.g., high, low, open circuit etc.
FPE	Front Panel editor
GB	Gigabyte

Parameter descriptions are continued overleaf…

Term	Description
GSM	Global System for Mobile communications. Cell phone technology used in most of the World.
CDMA	Code Division Multiple Access. Cell phone access used in small number of areas including parts of the USA and Australia.
GPRS	General Packet Radio Service
IDMT	Inverse Definite Minimum Time
IEEE	Institute of Electrical and Electronics Engineers
ISBN	International Standard Bibliographic Description
LAN	Local area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MAC	Media Access Control Address. A MAC address is a hardware identification number that uniquely identifies each device on a network.
MPU	Magnetic Pickup
NAPT	Network Address and Port Translation
NVD	Neutral Voltage Displacement
OC	Occurrence Count. A part of DTC that indicates the number of times that failure has occurred.
OEM	Original Equipment Manufacturer
PCI	Peripheral Component Interface
PCMCIA	Personal Computer Memory Card International Association
PDU	Protocol Data Unit.
PGN	Parameter Group Number. A CANbus address for a set of parameters that relate to the same topic and share the same transmission rate.
PID	Gain (P), Stability (I) and Derivative (D) settings of the engine's governor
PIN	PIN number
PLC	Programmable Logic Controller. A programmable digital device used to create logic for a specific purpose.
RMS	Root Mean Square
ROCOF	Rate Of Change Of Frequency
RPM	Revolutions Per Minute
RTD	Resistance Thermometer Detectors
SCADA	Supervisory Control And Data Acquisition. A system that operates with coded signals over communication channels to provide control and monitoring of remote equipment
SCR	Selective Catalytic Reduction. A process that uses DEF with the aid of a catalyst to convert nitric oxide and nitrogen dioxide into nitrogen and water to reduce engine exhaust emission.
SNMP	Simple Network Management Protocol. An international standard protocol for managing devices on IP networks.
SPN	Suspect Parameter Number. A part of DTC that indicates what the failure is, e.g., oil pressure, coolant temperature, turbo pressure etc.
TCP	TCP (Transmission Control Protocol) is a standard that outlines the procedures for establishing and maintaining a network conversation that enables application programs to exchange data.
UL	Underwriters Laboratory
USB	Universal Serial Bus
WAN	Wide Area Network
WEEE	Waste Electrical and Electronic Equipment

Parameter descriptions are continued overleaf…

1.3 BIBLIOGRAPHY

This document refers to, and is referred by the following DSE publications which are obtained from the DSE website: www.deepseaelectronics.com or by contacting DSE technical support: support@deepseaelectronics.com.

1.3.1 INSTALLATION INSTRUCTIONS

Installation instructions are obtained from the DSE website: www.deepseaelectronics.com or by contacting DSE technical support: support@deepseaelectronic.com and are intended as a 'quick start' guide only.

DSE Part	Description
053-032	DSE2548 LED Expansion Annunciator Installation Instructions
053-033	DSE2130 Input Expansion Installation Instructions
053-034	DSE2157 Output Expansion Installation Instructions
053-049	DSE9xxx Battery Charger Installation Instructions
053-125	DSE2131 Ratio-metric Input Expansion Installation Instructions
053-126	DSE2133 RTD/Thermocouple Input Expansion Installation Instructions
053-134	DSE2152 Ratio-metric Output Expansion Installation Instructions
053-147	DSE9460 & DSE9461 Battery Charger Installation Instructions
053-185	DSE9473 & DSE9483 Battery Charger Installation Instructions
053-251	DSE BC2410Ei Installation Instructions
053-256	DSEG8600 Installation Instructions
053-263	DSEG0123 Installation Instructions
053-267	DSE BC1205 & DSE BC2405 Installation Instructions

1.3.2 MANUALS

Product manuals are obtained from the DSE website: www.deepseaelectronics.com or by contacting DSE technical support: support@deepseaelectronic.com.

DSE Part	Description
057-004	Electronic Engines and DSE Wiring Guide
057-045	Guide to Synchronising and Load Sharing Part 1 (Usage of DSE Load Share Controllers in synchronisation / load sharing systems.)
057-046	Guide to Synchronising and Load Sharing Part 2 (Governor & AVR Interfacing)
057-047	Load Share System Design and Commissioning Guide
057-082	DSE2130 Input Expansion Operator Manual
057-083	DSE2157 Output Expansion Operator Manual
057-084	DSE2548 Annunciator Expansion Operator Manual
057-085	DSE9xxx Battery Charger Operator Manual
057-139	DSE2131 Ratio-metric Input Expansion Manual
057-140	DSE2133 RTD/Thermocouple Expansion Manual
057-141	DSE2152 Ratio-metric Output Expansion Manual
057-151	DSE Configuration Suite PC Software Installation & Operation Manual
057-175	PLC Programming Guide for DSE Controllers
057-176	DSE9460 & DSE9461 Battery Charger Operator Manual
057-220	Options for Communications with DSE Controllers
057-254	DSE8610 MKII Operator Manual
057-301	DSE8620 MKII Operator Manual
057-315	DSE BC2410Ei Configuration Suite PC Software Manual
057-350	DSEG0123 Operator Manual
057-355	DSE BC1205 & BC2405 Operator Manual
N/A	DSEGencomm (Modbus protocol for DSE controllers)

1.3.3 TRAINING GUIDES

Training guides are provided as ‘hand-out’ sheets on specific subjects during training sessions and contain specific information regarding to that subject.

DSE Part	Description
056-001	Four Steps To Synchronising
056-005	Using CTs With DSE Products
056-006	Introduction to Comms
056-010	Over Current Protection
056-013	Load Demand Scheme
056-018	Negative Phase Sequence
056-019	Earth Fault Protection
056-020	Loss of Excitation
056-021	Mains Decoupling
056-022	Breaker Control
056-023	Adding New CAN Files
056-024	GSM Modem
056-026	kW, kvar, k VA and pf.
056-029	Smoke Limiting
056-030	Module PIN Codes
056-033	Synchronising Requirements
056-036	Expansion Modules
056-043	Sync Process
056-045	PLC as Load Demand Controller
056-047	Out of Sync and Failed to Close
056-051	Modbus Control
056-053	Recommended Modems
056-055	Alternate Configurations
056-057	SW1 & SW2
056-069	Firmware Update
056-072	Dead Bus Synchronising
056-075	Adding Language Files
056-076	Gencomm Alarms
056-079	Gencomm Status
056-080	Modbus
056-081	Screen Heaters
056-082	Override Gencomm PLC Example
056-084	Synchronising & Load sharing
056-086	G59
056-091	Equipotential Earth Bonding
056-092	Best Practices for Wiring Restive Sensors
056-095	Remote Start Input Functions
056-097	USB Earth Loop and Isolation
056-099	Digital Output to Digital Input Connection

1.3.4 THIRD PARTY DOCUMENTS

The following third-party documents are also referred to:

Reference	Description
ISBN 1-55937-879-4	IEEE Std C37.2-1996 IEEE Standard Electrical Power System Device Function Numbers and Contact Designations. Institute of Electrical and Electronics Engineers Inc
ISBN 0-7506-1147-2	Diesel Generator Handbook. L.L.J. Mahon
ISBN 0-9625949-3-8	On-Site Power Generation. EGSA Education Committee.

2 MULTI SET (MS) AND SINGLE SET (SS) APPLICATION SELECTION MENU

NOTE: Care must be taken when updating the module's firmware as this resets the configuration files for the Multi Set (MS) and the Single Set (SS) software applications back to their factory defaults.

NOTE: The module contains one Data Logging file for both the Multi Set (MS) and the Single Set (SS) software applications. The logged data is maintained and is accessible after the software application is changed.

The DSEG8600 module contains two selectable software applications:

- Multi Set (MS)
- Single Set (SS)

The two software applications within the DSEG8600 module allows the user to easily convert to Multi Set (MS) if required. This is useful when the system is upgraded to a multiple generator synchronising system as the Multi Set (MS) application enables the AMSC connection to other DSEG8600 modules. For further details, refer to the sections *Display Settings* and *Front Panel Editor* elsewhere in this document.

3 SPECIFICATION

3.1 OPERATING TEMPERATURE

Module	Specification
DSEG86xx	-30 ºC +70 ºC (-22 ºF +158 ºF)
Display Heater	-40 ºC +70 ºC (-40 ºF +158 ºF)

3.1.1 SCREEN HEATER OPERATION

The heater operates on a sliding power output to maintain good visibility below 0ºC.

3.2 REQUIREMENTS FOR UL

WARNING!: More than one live circuit exists, refer to the section entitled *Typical Wiring Diagram* elsewhere in this document.

Specification	Description
Screw Terminal Tightening Torque	4.5 lb-in (0.5 Nm)
Conductors	Terminals suitable for connection of conductor size 13 AWG to 20 AWG (0.5 mm² to 2.5 mm²). Conductor protection must be provided in accordance with NFPA 70, Article 240. Low voltage circuits (35 V or less) must be supplied from the engine starting battery or an isolated secondary circuit. The communication, sensor, and/or battery derived circuit conductors shall be separated and secured to maintain at least ¼" (6 mm) separation from the generator and mains (utility) connected circuit conductors unless all conductors are rated 600 V or greater.
Current Inputs	Must be connected through UL Listed or Recognized isolating current transformers with the secondary rating of 5 A max.
CTs	Protection Class CTs must be used on the phases for the Short Circuit Protection
Communication Circuits	Must be connected to communication circuits of UL Listed equipment
Fuel Output Relay	The slave relay on the Fuel output must meet the UL 6200 requirements.
DC Output Pilot Duty	Fuel and Crank: 2.0 A VA/Pilot Duty Auxiliaries: 1.0 A VA/Pilot Duty
Mounting	Suitable for flat surface mounting in Type 1 Enclosure Type rating with surrounding air temperature -22 ºF to +158 ºF (-30 ºC to +70 ºC). Suitable for pollution degree 3 environments when voltage sensing inputs do not exceed 300 V. When used to monitor voltages over 300 V device to be installed in an unventilated or filtered ventilation enclosure to maintain a pollution degree 2 environment.
Operating Temperature	-22 ºF to +158 ºF (-30 ºC to +70 ºC)
VTs	When using voltage transformers (VTs) they must be fitted to both generator and bus sensing, have the same ratio from the primary to secondary windings, and a 0° phase offset between the primary and secondary windings.

3.3 TERMINAL SPECIFICATION

Description	Specification	
Connection Type	Two-part connector. Male part fitted to module Female part supplied in module packing case - Screw terminal, rising clamp, no internal spring.	 Example showing cable entry and screw terminals of a 10-way connector
Minimum Cable Size	0.5 mm² (AWG 20)	
Maximum Cable Size	2.5 mm² (AWG 13)	
Tightening Torque	0.5 Nm (4.5 lb-in)	
Wire Strip Length	7 mm (9/32”)	

3.4 POWER SUPPLY REQUIREMENTS

Description	Specification
Minimum Supply Voltage	5 V continuous
Cranking Dropouts	Able to survive 0 V for 100 ms providing the supply was at least greater than 5 V for 2 seconds before the dropout and recovers to 5 V afterwards.
Maximum Supply Voltage	35 V continuous (60 V protection)
Reverse Polarity Protection	-35 V continuous
Maximum Operating Current	700 mA at 12 V 350 mA at 24 V
Maximum Standby Current	350 mA at 12 V 190 mA at 24 V
Maximum Current When In Sleep Mode	110 mA at 12 V 60 mA at 24 V
Typical Power (Controller On, Heater Off)	4.0 W to 4.5 W
Typical Power (Controller On, Heater On)	4.5 W to 11 W

3.4.1 MODULE SUPPLY INSTRUMENTATION DISPLAY

Description	Specification
Range	0 V to 70 V DC (Maximum continuous operating voltage of 35 V DC)
Resolution	0.1 V
Accuracy	1 % full scale (±0.35 V)

3.5 VOLTAGE & FREQUENCY SENSING

Description	Specification
Measurement Type	True RMS conversion
Sample Rate	40 kHz
Harmonics	Up to 21st or better
Input Impedance	450 kΩ phase to neutral
Phase To Neutral	15 V (minimum required for sensing frequency) to 415 V AC (absolute maximum) Suitable for 345 V AC nominal (±20 % for under/overvoltage detection)
Phase To Phase	25 V (minimum required for sensing frequency) to 720 V AC (absolute maximum) Suitable for 600 V AC nominal (±20 % for under/overvoltage detection)
Common Mode Offset From Earth	100 V AC (max)
Resolution	1 V AC phase to neutral 2 V AC phase to phase
Accuracy	±1 % of full-scale phase to neutral ±1 % of full-scale phase to phase
Minimum Frequency	3.5 Hz
Maximum Frequency	75.0 Hz
Frequency Resolution	0.1 Hz
Frequency Accuracy	±0.05 Hz
Overvoltage category III	Up to 300V L-N and up to an altitude of 2000 m
Overvoltage category II	Greater than 300V and less than 415V L-N, up to an altitude 2000 m
Overvoltage category II	Less than 300V L-N and up to an altitude of 5000 m

3.6 CURRENT SENSING

Description	Specification
Measurement Type	True RMS conversion
Sample Rate	40 kHz
Harmonics	Up to 21st or better
Nominal CT Secondary Rating	1 A and 5 A
Maximum Continuous Current	5 A
Overload Measurement	15 A
Absolute Maximum Overload	50 A for 1 second
Burden	0.5 VA (0.02 Ω current shunts)
Common Mode Offset	70 V peak plant ground to CT common terminal under fault condition
Resolution	25 mA
Accuracy	±1 % of Nominal (excluding CT error)

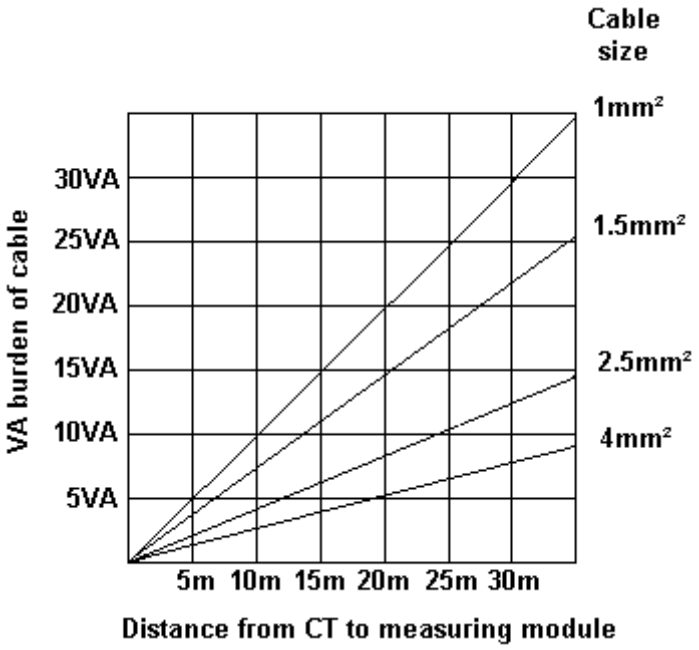
3.6.1 VA RATING OF THE CTS

NOTE: Details for 4 mm² cables are shown for reference only. The connectors on the DSE modules are only suitable for cables up to 2.5 mm².

The VA burden of the module on the CTs is 0.5 VA. However, depending upon the type and length of cabling between the CTs and the module, CTs with a greater VA rating than the module are required.

Estimate the distance between the CTs and the measuring module and cross-reference it against the chart opposite to find the VA burden of the cable itself."

If the CTs are fitted within the alternator top box, connect the star point (common) of the CTs to system ground (earth) as close as possible to the CTs. This minimizes the length of cable used to connect the CTs to the DSE module.



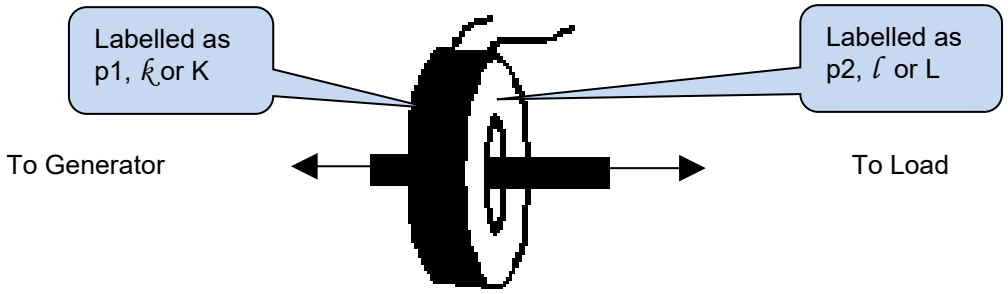
Example:
If 1.5 mm² cable is used and the distance from the CT to the measuring module is 20 m, then the burden of the cable alone is approximately 15 VA. As the burden of the DSE controller is .5 VA, then a CT with a rating of at least 15 VA + 0.5 VA = 15.5 VA must be used. 0.5 VA, then a CT with a rating of at least 15 VA + 0.5 VA = 15.5 VA must be used. If 2.5 mm² cables are used over the same distance of 20 m, then the burden of the cable on the CT is approximately 7 VA. CT's required in this instance is at least 7.5 VA (7 + 0.5).

3.6.2 CT POLARITY

NOTE: Take care to ensure correct polarity of the CT primary as shown above. If in doubt, check with the CT supplier.

Take care to ensure the correct polarity of the CTs. Incorrect CT orientation leads to negative kW readings when the set is supplying power. Take note that paper stick-on labels on CTs that show the orientation are often incorrectly placed on the CT. It is more reliable to use the labelling in the case moulding as an indicator to orientation (if available).

To test orientation, run the generator in island mode (not in parallel with any other supply) and load the generator to around 10 % of the set rating. Ensure the DSE module shows positive kW for all three individual phase readings.



Polarity of CT Primary

3.6.3 CT PHASING

Take particular care that the CTs are connected to the correct phases. For instance, ensure that the CT on phase 1 is connected to the terminal on the DSE module intended for connection to the CT for phase 1.

Additionally, ensure that the voltage sensing for phase 1 is connected to generator phase 1. Incorrect connection of the phases as described above results in incorrect power factor (pf) measurements, which in turn results in incorrect kW measurements.

One way to check for this is to make use of a single-phase load. Place the load on each phase in turn, run the generator and ensure the kW value appears in the correct phase. For instance, if the load is connected to phase 3, ensure the kW figure appears in phase 3 display and not in the display for phase 1 or 2.

3.6.4 CT CLASS

Ensure the correct CT type is chosen. For instance, if the DSE module is providing over current protection, ensure the CT measures the overload level required to protect against, and at the accuracy level required.

For instance, this may mean fitting a protection class CT (P15 type) to maintain high accuracy while the CT is measuring overload currents.

Conversely, if the DSE module is using the CT for instrumentation only (current protection is disabled or not fitted to the controller), then measurement class CTs are used. Again, bear in mind the accuracy required. The DSE module is accurate to better than 1% of the full-scale current reading. To maintain this accuracy, fit a Class 0.5 or Class 1 CT.

Check with the CT manufacturer for further advice on selecting CTs.

3.7 INPUTS

3.7.1 DIGITAL INPUTS

Description	Specification
Number	9 configurable digital inputs (16 when *Analogue Inputs* are configured as digital inputs)
Arrangement	Contact between terminal and ground
Low Level Threshold	2.1 V minimum
High Level Threshold	6.6 V maximum
Maximum Input Voltage	+50 V DC with respect to plant supply negative
Minimum Input Voltage	-24 V DC with respect to plant supply negative
Contact Wetting Current	7 mA typical
Open Circuit Voltage	12 V typical

3.7.2 EMERGENCY STOP

Description	Specification
Arrangement	Contact between terminal and module supply positive
Closed Threshold	5 V minimum
Open Threshold	3 V maximum
Maximum Input Voltage	+35 V DC with respect to plant supply negative (60 V protection for 1 minute)
Minimum Input Voltage	-24 V DC with respect to plant supply negative
Maximum Current Rating	15 A
Open Circuit Voltage	0 V

3.7.3 ANALOGUE INPUTS

All the analogue inputs are flexible within the DSE module

NOTE: The resistive input display range is configurable for all the analogue inputs from the flex sensor input type configuration. The range and fault thresholds are editable using the change axis range options. The fixed functions oil / temp / fuel level are editable from the engine oil / fuel / temp input options.

3.7.3.1 ANALOGUE INPUT A

Description	Specification
Input Type	Flexible: Configured for *Oil Sensor* in the DSE default configuration. Flexible Options: Not used, Digital Input, Flexible Analogue Oil Sensor
Flexible Input Selection	Pressure Sensor, Percentage Sensor, or Temperature Sensor
Flexible Measured Quantity	Current, Restive or Voltage

Resistive Configuration

Description	Specification
Measurement Type	Resistance measurement by measuring voltage across sensor with a fixed current applied
Arrangement	Differential resistance measurement input
Measurement Current	15 mA ± 2 mA %
Full Scale	3KΩ (H/W functionality to >30KΩ) S/W controlled Over range > 3000R S/W determined
Over Range / Fail	350 Ω
Resolution	±1 % of full scale
Accuracy	±2 % of full-scale resistance (±9.6 Ω) excluding sensor error
Max Common Mode Voltage	±2 V
Display Range	Configurable by PC Software

0 V to 10 V Configuration

Description	Specification
Full Scale	0 V to 10 V
Over Range / Fail	11 V
Resolution	±1% of full scale
Accuracy	±2% of full-scale voltage (±0.2 V) excluding sensor error
Max Common Mode Voltage	±2 V
Display Range	Configurable by PC Software

4 mA to 20 mA Configuration

Description	Specification
Full Scale	0 mA to 20 mA
Over Range / Fail	22 mA
Resolution	1% of full scale
Accuracy	±2% of full-scale current (±0.4 mA) excluding sensor error
Max Common Mode Voltage	±2 V
Display Range	Configurable by PC Software

3.7.3.2 ANALOGUE INPUT B, C & D

Description	Specification
Analogue Input B Type	Flexible: Configured for *Temperature Sensor* in the DSE default configuration. Flexible Options: Not used, Digital Input and Flexible Analogue
Analogue Input C Type	Flexible: Configured for *Fuel Sensor* in the DSE default configuration. Flexible Options: Not used, Digital Input and Flexible Analogue
Analogue Input D Type	Flexible: Configured for *Flexible Analogue* in the DSE default configuration. Flexible Options: Not used, Digital Input and Flexible Analogue
Flexible Input Selection	Pressure Sensor, Percentage Sensor, or Temperature Sensor
Flexible Measured Quantity	Current, Restive or Voltage

Resistive Configuration

Description	Specification
Measurement Type	Resistance measurement by measuring voltage across sensor with a fixed current applied
Arrangement	Differential resistance measurement input
Measurement Current	Nominal 10mA into short circuit for resistance measurement
Full Scale	5kΩ (H/W functionality to >50KΩ) S/W controlled Over range: > 5000R S/W determined
Over Range / Fail	600 Ω
Resolution	±1 % of full scale
Accuracy	±2 % of full-scale resistance (±9.6 Ω) excluding sensor error
Max Common Mode Voltage	±2 V
Display Range	Configurable by PC Software

0 V to 10 V Configuration

Description	Specification
Full Scale	0 V to 10 V
Over Range / Fail	11 V
Resolution	±1% of full scale
Accuracy	±2% of full-scale voltage (±0.2 V) excluding sensor error
Max Common Mode Voltage	±2 V
Display Range	Configurable by PC Software

4 mA to 20 mA Configuration

Description	Specification
Full Scale	0 mA to 20 mA
Over Range / Fail	22 mA
Resolution	±1% of full scale
Accuracy	±2% of full-scale current (±0.4 mA) excluding sensor error
Max Common Mode Voltage	±2 V
Display Range	Configurable by PC Software

3.7.4 CHARGE FAIL INPUT

The charge fail input is a combined input and output. Whenever the generator is required to run, the terminal provides excitation current to the charge alternator field winding.

When the charge alternator is correctly charging the battery, the voltage of the terminal is close to the plant battery supply voltage. In a failed charge situation, the voltage of this terminal is pulled down to a low voltage. It is this drop in voltage that triggers the *Charge Failure* alarm. The level at which this operates and whether this triggers a warning or shutdown alarm is configurable using the DSE Configuration Suite Software.

Description	Specification
Minimum Voltage	0 V
Maximum Voltage	35 V
Resolution	0.2 V
Accuracy	±1 % of full scale
Excitation	Active circuit constant power output
Output Power	2.5 W nominal at 12 V and 24 V
Current At 12V	210 mA
Current At 24V	105 mA

3.7.5 MAGNETIC PICK-UP

Magnetic Pickup devices are often shared between two or more devices. For example, one device often supplies the signal to both the DSE module and the engine governor. The possibility of this depends upon the amount of current that the magnetic pickup is able to supply.

Description	Specification
Type	Differential input
Minimum Voltage	0.5 V RMS
Maximum Voltage	70 V RMS
Max Common Mode Voltage	±2 V peak
Minimum Frequency	5 Hz
Maximum Frequency	10,000 Hz
Resolution	6.25 rpm
Accuracy	± 25 rpm
Flywheel Teeth	10 to 500

3.8 OUTPUTS

3.8.1 DC OUTPUTS A & B (FUEL & START)

Description	Specification
Type	Normally used as Fuel & Start outputs. Fully configurable for other purposes if the module is configured to control an electronic engine.
Rating	15 A resistive at Emergency Stop supply.

3.8.2 CONFIGURABLE VOLT-FREE RELAY OUTPUTS C & D

Description	Specification
Type	Normally used for load switching control Fully configurable volt-free relays. Output C normally closed and Output D normal open.
Rating	8 A resistive at 250 V AC

3.8.3 CONFIGURABLE DC OUTPUTS E, F, G, H, I, J, K & L

Description	Specification
Type	Fully configurable, supplied from DC supply terminal 2.
Rating	2 A resistive at module supply.
Capacity	Maximum Total Current Not to Exceed 15A at DC Plant supply Input (Pin 2)

3.8.4 GOVERNOR CONTROL OUTPUT

Description	Specification
Arrangement	Supplied from DC supply terminal 2
Type	Isolated DC output, voltage controlled
Voltage Range	-10 V to +10 V DC
Max Common Mode Voltage	±1 kV
Resolution	Less than 1 mV
Accuracy	±1%
Minimum Load	500 Ω
Current Mode	0-20mA / 4-20mA

3.8.5 AVR CONTROL OUTPUT

Description	Specification
Arrangement	Supplied from DC supply terminal 2
Type	Isolated DC output, voltage controlled
Voltage Range	-10 V to +10 V DC
Max Common Mode Voltage	±3 kV
Resolution	Less than 1 mV
Accuracy	±1 %
Minimum Load	500 Ω
Current Mode	0-20mA / 4-20mA

3.9 COMMUNICATION PORTS

NOTE: All communication ports are able to be used at the same time.

Description	Specification
USB Server Port	Type B USB 2.0 For connection to PC running DSE Configuration Suite Max distance 5 m (16 feet)
USB Host Port	Type A USB 2.0 Capability to add a maximum of 16 GB USB storage device for data recording only
2 x RS485 Serial Ports	Isolated Data connection 2 wire + common Half Duplex Data direction control for Transmit (by s/w protocol) Max Baud Rate 115.2 kbaud subject to configuration External termination required (120 Ω) Max common mode offset 70 V (on board protection transorb) Max distance 1.2 km (¾ mile)
Ethernet	Auto detecting 10/100 Mbit Ethernet port.
AMSC (Advanced Multi Set Communication) and CAN Port	**NOTE: For additional length, the DSE124 CAN Extender is available. For more information, refer to DSE Publication: *057-116 DSE124 Operator Manual*** Standard implementation of 'Slow mode,' up to 250 kbits/s Data connection 2 wire + common Isolated External termination required (120 Ω) Max common mode offset max 70 V, 1kv surge ECU port isolated Max distance 250 m (273 yards) using Belden 9841 Cable or equivalent Redundant AMSC 2 (CAN Port 3)
ECU Port	**NOTE: For additional length, the DSE124 CAN Extender is available. For more information, refer to DSE Publication: *057-116 DSE124 Operator Manual*** Engine CAN Port Standard implementation of 'Slow mode,' up to 250 kbit/s Isolated. Internal Termination enabled by software configuration provided (120 Ω) Max distance 40 m (43.5 yards)
DSENet® (Expansion Comms) Port	Non-isolated Data connection 2 wire + common Half Duplex Data direction control for Transmit (by s/w protocol) Baud Rate of 115 kbaud Internal termination fitted (120 Ω) Max common mode offset ±5 V Max distance 1.2 km (¾ mile)

3.10 COMMUNICATION PORT USAGE

3.10.1 USB SERVER PORT (PC CONFIGURATION)

NOTE: DSE stock 2 m (6.5 feet) USB type A to type B cable, DSE Part Number: 016-125. Alternatively, they are purchased from any PC or IT store.

NOTE: The DC supply must be connected to the module for configuration by PC.

NOTE: For further details of module configuration, refer to DSE Publication: *057-322* DSEG8600 Configuration Suite PC Software Manual.

The USB port is provided to give a simple means of connection between a PC and the controller. Using the DSE Configuration Suite Software, the operator is then able to control the module, starting or stopping the engine, selecting operating modes, etc.

Additionally, the various operating parameters (such as coolant temperature, oil pressure, etc.) of the engine are available to be viewed or changed.

To connect a module to a PC by USB, the following items are required:

DSEG8600 Controller

DSE Configuration Suite PC Software
(Available from www.deepseaelectronics.com).

USB cable Type A to Type B.
(This is the same cable as often used between a PC and a USB printer)

DSE supplies this cable if required:
PC Configuration interface lead (USB type A – type B) DSE Part No 016-125

3.10.2 USB HOST PORT (DATA LOGGING)

USB Type A connection for an of external USB storage device of maximum 16 GB for instrumentation data logging. The *Data Logging* instrument page in shows details of available memory capacity.

3.10.3 RS485 PORT

NOTE: For a single module to PC connection and distances up to 6 m (20 feet) the USB connection method is more suitable and provides for a lower cost alternative to RS485 (which is more suited to longer distance connections).

The RS485 port on the controller supports the Modbus RTU protocol and is for connection to a single Modbus client device only.

The DSE Modbus register table for the controller is available upon request from the DSE Technical Support Department.

RS485 is used for point-to-point cable connection of more than one device (maximum 64 devices) and allows for connection to PCs, PLCs, and Building Management Systems (to name just a few devices).

One advantage of the RS485 interface is the large distance specification (1.2 km when using Belden 9841 (or equivalent) cable. This allows for a large distance between the module and a PC running the DSE Configuration Suite software. The operator is then able to control the module, starting or stopping the engine, selecting operating modes, etc.

The various operating parameters (such as coolant temperature, oil pressure, etc.) of the remote engine are viewed or changed.

Many PCs are not fitted with an internal RS485 serial port. DSE DOES NOT recommend the use of USB to RS485 converters but is able to recommend PC add-ons to provide the computer with an RS485 port.

3.10.3.1 CABLE SPECIFICATION

NOTE: DSE recommend Belden 9841 (or equivalent) cable for RS485 communication. This is rated to a maximum cable length of 1.2 km. DSE Stock Belden 9841 cable, DSE Part Number: 016-030.

Description	Specification
Cable Type	Two core screened and shielded twisted pair
Cable Characteristics	120 Ω impedance Low capacitance
Recommended Cable	Belden 9841 Belden 9271
Maximum Cable Length	1200 m (¾ mile) when using Belden 9841 or direct equivalent. 600 m (656 yards) when using Belden 9271 or direct equivalent.
RS485 Topology	“Daisy Chain” Bus with no stubs (spurs)
RS485 Termination	120 Ω. Not fitted internally to module. Must be fitted externally to the ‘first’ and ‘last’ device on the RS485 link.

3.10.3.2 RECOMMENDED PC RS485 SERIAL PORT ADD-ONS

NOTE: DSE have no business tie to Brainboxes. Over many years, our own engineers have used these products and are happy to recommend them.

NOTE: For further details of setting up the devices below, refer to the manufacture whose details are below.

Ensure these parts are suitable for the PC. Consult the supplier for further advice.

Brainboxes PM154 PCMCIA RS485 card (for laptops PCs)
Set to ‘Half Duplex, Autogating” with ‘CTS True’ set to ‘enabled’

Brainboxes UC320 PCI Velocity RS485 card (for desktop PCs)
Set to ‘Half Duplex, Autogating” with ‘CTS True’ set to ‘enabled’

Brainboxes PX-324 PCI Express 1 Port RS422/485 (for desktop PCs)

Supplier:
Brainboxes
Tel: +44 (0)151 220 2500
Web: http://www.brainboxes.com
Email: Sales: sales@brainboxes.com

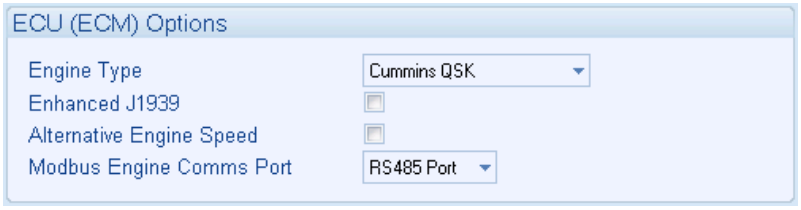
3.10.3.3 RS485 USED FOR MODBUS ENGINE CONNECTION

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

The RS485 port is configurable for connecting to Cummins Modbus engines, specifically those equipped with the Cummins GCS (G-Drive Control System).
This leaves the DSENet® interface free for connection to expansion devices.

While this is a particularly useful feature in some applications, the obvious drawback is that the RS485 interface is no longer available connection or remote monitoring equipment (i.e., Building Management System or PLC).

Example of configuring the DSENet® for connection to Cummins QSK GCS using the DSE Configuration Suite Software:

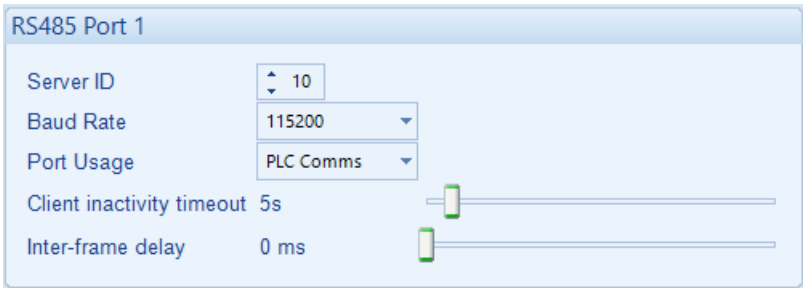


3.10.3.4 RS485 USED FOR PLC COMMUNICATION

NOTE: When the *RS485 Port Usage* is selected to "*PLC Comms*" the module becomes the Client RS485, all other modules' *Port Usage* must be configured to "*Gencomm*". This allows the "*PLC Comms*" configured module read from the "*Gencomm*" configured module(s).
For details on how to configure the *PLC Editor* to read through its RS485, refer to DSE Publication: *057-314 Advanced PLC Software Manual* which is found on our website: www.deepseaelectronics.com

The DSE module is able to communicate with other DSE modules using its RS485 when its *Port Usage* is configured to *PLC Comms.* This allows the DSE module to read from other modules by RS485. This is controlled from the PLC by defining the specific GenComm registers to read then the values read are used inside the PLC to perform certain tasks.
The other modules must all have their RS485 Port Usage set to *Gencomm* to act as a server and be able to respond to the 'Client' (configured to *PLC Comms*). This is because there cannot be two 'Clients' over the same RS485 network.
All the DSE modules must have the same *Baud Rate*, but different *Server ID*.

Example of configuring the RS485 Port for PLC Comms using the DSE Configuration Suite Software:



3.10.4 ETHERNET PORT

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

NOTE: For a single module to PC connection and distances up to 6 m (20 feet) the USB connection method is more suitable and provides for a lower cost alternative to Ethernet (which is more suited to longer distance connections).

NOTE: DSE stock 2 m (6.5 feet) Ethernet Cable, DSE Part Number: 016-137. Alternatively, they may be purchased from any PC or IT store.

Ethernet is used for point-to-point cable connection of more than one device and allows for connection to PCs, PLCs, Building Management Systems and SNMP Managers (to name just a few devices).

One advantage of the Ethernet interface is the ability to interface into an existing LAN (Local Area Network) connection for remote connection via an internet connection. This allows for a large distance between the module and a PC running the DSE Configuration Suite software or any external device. The operator is then able to control the module, starting or stopping the engine, selecting operating modes, etc through various means.

3.10.4.1 MODBUS TCP

The Ethernet port on the controller supports the Modbus TCP protocol and is for connection for up to five Modbus client devices. The various operating parameters (such as coolant temperature, oil pressure, etc.) of the remote engine are viewed or changed.

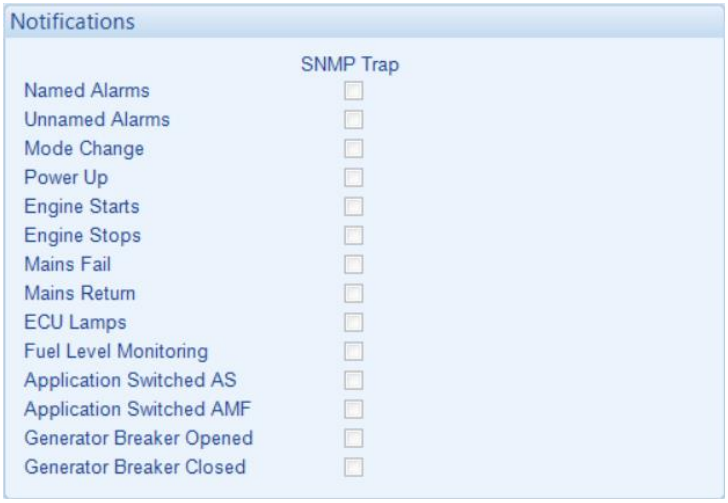
The DSE Modbus register table for the controller is available upon request from the DSE Technical Support Department.

3.10.4.2 SNMP

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

The Ethernet port on the controller is compatible with V2c of the Simple Network Management Protocol (SNMP) and has the capability to connect to two SNMP managers. SNMP is an international standard protocol for managing devices on IP networks. It is used to monitor network-attached devices for conditions that warrant administrative attention.

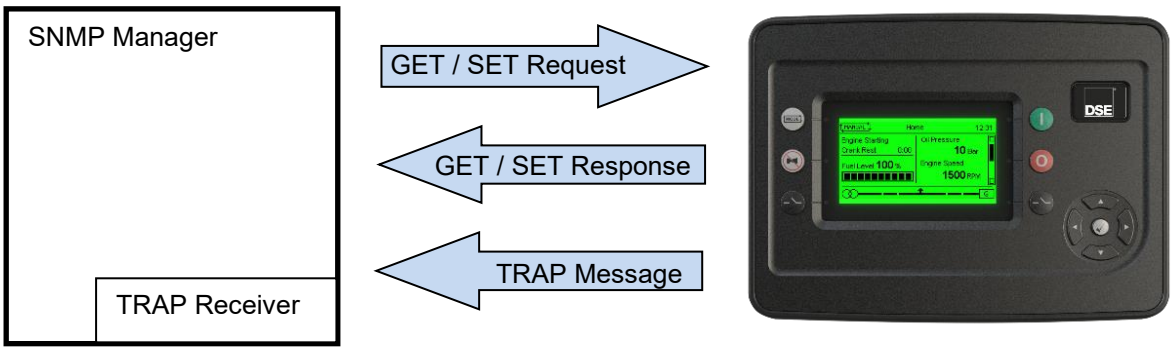
Up to two administrative computers (SNMP managers) monitor the DSE module. If an 'event' occurs, the DSE module reports information via SNMP TRAP messages to the SNMP manager. The SNMP TRAP messages that are sent are configured used the DSE Configuration Suite PC Software by the system integrator. An example of the available SNMP TRAP messages is shown below.



Additionally, the DSE module responds to GET / SET messages from the SNMP manager to allow the operating mode of the DSE module to be changed, or instrumentation values to be retrieved. The SNMP manager knows how to communicate to the DSE module by using the .MIB file provided by DSE.

Many third-party SNMP managers exist. DSE do not produce or supply SNMP managers.

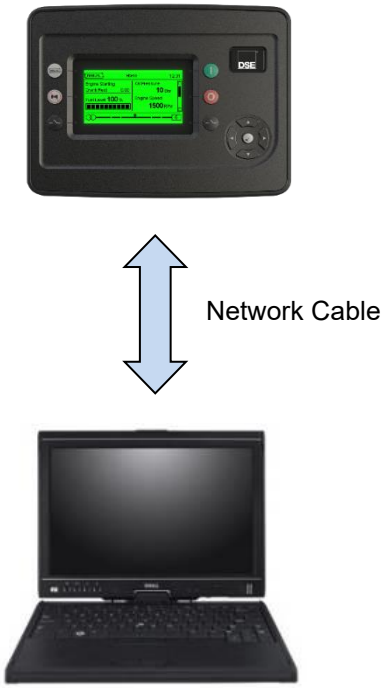
The DSE MIB file for the controller is available upon request from the DSE Technical Support Department or by downloading it from the DSE website, www.deepseaelectronics.com.



3.10.4.3 DIRECT PC CONNECTION

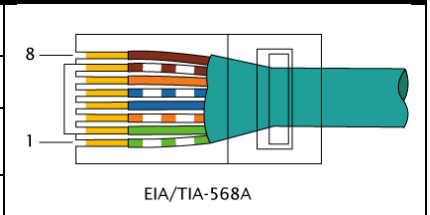
Requirements

- Ethernet cable (see below)
- PC with Ethernet port



Ethernet Cable Wiring Detail

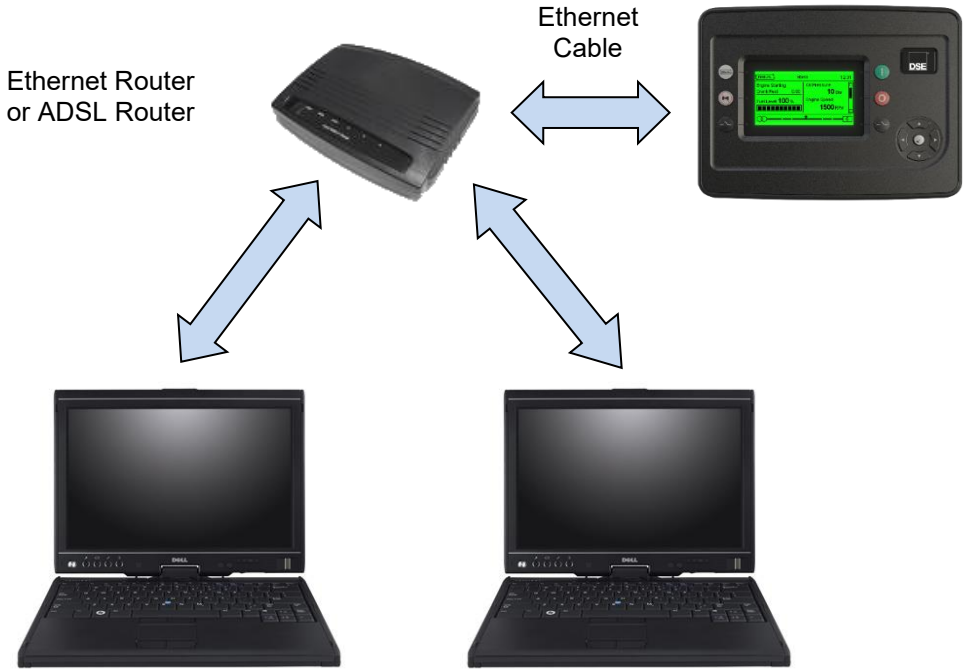
NOTE: DSE stock 2 m (6.5 feet) Ethernet Cable, DSE Part Number: 016-137. Alternatively, they are available from any PC or IT store.

Pin	Connection 1 (T568A)	Connection 2 (T568A)	
1	white/green stripe	white/green stripe	
2	green solid	green solid	
3	white/orange stripe	white/orange stripe	
4	blue solid	blue solid	
5	white/blue stripe	white/blue stripe	
6	orange solid	orange solid	
7	white/brown stripe	white/brown stripe	
8	brown solid	brown solid	

3.10.4.4 CONNECTION TO BASIC ETHERNET

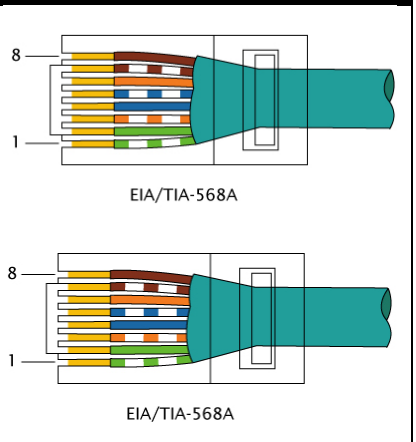
Requirements

- Ethernet cable (see below)
- Working Ethernet (company or home network)
- PC with Ethernet port



Ethernet Cable Wiring Detail

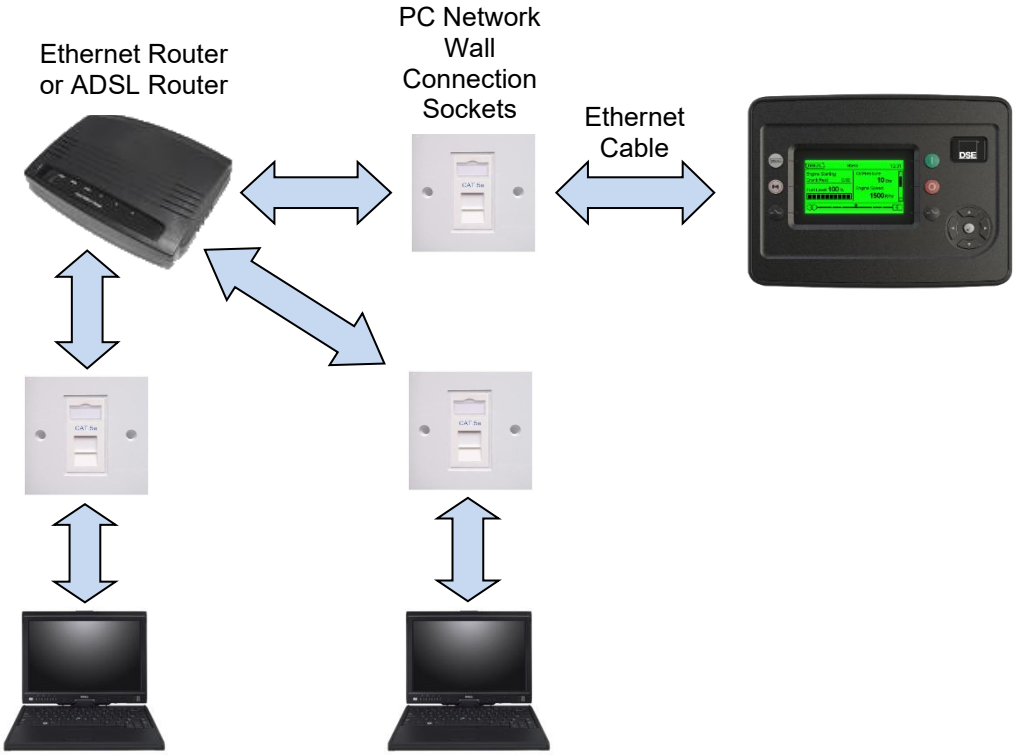
NOTE: DSE stock 2 m (6.5 feet) Ethernet Cable, DSE Part Number: 016-137. Alternatively, they are available from any PC or IT store.

Pin	Connection 1 (T568A)	Connection 2 (T568A)	
1	white/green stripe	white/green stripe	
2	green solid	green solid	
3	white/orange stripe	white/orange stripe	
4	blue solid	blue solid	
5	white/blue stripe	white/blue stripe	
6	orange solid	orange solid	
7	white/brown stripe	white/brown stripe	
8	brown solid	brown solid	

3.10.4.5 CONNECTION TO COMPANY ETHERNET INFRASTRUCTURE

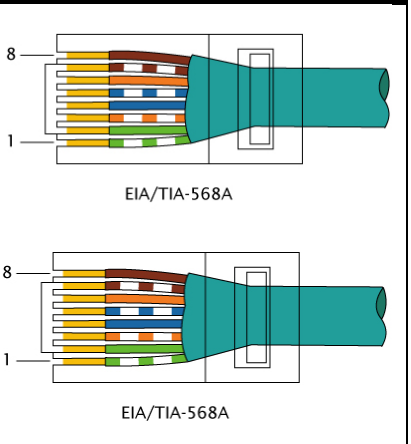
Requirements

- DSE module with the ability to connect to Ethernet
- Ethernet cable (see below)
- Working Ethernet (company or home network)
- PC with Ethernet port



Ethernet Cable Wiring Detail

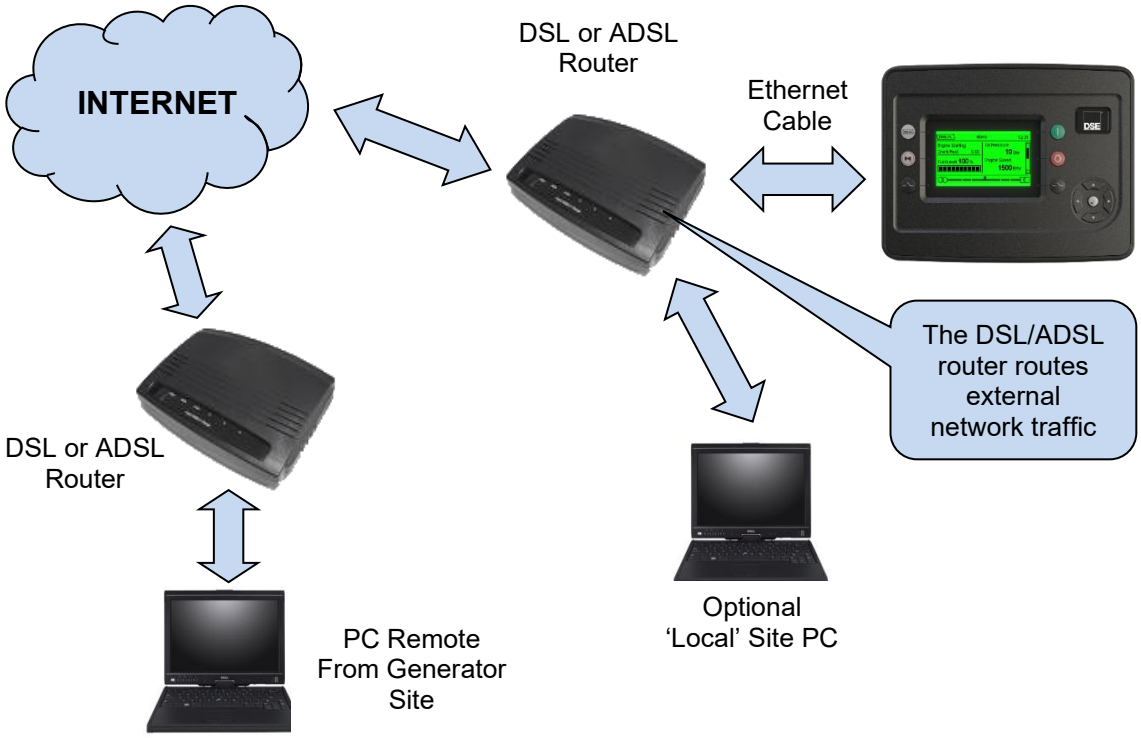
NOTE: DSE stock 2 m (6.5 feet) Ethernet Cable, DSE Part Number: 016-137. Alternatively, they are available from any PC or IT store.

Pin	Connection 1 (T568A)	Connection 2 (T568A)	
1	white/green stripe	white/green stripe	
2	green solid	green solid	
3	white/orange stripe	white/orange stripe	
4	blue solid	blue solid	
5	white/blue stripe	white/blue stripe	
6	orange solid	orange solid	
7	white/brown stripe	white/brown stripe	
8	brown solid	brown solid	

3.10.4.6 CONNECTION TO THE INTERNET

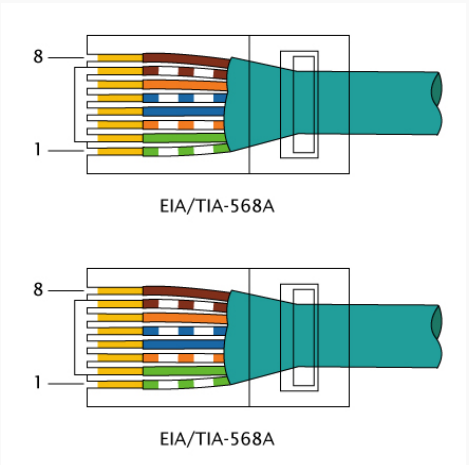
Requirements

- Ethernet cable (see below)
- Working Ethernet (company or home network)
- Working Internet connection (ADSL or DSL recommended)



Ethernet Cable Wiring Detail

NOTE: An Ethernet patch cable is suitable for this type of connection and is obtainable from any computer or information technology store.

Pin	Connection 1 (T568A)	Connection 2 (T568A)	
1	white/green stripe	white/green stripe	
2	green solid	green solid	
3	white/orange stripe	white/orange stripe	
4	blue solid	blue solid	
5	white/blue stripe	white/blue stripe	
6	orange solid	orange solid	
7	white/brown stripe	white/brown stripe	
8	brown solid	brown solid	

3.10.4.7 FIREWALL CONFIGURATION FOR INTERNET ACCESS

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

As modem/routers differ enormously in their configuration, it is not possible for DSE to give a complete guide to their use with the module. However, it is possible to give a description of the requirements in generic terms. For details of how to achieve the connection to the modem/router, refer to the supplier of the modem/router equipment.

The module makes its data available over Modbus TCP or SNMP V2c and as such communicates over the Ethernet using a Port configured via the DSE Configuration Suite software.

Configure the modem/router to allow inbound traffic on this port. For more information, refer to the WAN interface device (modem/router) manufacturer.

It is also important to note that if the port assigned is already in use on the LAN, the module cannot be used, and another port must be used.

Outgoing Firewall Rule

As the module makes its user interface available to standard web browsers, all communication uses the chosen port. It is usual for a firewall to make the same port outgoing open for communication.

Incoming Traffic (Virtual Server)

Network Address and Port Translation (NAPT) allows a single device, such as the modem/router gateway, to act as an agent between the Internet (or "public external network") and a local (or "internal private") network. This means that only a single, unique IP address is required to represent an entire group of computers.

For our application, this means that the WAN IP address of the modem/router is the IP address we need to access the site from an external (internet) location.

When the requests reach the modem/router, we want this passed to a ‘virtual server’ for handling, in our case this is the module.

Result: Traffic arriving from the WAN (internet) on port xxx is automatically sent to IP address set within the configuration software on the LAN for handling.

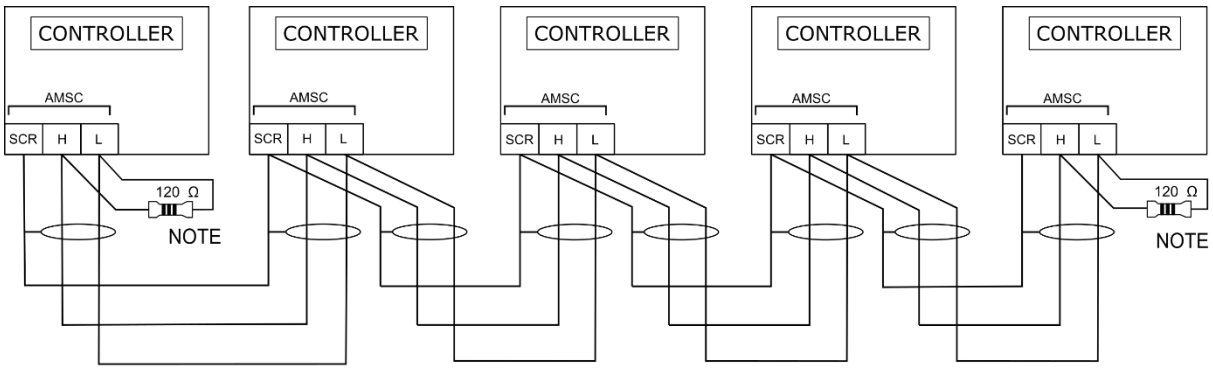
3.10.5 AMSC (MULTI-SET COMMUNICATIONS) LINK

NOTE: The AMSC Link communication port is only applicable when the DSEG8600 Multi Set software application is activated on the DSE module. For further details on how to activate the DSEG8600 software application refer to the section entitled *Multi Set (MS) & Single Set (SS) Application Selection Menu* elsewhere in this document.

NOTE: For further details of Multi Set (MS) module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

The AMSC is an inter-module communications bus, allowing multiple modules in a load share system to communicate with each other via connections at the rear of each module. The information transmitted on the AMSC network provide control and monitoring data for all aspects of the genset, breakers, load sharing and system operating principle, as well as custom PLC data. This makes the AMSC communication bus critical to safe system control.

The AMSC link is the interconnection cable between all DSE synchronising controllers and must not be connected to any device other than DSE equipment designed for connection to the AMSC link



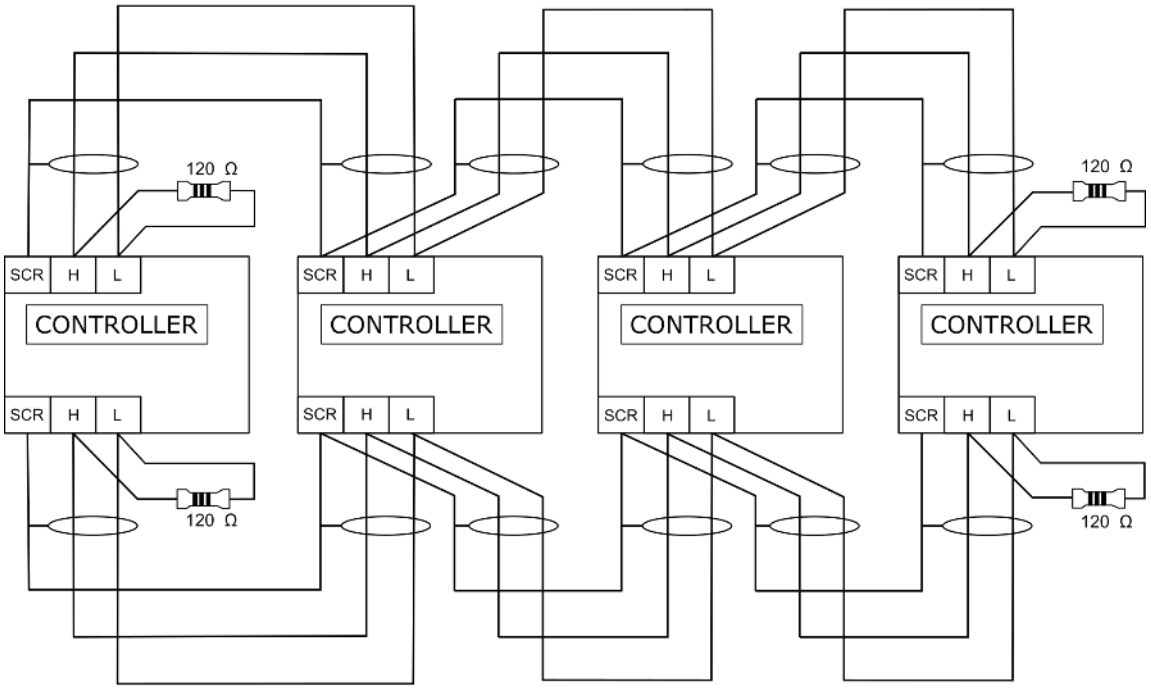
NOTE
A 120 OHM TERMINATION RESISTOR MUST BE FITTED
TO THE FIRST AND LAST UNIT ONTHE AMSC LINK

Description	Specification
Cable Type	Two core screened and shielded twisted pair
Cable Characteristics	120 Ω, Low capacitance
Recommended Cable	Belden 9841, Belden 9271
Maximum Cable Length	**NOTE: For additional length, the DSE124 CAN Extender is available. For more information, refer to DSE Publication: *057-116 DSE124 Operator Manual*** 250 m (273 yards) when using Belden 9841 or direct equivalent. 125 m (136 yards) when using Belden 9271 or direct equivalent.
AMSC Topology	"Daisy Chain" Bus with no stubs (spurs)
AMSC Termination	120 Ω. Must be fitted externally to the first and last module.
Maximum DSEG8600 Modules	The maximum number of DSEG8600 (Multiset) modules on an AMSC link is 64.

3.10.6 REDUNDANT AMSC LINK

The additional CAN port (CAN Port 3) is used as a redundant AMSC link between the DSEG86xx modules. The AMSC link is the interconnection cable between all DSE synchronising controllers and must not be connected to any device other than DSE equipment designed for connection to the AMSC link. In the event of a failure of the primary AMSC link, the user has the option to configure the DSEG86xx modules to switch to the redundant AMSC link connection via the CAN port connection.

REDUNDANT AMSC CONNECTED TO CAN CONNECTIONS AT THE REAR OF THE MODULE



PRIMARY AMSC CONNECTED TO RS485 AT THE REAR OF THE MODULE

NOTE
A 120 OHM TERMINATION
RESISTOR MUST BE FITTED TO
THE FIRST AND LAST UNIT ON
THE AMSC LINK

NOTE: For further details about the *Redundant AMSC* activation on the *Multi Set (MS)* application, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

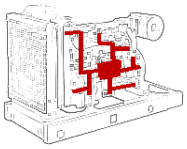
3.10.7 ECU PORT (J1939)

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

NOTE: For further details on connection to electronic engines, refer to DSE Publication: *057-004 Electronic Engines and DSE Wiring*

NOTE: Screened 120 Ω impedance cable specified for use with CAN must be used for the CAN link.
DSE stock and supply Belden cable 9841 which is a high quality 120 Ω impedance cable suitable for CAN use (DSE part number 016-030)

NOTE: For additional length, the DSE124 CAN Extender is available. For more information, refer to DSE Publication: *057-116 DSE124 Operator Manual*



The modules are fitted with a CAN interface as standard and receive engine data from engine ECU/ECMs compliant with the CAN J1939 standard.

ECU/ECMs monitor the engine's operating parameters such as speed, oil pressure, coolant temperature (among others) to closely monitor and control the engine. The industry standard communications interface (CAN) transports data gathered by the engine's ECU/ECM using the J1939 protocol. This allows engine controllers such as DSE to access these engine parameters with no physical connection to the sensor device.

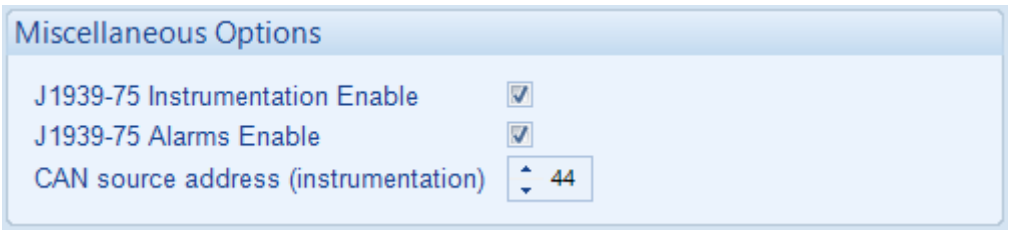
The *ECU Port* is used for point-to-point cable connection of more than one device and allows for connection to CAN Scanner, PLC, and CAN controllers (to name just a few devices). The operator is then able to view the various operating parameters.

3.10.7.1 J1939-75

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

NOTE: For further details of CAN communication, see the section entitled CAN Interface Specification (J1939-75) elsewhere in this document.

When the J1939-75 is enabled in the module's configuration, the module's AC measurements and alarms are sent onto the CANbus using the *ECU Port* to be received by an external monitoring device. There are two check boxes to enable each of the two parts of the interface as shown below, AC measurement and AC related alarms. The module AC alarms are translated into J1939 DM1 diagnostic messages. There are no additional display screens visible on the module when these options are selected. The default CAN source address for additional J1939-75 messages is 44 however this may be changed by the generator supplier.



3.10.8 DSENET® (EXPANSION MODULES)

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

NOTE: As a termination resistor is internally fitted to the controller, the controller must be the 'first' unit on the DSENet® link. A termination resistor MUST be fitted to the 'last' unit on the DSENet® link. For connection details, refer to the section entitled *Typical Arrangement of DSENet* elsewhere in this document.

NOTE: DSE recommend Belden 9841 (or equivalent) cable for DSENet® communication. This is rated to a maximum cable length of 1.2 km. DSE Stock Belden 9841 cable, DSE Part Number: 016-030.

DSENet® is the interconnection cable between the host controller and the expansion module(s) and must not be connected to any device other than DSE equipment designed for connection to the DSENet®

Description	Specification
Cable Type	Two core screened and shielded twisted pair
Cable Characteristics	120 Ω impedance Low capacitance
Recommended Cable	Belden 9841 Belden 9271
Maximum Cable Length	1200 m (¾ mile) when using Belden 9841 or direct equivalent. 600 m (656 yards) when using Belden 9271 or direct equivalent.
DSENet® Topology	"Daisy Chain" Bus with no stubs (spurs)
DSENet® Termination	120 Ω. Fitted internally to host controller. Must be fitted externally to the 'last' expansion module.
Maximum Expansion Modules	**NOTE: Only supported DSE Intelligent Battery Chargers may be connected to the DSENet®. Contact DSE Technical Support for further information.** Total 20 devices made up of DSE2130 (up to 4), DSE2131 (up to 4), DSE2133 (up to 4), DSE2152 (up to 4), DSE2157 (up to 10), DSE2548 (up to 10) and DSE Intelligent Battery Chargers (up to 4) This gives the possibility of: • Maximum 32 additional 0-10 V or 4-20 mA outputs (DSE2152) • Maximum 80 additional relay outputs (DSE2157) • Maximum 80 additional LED indicators (DSE2548) • Maximum 24 additional RTD or thermocouple inputs (DSE2133). • Maximum 32 additional inputs (Are configured as either digital, or resistive when using DSE2130) • Maximum 40 additional flexible inputs (All are configured as either digital, resistive, 0-10 V or 4-20 mA when using DSE2131) • Maximum 4 DSE Intelligent Battery Chargers.

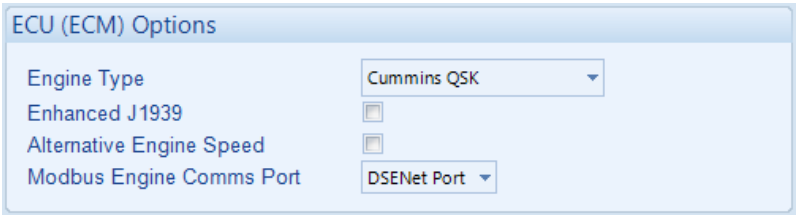
3.10.8.1 DSENET® USED FOR MODBUS ENGINE CONNECTION

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

As DSENet® utilises an RS485 hardware interface, this port is configured for connection to Cummins Modbus engines (Engines fitted with Cummins GCS (G-Drive Control System)).
This leaves the RS485 interface free for connection to remote monitoring equipment (i.e., Building Management System, PLC, or PC RS485 port).

While this is a particularly useful feature in some applications, the obvious drawback is that the DSENet® interface is no longer available for connection to expansion devices.

Example of configuring the DSENet® for connection to Cummins QSK GCS using the DSE Configuration Suite Software:



3.11 SOUNDER

The module features an internal sounder to draw attention to warning, electrical trip, and shutdown alarms.

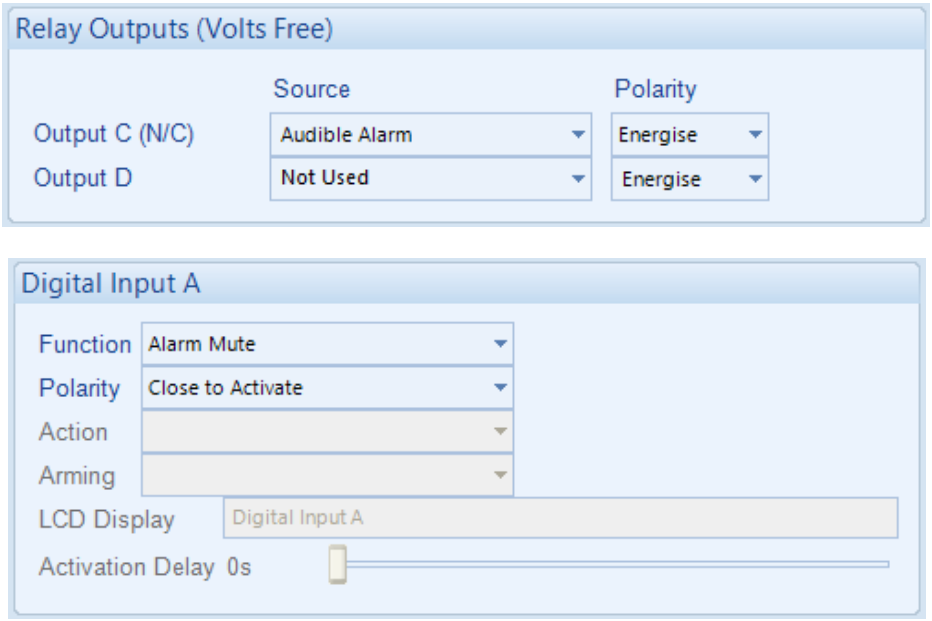
Description	Specification
Sounder Level	64 db at 1 m

3.11.1 ADDING AN EXTERNAL SOUNDER

If an external alarm or indicator is required, this is achieved by using the DSE Configuration Suite PC software to configure an auxiliary output for *Audible Alarm,* and by configuring an auxiliary input for *Alarm Mute* (if required).

The audible alarm output activates and de-activates at the same time as the module's internal sounder. The Alarm mute input and internal ***Lamp Test / Alarm Mute*** button activate 'in parallel' with each other. Either signal mutes both the internal sounder and audible alarm output.

Example of configuration to achieve external sounder with external alarm mute button:



3.12 HOURS RUN AND NUMBER OF STARTS

NOTE: When the number of logged *Engine Hours* and *Number of Starts* value exceeds the maximum number as listed below, the value is reset and begins counting from zero again.

The number of logged *Engine Hours* and *Number of Starts* are set/reset using the DSE Configuration Suite PC software. Depending upon module configuration, this may have been PIN number locked by the generator supplier.

Description	Specification
Engine Hours Run	Maximum 99999 hrs 59 minutes (Approximately 11yrs 4 months)
Number of Starts	1,000,000 (1 Million)
Accumulated Power	999999 kWh / kvarh / kVAh
Load Demand Run Hours	Maximum 99999 hrs 59 minutes (Approximately 11yrs 4 months)

3.13 ACCUMULATED INSTRUMENTATION

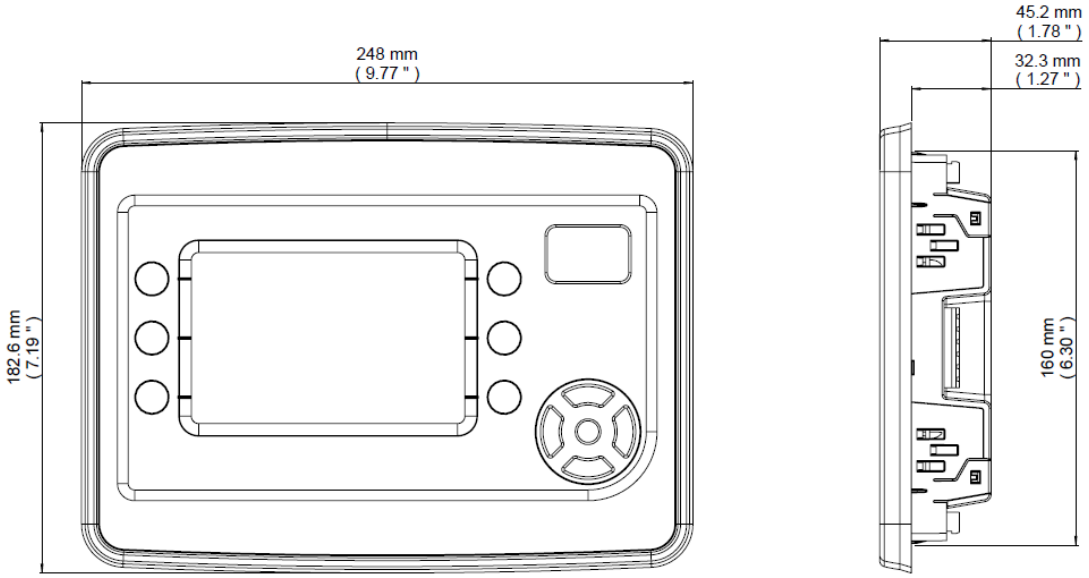
NOTE: When the number of Accumulated Instrumentation value exceeds the maximum number as listed below, the value is reset and begins counting from zero again.

The number of logged *Engine Hours* and *Number of Starts* are set/reset using the DSE Configuration Suite PC software. Depending upon module configuration, this may have been PIN number locked by the generator supplier.

Description	Specification
Accumulated Power	999999 kWh / kvar h / kVA h
Fault Ride Through	Events

3.14 DIMENSIONS AND MOUNTING

Parameter	Specification
Panel Cutout	220 mm x 160 mm (8.66 ” x 6.29 ”)
Overall Size	248 mm x 182.6 mm x 45.2 mm (9.76 ” x 7.18 ” x 1.77 ”)
Case Material	Polycarbonate
Keypad Material	Silicone
Protection Category	IP65 panel mounted with gasket. IP4x panel mounted with no gasket.
Weight	0.76 kg (1.67 lb)
Mounting Type	Panel Mounting. Base mounted to a vertical surface with connection terminals to the rear.
Mounting Torque	Mounting Torque 4x 020-294 Clip M4 3 prong, mounting torque 0.2 Nm

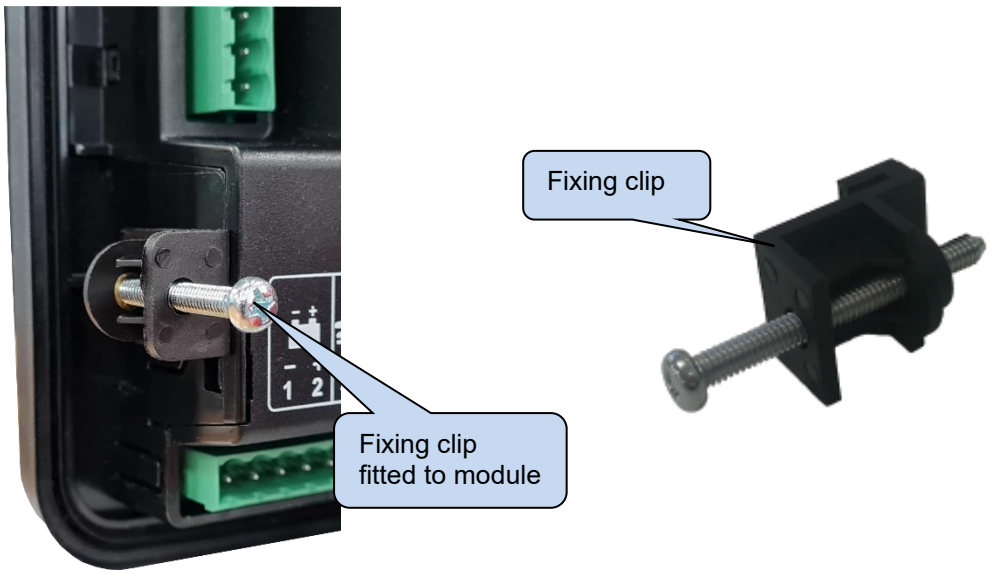


3.14.1 FIXING CLIPS

NOTE: In conditions of excessive vibration, mount the module on suitable anti-vibration mountings.

The module is held into the panel fascia using the supplied fixing clips:

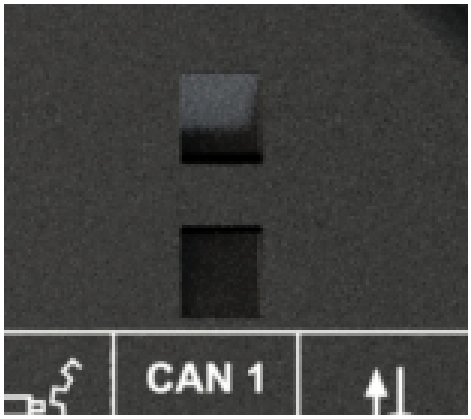
- Withdraw the fixing clip screw (turn anticlockwise) until only the pointed end is protruding from the clip.
- Insert the three ‘prongs’ of the fixing clip into the slots in the side of the module case.
- Pull the fixing clip backwards (towards the back of the module) ensuring all three prongs of the clip are inside their allotted slots.
- Turn the fixing clip screws clockwise until they contact the panel fascia.
- Turn the screw a quarter of a turn to secure the module into the panel fascia. Care must be taken not to over tighten the fixing clip screws.



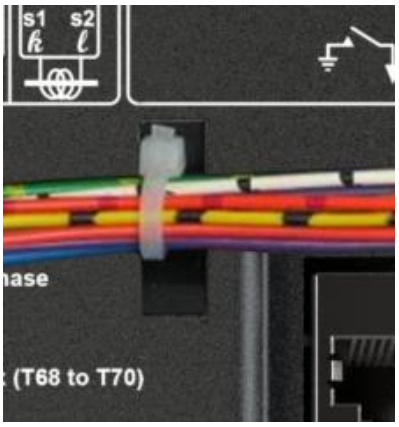
3.14.2 CABLE TIE FIXING POINTS

Cable tie fixing points are included on the rear of the module's case to aid wiring. This additionally provides strain relief to the cable loom by removing the weight of the loom from the screw connectors, reducing the chance of future connection failures.

Care must be taken not to over tighten the cable tie (for instance with cable tie tools) to prevent the risk of damage to the module case.



Cable Tie Fixing Point



With Cable and Tie in Place

3.14.3 SEALING GASKET

The gasket provides improved sealing between module and the panel fascia. The gasket is incorporated into the module as shown below. Ensure correct fitment to the panel facia to maintain the integrity of the seal.

3.15 APPLICABLE STANDARDS

Standard	Description
BS EN 60068-2-1 (Minimum temperature)	-30 °C (-22 °F)
BS EN 60068-2-2 (Maximum temperature)	+70 °C (158 °F)
BS EN 60068-2-6 (Vibration)	Ten sweeps in each of three major axes 5 Hz to 8 Hz at ± 7.5 mm 8 Hz to 500 Hz at 2 gn
BS EN 60068-2-27 (Shock)	Three shocks in each of three major axes 15 gn in 11 ms
BS EN 60068-2-30 (Damp heat cyclic)	20 °C to 55 °C at 95% relative humidity for 48 hours
BS EN 60068-2-78 (Damp heat static)	40 °C at 95% relative humidity for 48 hours
BS EN 60950 (Electrical safety)	Safety of information technology equipment, including electrical business equipment
BS EN 61000-6-2 (Electro-magnetic Compatibility)	EMC Generic Immunity Standard (Industrial)
BS EN 61000-6-4 (Electro-magnetic Compatibility)	EMC Generic Emission Standard (Industrial)
BS EN 60529 (Degrees of protection provided by enclosures)	IP65 (front of module when installed into the control panel with the sealing gasket) IP42 (front of module when installed into the control panel WITHOUT being sealed to the panel)
UL508 NEMA rating (Approximate)	12 (Front of module when installed into the control panel with the sealing gasket). 2 (Front of module when installed into the control panel WITHOUT being sealed to the panel)
IEEE C37.2 (Standard Electrical Power System Device Function Numbers and Contact Designations)	Under the scope of IEEE 37.2, function numbers are also used to represent functions in microprocessor devices and software programs. The controller is device number 11L-8000 (Multifunction device protecting Line (generator) –module). As the module is configurable by the generator OEM, the functions covered by the module vary. Depending on module configuration, the device numbers included within the module might be: 2 – Time delay starting or closing relay 3 – Checking or interlocking relay 5 – Stopping device 6 – Starting circuit breaker 8 – Control power disconnecting device 10 – Unit sequence switch 11 – Multifunction device 12 – Overspeed device 14 – Underspeed device

Parameter descriptions are continued overleaf…

Standard	Description
IEEE C37.2 (Standard Electrical Power System Device Function Numbers and Contact Designations)	Continued… 15 – Speed or frequency matching device. 23 – Temperature control device 25 – Synchronising or synchronism check relay 26 – Apparatus thermal device 27AC – AC undervoltage relay 27DC – DC undervoltage relay 29 – Isolating contactor or switch 30 – Annunciator relay 31 – Separate Excitation Device 37 – Undercurrent or underpower relay (**USING INTERNAL PLC EDITOR**) 40 – Field relay / Loss of excitation 42 – Running circuit breaker 44 – Unit sequence relay 46 – Reverse-phase or phase-balance current relay 48 – Incomplete sequence relay 49 – Machine or transformer thermal relay 50 – Instantaneous overcurrent relay 51 – AC time overcurrent relay 52 – AC circuit breaker 53 – Exciter or DC generator relay 54 – Turning gear engaging device 55 – Power factor relay (**USING INTERNAL PLC EDITOR**) 59AC – AC overvoltage relay 59DC – DC overvoltage relay 62 – Time delay stopping or opening relay 63 – Pressure switch 71 – Level switch 74 – Alarm relay 78 – Phase-angle measuring relay 79 – Reclosing relay (**USING INTERNAL PLC EDITOR**) 81 – Frequency relay 83 – Automatic selective control or transfer relay 86 – Lockout relay

3.15.1 ENCLOSURE CLASSIFICATIONS

3.15.1.1 IP CLASSIFICATIONS

The modules specification under BS EN 60529 Degrees of protection provided by enclosures

IP65 (Front of module when module is installed into the control panel).

First Digit Protection against contact and ingress of solid objects	Second Digit Protection against ingress of water
0 No protection	0 No protection
1 Protected against ingress solid objects with a diameter of more than 50 mm. No protection against deliberate access, e.g., with a hand, but large surfaces of the body are prevented from approach.	1 Protection against dripping water falling vertically. No harmful effect must be produced (vertically falling drops).
2 Protected against penetration by solid objects with a diameter of more than 12 mm. Fingers or similar objects prevented from approach.	2 Protection against dripping water falling vertically. There must be no harmful effect when the equipment (enclosure) is tilted at an angle up to 15° from its normal position (drops falling at an angle).
3 Protected against ingress of solid objects with a diameter of more than 2.5 mm. Tools, wires etc. with a thickness of more than 2.5 mm are prevented from approach.	3 Protection against water falling at any angle up to 60° from the vertical. There must be no harmful effect (spray water).
4 Protected against ingress of solid objects with a diameter of more than 1 mm. Tools, wires etc. with a thickness of more than 1 mm are prevented from approach.	4 Protection against water splashed against the equipment (enclosure) from any direction. There must be no harmful effect (splashing water).
5 Protected against harmful dust deposits. Ingress of dust is not totally prevented but the dust must not enter in sufficient quantity to interface with satisfactory operation of the equipment. Complete protection against contact.	5 Protection against water projected from a nozzle against the equipment (enclosure) from any direction. There must be no harmful effect (water jet).
6 Protection against ingress of dust (dust tight). Complete protection against contact.	6 Protection against heavy seas or powerful water jets. Water must not enter the equipment (enclosure) in harmful quantities (splashing over).

3.15.1.2 NEMA CLASSIFICATIONS

⚠NOTE: There is no direct equivalence between IP / NEMA ratings. IP figures shown are approximate only.

12 (Front of module when module is installed into the control panel).

1 **IP30**	Provides a degree of protection against contact with the enclosure equipment and against a limited amount of falling dirt.
2 **IP31**	Provides a degree of protection against limited amounts of falling water and dirt.
3 **IP64**	Provides a degree of protection against windblown dust, rain, and sleet; undamaged by the formation of ice on the enclosure.
3R **IP32**	Provides a degree of protection against rain and sleet; undamaged by the formation of ice on the enclosure.
4 (X) **IP66**	Provides a degree of protection against splashing water, windblown dust and rain, hose directed water, undamaged by the formation of ice on the enclosure. (Resist corrosion).
12/12K **IP65**	Provides a degree of protection against dust, falling dirt and dripping noncorrosive liquids.
13 **IP65**	Provides a degree of protection against dust and spraying of water, oil, and non-corrosive coolants.

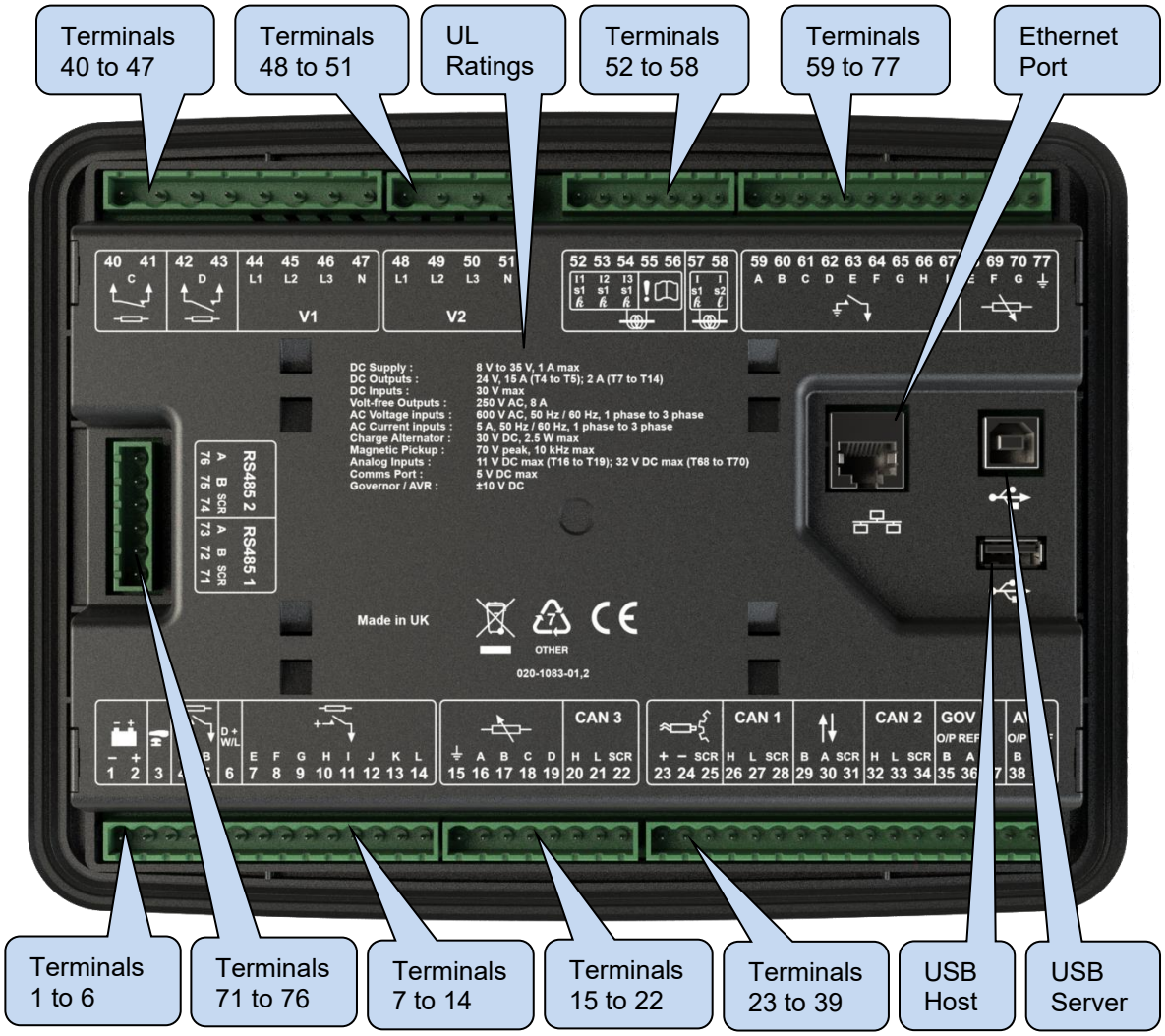
4 INSTALLATION

The module is designed to be mounted on the panel fascia. For dimension and mounting details, see the section entitled *Dimension and Mounting* elsewhere in this document.

4.1 USER CONNECTIONS

NOTE: Availability of some terminals depends upon module version. Full details are given in the section entitled *Terminal Specification* elsewhere in this document.

To aid user connection, icons are used on the rear of the module to help identify terminal functions. An example of this is shown below.



4.2 CONNECTION DESCRIPTIONS

4.2.1 DC SUPPLY, E-STOP INPUT, DC OUTPUTS & CHARGE FAIL INPUT

NOTE: When the module is configured for operation with an electronic engine, *Fuel* and *Start* output requirements may be different. For further details on connection to electronic engines, refer to DSE Publication: *057-004 Electronic Engines and DSE Wiring*

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

	Pin No	Description	Cable Size	Notes
	1	DC Plant Supply Input (Negative)	2.5 mm² AWG 13	Connect to ground where applicable.
	2	DC Plant Supply Input (Positive)	2.5 mm² AWG 13	Supplies the module and DC Outputs E, F, G, H, I & J
	3	Emergency Stop Input	2.5 mm² AWG 13	Plant Supply Positive. Supplies DC Outputs A & B.
	4	DC Output A (FUEL)	2.5 mm² AWG 13	Plant Supply Positive from terminal 3. 15 A DC rated Fixed as fuel relay if electronic engine is not configured.
	5	DC Output B (START)	2.5 mm² AWG 13	Plant Supply Positive from terminal 3. 15 A DC rated Fixed as start relay if electronic engine is not configured.
D+ W/L	6	Charge Fail / Excite	2.5 mm² AWG 13	Do not connect to ground (battery negative). If charge alternator is not fitted, leave this terminal disconnected.
	7	DC Output E	1.0 mm² AWG 18	Plant Supply Positive from terminal 2. 2 A DC rated.
	8	DC Output F	1.0 mm² AWG 18	Plant Supply Positive from terminal 2. 2 A DC rated.
	9	DC Output G	1.0 mm² AWG 18	Plant Supply Positive from terminal 2. 2 A DC rated.
	10	DC Output H	1.0 mm² AWG 18	Plant Supply Positive from terminal 2. 2 A DC rated.
	11	DC Output I	1.0 mm² AWG 18	Plant Supply Positive from terminal 2. 2 A DC rated.
	12	DC Output J	1.0 mm² AWG 18	Plant Supply Positive from terminal 2. 2 A DC rated.
	13	DC Output K	1.0 mm² AWG 18	Plant Supply Positive from terminal 2. 2 A DC rated.
	14	DC Output L	1.0 mm² AWG 18	Plant Supply Positive from terminal 2. 2 A DC rated.

4.2.2 ANALOGUE SENSOR INPUTS & CAN

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

NOTE: It is VERY important that terminal 15 (sensor common) is connected to an earth point on the ENGINE BLOCK, not within the control panel, and must be a sound electrical connection to the sensor bodies. This connection MUST NOT be used to provide an earth connection for other terminals or devices. The simplest way to achieve this is to run a SEPARATE earth connection from the system earth star point to terminal 15 directly and not use this earth for other connections.

NOTE: If PTFE insulating tape is used on the sensor thread when using earth return sensors, ensure not to insulate the entire thread, as this prevents the sensor body from being earthed via the engine block.

NOTE: Screened 120 Ω impedance cable specified for use with CAN must be used for the CAN & AMSC links.
DSE stock and supply Belden cable 9841 which is a high quality 120 Ω impedance cable suitable for CAN use (DSE part number 016-030)

	Pin No	Description	Cable Size	Notes
	15	Sensor Common Return	0.5 mm² AWG 20	Ground Return Feed For Sensors
	16	Analogue Sensor Input A	0.5 mm² AWG 20	Connect To Oil Pressure Sensor
	17	Analogue Sensor Input B	0.5mm² AWG 20	Connect To Coolant Temperature Sensor
	18	Analogue Sensor Input C	0.5 mm² AWG 20	Connect To Fuel Level Sensor
	19	Analogue Sensor Input D	0.5 mm² AWG 20	Connect To Additional Sensor (User Configurable)
CAN 3 REDUNDANT AMSC 2 (MULTISET ONLY)	20	CAN Port H	0.5 mm² AWG 20	Use only 120 Ω CAN or RS485 approved cable
	21	CAN Port L	0.5 mm² AWG 20	Use only 120 Ω CAN or RS485 approved cable
	22	CAN Port Screen	Shield	Use only 120 Ω CAN or RS485 approved cable

4.2.3 MPU, ECU, AMSC & DSENET®

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

NOTE: For further details on connection to electronic engines, refer to DSE Publication: *057-004 Electronic Engines and DSE Wiring*

NOTE: Screened 120 Ω impedance cable specified for use with CAN must be used for the CAN & AMSC links.
DSE stock and supply Belden cable 9841 which is a high quality 120 Ω impedance cable suitable for CAN use (DSE part number 016-030)

NOTE: The AMSC port is only active when the module is converted to *Multi Set (MS)*

NOTE: As a termination resistor is internally fitted to the controller, the controller must be the 'first' unit on the DSENet® link. A termination resistor MUST be fitted to the 'last' unit on the DSENet® link. For connection details, refer to the section entitled *Typical Wiring Diagram* elsewhere in this document.

	Pin No	Description	Cable Size	Notes
	23	Magnetic Pickup Positive	0.5 mm² AWG 20	Connect To Magnetic Pickup Device
	24	Magnetic Pickup Negative	0.5 mm² AWG 20	Connect To Magnetic Pickup Device
	25	Magnetic Pickup Screen	Shield	Connect To Ground At One End Only
CAN 1	26	ECU Port H	0.5 mm² AWG 20	Use only 120 Ω CAN or RS485 approved cable
	27	ECU Port L	0.5 mm² AWG 20	Use only 120 Ω CAN or RS485 approved cable
	28	ECU Port Screen	Shield	Use only 120 Ω CAN or RS485 approved cable
	29	DSENet® Expansion B	0.5 mm² AWG 20	Use only 120 Ω CAN or RS485 approved cable
	30	DSENet® Expansion A	0.5 mm² AWG 20	Use only 120 Ω CAN or RS485 approved cable
	31	DSENet® Expansion Screen	Shield	Use only 120 Ω CAN or RS485 approved cable
CAN 2 AMSC	32	CAN Port H	0.5 mm² AWG 20	Use only 120 Ω CAN or RS485 approved cable
	33	CAN Port L	0.5 mm² AWG 20	Use only 120 Ω CAN or RS485 approved cable
	34	CAN Port Screen	Shield	Use only 120 Ω CAN or RS485 approved cable
GOV	35	Analogue Governor Output B	0.5mm² AWG 20	Analogue Governor DC Output
	36	Analogue Governor Output A	0.5mm² AWG 20	Analogue Governor Output Reference
	37	DO NOT CONNECT		DO NOT CONNECT
AVR	38	Analogue AVR Output B	0.5mm² AWG 20	Analogue AVR DC Output
	39	Analogue AVR Output A	0.5mm² AWG 20	Analogue AVR Output Reference

4.2.4 OUTPUT C & D & V1 (GENERATOR) VOLTAGE & FREQUENCY SENSING

NOTE: The below table describes connections to a three phase, four wire alternator. For alternative wiring topologies, see the sections *Single Set Alternate Topology Schematic Diagrams* & *Multi Set Alternate Topology Schematic Diagrams* elsewhere in this document.

	Pin No	Description	Cable Size	Notes
	40	Normally Closed Volt-Free Relay Output C	1.0mm² AWG 18	Normally configured to close the mains (utility) contactor coil
	41		1.0mm² AWG 18	
	42	Normally Open Volt-Free Relay Output D	1.0mm² AWG 18	Normally configured to close the generator contactor coil
	43		1.0mm² AWG 18	
V1	44	Generator L1 (U) Voltage Sensing	1.0 mm² AWG 18	Connect to generator L1 (U) output (AC) (Recommend 2 A fuse)
	45	Generator L2 (V) Voltage Sensing	1.0 mm² AWG 18	Connect to generator L2 (V) output (AC) (Recommend 2 A fuse)
	46	Generator L3 (W) Voltage Sensing	1.0 mm² AWG 18	Connect to generator L3 (W) output (AC) (Recommend 2 A fuse)
	47	Generator Neutral (N) Input	1.0 mm² AWG 18	Connect to generator Neutral terminal (AC)

CAUTION!:The Multi Set application requires Normally Closed Volt-Free Relay Output C closed so that the voltage measurement is available. Do not switch to a Multi Set application if connected to mains (utility).

4.2.5 V2 MAINS(UTILITY) VOLTAGE & BUS SENSING

NOTE: The below table describes connections to a three phase, four wire supply. For alternative wiring topologies, see the sections *Single Set Alternate Topology Schematic Diagrams* & *Multi Set Alternate Topology Schematic Diagrams* elsewhere in this document.

	Pin No	Description	Cable Size	Notes
V2	48	L1 (R) Mains (utility) Voltage Sensing (SS) Bus Voltage Sensing (MS)	1.0 mm² AWG 18	Connect to Mains (utility) L1 (R) output (AC) (Recommend 2 A fuse)
	49	L2 (S) Mains (utility) Voltage Sensing (SS) Bus Voltage Sensing (MS)	1.0 mm² AWG 18	Connect to Mains (utility) L2 (S) output (AC) (Recommend 2 A fuse)
	50	L3 (T) Voltage Sensing Mains (utility) Voltage Sensing (SS) Bus Voltage Sensing (MS)	1.0 mm² AWG 18	Connect to Mains (utility) L3 (T) output (AC) (Recommend 2 A fuse)
	51	Mains (utility) Neutral (N) Input	1.0 mm² AWG 18	Connect to Mains (utility) Neutral terminal (AC)

4.2.6 CURRENT TRANSFORMERS

WARNING!: Do not disconnect this plug when the CTs are carrying current. Disconnection open circuits the secondary of the C.T.'s and dangerous voltages may then develop. Always ensure the CTs are not carrying current and the CTs are short circuit connected before making or breaking connections to the module.

NOTE: The module has a burden of 0.25 VA on the CT. Ensure the CT is rated for the burden of the controller, the cable length being used and any other equipment sharing the CT. If in doubt, consult with the CT supplier.

NOTE: Take care to ensure correct polarity of the CT primary as shown below. If in doubt, consult with the CT supplier.

4.2.6.1 GENERATOR CURRENT TRANSFORMERS

	Pin No	Description	Cable Size	Notes
	52	CT Secondary for Generator L1	2.5 mm² AWG 13	Connect to s1 secondary of Generator L1 monitoring CT
	53	CT Secondary for Generator L2	2.5 mm² AWG 13	Connect to s1 secondary of Generator L2 monitoring CT
	54	CT Secondary for Generator L3	2.5 mm² AWG 13	Connect to s1 secondary of Generator L3 monitoring CT

NOTE: The function of terminals 55 and 56 changes depending upon what type of earth fault protection (if any) is being used:

	Topology	Pin No	Notes	Cable Size
	No earth fault measuring	55	DO NOT CONNECT	
		56	Connect to s2 of the CTs connected to Generator L1, L2, L3.	2.5mm² AWG 13
	Restricted earth fault measuring	55	Connect to s2 of the CTs connected to Generator L1, L2, L3, N	2.5mm² AWG 13
		56	Connect to s1 of the CT on the Generator neutral conductor	2.5mm² AWG 13
	Un-restricted earth fault measuring (Earth fault CT is fitted in the neutral to earth link)	55	Connect to s2 of the CT on the Generator neutral to earth link.	2.5mm² AWG 13
		56	Connect to s1 of the CT on the Generator neutral to earth link. Also connect to the s2 of CTs connected to Generator L1, L2, L3.	2.5mm² AWG 13

4.2.6.2 MAINS (UTILITY) CURRENT TRANSFORMERS

	Pin No	Description	Cable Size	Notes
SINGLE SET ONLY	57	CT Secondary for Mains (utility) L1	2.5 mm² AWG 13	Connect to s1 secondary of Mains (utility) L1 monitoring CT Also connect to Earth
	58	CT Secondary for Mains (utility) L1	2.5 mm² AWG 13	Connect to s2 secondary of Mains (utility) L1 monitoring CT

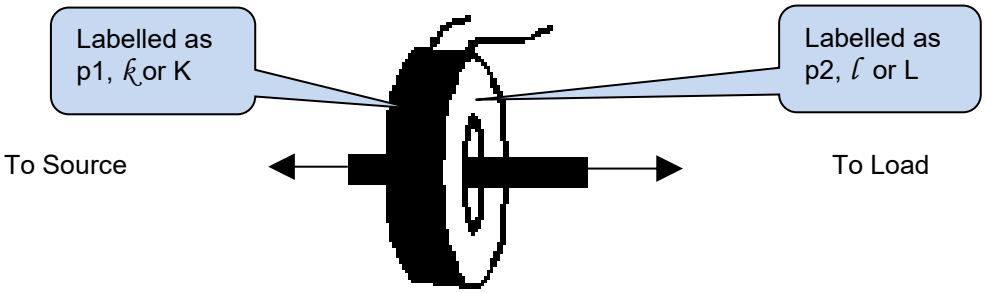
4.2.6.3 CT CONNECTIONS

p1, k or K is the primary of the CT that 'points' towards the Generator

p2, l or L is the primary of the CT that 'points' towards the Load

s1 is the secondary of the CT that connects to the DSE Module's input for the CT measuring

s2 is the secondary of the CT that is connected with other common s2 connections of all the other CTs and connected to the CT common terminal of the module.



Polarity of CT Primary

4.2.7 DIGITAL INPUTS

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

	Pin No	Description	Cable Size	Notes
	59	Configurable Digital Input A	0.5 mm² AWG 20	Switch To Negative
	60	Configurable Digital Input B	0.5 mm² AWG 20	Switch To Negative
	61	Configurable Digital Input C	0.5 mm² AWG 20	Switch To Negative
	62	Configurable Digital Input D	0.5 mm² AWG 20	Switch To Negative
	63	Configurable Digital Input E	0.5 mm² AWG 20	Switch To Negative
	64	Configurable Digital Input F	0.5 mm² AWG 20	Switch To Negative
	65	Configurable Digital Input G	0.5 mm² AWG 20	Switch To Negative
	66	Configurable Digital Input H	0.5 mm² AWG 20	Switch To Negative
	67	Configurable Digital Input I	0.5 mm² AWG 20	Switch To Negative

4.2.8 ANALOGUE SENSOR INPUTS

	Pin No	Description	Cable Size	Notes
	68	Analogue Sensor Input E	0.5 mm² AWG 20	Connect To Additional Sensor (User Configurable)
	69	Analogue Sensor Input F	0.5 mm² AWG 20	Connect To Additional Sensor (User Configurable)
	70	Analogue Sensor Input G	0.5 mm² AWG 20	Connect To Additional Sensor (User Configurable)
	77	Sensor Common Return	0.5 mm² AWG 20	Ground Return Feed For Sensors

4.2.9 RS485

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

NOTE: A 120 Ω termination resistor must be fitted across terminals A and B if the DSE module is the first or last device on the R485 link.

NOTE: Screened 120 Ω impedance cable specified for use with RS485 must be used for the RS485 link.
DSE stock and supply Belden cable 9841 which is a high quality 120 Ω impedance cable suitable for CAN use (DSE part number 016-030)

	Pin No	Description	Cable Size	Notes
RS485 1	71	RS485 Port Screen	Shield	Use only 120 Ω CAN or RS485 approved cable
	72	RS485 Port B (+)	0.5 mm² AWG 20	Connect to RXD+ and TXD+ Use only 120 Ω CAN or RS485 approved cable
	73	RS485 Port A (-)	0.5 mm² AWG 20	Connect to RXD- and TXD- Use only 120 Ω CAN or RS485 approved cable
RS485 2	74	RS485 Port Screen	Shield	Use only 120 Ω CAN or RS485 approved cable
	75	RS485 Port B (+)	0.5 mm² AWG 20	Connect to RXD+ and TXD+ Use only 120 Ω CAN or RS485 approved cable
	76	RS485 Port A (-)	0.5 mm² AWG 20	Connect to RXD- and TXD- Use only 120 Ω CAN or RS485 approved cable

4.2.10 USB SERVER (PC CONFIGURATION) CONNECTOR

NOTE: The USB connection cable between the PC and the module must not be extended beyond 5 m (yards). For distances over 5 m, it is possible to use a third-party USB extender. Typically, they extend USB up to 50 m. The supply and support of this type of equipment is outside the scope of Deep Sea Electronics.

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

	Description	Cable Size	Notes
	Socket for connection to PC with DSE Configuration Suite Software	0.5 mm² AWG 20	This is a standard USB type A to type B connector. 

4.2.11 USB HOST (DATA LOGGING) CONNECTOR

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

NOTE: For further details on how to add and remove a USB storage device, refer to the section entitled *Data Logging Pages* elsewhere in this document.

	Description	Storage Size	Notes
	Socket for connection to USB storage device for data logging	Maximum 16 GB	USB storage device must be formatted as FAT32.

4.3 TYPICAL SCHEMATIC DIAGRAMS

As every system has different requirements, these diagrams show only a typical system and do not intend to show a complete system.

Genset manufacturers and panel builders may use these diagrams as a starting point; however always refer to the completed system diagram provided by the system manufacturer for complete wiring detail.

Further wiring suggestions are available in the following DSE publications, available at www.deepseaelectronics.com to website members.

DSE Part	Description
056-022	Breaker Control (Training guide)
056-005	Using CTs With DSE Products
056-022	Breaker Control
056-091	Equipotential Earth Bonding
056-092	Best Practices for Wiring Resistive Sensors

4.3.1 EARTH SYSTEMS

4.3.1.1 NEGATIVE EARTH

The typical wiring diagrams located within this document show connections for a negative earth system (the battery negative connects to Earth).

4.3.1.2 POSITIVE EARTH

When using a DSE module with a Positive Earth System (the battery positive connects to Earth), the following points must be followed:

Follow the typical wiring diagram as normal for all sections ***except*** the earth points.
All points shown as Earth on the typical wiring diagram are connected to ***battery negative*** (not earth).

4.3.1.3 FLOATING EARTH

Where neither the battery positive nor battery negative terminals are connected to earth the following points must be followed:

Follow the typical wiring diagram as normal for all sections ***except*** the earth points.
All points shown as Earth on the typical wiring diagram are connected to ***battery negative*** (not earth).

4.3.2 TYPICAL ARRANGEMENT OF DSENET®

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

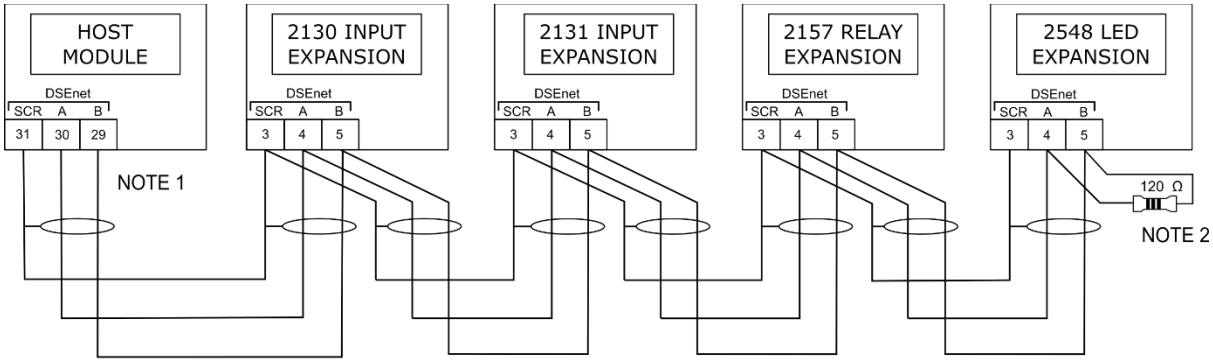
NOTE: This feature is not available if the DSEG8600 module has been configured to use the DSENet® port as the interface to a Cummins MODBUS GCS ECU.

NOTE: Screened 120 Ω impedance cable specified for use with CAN must be used for the DSENet® (RS485) connection.

DSE stock and supply Belden cable 9841 which is a high quality 120Ω impedance cable suitable for DSENet® use (DSE part number 016-030)

DSENet® supports the connection of Twenty (20) devices made up of the following:

Device	Maximum Number Supported
DSE2130 Input Expansion	4
DSE2131 Input Expansion	4
DSE2133 Input Expansion	4
DSE2152 Analogue Output Expansion Module	4
DSE2157 Relay Output Expansion	10
DSE2160 Input Expansion	4
DSE2170 Input Expansion	4
DSE2548 LED Expansion	10
DSE Intelligent Battery Chargers	4



NOTE 1
AS A TERMINATING RESISTOR IS INTERNALLY FITTED TO THE HOST CONTROLLER, THE HOST CONTROLLER MUST BE THE FIRST UNIT ON THE DSEnet

NOTE 2
A 120 OHM TERINATION RESISTOR MUST BE FITTED TO THE LAST UNIT ON THE DSEnet

4.3.3 TYPICAL ARRANGEMENT OF AMSC LINK

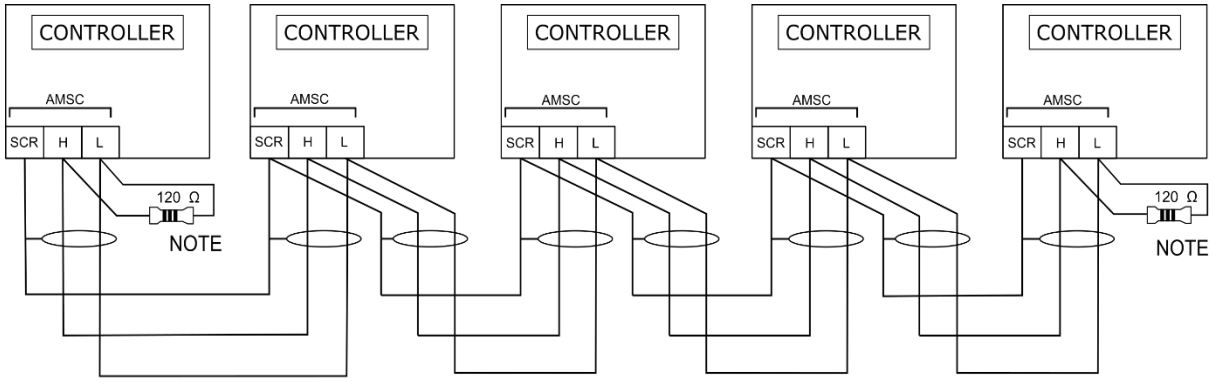
NOTE: For further information on the maximum number of modules that the AMSC link and Redundant AMSC link supports, refer to the sections entitled *AMSC (Multi-Set Communications) Link* and *CAN Port (Redundant AMSC)* elsewhere in this document.

NOTE: For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite Software Manual.*

NOTE: Screened 120 Ω impedance cable specified for use with CAN must be used for the AMSC link connection.

DSE stock and supply Belden cable 9841 which is a high quality 120 Ω impedance cable suitable for AMSC link (DSE part number 016-030)

NOTE: A termination resistor MUST be fitted to the first and last unit on the AMSC link.



NOTE
A 120 OHM TERMINATION RESISTOR MUST BE FITTED
TO THE FIRST AND LAST UNIT ONTHE AMSC LINK

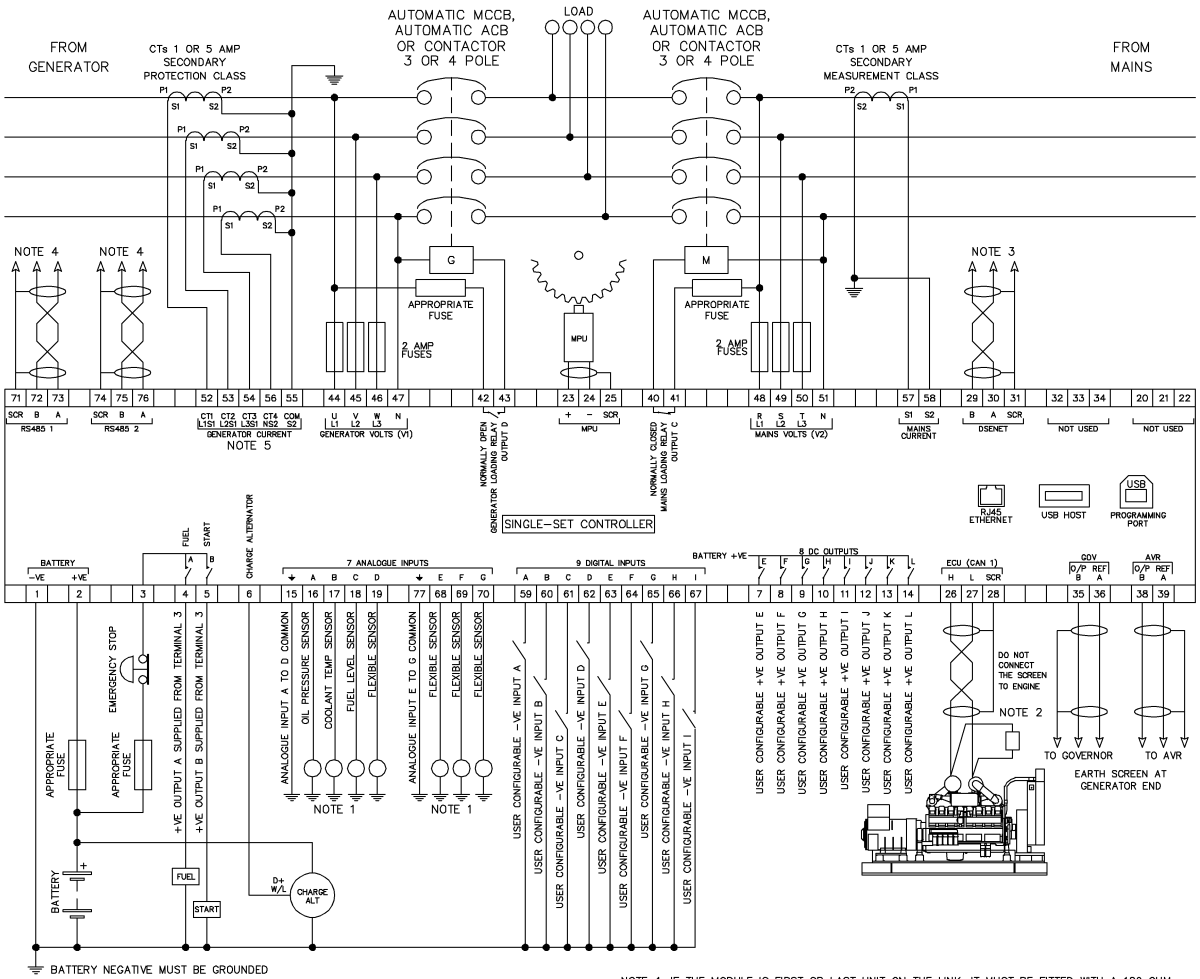
4.4 SINGLE SET ALTERNATE TOPOLOGY WIRING DIAGRAMS

4.4.1 3 PHASE 4 WIRE WITH RESTRICTED EARTH FAULT (SINGLE SET CONTROLLER)

NOTE: The below diagram is applicable for the following AC topologies: 3 Phase 4 Wire Star, 3 Phase 4 Wire Delta L1-N-L2, 3 Phase 4 Wire Delta L1-N-L3 and 3 Phase 4 Wire Delta *L2-N-L3*. For further details of module configuration to suit these different topologies, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

NOTE: Earthing the neutral conductor 'before' the neutral CT allows the module to read earth faults 'after' the CT only (Restricted to load / downstream of the CT)
Earthing the neutral conductor 'after' the neutral CT allows the module to read earth faults 'before' the CT only (Restricted to generator / upstream of the CT)

CAUTION!: The mains breaker closes without synchronisation protections when the module is switched to Single Set from Multi Set, therefore caution must be exercised if dual operation is enabled.



BATTERY NEGATIVE MUST BE GROUNDED

NOTE 1. THESE GROUND CONNECTIONS MUST BE ON THE ENGINE BLOCK, AND MUST BE TO THE SENSOR BODIES.

NOTE 2. 120 R TERMINATING RESISTOR MAY BE REQUIRED EXTERNALLY, SEE ENGINE MANUFACTURERS LITERATURE.

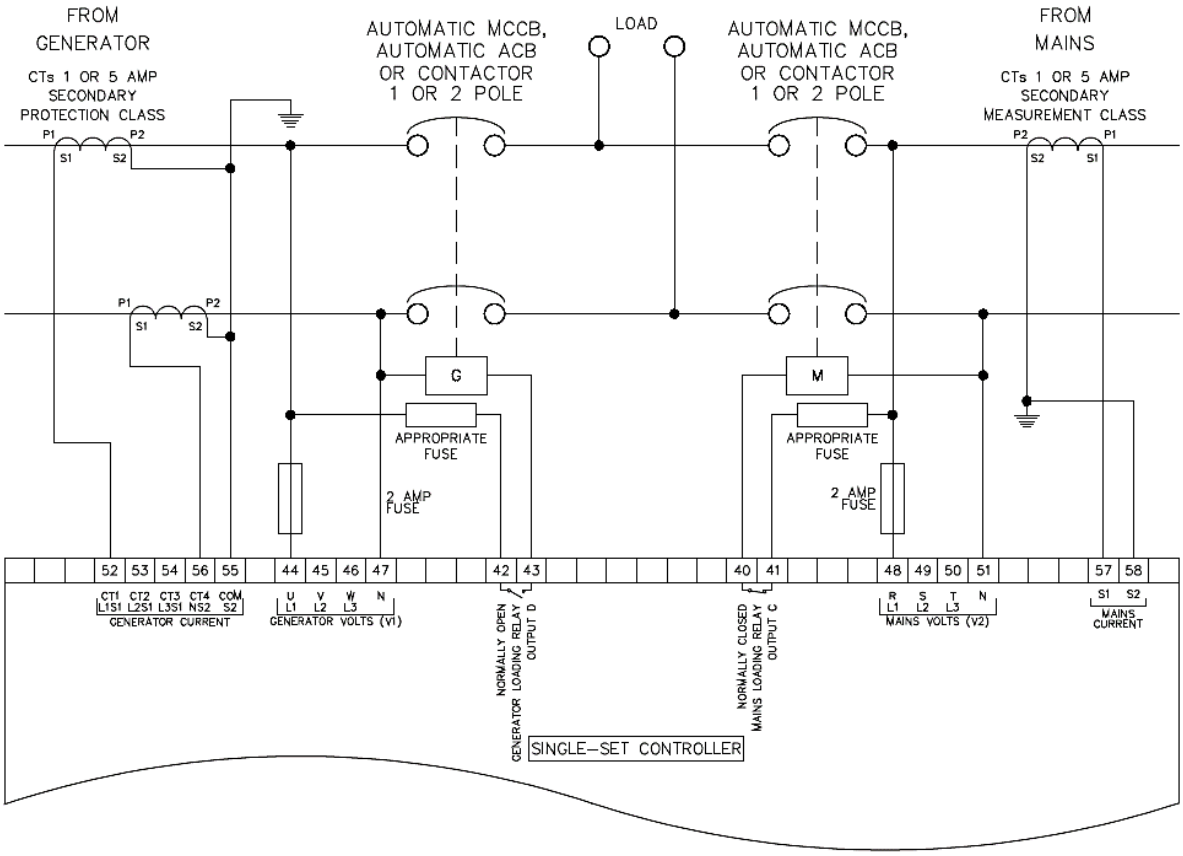
NOTE 3. MUST BE FITTED AS FIRST OR LAST UNIT ON DSENET WITH NO TERMINATION RESISTOR. THE SUBSEQUENT FIRST OR LAST UNIT ON DSENET MUST BE FITTED WITH A 120 OHM TERMINATION RESISTOR TERMINALS A AND B.

NOTE 4. IF THE MODULE IS FIRST OR LAST UNIT ON THE LINK, IT MUST BE FITTED WITH A 120 OHM TERMINATION RESISTOR ACROSS TERMINALS H AND L.

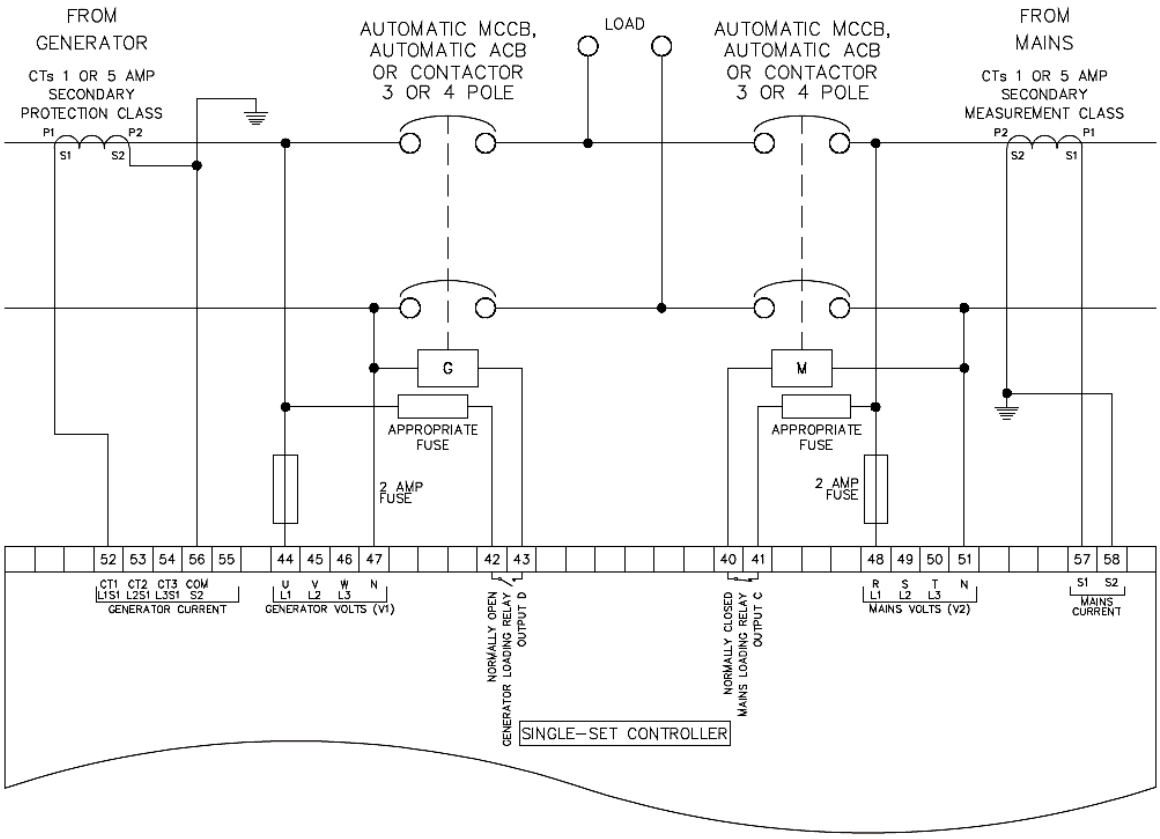
NOTE 5. WHEN THE 4TH CT IS PLACED ON THE NEUTRAL, TERMINAL 55 IS THE CT COMMON. WHEN THE 4TH IS NOT IN USE OR PLACED ON THE EARTH CONNECTION, TERMINAL 56 IS THE CT COMMON

4.4.2 SINGLE PHASE (L1 & N) 2 WIRE WITH RESTRICTED EARTH FAULT

NOTE: Earthing the neutral conductor 'before' the neutral CT allows the module to read earth faults 'after' the CT only (Restricted to load / downstream of the CT)
Earthing the neutral conductor 'after' the neutral CT allows the module to read earth faults 'before' the CT only (Restricted to generator / upstream of the CT)

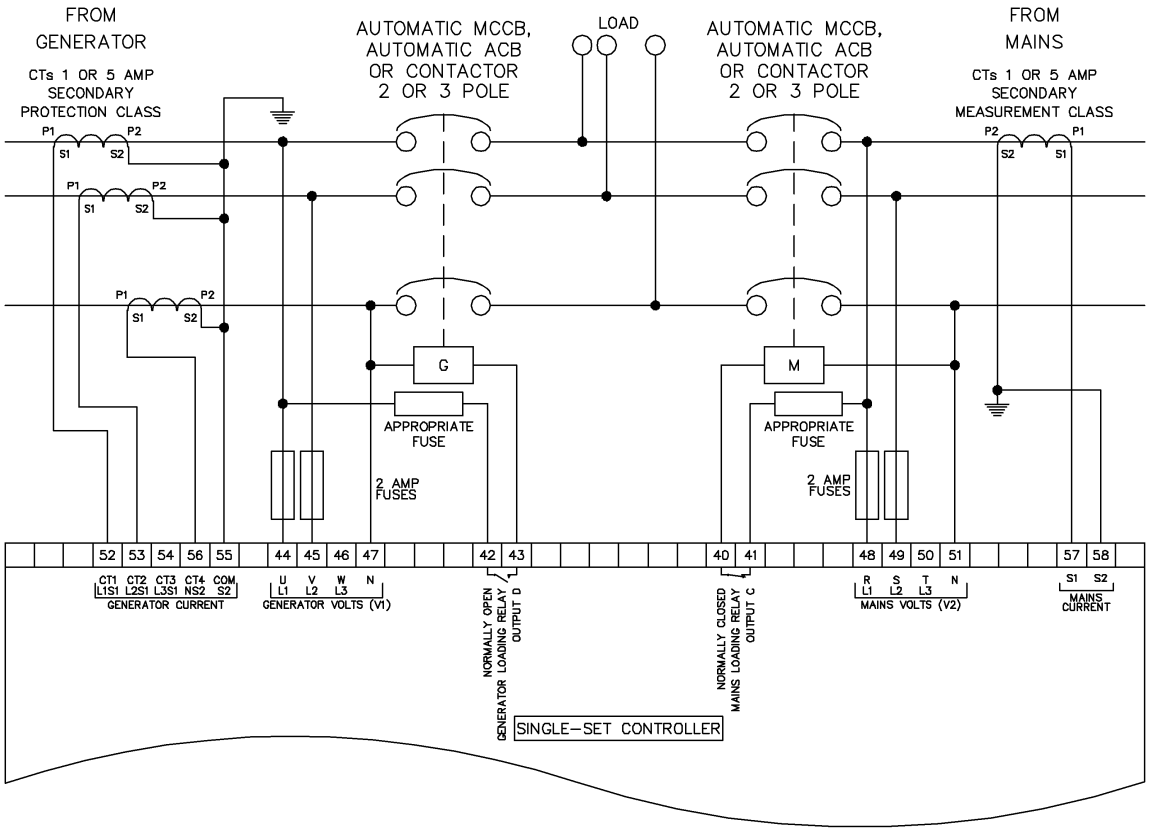


4.4.3 SINGLE PHASE (L1 & N) 2 WIRE WITHOUT EARTH FAULT

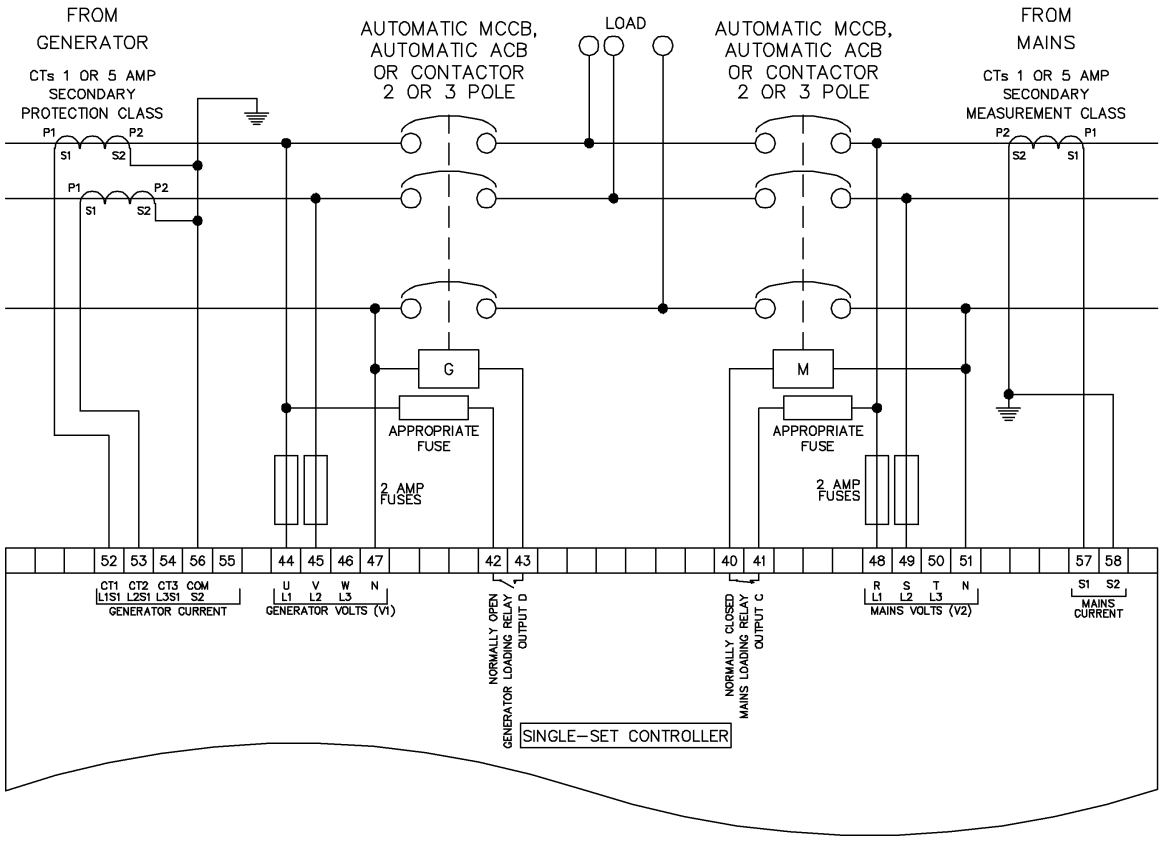


4.4.4 2 PHASE (L1 & L2) 3 WIRE WITH RESTRICTED EARTH FAULT

NOTE: Earthing the neutral conductor 'before' the neutral CT allows the module to read earth faults 'after' the CT only (Restricted to load / downstream of the CT)
Earthing the neutral conductor 'after' the neutral CT allows the module to read earth faults 'before' the CT only (Restricted to generator / upstream of the CT)

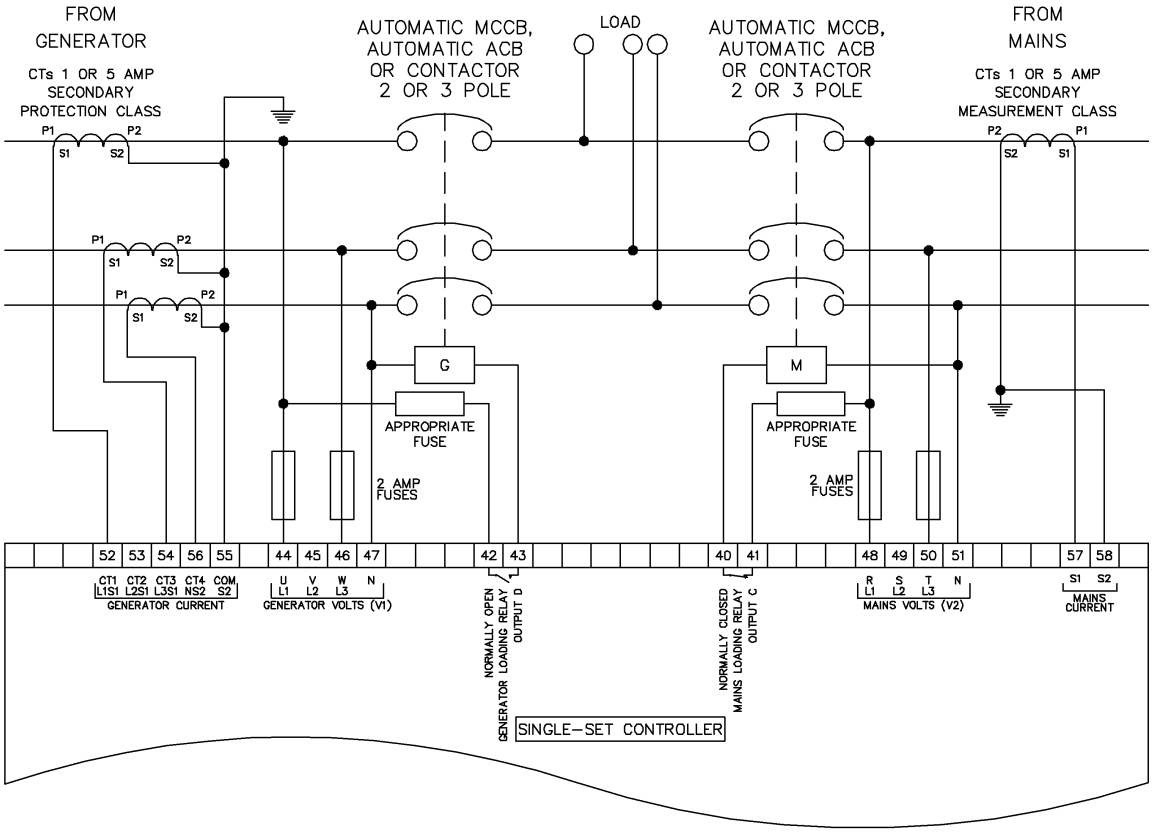


4.4.5 2 PHASE (L1 & L2) 3 WIRE WITHOUT EARTH FAULT

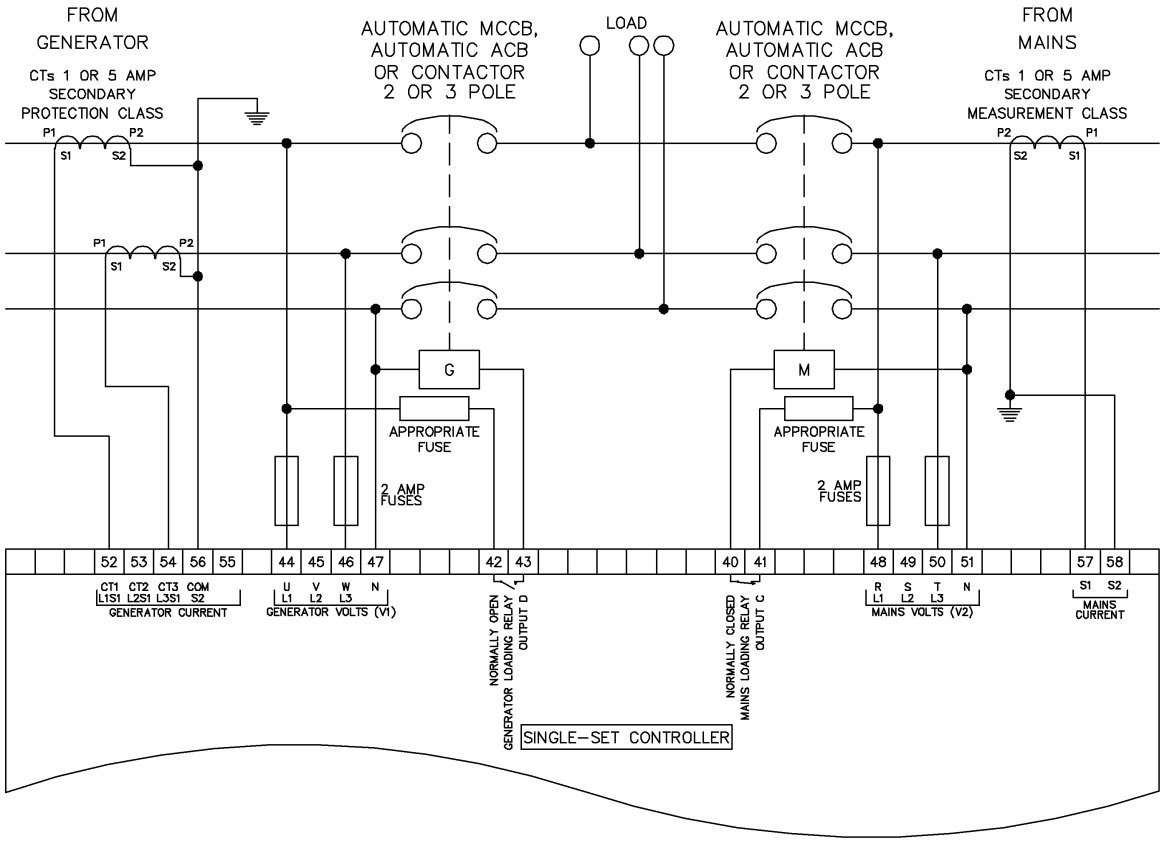


4.4.6 2 PHASE (L1 & L3) 3 WIRE WITH RESTRICTED EARTH FAULT

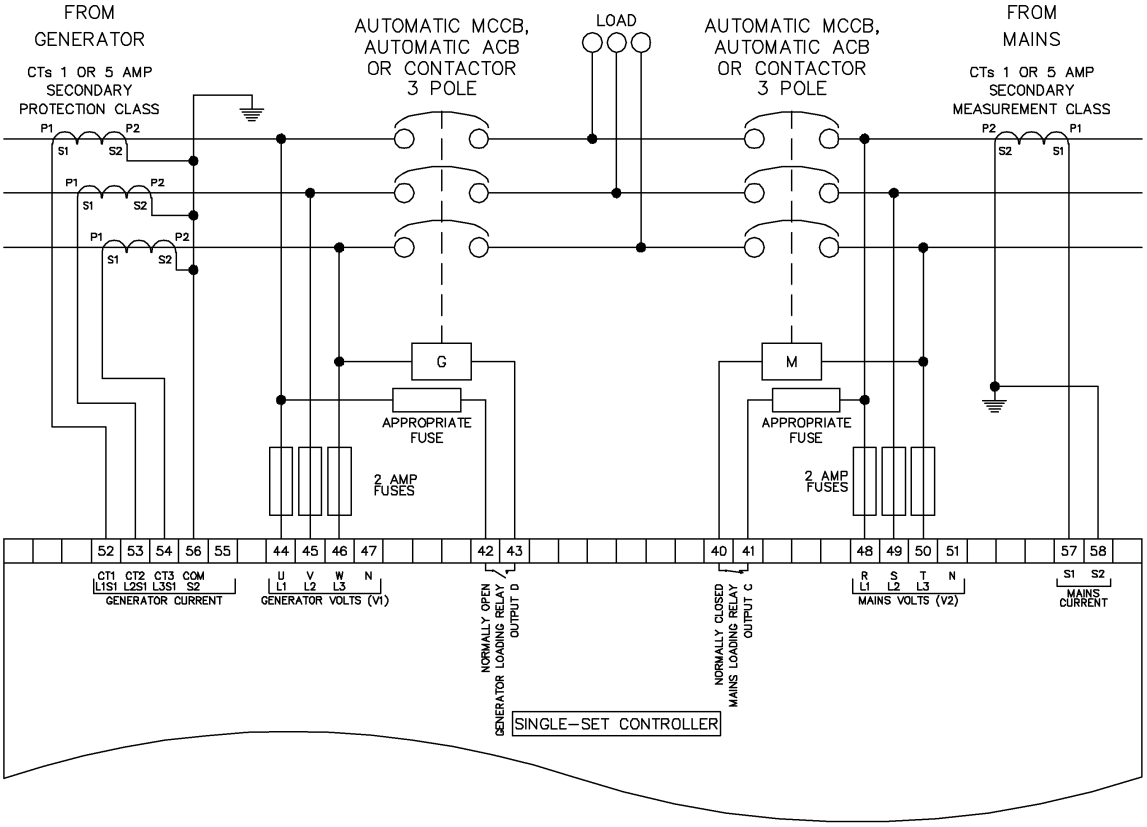
NOTE: Earthing the neutral conductor 'before' the neutral CT allows the module to read earth faults 'after' the CT only (Restricted to load / downstream of the CT)
Earthing the neutral conductor 'after' the neutral CT allows the module to read earth faults 'before' the CT only (Restricted to generator / upstream of the CT)



4.4.7 2 PHASE (L1 & L3) 3 WIRE WITHOUT EARTH FAULT MEASURING

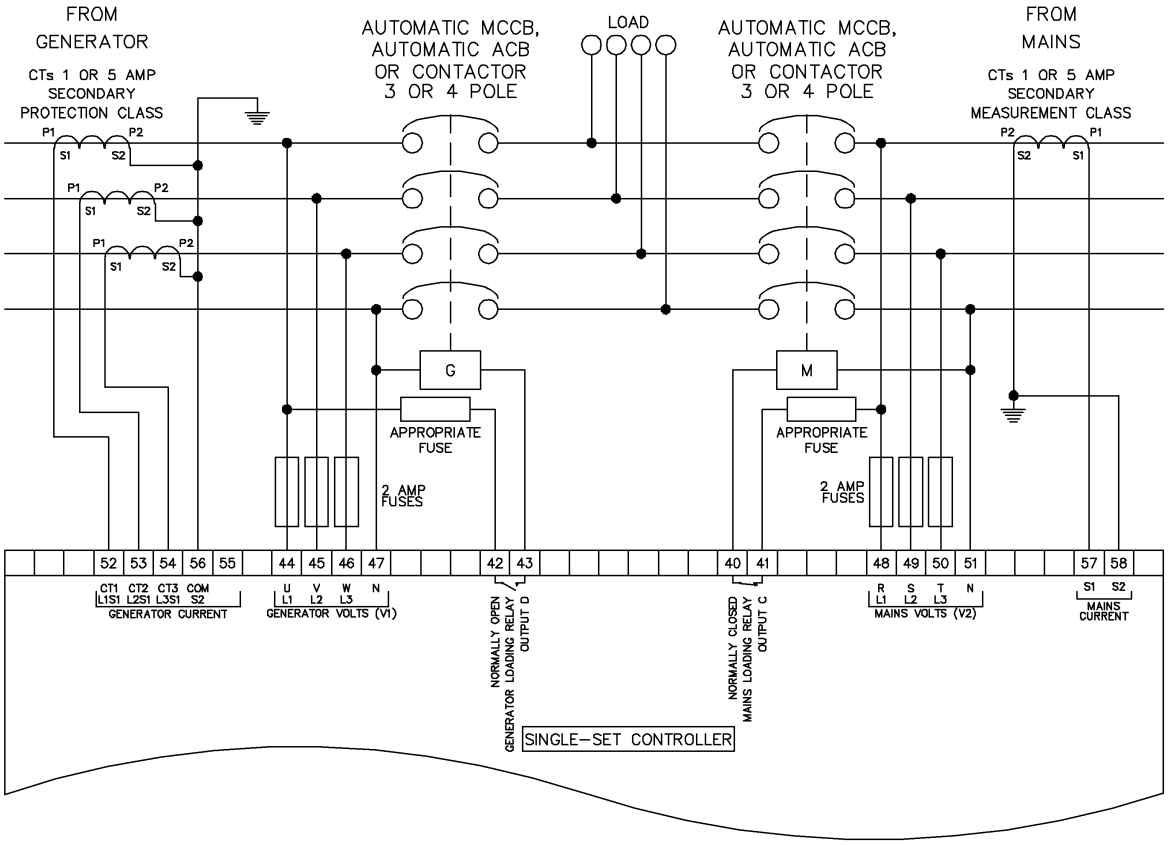


4.4.8 3 PHASE 3 WIRE DETLA WITHOUT EARTH FAULT



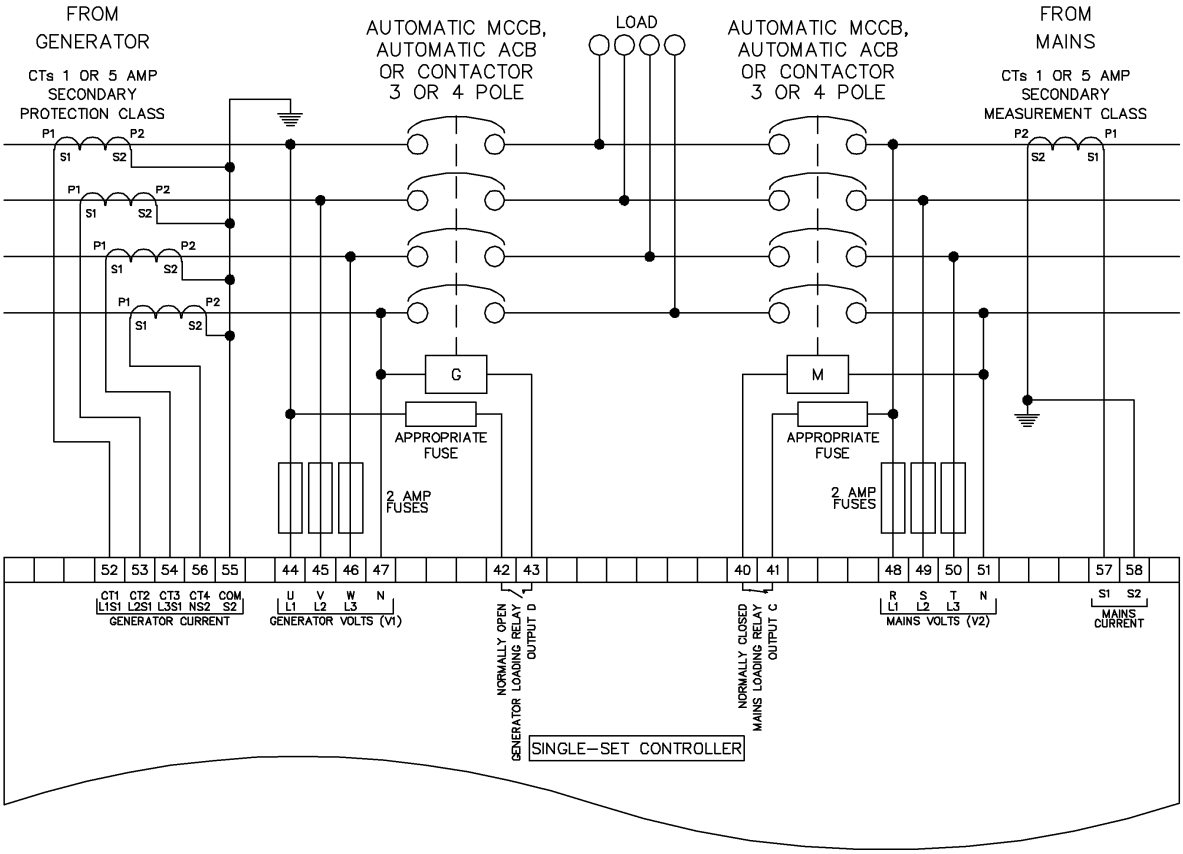
4.4.9 3 PHASE 4 WIRE WITHOUT EARTH FAULT

NOTE: The below diagram is applicable for the following AC topologies: 3 Phase 4 Wire Star, 3 Phase 4 Wire Delta L1-N-L2, 3 Phase 4 Wire Delta L1-N-L3 and 3 Phase 4 Wire Delta *L2-N-L3*. For further details of module configuration to suit these different topologies, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*



4.4.10 3 PHASE 4 WIRE WITH RESTRICTED EARTH FAULT

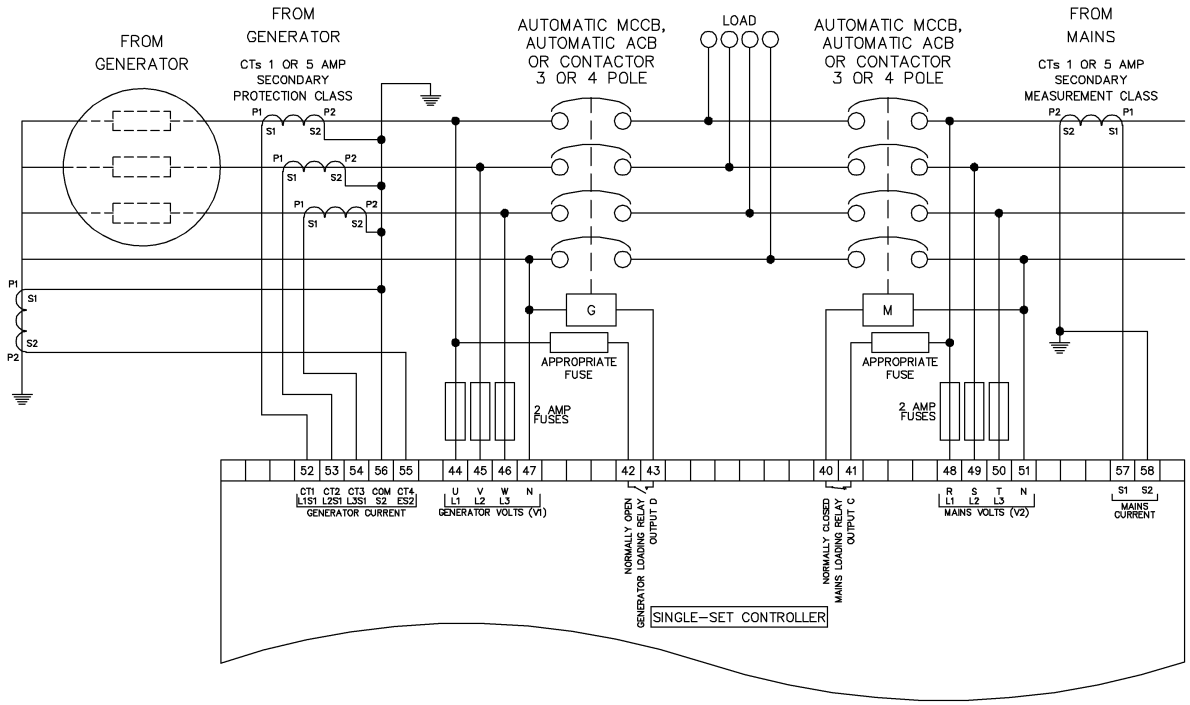
NOTE: The below diagram is applicable for the following AC topologies: 3 Phase 4 Wire Star, 3 Phase 4 Wire Delta L1-N-L2, 3 Phase 4 Wire Delta L1-N-L3 and 3 Phase 4 Wire Delta *L2-N-L3*. For further details of module configuration to suit these different topologies, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*



4.4.11 3 PHASE 4 WIRE WITH UNRESTRICTED EARTH FAULT

NOTE: The below diagram is applicable for the following AC topologies: 3 Phase 4 Wire Star, 3 Phase 4 Wire Delta L1-N-L2, 3 Phase 4 Wire Delta L1-N-L3 and 3 Phase 4 Wire Delta *L2-N-L3*. For further details of module configuration to suit these different topologies, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

This example shows the CTs in the neutral to earth link for a three phase four wire system to provide unrestricted earth fault protection, but the same philosophy is applicable to the other topologies.

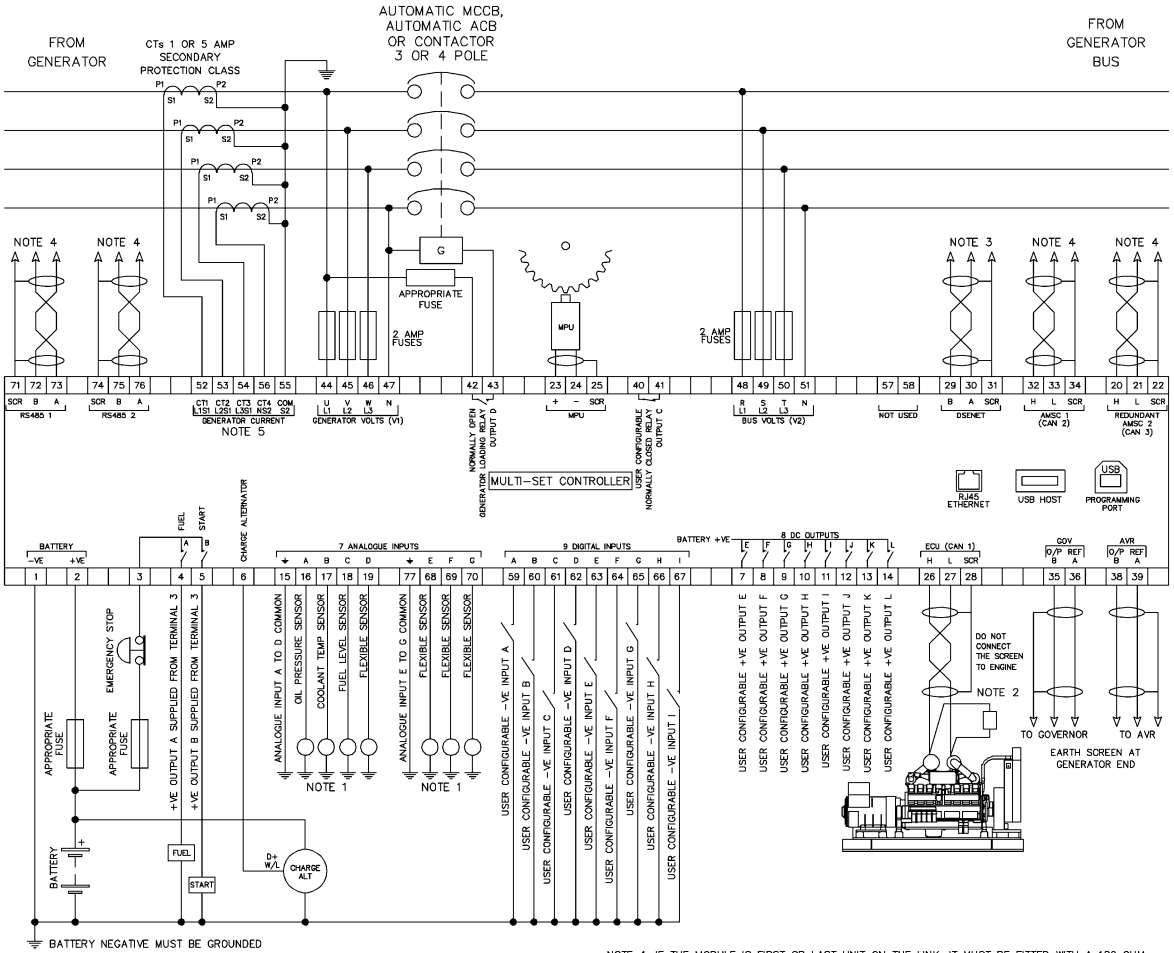


4.5 MULTI SET ALTERNATE TOPOLOGY WIRING DIAGRAMS

4.5.1 3 PHASE 4 WIRE WITH RESTRICTED EARTH FAULT (MULTISET CONTROLLER)

NOTE: The below diagram is applicable for the following AC topologies: 3 Phase 4 Wire Star, 3 Phase 4 Wire Delta L1-N-L2, 3 Phase 4 Wire Delta L1-N-L3 and 3 Phase 4 Wire Delta *L2-N-L3*. For further details of module configuration to suit these different topologies, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

NOTE: Earthing the neutral conductor 'before' the neutral CT allows the module to read earth faults 'after' the CT only (Restricted to load / downstream of the CT)
Earthing the neutral conductor 'after' the neutral CT allows the module to read earth faults 'before' the CT only (Restricted to generator / upstream of the CT).



BATTERY NEGATIVE MUST BE GROUNDED

NOTE 1. THESE GROUND CONNECTIONS MUST BE ON THE ENGINE BLOCK, AND MUST BE TO THE SENSOR BODIES.

NOTE 2. 120 R TERMINATING RESISTOR MAY BE REQUIRED EXTERNALLY, SEE ENGINE MANUFACTURERS LITERATURE.

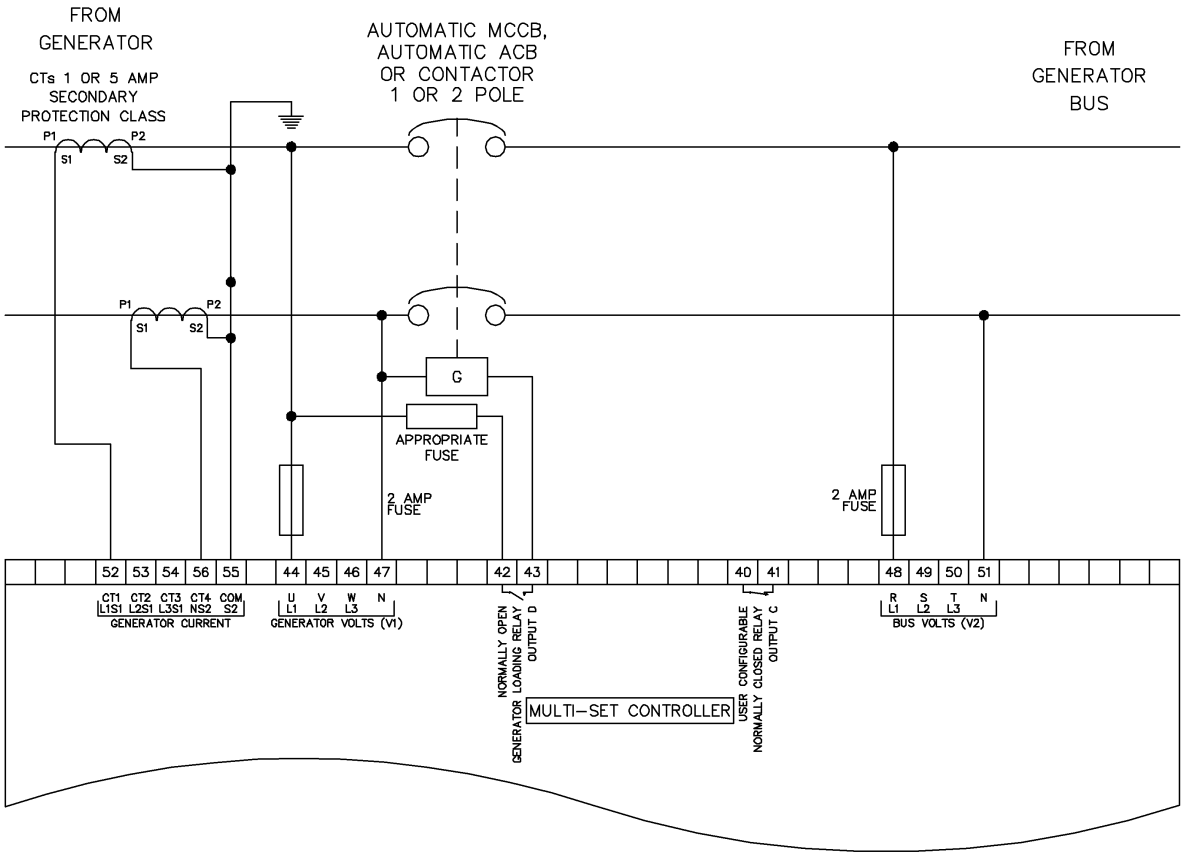
NOTE 3. MUST BE FITTED AS FIRST OR LAST UNIT ON DSENET WITH NO TERMINATION RESISTOR. THE SUBSEQUENT FIRST OR LAST UNIT ON DSENET MUST BE FITTED WITH A 120 OHM TERMINATION RESISTOR TERMINALS A AND B.

NOTE 4. IF THE MODULE IS FIRST OR LAST UNIT ON THE LINK, IT MUST BE FITTED WITH A 120 OHM TERMINATION RESISTOR ACROSS TERMINALS H AND L.

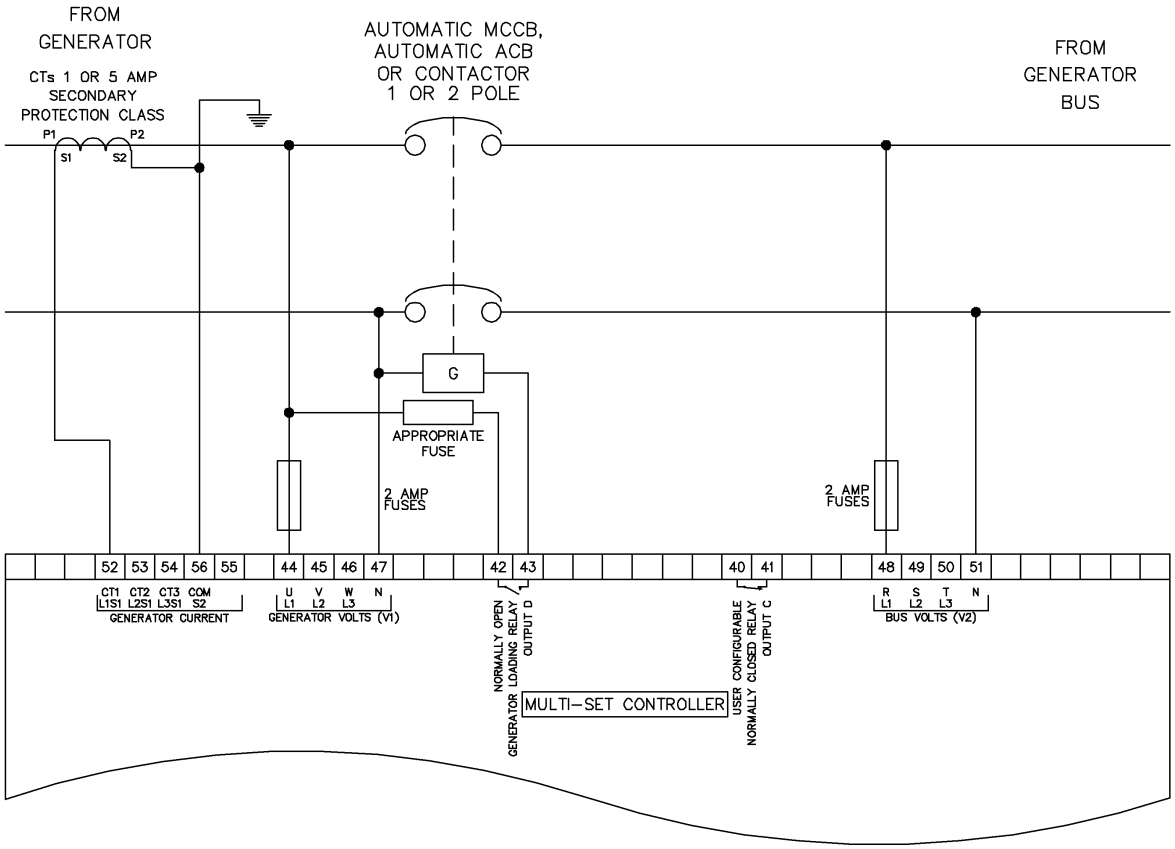
NOTE 5. WHEN THE 4TH CT IS PLACED ON THE NEUTRAL, TERMINAL 55 IS THE CT COMMON. WHEN THE 4TH IS NOT IN USE OR PLACED ON THE EARTH CONNECTION, TERMINAL 56 IS THE CT COMMON

4.5.2 SINGLE PHASE (L1 & N) 2 WIRE WITH RESTRICTED EARTH FAULT

NOTE: Earthing the neutral conductor 'before' the neutral CT allows the module to read earth faults 'after' the CT only (Restricted to load / downstream of the CT)
Earthing the neutral conductor 'after' the neutral CT allows the module to read earth faults 'before' the CT only (Restricted to generator / upstream of the CT)

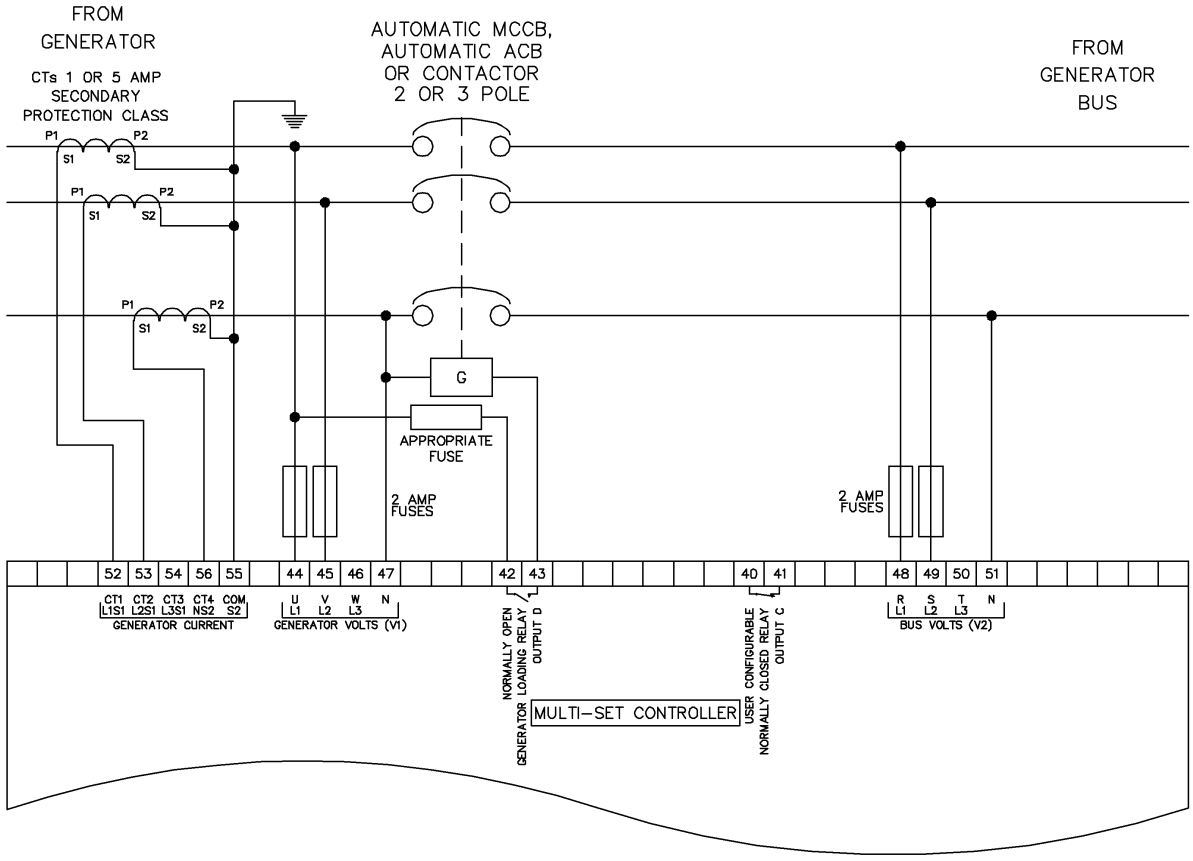


4.5.3 SINGLE PHASE (L1 & N) 2 WIRE WITHOUT EARTH FAULT

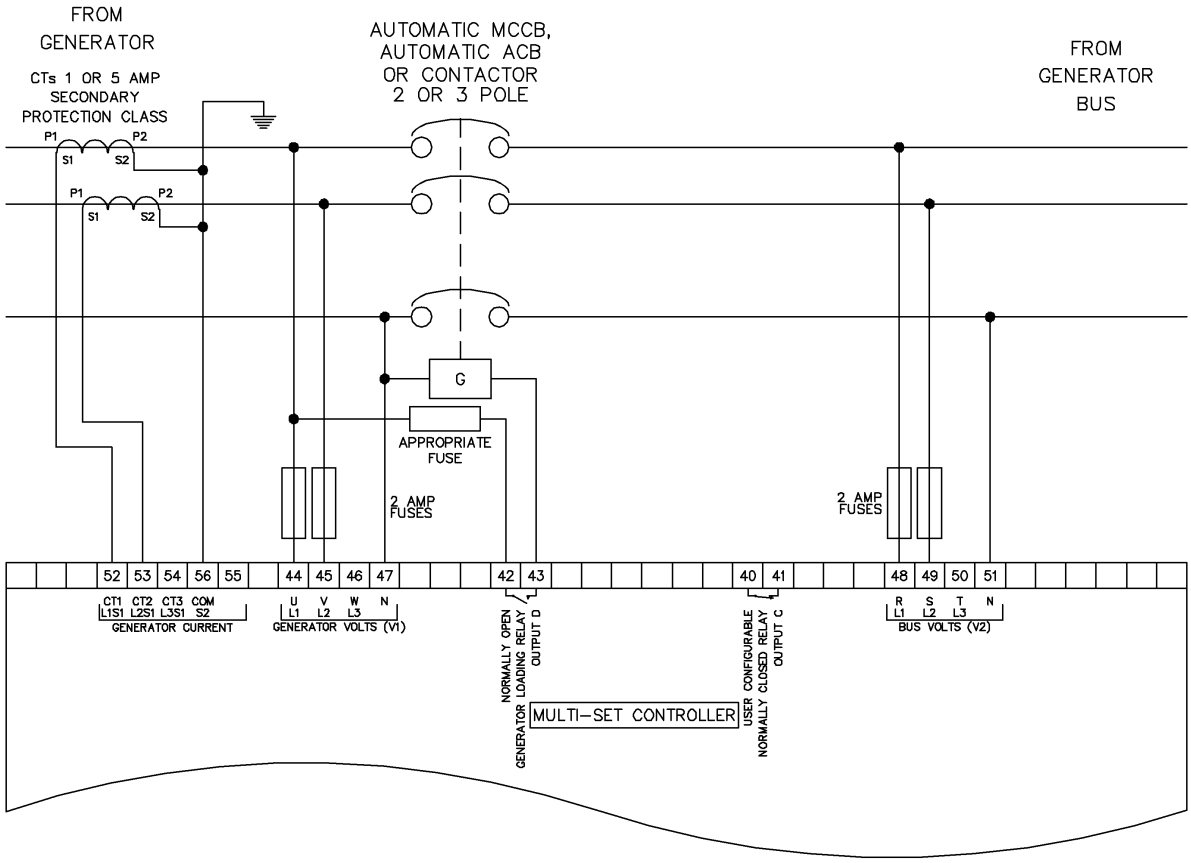


4.5.4 2 PHASE (L1 & L2) 3 WIRE WITH RESTRICTED EARTH FAULT

NOTE: Earthing the neutral conductor 'before' the neutral CT allows the module to read earth faults 'after' the CT only (Restricted to load / downstream of the CT)
Earthing the neutral conductor 'after' the neutral CT allows the module to read earth faults 'before' the CT only (Restricted to generator / upstream of the CT)

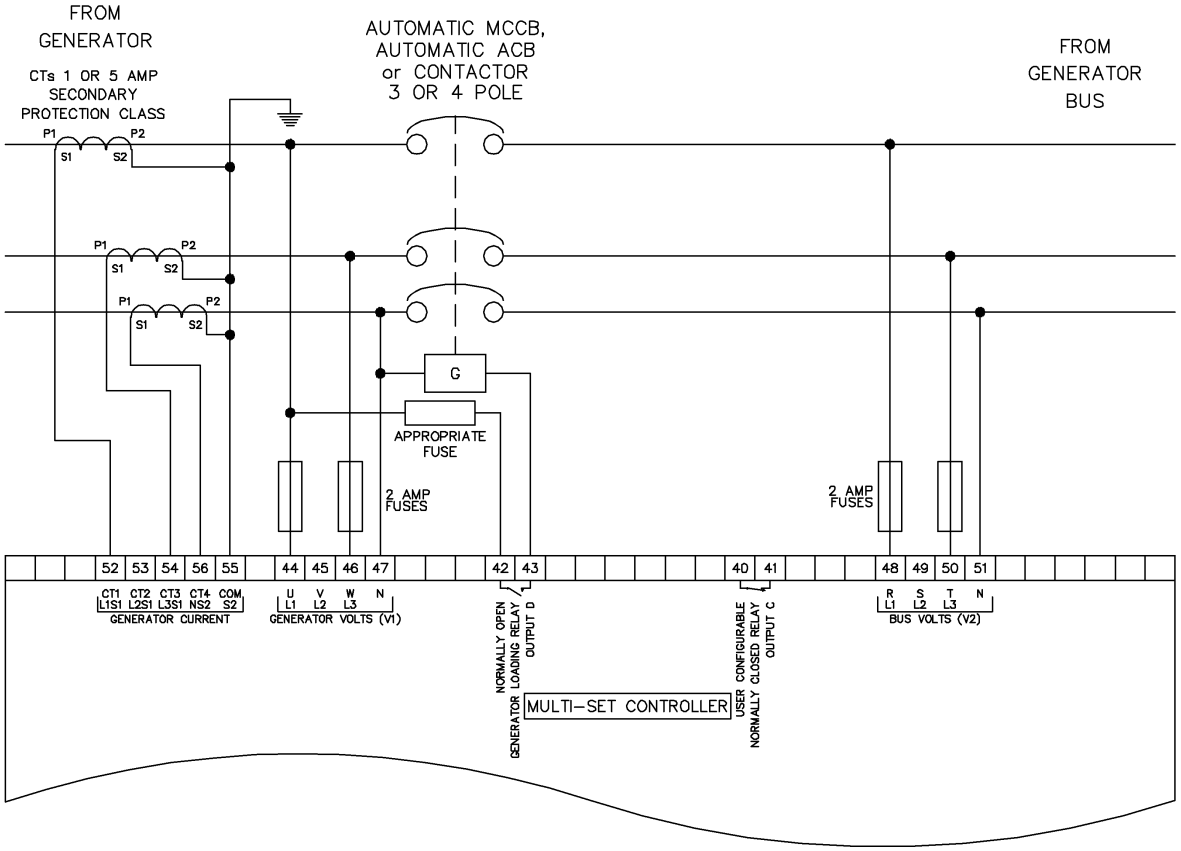


4.5.5 2 PHASE (L1 & L2) 3 WIRE WITHOUT EARTH FAULT

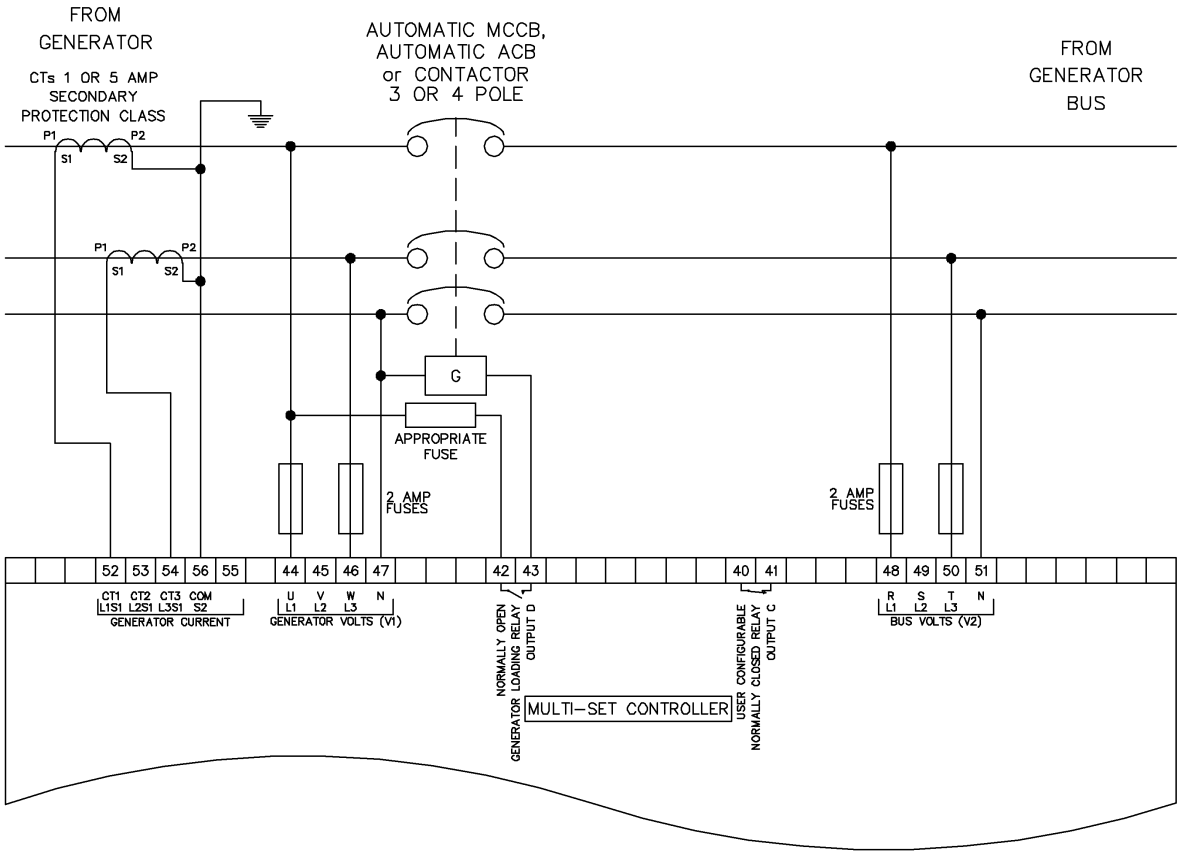


4.5.6 2 PHASE (L1 & L3) 3 WIRE WITH RESTRICTED EARTH FAULT

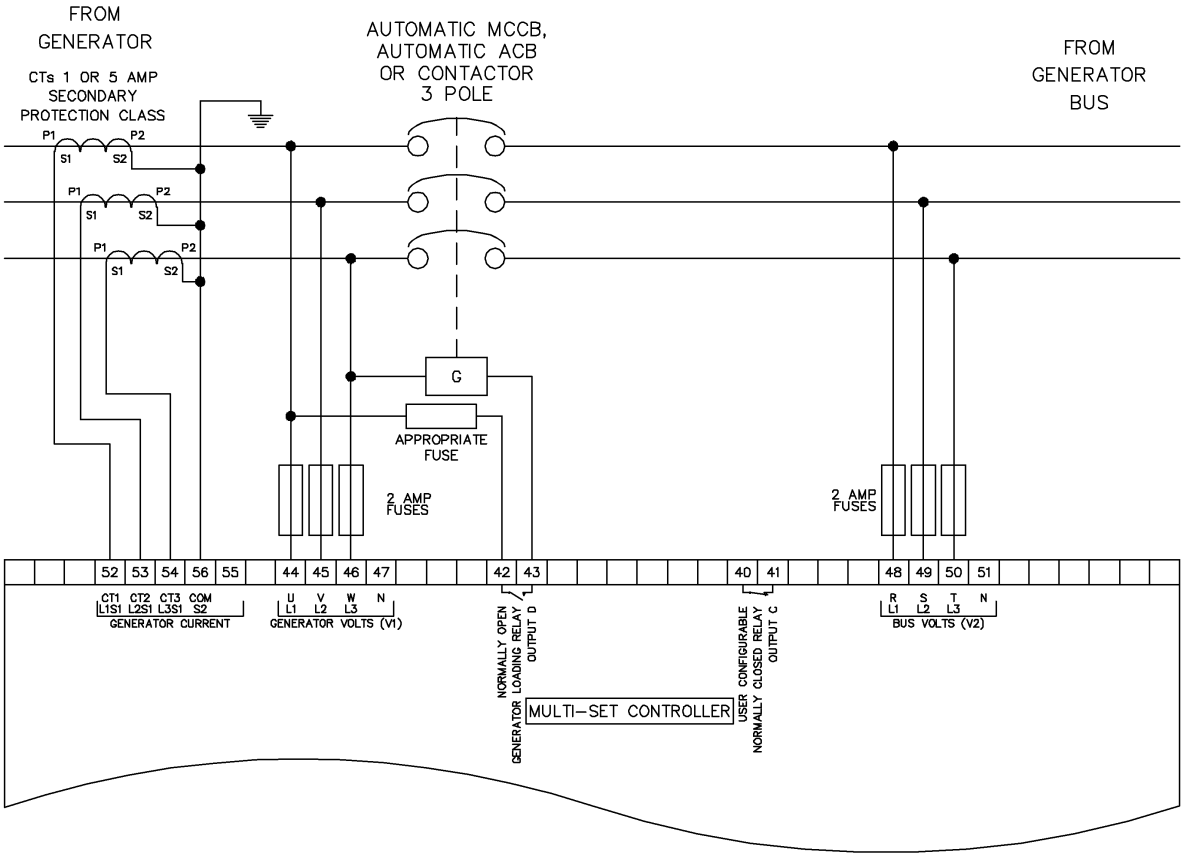
NOTE: Earthing the neutral conductor 'before' the neutral CT allows the module to read earth faults 'after' the CT only (Restricted to load / downstream of the CT)
Earthing the neutral conductor 'after' the neutral CT allows the module to read earth faults 'before' the CT only (Restricted to generator / upstream of the CT)



4.5.7 2 PHASE (L1 & L3) 3 WIRE WITHOUT EARTH FAULT

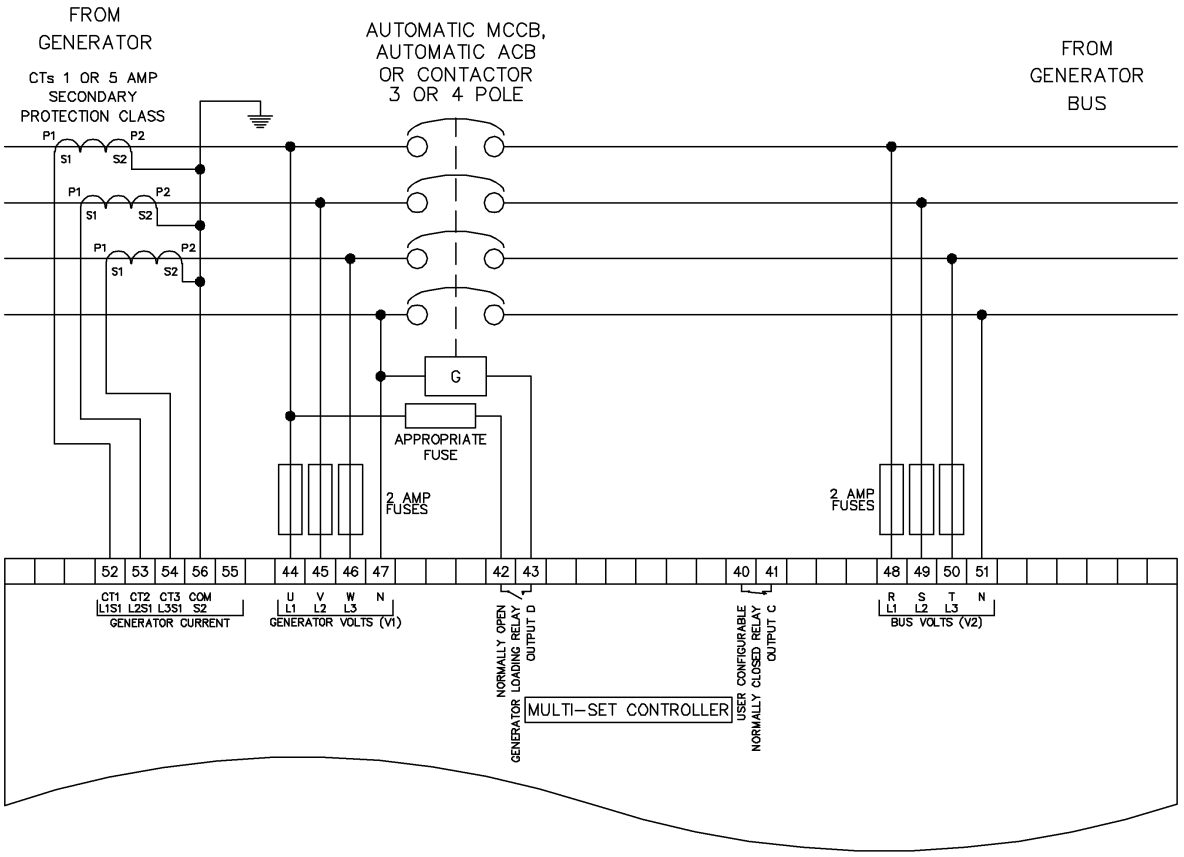


4.5.8 3 PHASE 3 WIRE DETLA WITHOUT EARTH FAULT



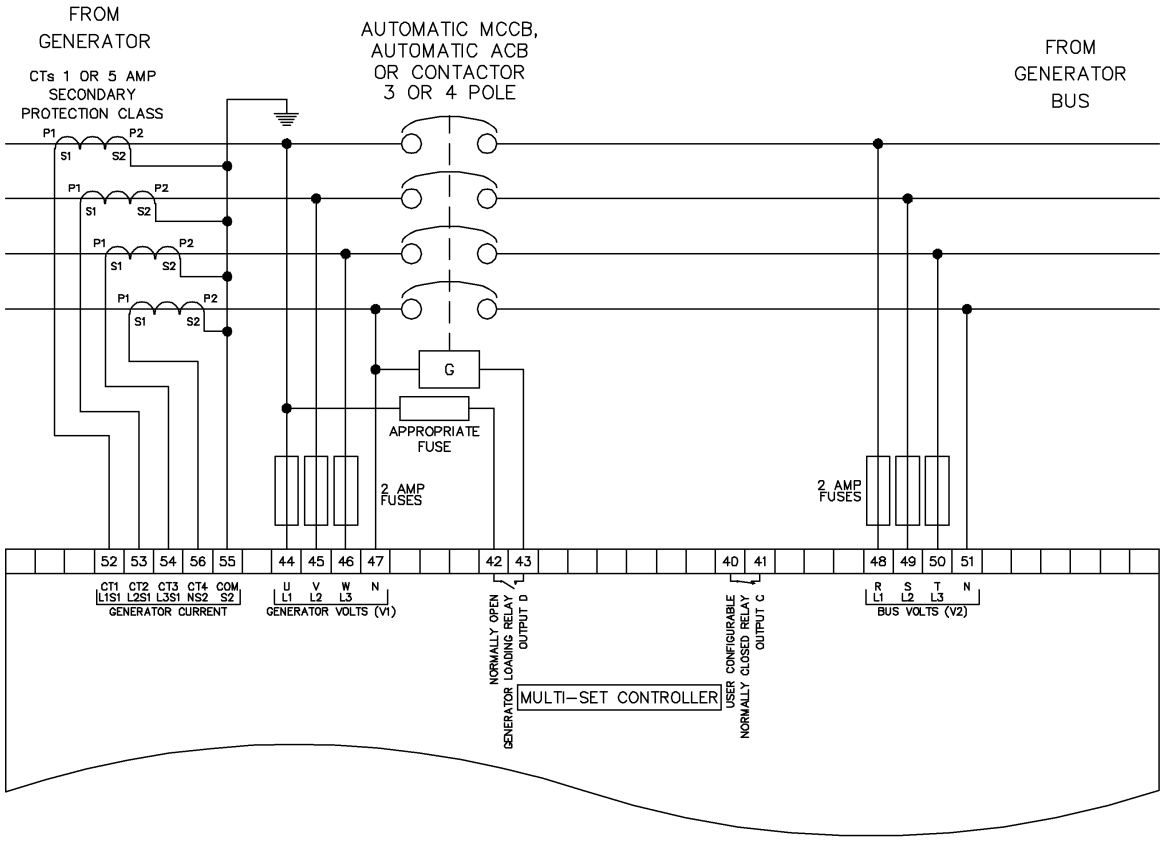
4.5.9 3 PHASE 4 WIRE WITHOUT EARTH FAULT

NOTE: The below diagram is applicable for the following AC topologies: 3 Phase 4 Wire Star, 3 Phase 4 Wire Delta L1-N-L2, 3 Phase 4 Wire Delta L1-N-L3 and 3 Phase 4 Wire Delta *L2-N-L3*. For further details of module configuration to suit these different topologies, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*



4.5.10 3 PHASE 4 WIRE WITH RESTRICTED EARTH FAULT

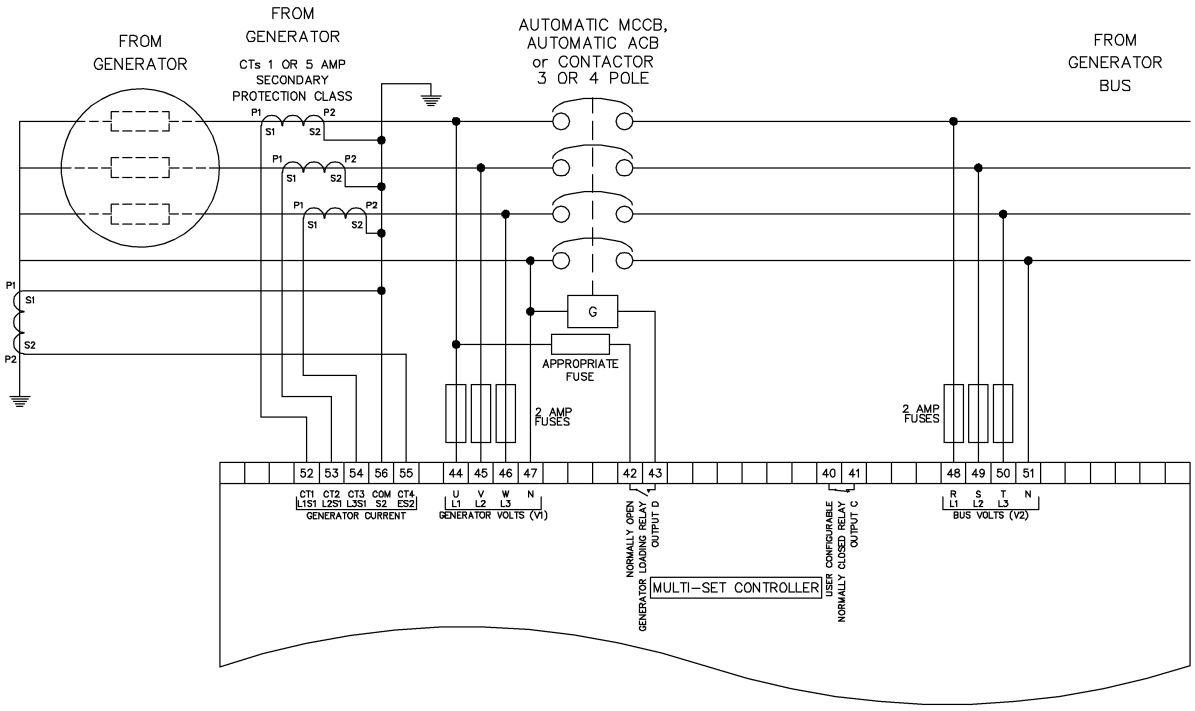
NOTE: The below diagram is applicable for the following AC topologies: 3 Phase 4 Wire Star, 3 Phase 4 Wire Delta L1-N-L2, 3 Phase 4 Wire Delta L1-N-L3 and 3 Phase 4 Wire Delta *L2-N-L3*. For further details of module configuration to suit these different topologies, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*



4.5.11 3 PHASE 4 WIRE WITH UNRESTRICTED EARTH FAULT

NOTE: The below diagram is applicable for the following AC topologies: 3 Phase 4 Wire Star, 3 Phase 4 Wire Delta L1-N-L2, 3 Phase 4 Wire Delta L1-N-L3 and 3 Phase 4 Wire Delta *L2-N-L3*. For further details of module configuration to suit these different topologies, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

This example shows the CTs in the neutral to earth link for a three phase four wire system to provide unrestricted earth fault protection, but the same philosophy is applicable to the other topologies.

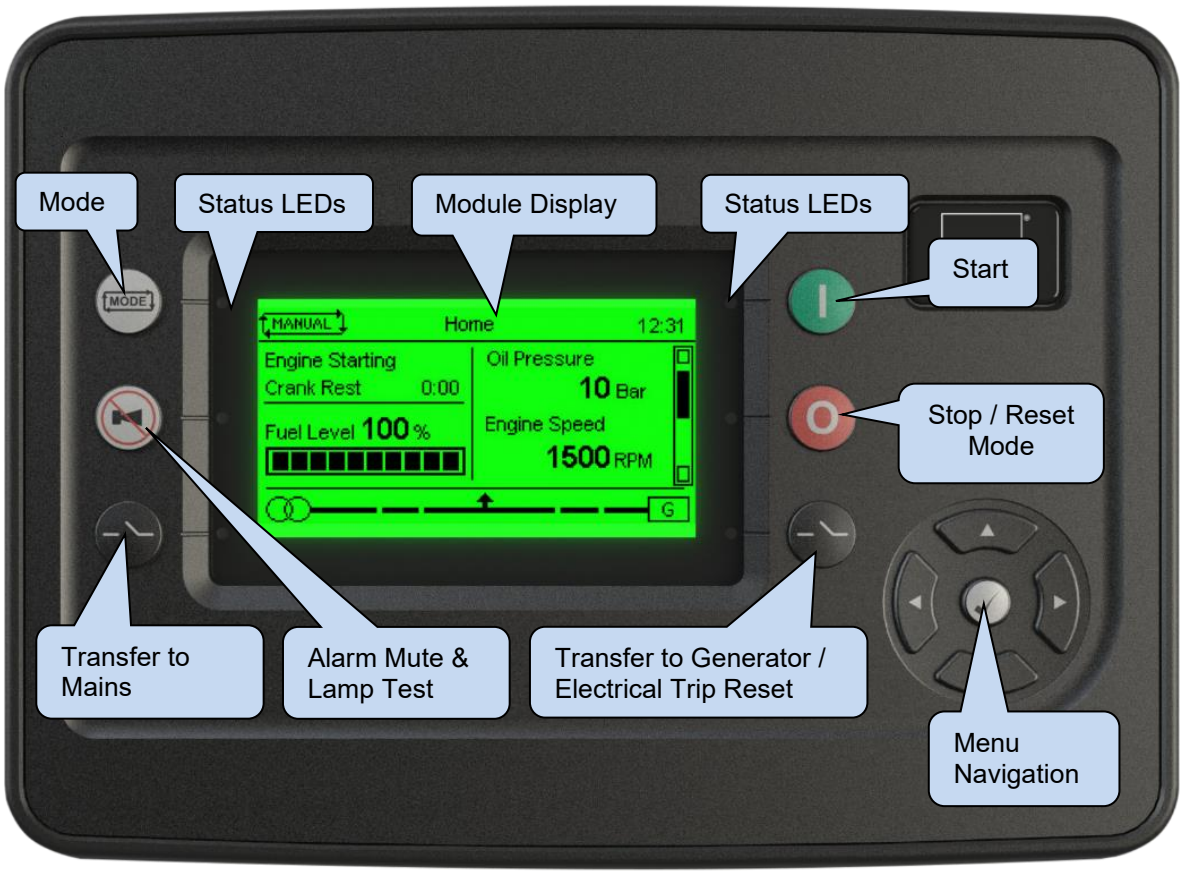


5 DESCRIPTION OF CONTROLS

CAUTION: The module may instruct an engine start event due to external influences. Therefore, it is possible for the engine to start at any time without warning. Prior to performing any maintenance on the system, it is recommended that steps are taken to remove the battery and isolate supplies.

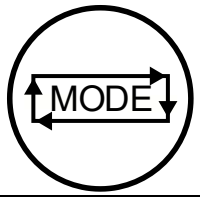
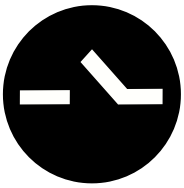
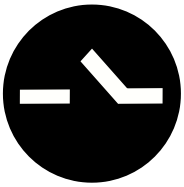
NOTE: The following descriptions detail the sequences followed by a module containing the standard 'factory configuration.' Always refer to the configuration source for the exact sequences and timers observed by any module in the field

Control of the module is via push buttons mounted on the front of the module with ***Stop/Reset Mode***, **Start/*Manual Mode***, ***Auto Mode, Test Mode, Manual Mode***, ***Alarm Mute/Lamp Test***, ***Transfer to Mains*** and ***Transfer to Generator*** functions. For normal operation, these are the only controls which need to be operated. Details of their operation are provided later in this document.



5.1 CONTROL PUSH BUTTONS

NOTE: For further details, see the section entitled *Operation* elsewhere in this document.

Icon	Description
	**Mode Button** In the G8600 the mode button is used to select ***Auto Mode, Test Mode,*** or ***Manual Mode***. Pressing the button cycles through ***Auto mode > Test mode > Manual mode >***
	**Alarm Mute / Lamp Test** This button silences the audible alarm in the controller, de-activates the *Audible Alarm* output (if configured) and illuminates all the LEDs on the module's facia as a lamp test function.
	**Right Hand Side Breaker Button** The breaker button provides the following function: Transfer to generator / electrical trip reset.
	**Left Hand Side Breaker Button** The breaker button provides the following function: Transfer to mains (utility) / open generator.
	**Start** Pressing the ***Start*** I button in ***Stop/Reset Mode*** O powers up the engine's ECU but does not start the engine and places the module in ***Manual Mode*** MANUAL. This is used to check the status of the CAN communication and to prime the fuel system. Pressing the ***Start*** I button in ***Manual Mode*** MANUAL starts the generator and runs it off load in ***Manual Mode*** MANUAL.
	**Stop / Reset Mode** This button places the module into its ***Stop/Reset Mode*** O. This clears any alarm conditions for which the triggering criteria has been removed. If the engine is running and the module is put into ***Stop/Reset Mode*** O, the module automatically instructs the generator off load *('**Close Generator Output**' becomes inactive)* and place the mains (utility) on load *('**Close Mains Output**' becomes active).* The fuel supply de-energises and the engine comes to a standstill. The generator remains at rest if any form of *start signal* is present when in ***Stop/Reset Mode*** O.

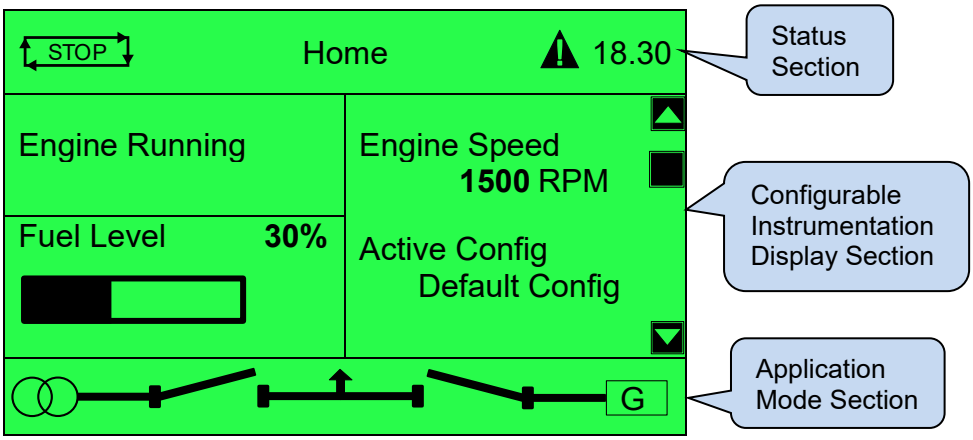
Parameter descriptions are continued overleaf…

NOTE: For further details, see the section entitled *Operation* elsewhere in this document.

Icon	Description
	**Menu Navigation** Used for navigating the instrumentation, event log and configuration screens.

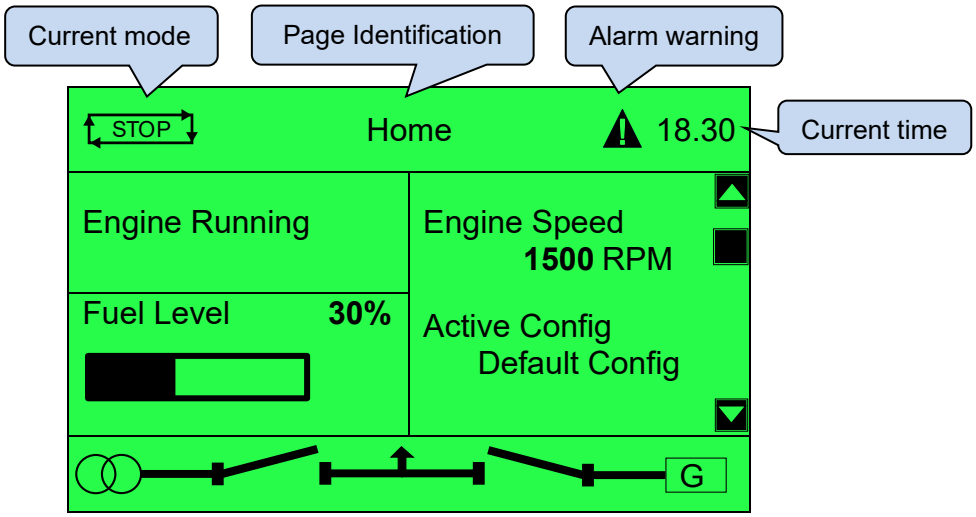
5.2 DISPLAY SCREEN

When an event or user interaction happens, this may be represented on the display graphically. There are three sections on the display namely the *Status*, *Configurable Instrumentation Display* and *Application Mode* section which helps the user identify what operating state the module is in.



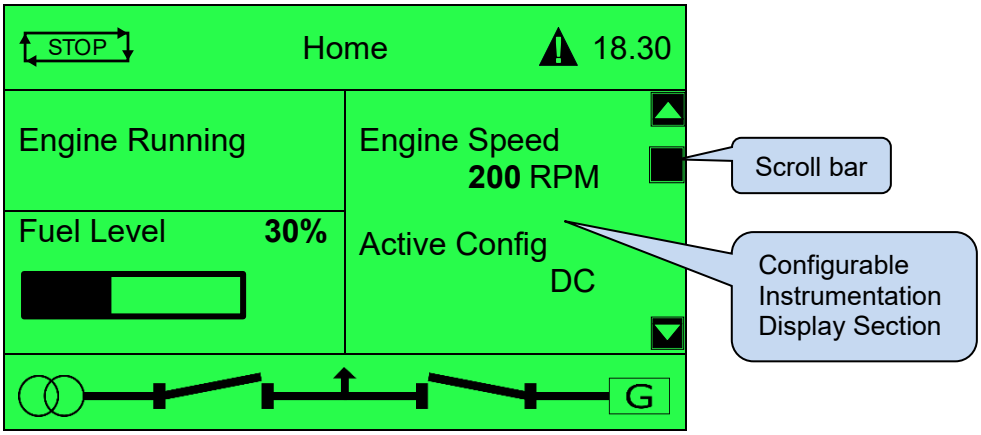
Status Section

The top of the display screen displays the status of the module.



Configurable Instrumentation Display Section

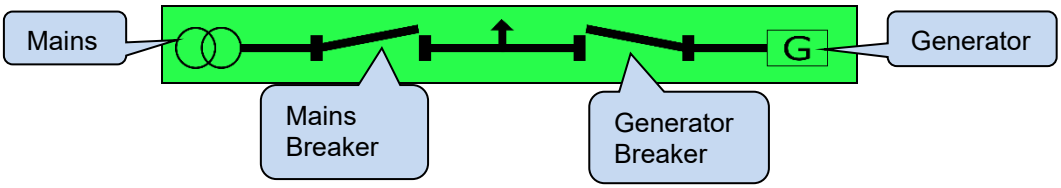
The middle section of the display shows any configured instrumentation.



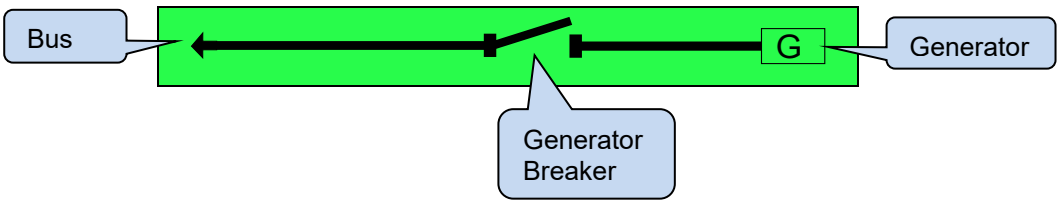
Application Mode Section

The bottom of the display screen is used to represent the application mode. The display shows the relevant breakers, bus, mains (utility), generators etc depending on which application is selected.

Single Set



Multi Set



5.3 VIEWING THE INSTRUMENT PAGES

NOTE: Depending upon the module's configuration, some display pages may be disabled. For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

Selecting Pages

To navigate to different pages or sub-pages the following sequence must be followed.

Once selected, the page remains on the LCD display until the user selects a different page, or after an extended period of inactivity (*LCD Page Timer*), the module reverts to the home display.

Home Page

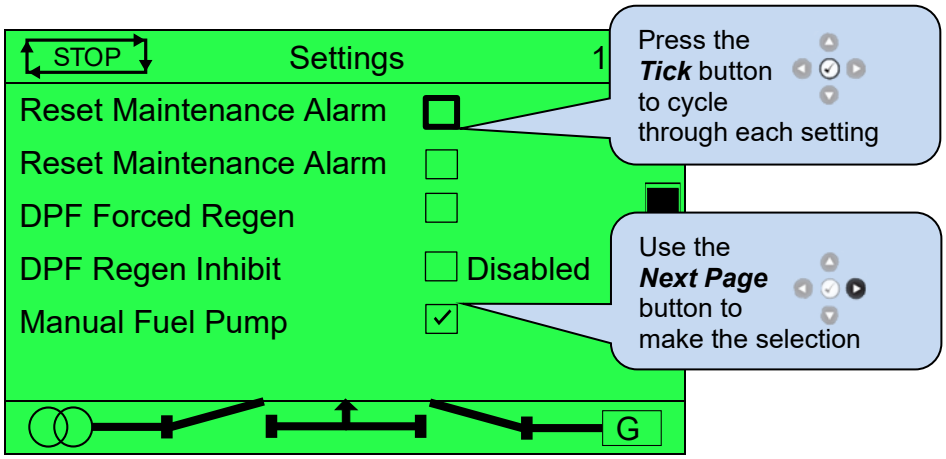
To navigate back to the home page the following sequence must be observed.

Repeated presses of the ***Previous Page*** button eventually reveals the *Back Button* and pressing the *Tick* button returns to the Home page.

Enabling/Disabling Items

Selecting an item on a page is achieved by repeatably pressing the ***Tick*** button to cycle through each item and then using the ***Next Page*** button to make the selection.

Example

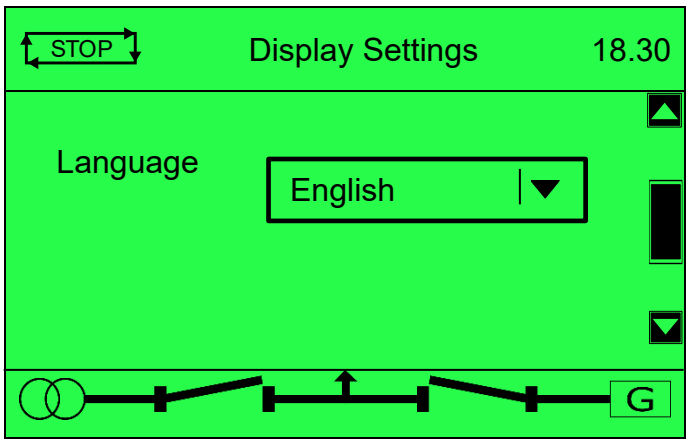


Using Drop-Down Menus

Press the ***Tick*** button and press the ***Next Page*** button to open the drop-down menu.

Use the ***Scroll*** buttons to navigate.

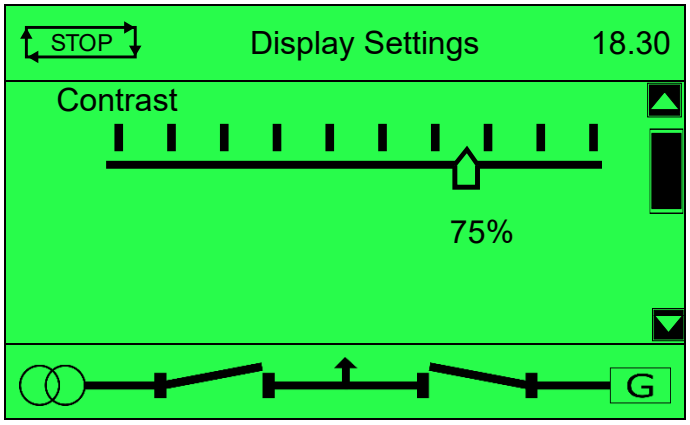
Press the ***Tick*** button to select and save the setting.



Using Slider Controls

Press the ***Tick*** button and using the ***Next or Previous*** page buttons adjust the slider.

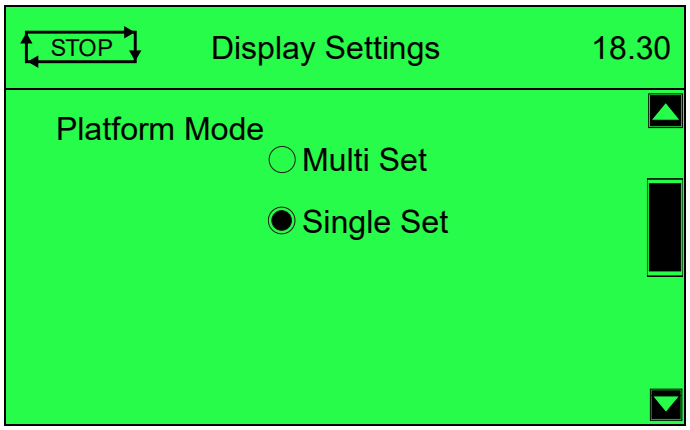
Once the selection has been made press the ***Tick*** button again to save the setting.



Making Selections

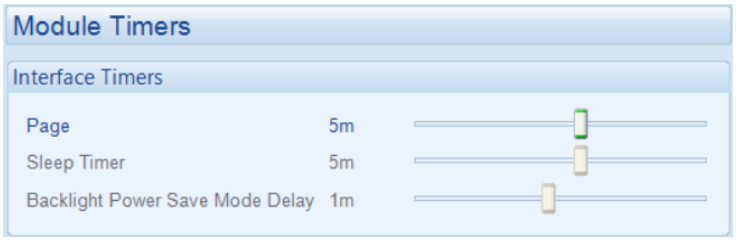
Press the ***Tick*** button to highlight and use the ***Scroll*** buttons to change the selection.

Once a selection has been made press the ***Tick*** button to confirm.



Configuring Timers

The *LCD Page* timers are configurable using the DSE Configuration Suite Software or by using the Front Panel Editor.



The screenshot shows the factory settings for the timers, taken from the DSE Configuration Suite PC Software.

Alternatively, to scroll manually through all instruments on the currently selected page, press the ***Scroll*** buttons.

When scrolling manually, the display automatically returns to the Status page if no buttons are pressed for the duration of the configurable *LCD Page Timer*.

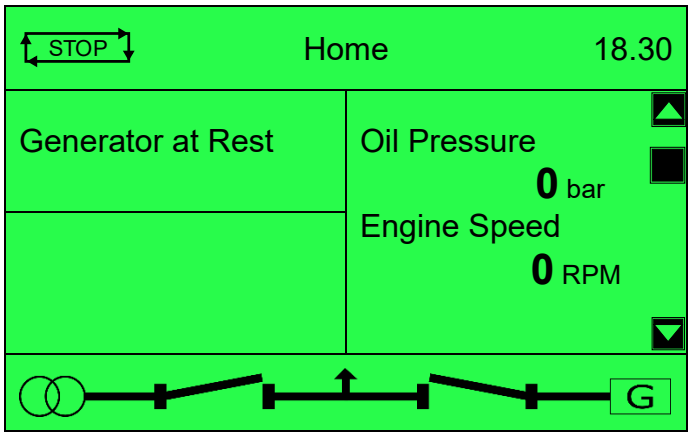
If an alarm becomes active while viewing the status page, the display shows the Alarms page to draw the operator's attention to the alarm condition. The complete order and contents of each information page are given in the following sections.

5.3.1 HOME

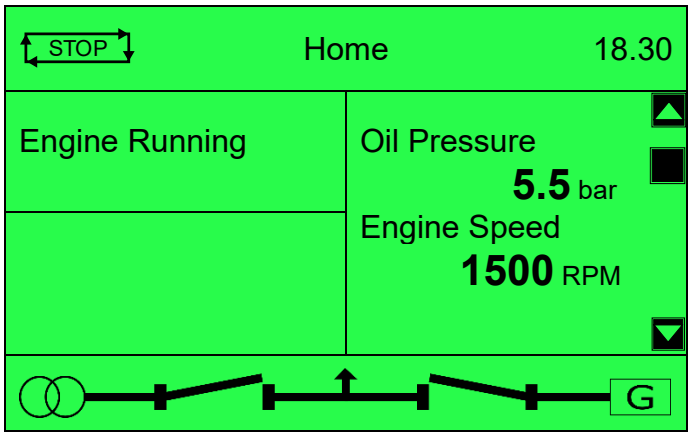
NOTE: Press the *Instrumentation Scroll* buttons on the *Home Page* to view other Configurable Status Pages if configured. For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

This is the 'Home' page, the page that is displayed when no other page has been selected, and the page that is automatically displayed after a period of inactivity (*LCD Page Timer)* of the module control buttons.

This page changes with the action of the controller for example when the generator is running and available:

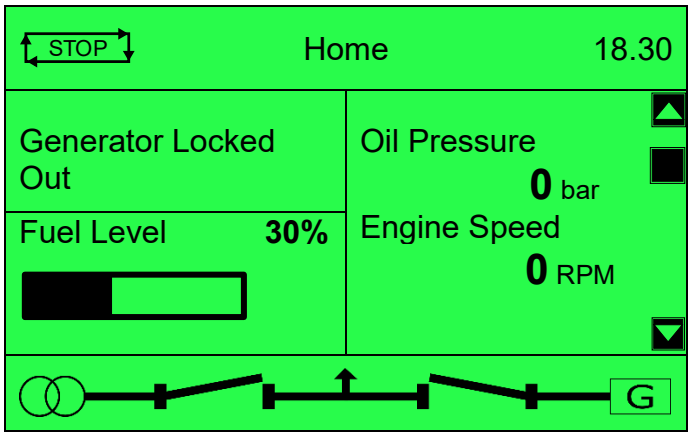


Factory setting of *Home* page showing engine stopped...



and engine running...

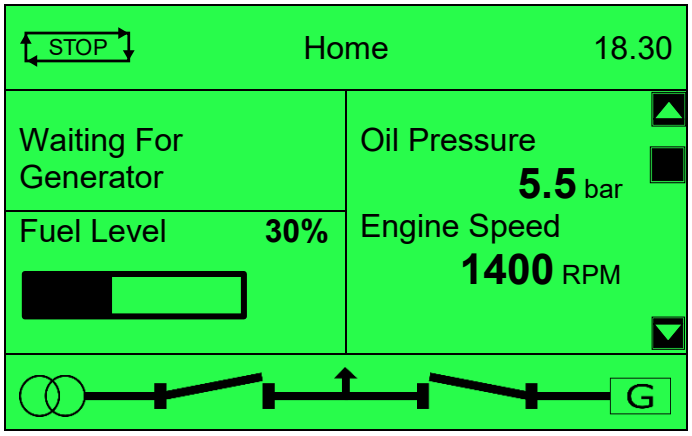
5.3.1.1 GENERATOR LOCKED OUT



Generator Locked Out indicates that the Generator cannot be started due to an active *Shutdown* or *Electrical Trip Alarm* on the module. Press the ***Next Page*** button to scroll to the alarms page to investigate. Press the ***Stop/Reset Mode*** button to clear the alarm, if the alarm does not clear the fault is still active.

5.3.1.2 WAITING FOR GENERATOR

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 DSEG8600 Configuration Suite PC Software Manual.



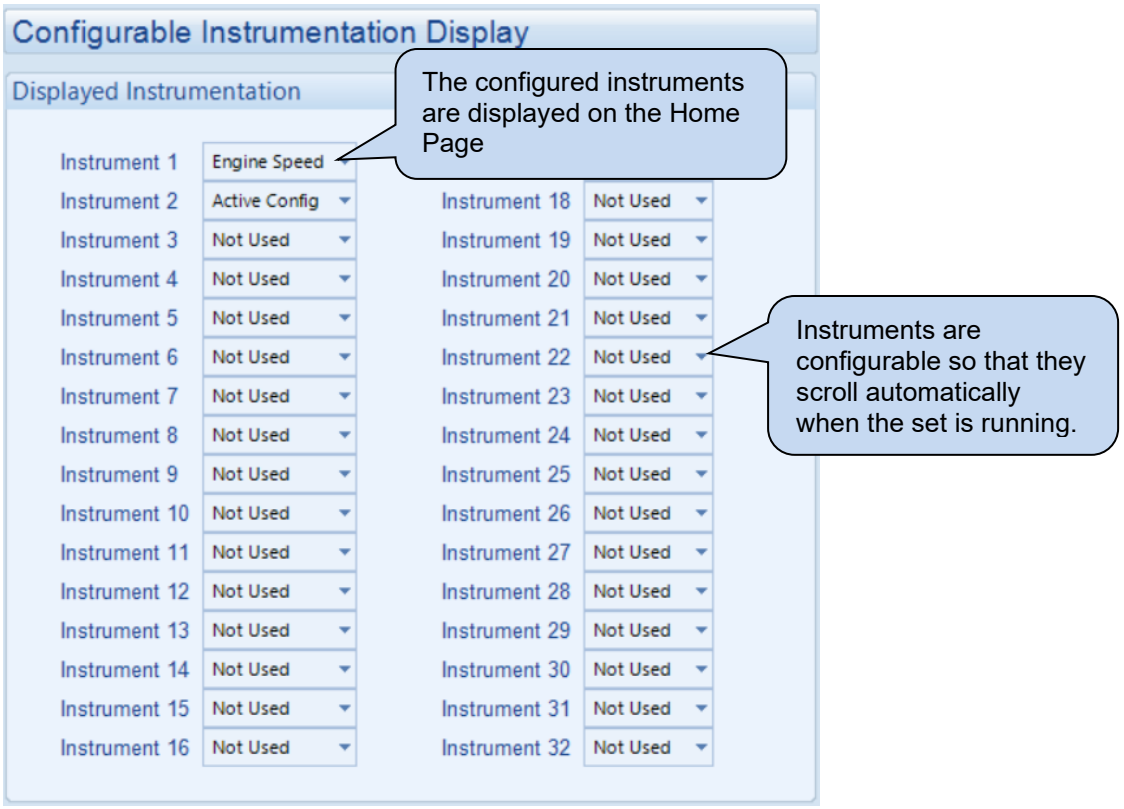
Waiting For Generator indicates that the Generator has started but has not reached the required *Loading Voltage* and or *Loading Frequency* as set in the module's configuration.

Press the ***Next Page***  button to access the *Generator* page.

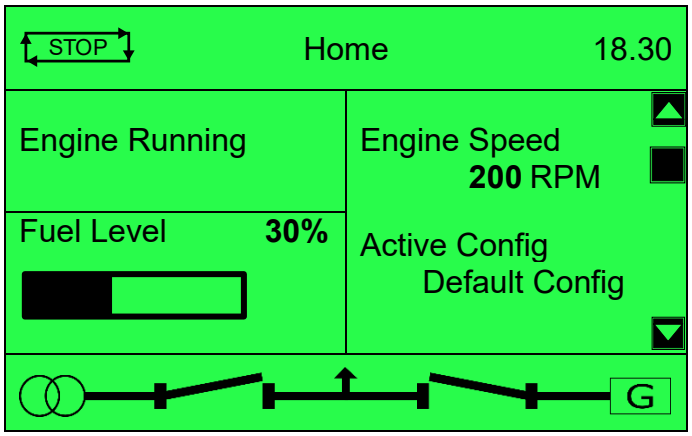
Press the  ***Next or Previous Page*** buttons, to check to see if the generator voltage and frequency is higher than the configured *Loading Voltage* and *Loading Frequency*.

5.3.1.3 CONFIGURABLE INSTRUMENT DISPLAY

The contents of the Home Page may vary depending upon configuration by the generator manufacturer or supplier. Below is an example of the Home Page being changed in the *Configuration Suite* to show engine CAN related information.



Home Page Example:

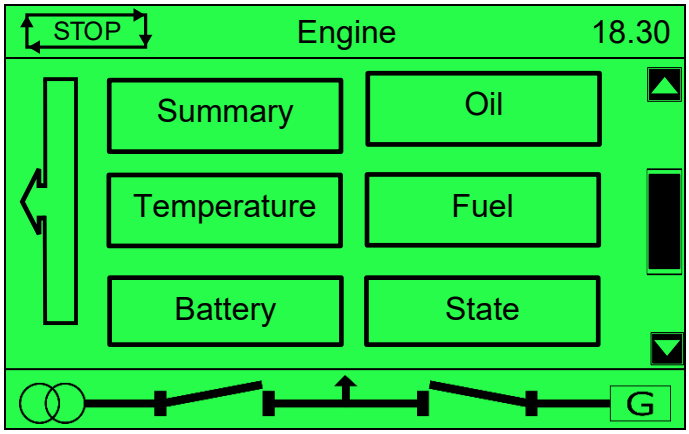


For further information about the icons, refer to section 5.2 in this manual.

5.3.2 ENGINE

NOTE: For further details of support engine, refer to DSE Publication: *057-004 Electronic Engines and DSE Wiring Guide.*

These pages contain instrumentation gathered about the engine measured or derived from the module's inputs, some of which may be obtained from the engine ECU.



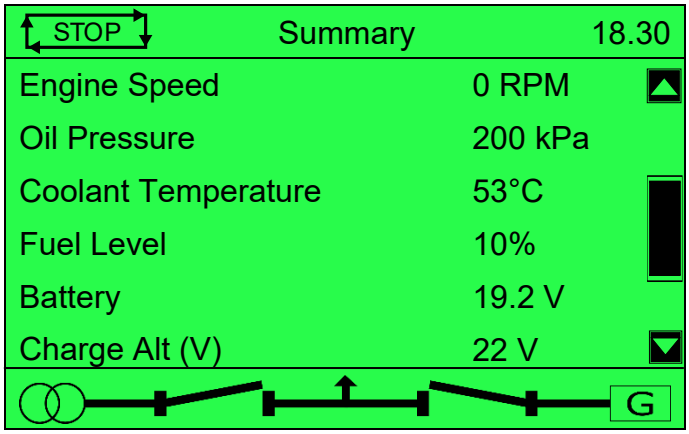
Engine Page

- Summary (all instruments are on here for conventional engines except maintenance alarms and analogue senders)
- Oil
- Temperature
- Fuel
- Battery
- State
- Settings
- Configurable CAN

NOTE*: Some screens are not available if the engine type is set to *Conventional Diesel* in ECU (ECM) options.

5.3.2.1 SUMMARY

The Summary page gives an overview of the instrumentation engine parameters measured or derived from the module's inputs.

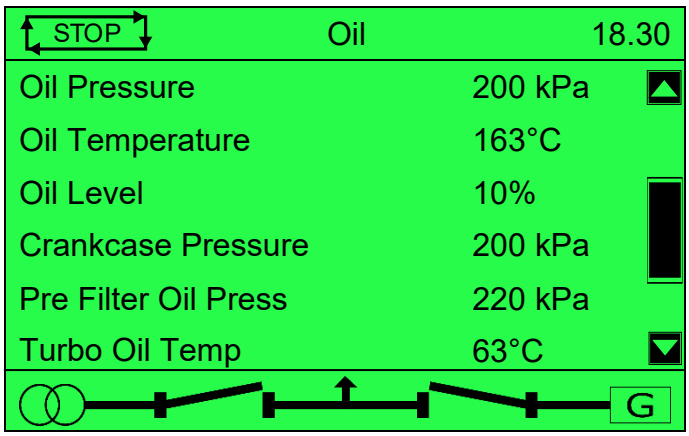


The list of parameters are:

- Engine Speed (RPM)
- Oil Pressure (kPa)
- Coolant Temperature (°C)
- Fuel Level (%)
- Battery (V)
- Charge Alt (V)
- Engine Run Time (hh:mm:ss)
- Start Attempts

5.3.2.2 OIL

The Oil page gives an overview of the instrumentation engine parameters

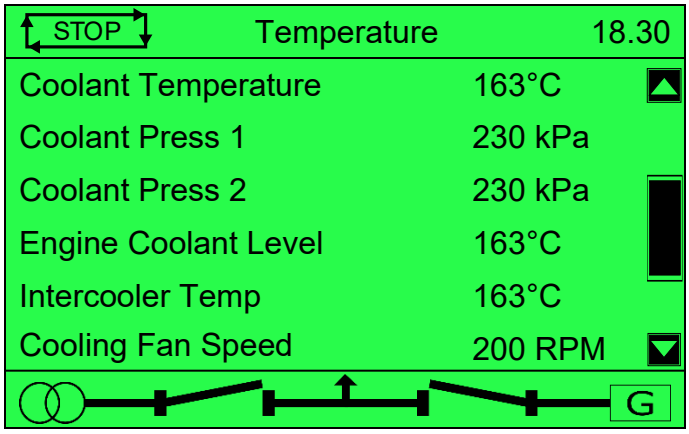


The list of parameters are:

- Oil Pressure (kPa)
- Oil Temperature (°C)
- Oil Level (%)
- Crankcase Pressure (kPa)
- Pre-Filter Oil Press (kPa)
- Turbo Oil Temp (°C)

5.3.2.3 TEMPERATURE

The Temperature page gives an overview of the instrumentation engine parameters measured or derived from the module's temperature/pressure sensor inputs.

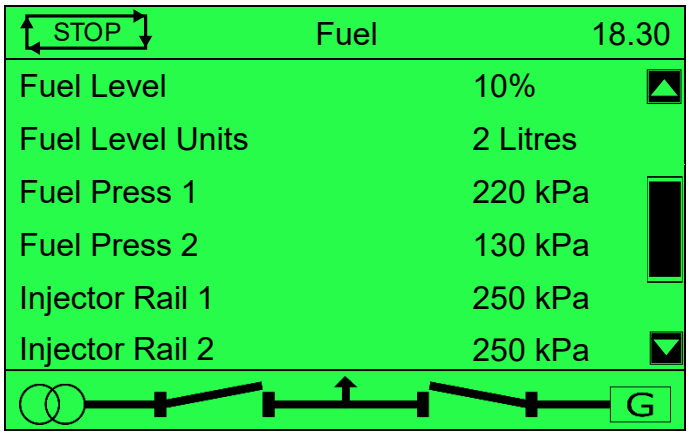


The list of parameters are:

- Coolant Temperature (°C)
- Coolant Press 1 (kPa)
- Coolant Press 2 (kPa)
- Engine Coolant Level (%)
- Intercooler Temp (°C)
- Intercooler Level (%)
- Cooling Fan Speed (RPM)

5.3.2.4 FUEL

The Fuel page gives an overview of the instrumentation engine parameters measured or derived from the module's fuel sensor inputs.

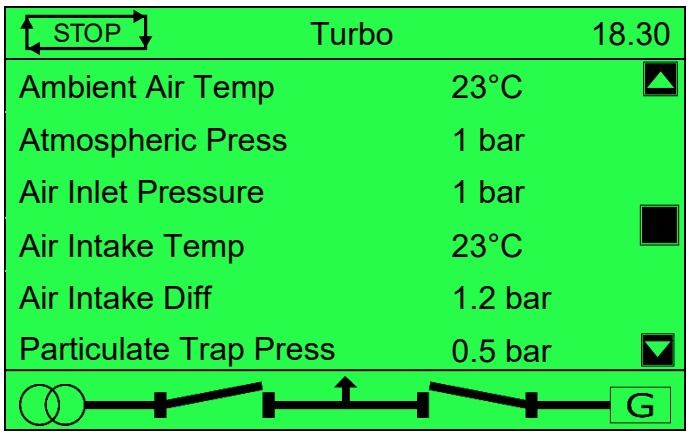


The list of parameters are:

- Fuel Level (%)
- Fuel Level Units (Litres)
- Fuel Press 1 (kPa)
- Fuel Press 2 (kPa)
- Injector Rail 1 (kPa)
- Injector Rail 2 (kPa)
- Fuel Temperature (°C)
- Fuel Consumption (L/h)
- Trip Fuel (Litres)
- Fuel Rate (%)
- Trip Average Fuel (L/h)
- Fuel Used (Litre

5.3.2.5 TURBO

The Turbo screen gives an overview of the instrumentation engine parameters measured or derived from the module's temperature and pressure sensor inputs.

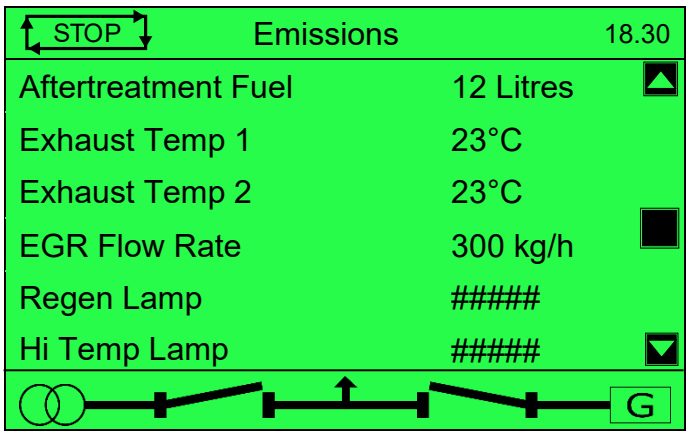


The list of parameters are:

- Ambient Air Temp
- Atmospheric Press
- Air Inlet Pressure
- Air Intake Temp
- Air Intake Diff
- Particulate Trap Press
- Inlet Temp 1
- Inlet Temp 2
- Inlet Temp 3
- Inlet Temp 4
- Inlet Temp 5
- Inlet Temp 6
- Turbo Press 1
- Turbo Press 2
- Turbo Press 3
- Turbo Press 4
- Manifold Pressure
- Gas Fuel Pressure

5.3.2.6 EMISSIONS

The Emissions screen gives an overview of the instrumentation engine parameters measured or derived from the module's temperature and pressure sensor inputs.

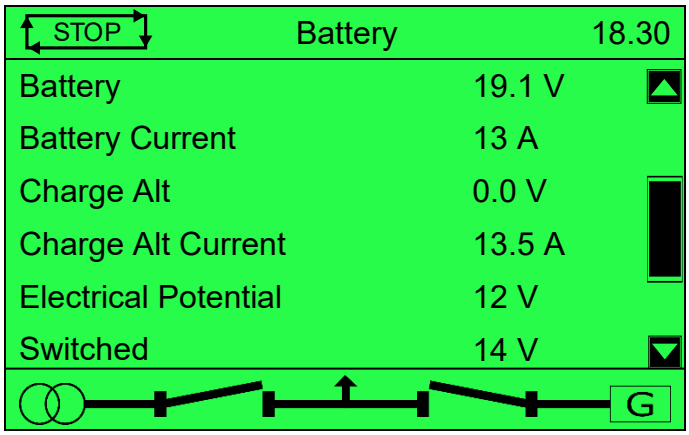


The list of parameters are:

Aftertreatment Fuel
Exhaust Temp 1
Exhaust Temp 2
EGR Flow Rate
Regen Lamp
Hi Temp Lamp
DPF Soot Load
DPF Ash Load
DEF Tank Level
DEF Tank Temp
DEF Consumption
SCR Inducement Reason
SCR Inducement Severity
SCR Action Countdown
SCR Action Derate
SCR Action Veh Spd
EGR Pressure
EGR Temperature
DPF Filter Status
DPF Regen Inhibit ET
DEF Level Status
DPTC Forced Regen

5.3.2.7 BATTERY

The Battery page gives an overview of the instrumentation engine parameters measured or derived from the module's battery settings.

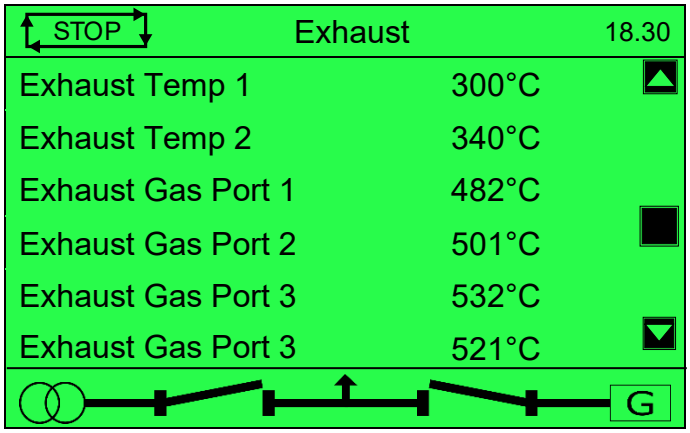


The list of parameters are:

- Battery (V)
- Battery Current (A)
- Charge Alt (V)
- Charge Alt Current (A)
- Electrical Potential (V)
- Switched (V)
- Charging (V)

5.3.2.8 EXHAUST

The Exhaust screen gives an overview of the instrumentation engine parameters measured or derived from the module's exhaust gas temperature.

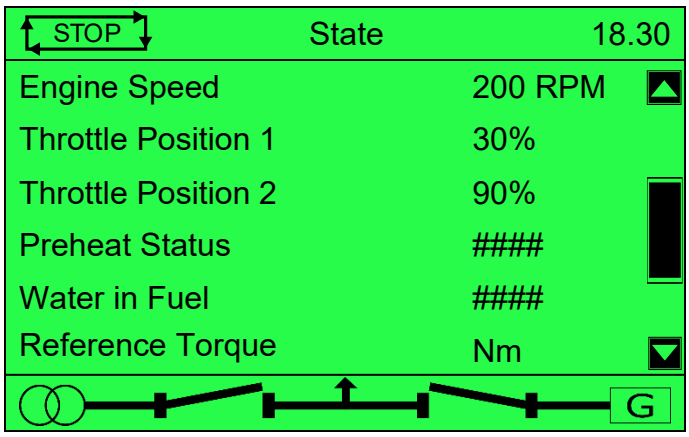


The list of parameters are:

Exhaust Temp 1
Exhaust Temp 2
Exhaust Gas Port 1-20

5.3.2.9 STATE

The State page gives an overview of the instrumentation engine parameters measured or derived from the module's various sensor inputs.

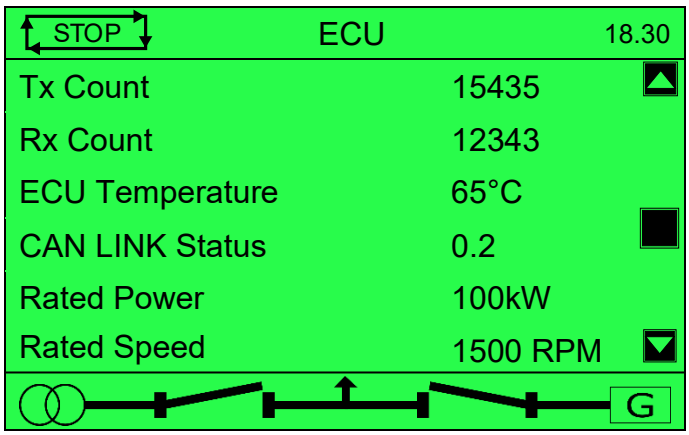


The list of parameters are:

- Engine Speed (RPM)
- Throttle Position 1 (%)
- Throttle Position 2 (%)
- Preheat Status
- Water in Fuel
- Reference Torque (Nm)
- Percent Torque (%)
- Demand Torque (%)
- Percent Load (%)
- Accelerator Pedal Pos (%)
- Nom Friction Torque (%)
- Nom Friction Torque (kW)
- Torque Mode
- Starter Mode
- Desired Speed (RPM)
- Total Revolutions (kR)

5.3.2.10 ECU

The ECU screen gives an overview of the instrumentation engine parameters measured or derived from the module's ECU status.

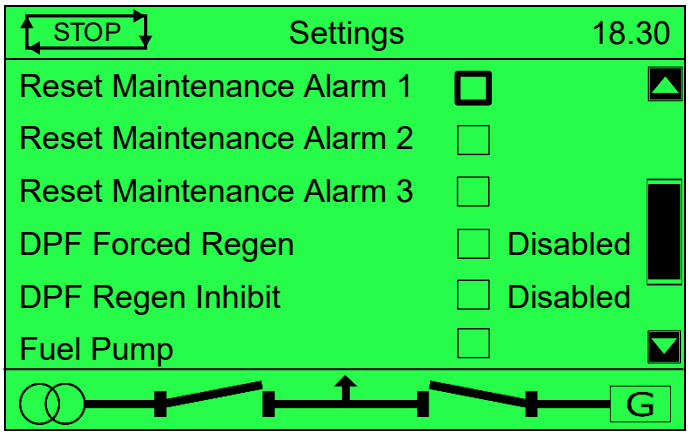


The list of parameters are:

Tx Count
Rx Count
ECU Temperature
CAN LINK Status
Rated Power
Rated Speed
Idle Speed
Engine Run Time
ECU Amber
ECU Red
ECU Protect
ECU Malfunc
ECU CI ECU Model
ECU CI engine make
ECU CI engine model
ECU CI serial
PGI Model
PGI Version
Wait to Start
ECU Protect
Approaching
ECM Operation

5.3.2.11 SETTINGS

The Settings page gives an overview of the instrumentation engine parameters measured or derived from the module's temperature and pressure sensor inputs.



The list of parameters are:

- Reset Maintenance Alarm 1
- Reset Maintenance Alarm 2
- Reset Maintenance Alarm 3
- DPF Forced Regen
- DPF Regen Inhibit
- Manual Fuel Pump

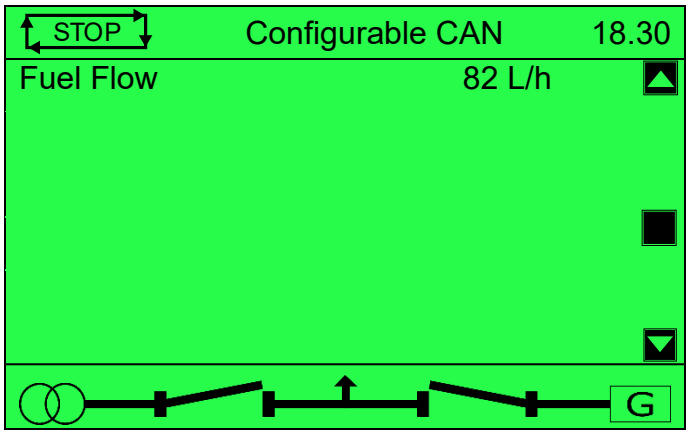
5.3.2.12 CONFIGURABLE CAN

NOTE: Depending upon the module's configuration, some display screens may be disabled. For further details of module configuration, refer to DSE Publication: 057-322 DSEG8600 Configuration Suite PC Software Manual.

The configurable CAN instruments are intended to display CAN information from external third-party CAN devices such as fuel flow meters. The contents of these screens vary depending upon configuration by the engine manufacturer or supplier.

Under default factory settings the configurable CAN instruments are not viewable. They are configurable by the system designer using the DSE Configuration Suite software.

Example:

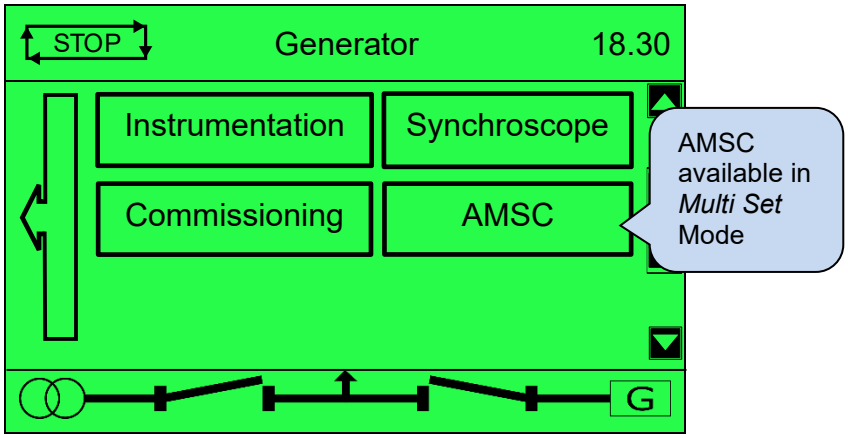


- Configurable CAN Instrument 1 to 30

5.3.3 GENERATOR

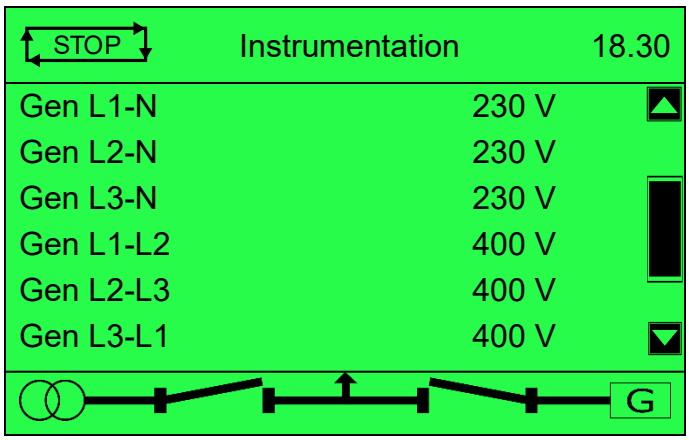
Contains electrical values of the Generator, measured, or derived from the module's voltage and current inputs.

Press the ***Scroll***  buttons to scroll through the ***Generator*** parameters.



5.3.3.1 INSTRUMENTATION

The Instrumentation page gives an overview of the instrumentation generator parameters measured or derived from the module's inputs.

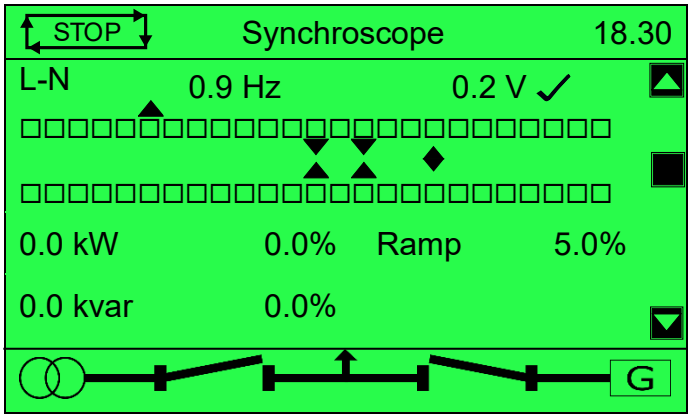


The parameters are:

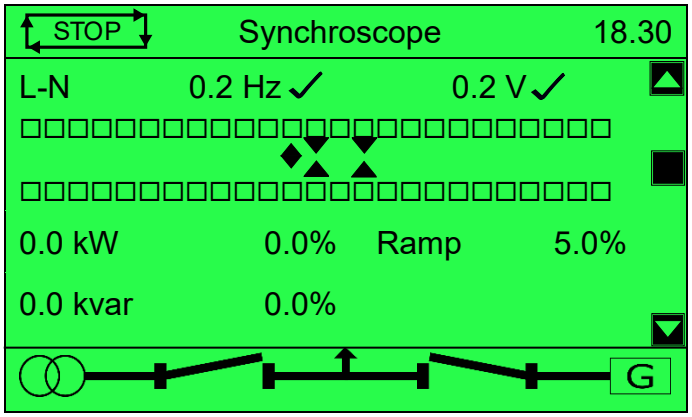
- Gen L1-N (V)
- Gen L2-N (V)
- Gen L3-N (V)
- Gen L1-L2 (V)
- Gen L2-L3 (V)
- Gen L3-L1 (V)
- Gen Frequency (Hz)
- Gen L1-N (A)
- Gen L2-N (A)
- Gen L3-N (A)
- Earth Current (A)
- Gen L1-N(kW)
- Gen L2-N (kW)
- Gen L3-N (kW)
- Gen kW Total (kW)
- Gen kW Total (%)
- Gen L1-N (kVA)
- Gen L2-N (kVA)
- Gen L3-N (kVA)
- Gen kVA Total (kVA)
- Gen kVA Total (%)
- Gen L1-N (kvar)
- Gen L2-N (kvar)
- Gen L3-N (kvar)
- Gen kvar Total (kvar)
- Gen kvar Total (%)
- Gen PF L1
- Gen PF L2
- Gen PF L3
- Gen PF Avg
- Accumulated (kWh)
- Accumulated (kVAh)
- Accumulated (kVArh)
- Phase Rotation
- Nominal Voltage
- Nominal Frequency (Hz)
- AC System
- Active Config
- Zero Sequence (V) (Single Set Mode)
- Positive Sequence (V) (Single Set Mode)
- Negative Sequence (V) (Single Set Mode)
- Asymmetry (V) (Single Set Mode)

5.3.3.2 SYNCHROSCOPE

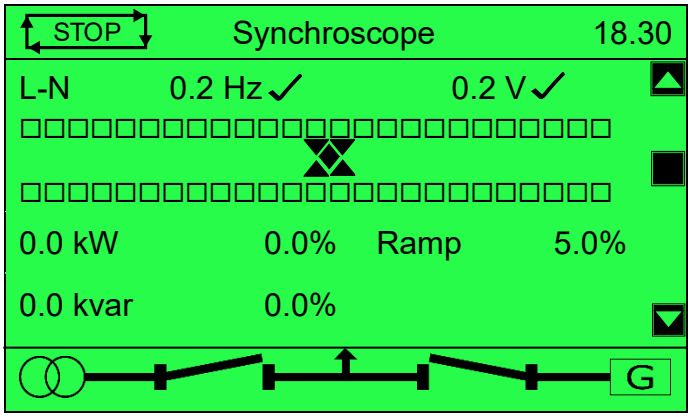
Note: If the module display is showing the status page when the synchronising process begins, the module automatically switches to the Synchroscope page. The ramp progress is also be displayed on the page once paralleling has taken place.



Initially the synchroscope display shows the difference between the mains (utility) and generator supplies. Here the display is showing a frequency mismatch of +0.9 Hz and a voltage mismatch of +0.2 V. The genset frequency is too high (indicated by the arrow) and must be reduced. The voltage is high but is within the limits set for synchronising (indicated by the tick).



When both the frequency and the voltage differences are within acceptable limits, the phase matching begins. Then the moving bar shows the phase difference between the two supplies. The engine speed is automatically adjusted, altering the phase, until the moving bar enters the centre of the scope.



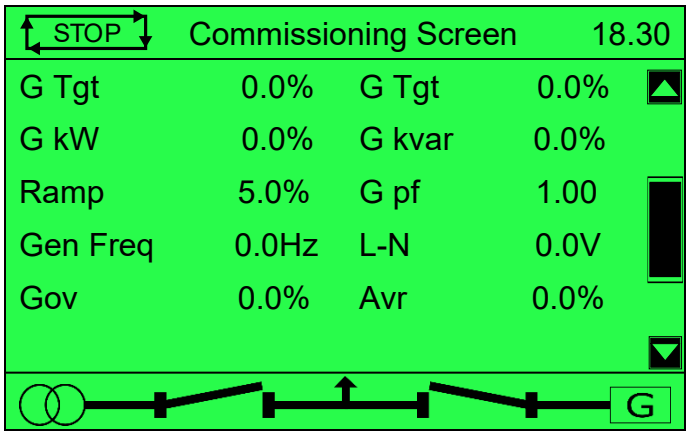
Once the mains (utility) and generator supplies are in sync, the module initiates a breaker close signal to the generator load switch closing the generator onto the mains (utility). The moving bar passes out of the synchronising window if the synchronism is broken and activates the Out of Sync alarm.

5.3.3.3 COMMISSIONING SCREENS

NOTE: Some of the items may be removed from the commissioning screens if they are not applicable to the module configuration.

Commissioning screens are available to both aid the commissioning process and to give additional information about the synchronising and load sharing process.
These screens are enabled and disabled in the module's display editor.

Example



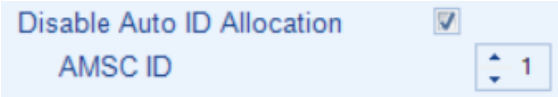
5.3.3.4 AMSC (MULTI SET)

NOTE: The A*MSC ID* is configured only using the DSE Configuration Suite Software. For further details, refer to DSE Publication: 057-322 *G8600 Configuration Suite PC Software Manual.*

NOTE: Depending on the module's configuration, the A*MSC ID* is set automatically or manually. For further details, refer to DSE Publication: 057-322 *G8600 Configuration Suite PC Software Manual.*

Every module connected on the AMSC link has a unique A*MSC ID* up to a maximum of 64.

The AMSC ID is set automatically or manually depending on the *Disable Auto ID Allocation* option in the DSE module's configuration.

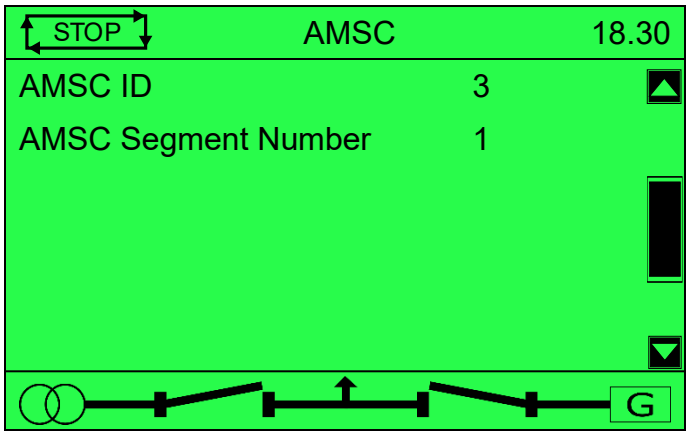


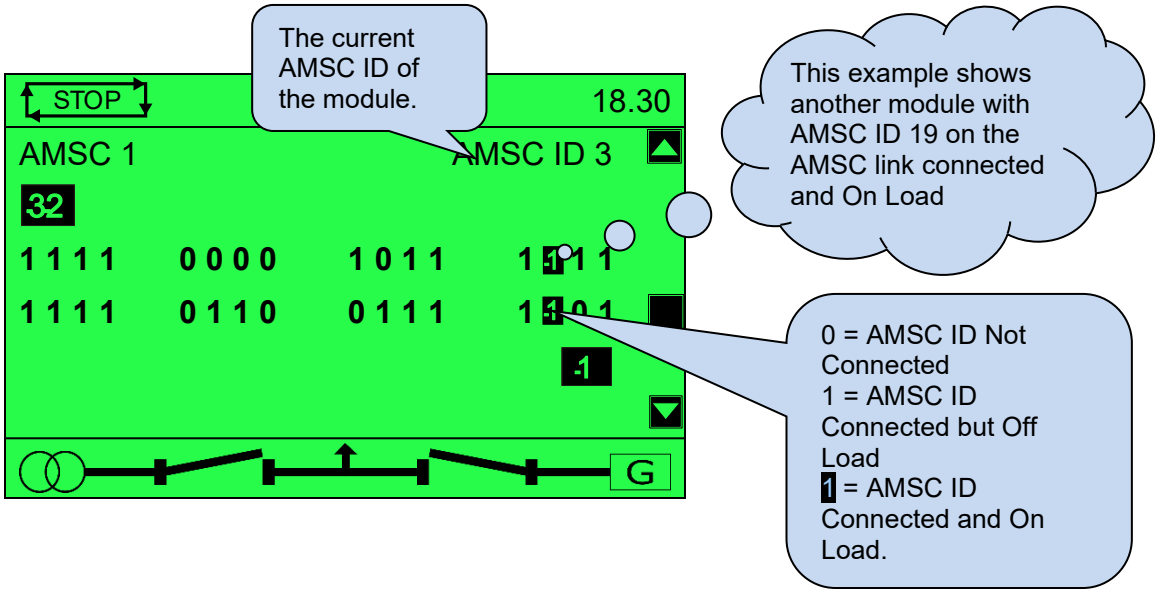
When the *Disable Auto ID Allocation* option is not enabled in the DSE module's configuration, the A*MSC ID* is automatically set when all the modules are powered up one at a time. If all the modules are powered up together, this may result in the A*MSC ID Error* alarm activating.

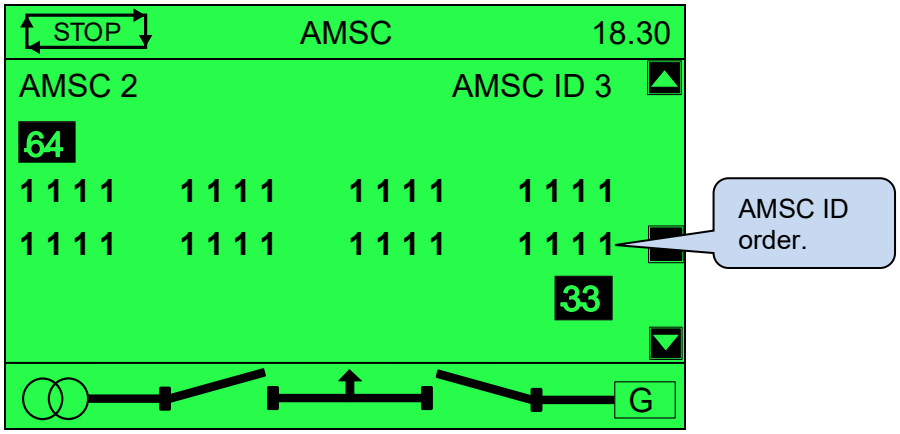
Manually setting the A*MSC ID* using the DSE Configuration Suite PC Software's SCADA allows this alarm to be reset and prevents this from occurring. It also has the benefit of being able to determine which module on the AMSC link has a communication issue and is also required for PLC comms across AMSC as the user needs to know which module is being addressed

When the *Disable Auto ID Allocation* option is enabled in the DSE module's configuration, the A*MSC ID* is assigned to the configured A*MSC ID* value when the module is powered up. Take note to enable this option in all the DSE modules if to be used, ensuring that each DSE module has a unique A*MSC ID*.

This display page shows this module's A*MSC ID* and shows which A*MSC IDs* are currently communicating on the AMSC link by the number '1' indication. A*MSC IDs* that are currently not communicating or not connected are indicated by the number '0'. If the A*MSC ID* for each module is known, this display page is used to determine which module is not communicating on the AMSC link. Each section of the ac bus requires a unique identifier, a segment number. All modules connected to the same section or segment must have the same number.



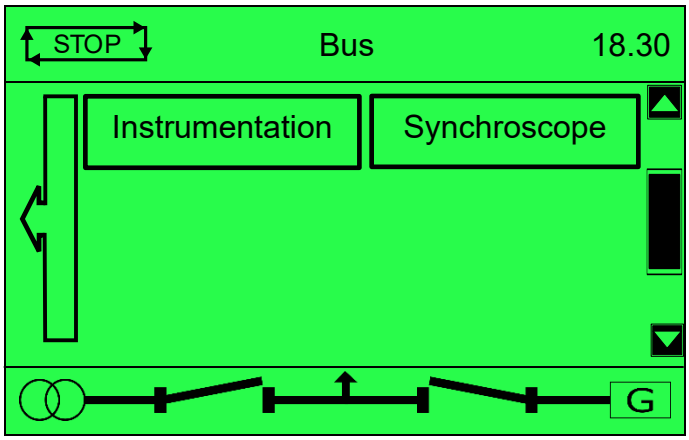




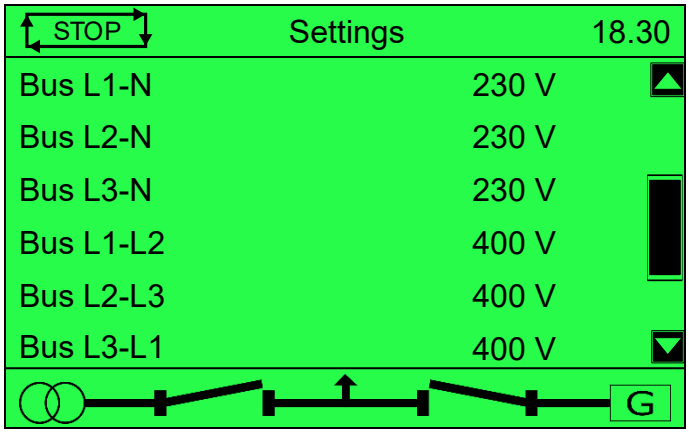
5.3.4 BUS (MULTI SET)

Contains electrical values of the Bus, measured, or derived from the module's voltage and current inputs.

Press the ***Instrumentation Scroll***  buttons to scroll through the ***Bus*** parameters.



5.3.4.1 INSTRUMENTATION

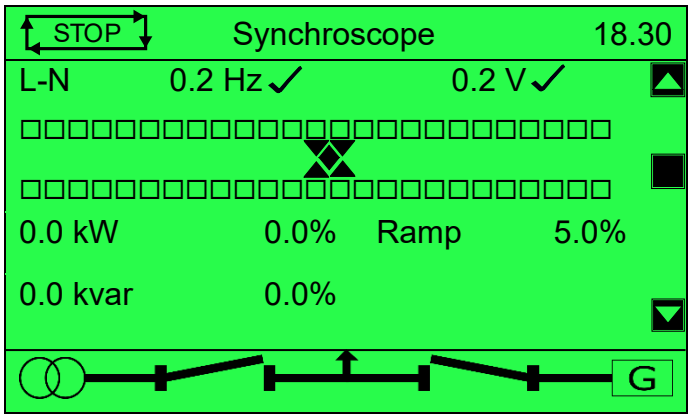


The parameters are:

- Bus L1-N (V)
- Bus L2-N (V)
- Bus L3-N (V)
- Bus L1-L2 (V)
- Bus L2-L3 (V)
- Bus L3-L1 (V)
- Frequency (Hz)
- Bus kW Total (kW)
- Bus kW Total (%)
- Bus kvar Total (kvar)
- Bus kvar Total (%)
- Phase Rotation
- Zero Sequence (V)
- Positive Sequence (V)
- Negative Sequence (V)
- Asymmetry (V)

5.3.4.2 SYNCHROSCOPE

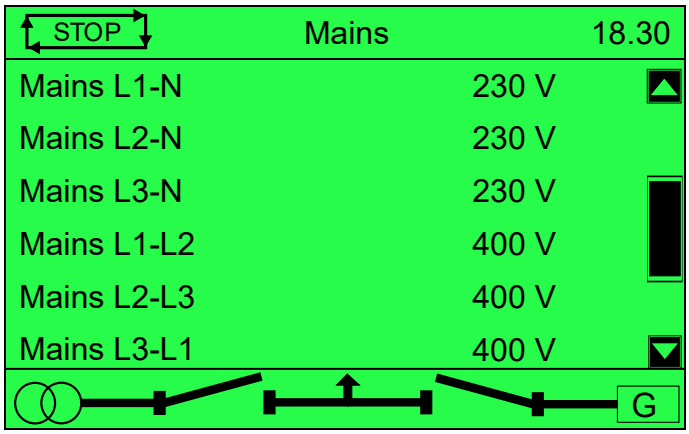
Once the mains (utility) and generator supplies are in sync, the module initiates a breaker close signal to the generator load switch closing the generator onto the mains (utility).



5.3.5 MAINS (SINGLE SET)

Contains electrical values of the mains (utility), measured, or derived from the module's (that controls the mains (utility) switch) voltage and current inputs.

Press the ***Scroll***  buttons to scroll through the ***Mains*** parameters.



The following parameters are available:

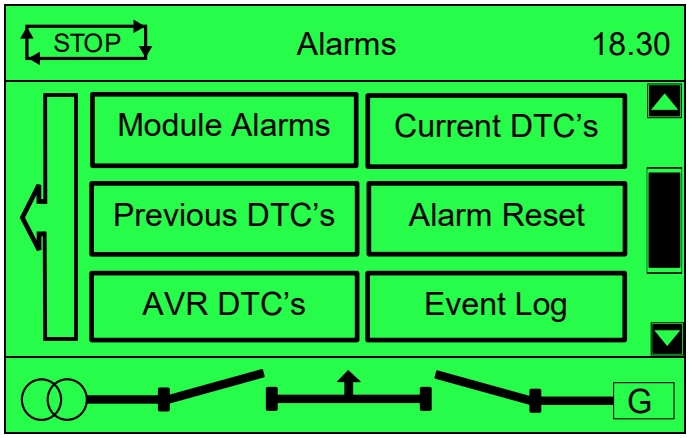
- Mains L1-N (V)
- Mains L2-N (V)
- Mains L3-N (V)
- Mains L1-L2 (V)
- Mains L2-L3 (V)
- Mains L3-L1 (V)
- Mains Frequency (Hz)
- Mains L1-N (A)
- Mains L1-N (kW)
- Mains kW Total (kW)
- Mains kW Total (%)
- Mains L1-N (kVA)
- Mains kVA Total (kVA)
- Mains kVA Total (%)
- Mains L1-N (kvar)
- Mains kvar Total (kvar)
- Mains kvar Total (%)
- Mains PF L1
- Mains PF Avg
- Phase Rotation
- Nominal Voltage (V)
- AC System
- Active Config
- Zero Sequence (V)
- Positive Sequence (V)
- Negative Sequence (V)
- Asymmetry (V)

5.3.6 ALARMS

When an alarm is active, the *Internal Audible Alarm* sounds and the Common Alarm LED illuminates. See section 7.2 for more information about indicators.

The audible alarm is silenced by pressing the ***Alarm Mute / Lamp Test*** button.

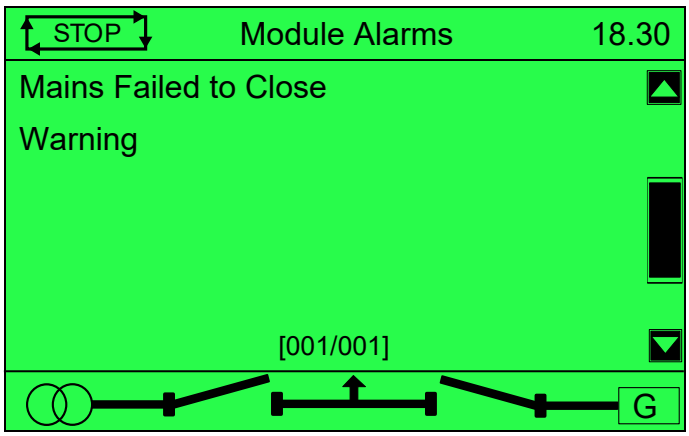
The LCD display jumps from the 'Information page' to display the Alarms Page



5.3.6.1 MODULE ALARMS

Any alarms associated with the module are displayed on the Module Alarms page.

Press the ***Scroll*** buttons to scroll to other available alarms.

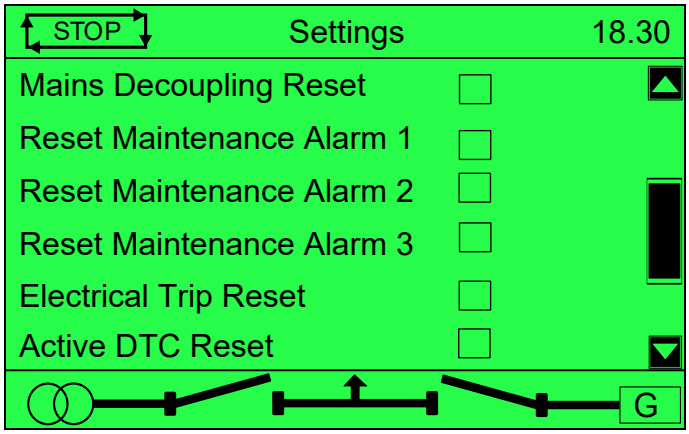


5.3.6.2 CURRENT/PREVIOUS & AVR DTC'S

Alarms associated with Diagnostic Trouble Codes (DTC) have unique pages for Current, Previous and AVR alarms. When a DTC alarm is triggered, it appears on the appropriate page.

5.3.6.3 ALARM RESET

The Alarm Reset page gives an overview of the current alarms that are resettable.



Press the ***Tick***  repeatedly to select alarm that is visible on the display to be reset.

Press the ***Next Page***  button to make the selection.

Press the ***Scroll***  buttons to scroll to other available alarms.

NOTE: Only alarms visible on screen are selectable. Pressing the Tick button repeatedly cycles through each alarm in succession. If the user presses the Tick button after the last visible alarm, the next selected alarm is the first item in the list.

The *Alarm Reset* page allows the reset of the following:

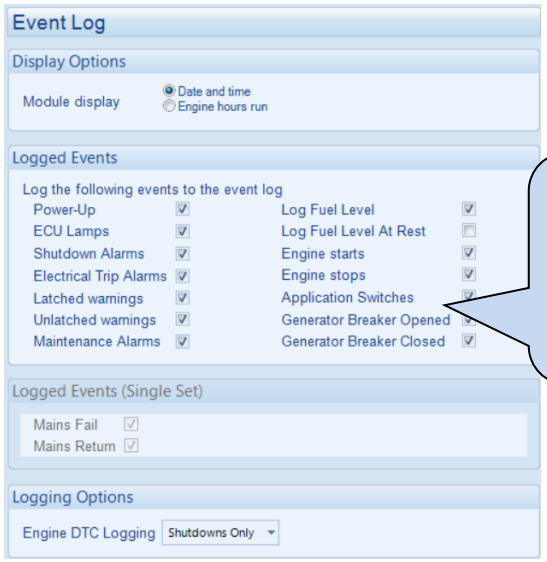
- Mains Decoupling Reset
- Reset Maintenance Alarm 1
- Reset Maintenance Alarm 2
- Reset Maintenance Alarm 3
- Electrical Trip Reset
- Active DTC Reset
- Inactive DTC Reset
- Mains Fail Reset

5.3.6.4 EVENT LOG

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 DSEG8600 Configuration Suite PC Software Manual.

The module maintains a log of past alarms and/or events e.g., application changes or fuel level The log size has been increased in the module over past module updates and is always subject to change. At the time of writing, the modules log is capable of storing the last 250 log entries.

Under default factory settings, the event log is configured to include all feasible options; however, this is configurable by the system designer using the DSE Configuration Suite software.



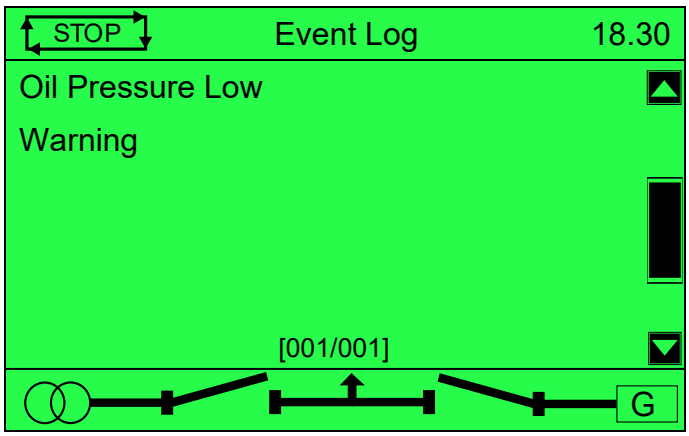
Example showing the possible configuration of the event log (DSE Configuration Suite Software).

This also shows the factory settings of the module.

When the event log is full, any subsequent event overwrites the oldest entry. Hence, the event log always contains the most recent events. The module logs the event type, along with the date and time (or engine running hours if configured to do so).

The *Event Log* page is situated in the *Alarms* section.

To view the event log, repeatedly press the ***Next or Previous Page***  buttons until the LCD screen displays the *Event Log* page.



Press the ***Scroll Down***  button to view the next most recent event.

Continuing to press the ***Scroll Down***  button cycles through the past events after which, the display shows the most recent alarm, and the cycle begins again.

To exit the event log and return to viewing the instruments, press the ***Previous Page***  button to select the next instrumentation page.

5.3.7 COMMUNICATIONS

5.3.7.1 RS485 SERIAL PORTS 1&2

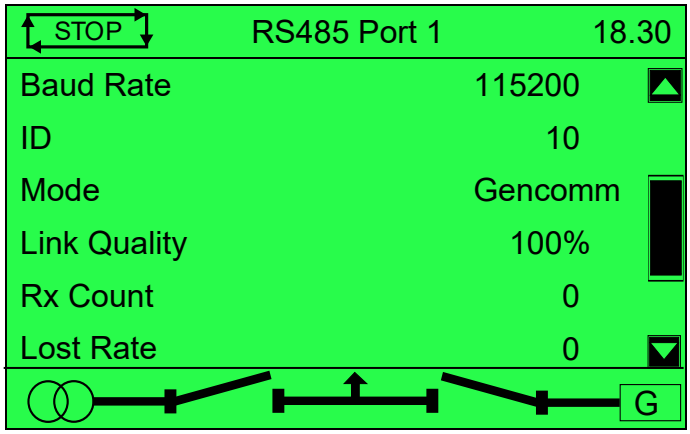
This section is included to give information about the currently selected serial port

The items displayed on this page change depending upon configuration of the module. Refer to the system supplier for further details.

NOTE: Factory Default settings are for the RS485 port to operate at 115200 baud, Modbus server address 10.

Connected to an R485 Modbus Client

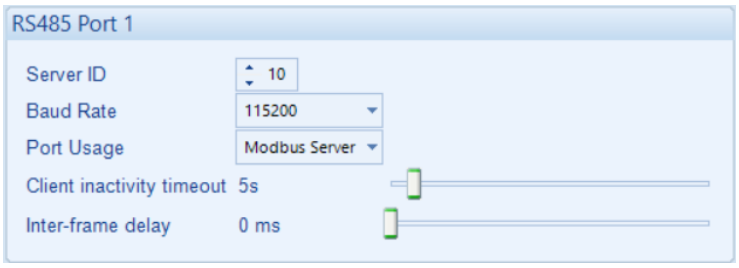
The modules operate as a Modbus RTU server device.
In a Modbus system, there is only one Client, typically a PLC, HMI system or PC SCADA system.



This client requests for information from the Modbus server (The module) and may (in control systems) also send request to change operating modes etc. Unless the client makes a request, the server is 'quiet' on the data link.

The factory settings are for the module to communicate at 115200 baud, Modbus server address 10.

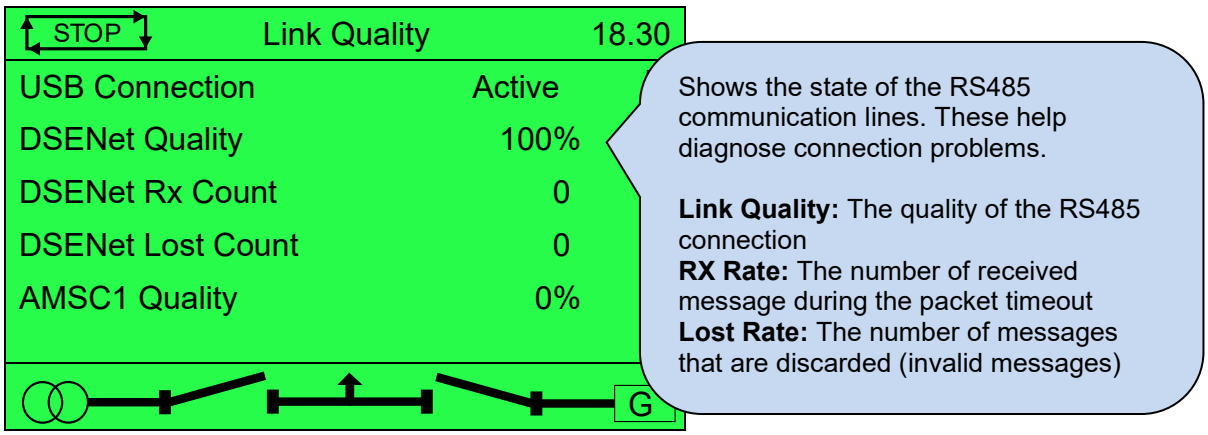
Set the client inactivity timeout to at least twice the value of the system scan time.
For example, if a Modbus client PLC requests data from the module once per second, set the timeout to at least 2 seconds.



The DSE GenComm document containing register mappings inside the DSE module is available upon request from support@deepseaelectronics.com. Email the request along with the serial number of the DSE module to ensure the correct information is sent.

5.3.7.2 LINK QUALITY RS485 MODBUS RTU DIAGNOSTICS

RS485 Modbus RTU diagnostic pages are included; press the ***Scroll Down***  button when viewing the *RS485 Serial Port* instruments to cycle to the available pages. If experiencing RS485 Modbus RTU communication problems, this information aids troubleshooting.



Typical Requests (Using Pseudo Code)

`BatteryVoltage=ReadRegister(10,0405,1)`: reads register (hex) 0405 as a single register (battery volts) from server address 10.

`WriteRegister(10,1008,2,35701, 65535-35701)`: Puts the module into AUTO mode by writing to (hex) register 1008, the values 35701 (auto mode) and register 1009 the value 65535-35701 (the bitwise opposite of auto mode)

`Warning=(ReadRegister(10,0306,1) >> 11) & 1)`: reads (hex) 0306 and looks at bit 12 (Warning alarm present)

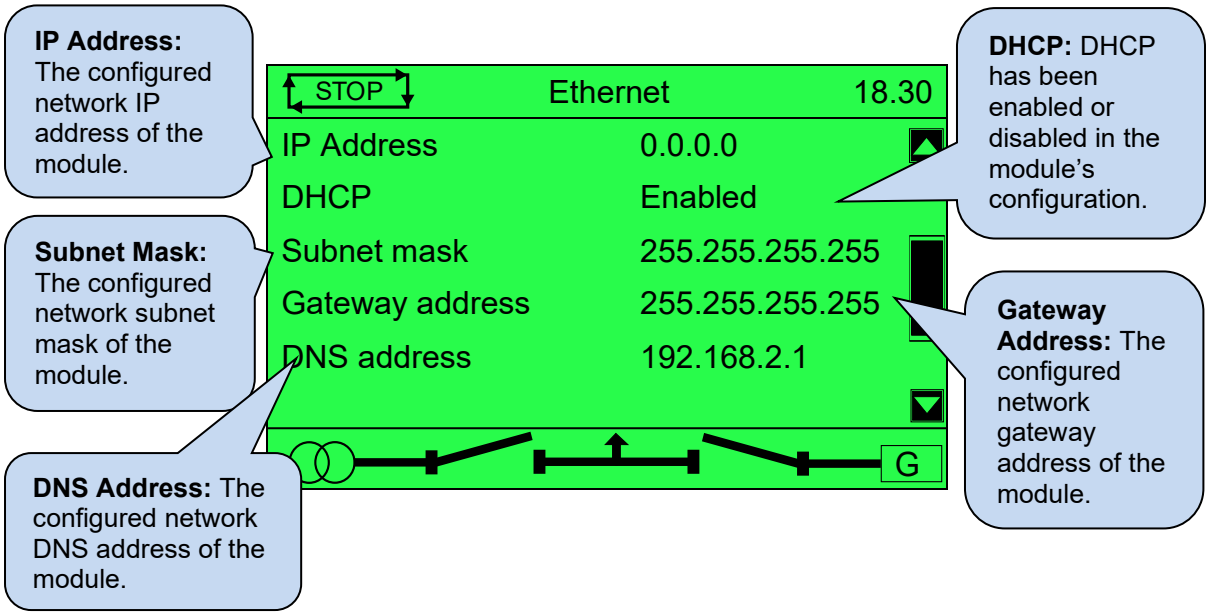
`ElectricalTrip=(ReadRegister(10,0306,1) >> 10) & 1)`: reads (hex) 0306 and looks at bit 11 (Electrical Trip alarm present)

`ControlMode=ReadRegister(10,0304,2)`: reads (hex) register 0304 (control mode).

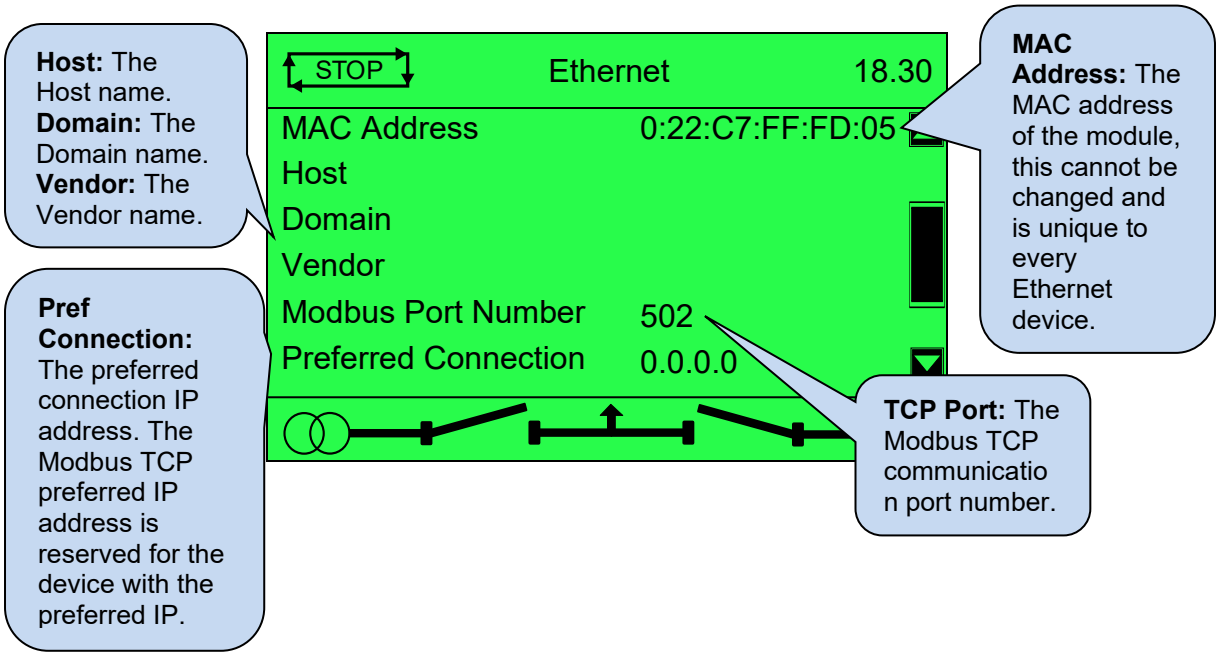
5.3.7.3 ETHERNET

Whilst in the *Communication* section, press the ***Scroll Down*** button  to access more information about the network settings.

Network settings are configured using DSE Configuration Suite PC Software. The module must be rebooted for the changes to take effect.



Press the ***Scroll Down***  button to access more information about the network settings.



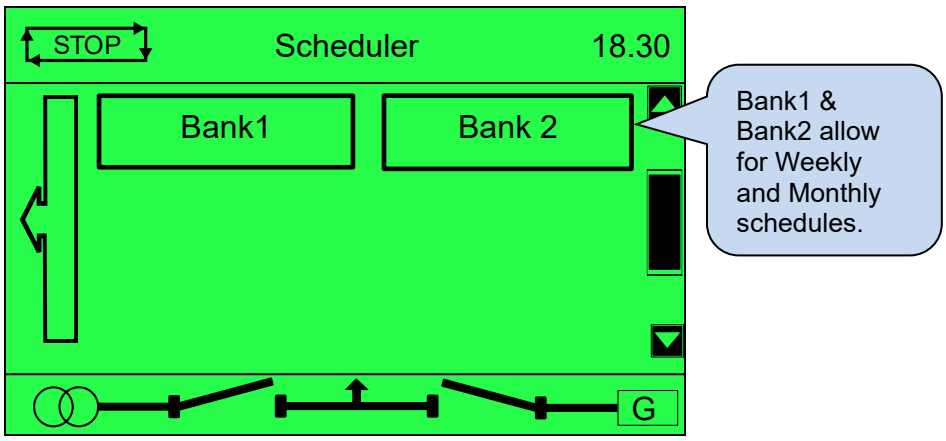
5.3.8 SCHEDULER

NOTE: For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*

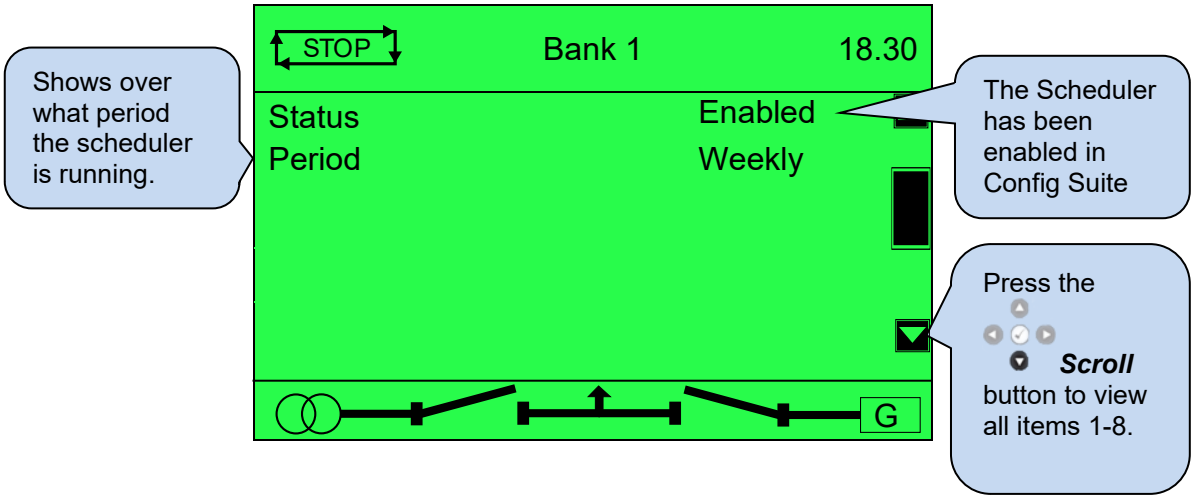
The controller contains an inbuilt exercise run scheduler, capable of automatically starting and stopping the set or inhibiting the set from starting. Up to 16 scheduled (in two banks of 8 items) start/stop/inhibiting start sequences are able to be configured to repeat on a 7-day or 28-day cycle.

Scheduled runs may be on load or off load depending upon module configuration.

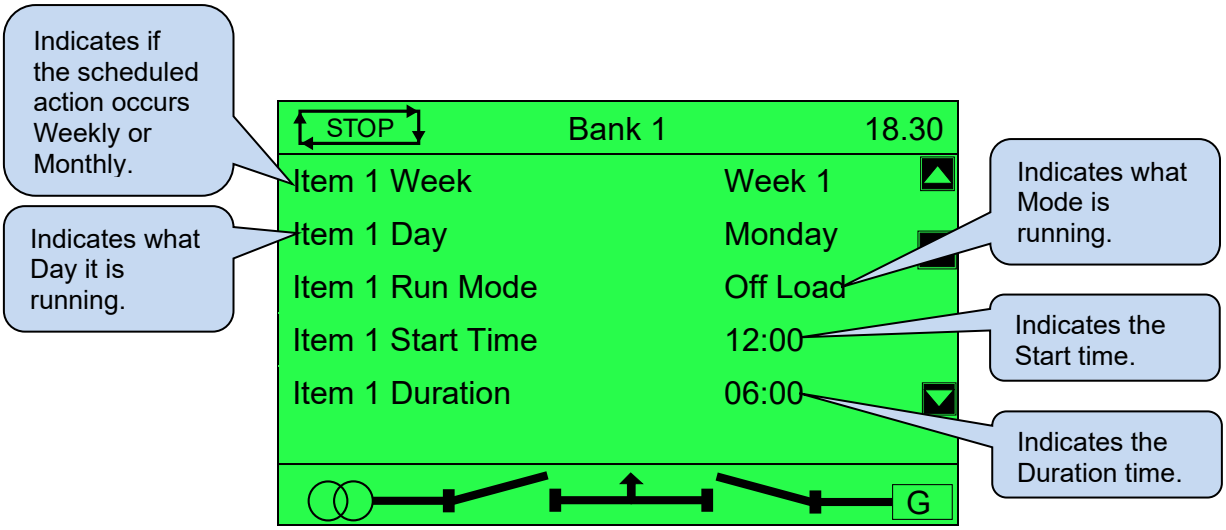
This section of the module's display shows how exactly the scheduler (if enabled) is configured. Under default factory settings the Schedule is not viewable. It is enabled by the system designer using the DSE Configuration Suite software.



Press the ***Tick*** button and then using the ***scroll*** buttons to view.



Example

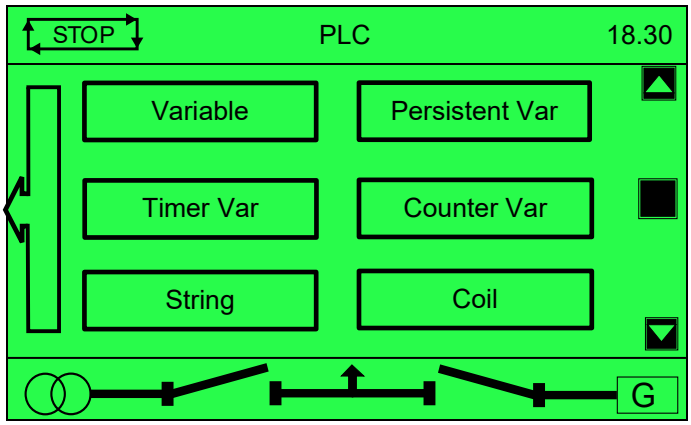

Indicates if the scheduled action occurs Weekly or Monthly.
Indicates what Day it is running.
STOP
Bank 1
18.30
Item 1 Week
Week 1
Item 1 Day
Monday
Item 1 Run Mode
Off Load
Item 1 Start Time
12:00
Item 1 Duration
06:00
G
Indicates what Mode is running.
Indicates the Start time.
Indicates the Duration time.

5.3.9 PLC INSTRUMENTS

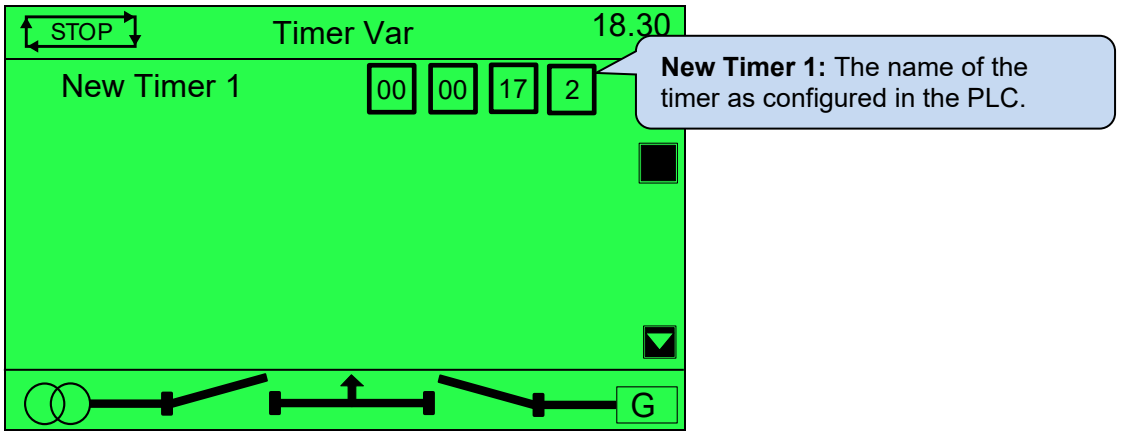
NOTE: Depending upon the module's configuration, some display screens may be disabled. The PLC Instrument screen is visible once watched variables have been written to the module using the PLC Editor. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*

Contains values from various elements from the module's internal PLC editor to enable the user to view them from the module's facia.

Press the ***Instrumentation Scroll*** buttons and the ***Next or Previous Page*** buttons scroll through the ***PLC Instruments*** parameters if configured.



Timer Var Example:

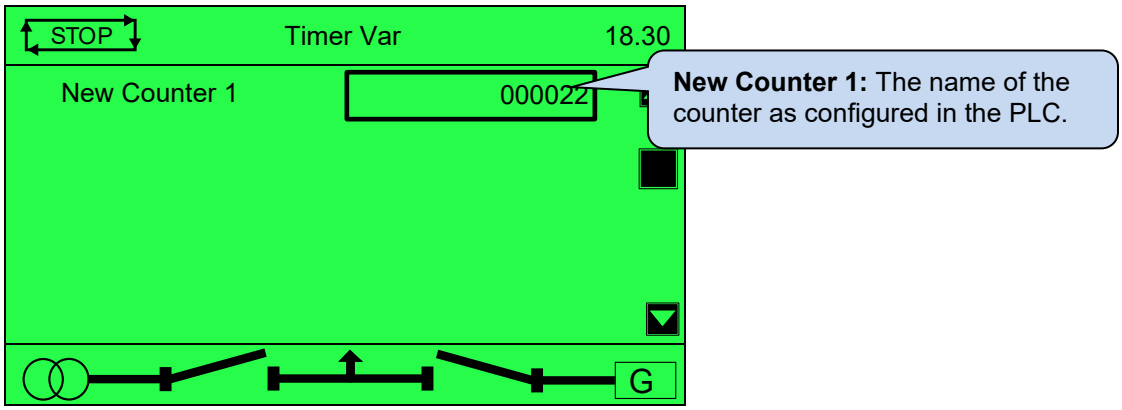


Press and hold the ***Tick*** button to cycle through to the setting to be adjusted.

Use the ***Instrumentation Scroll*** buttons to adjust the value.

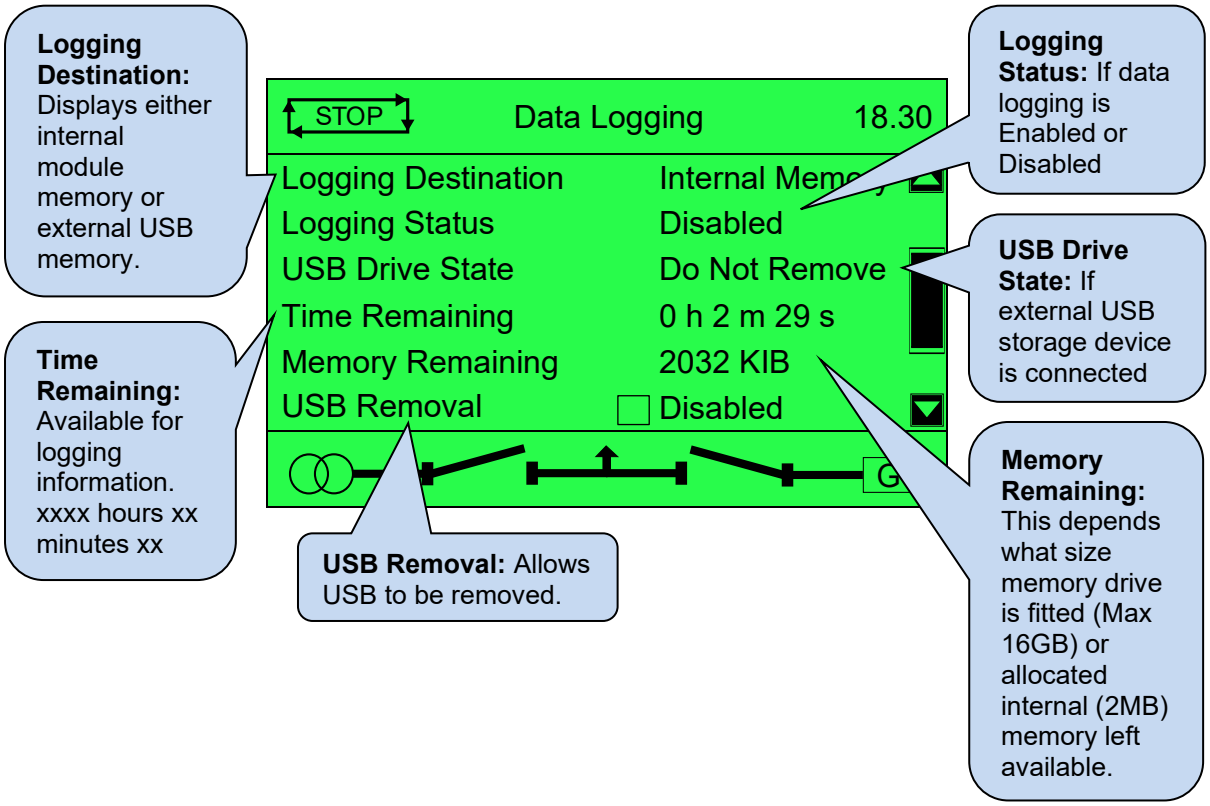
To exit the screen, press the ***Tick*** button repeatedly until no settings are selected and then press the ***Previous Page*** button to exit.

Counter Var Example



5.3.10 DATA LOGGING

Whilst on the *Data Logging* page use the ***Scroll*** buttons to access more information about the Data logging settings.



USB Eject Procedure

NOTE: Removal of the USB drive MUST only be carried out using the following method. Failure to do so results in loss of data. If a USB stick is not present (disabled) then it is not possible to make the selection.

Press and hold the ***Tick*** button until "*Safe to remove*" is displayed.

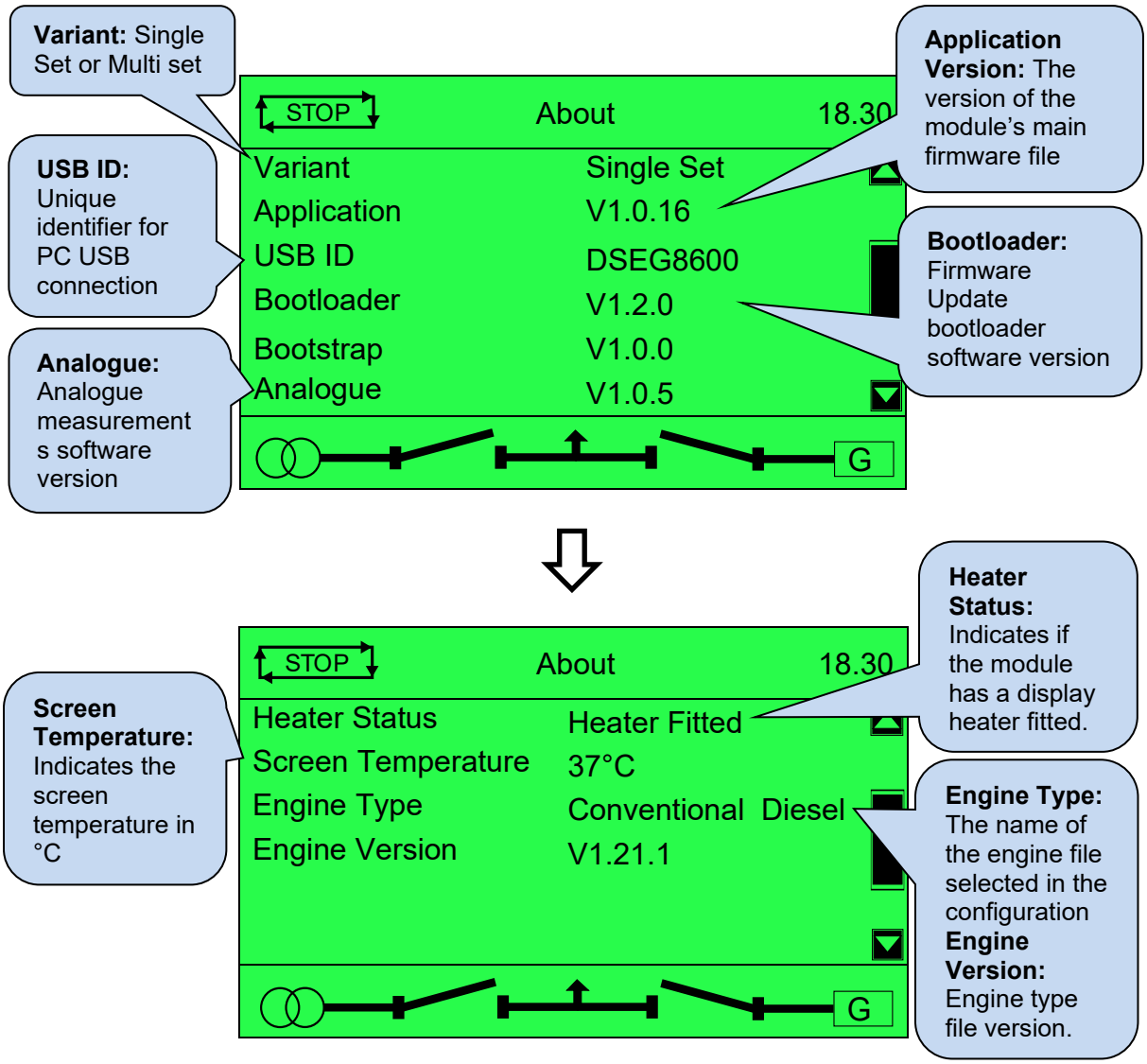
Press the ***Next Page*** button to make the selection.

If the display shows "*Safe To Remove*" then it is now safe to remove the USB drive.
This ensures the logging data file saves to memory complete and does not become corrupt.

5.3.11 ABOUT

Contains essential information about the module and the firmware versions. This information may be asked for when contacting DSE Technical Support Department for advice.

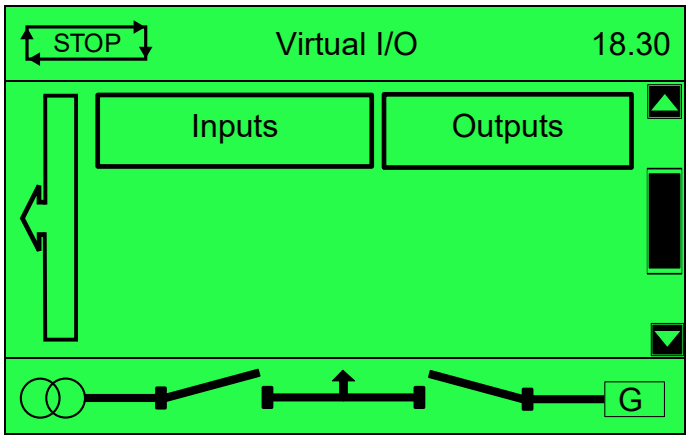
Use the ***Scroll***  buttons to access more information about the module.



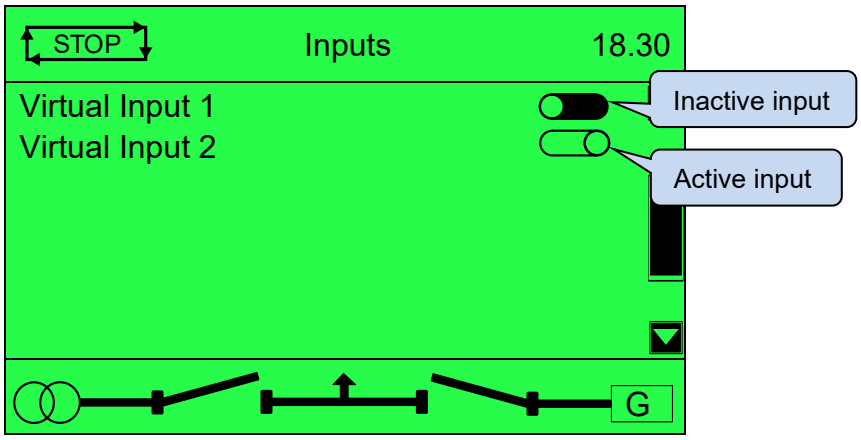
5.3.12 VIRTUAL I/O

NOTE: Virtual I/O is configured using the DSE Configuration Suite Software. For further details, refer to DSE Publication: 057-322 *G8600 Configuration Suite PC Software Manual.*

This page displays the inputs and outputs configured using the Configuration Suite PC Software using the *Virtual Input* and *Virtual LEDs* pages. The virtual LEDs provide a configuration of 'status' items. These items are available for viewing on the module and seen in the SCADA section of the PC software, or read by third party systems (i.e., BMS or PLCs) using the Modbus protocol.



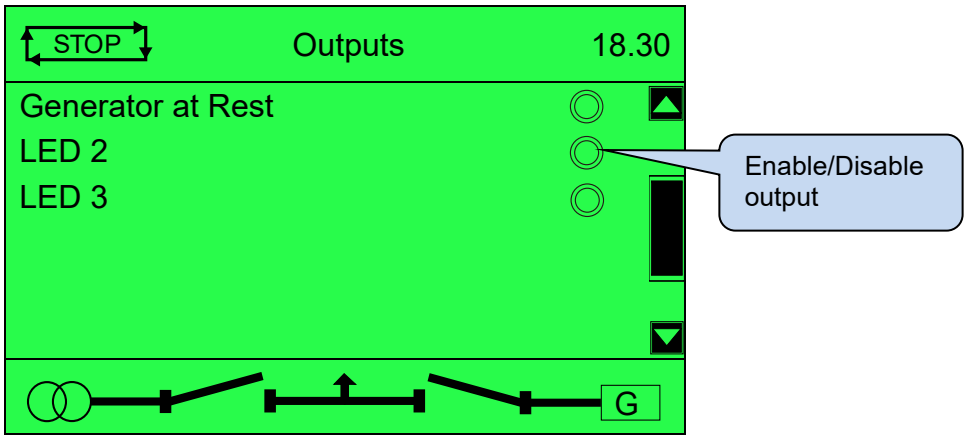
Inputs



Press the ***Tick*** button to cycle through the inputs.

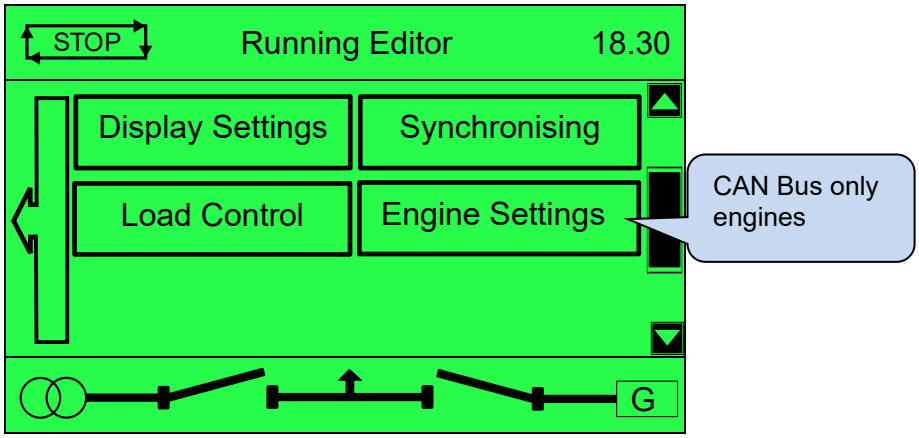
Press the ***Next Page*** button to switch the input On or Off

Outputs


STOP
Outputs
18.30
Generator at Rest
LED 2
LED 3
Enable/Disable output
G

5.3.13 RUNNING EDITOR

The 'running' editor is entered while the engine is running. All protections remain active if the engine is running while the running editor is entered.



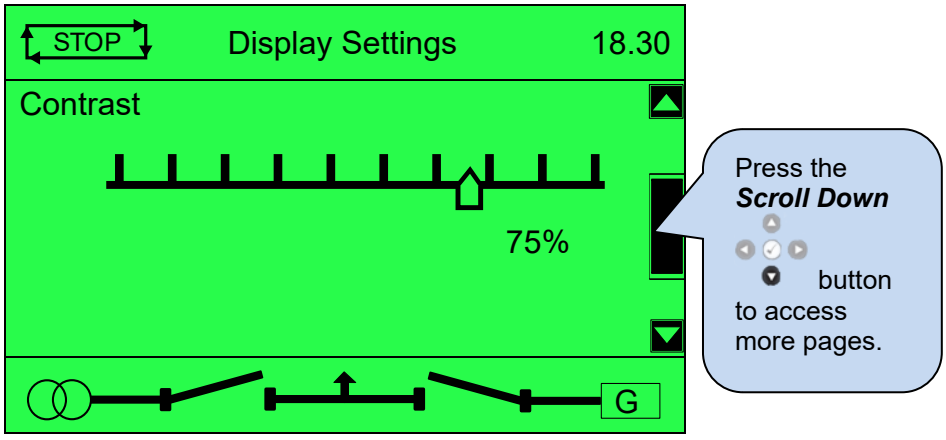
5.3.13.1 DISPLAY SETTINGS

The display settings allow the user to decide which language, units of measurement and level of contrast is used.

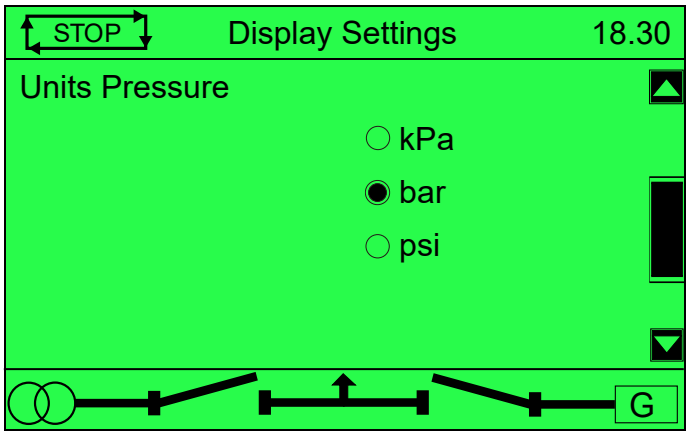
Contrast

Press the ***Tick*** button and using the ***Next or Previous*** buttons adjust the contrast

Press the ***Tick*** button again to save the setting



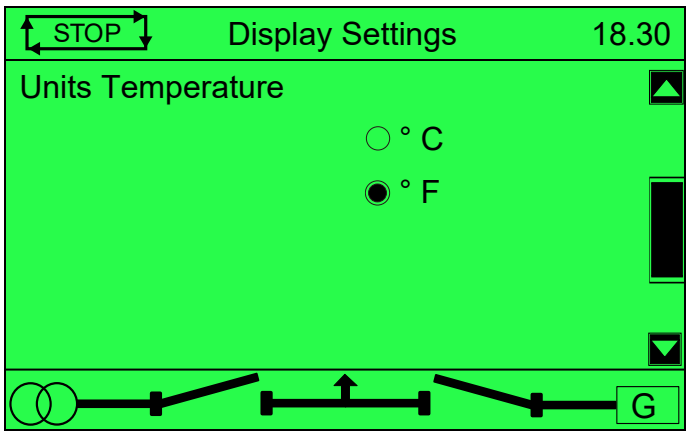
Units- Pressure



Press the ***Tick*** button to highlight and use the ***Scroll*** buttons to change the selection.

Once a selection has been made press the ***Tick*** button to confirm.

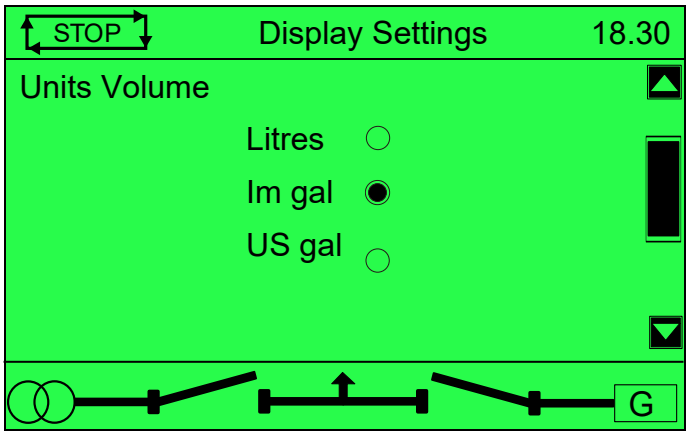
Units- Temperature



Press the ***Tick*** button to highlight and use the ***Scroll*** buttons to change the selection.

Once a selection has been made press the ***Tick*** button to confirm.

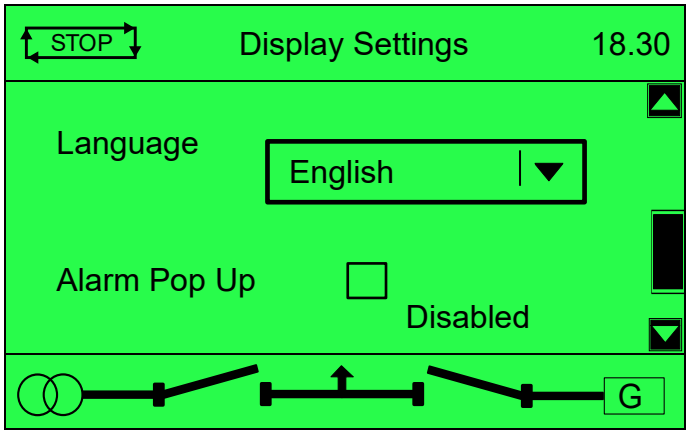
Units- Volume



Press the ***Tick*** button to highlight and use the ***Scroll*** buttons to change the selection.

Once a selection has been made press the ***Tick*** button to confirm.

Language



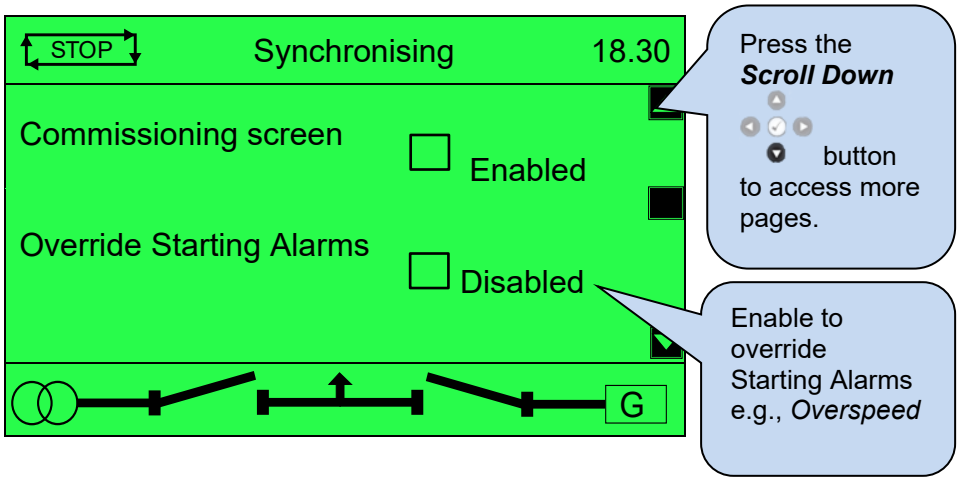
Press the ***Tick*** button and then using the ***Next Page*** button to reveal the 6 other language options.

Use the ***Scroll*** buttons to select the language option and press the ***Tick*** button again to save the setting.

NOTE: The Language Editor in Config Suite may be required to load languages into the module. For further details, refer to DSE Publication: 057-322 *G8600 Configuration Suite PC Software Manual*

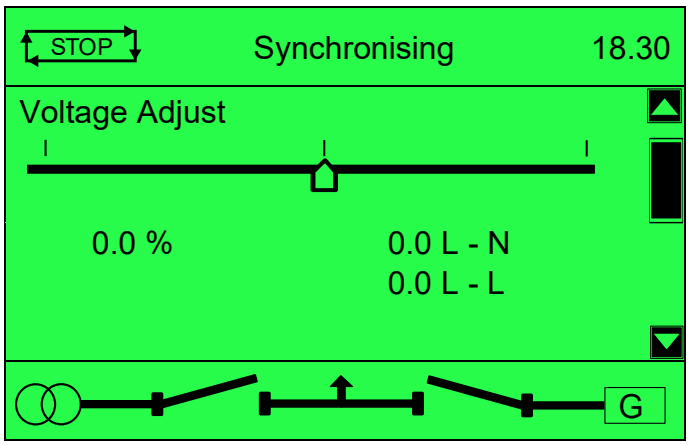
5.3.13.2 SYNCHRONISING

The synchronising pages allows adjustment of voltage and frequency as well as enabling/disabling the *Commissioning Screen* and *Starting Alarms.*



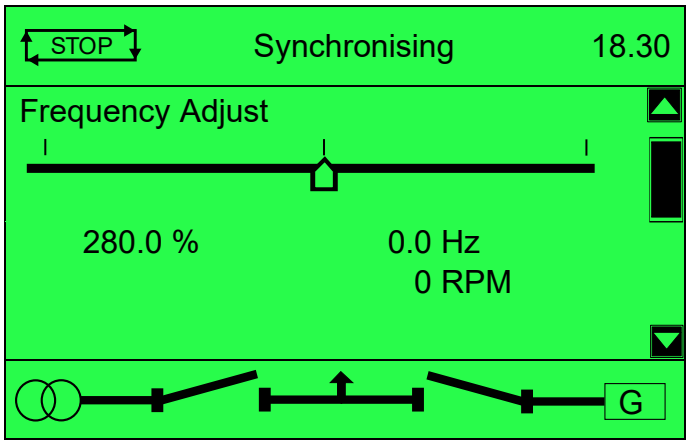
NOTE: Starting alarms are armed as soon as the module commences starting of the engine and remain armed until the engine is at rest. Enabling Override Starting Alarms disarms all starting alarms.

Press the ***Tick*** button and then using the ***Next Page*** button to enable the selection.



Press the ***Tick*** button and then using the ***Next or Previous*** buttons adjust the Setting.

Press the ***Tick*** button again to save the setting



Press the ***Tick*** button and then using the ***Next or Previous*** buttons adjust the Setting.

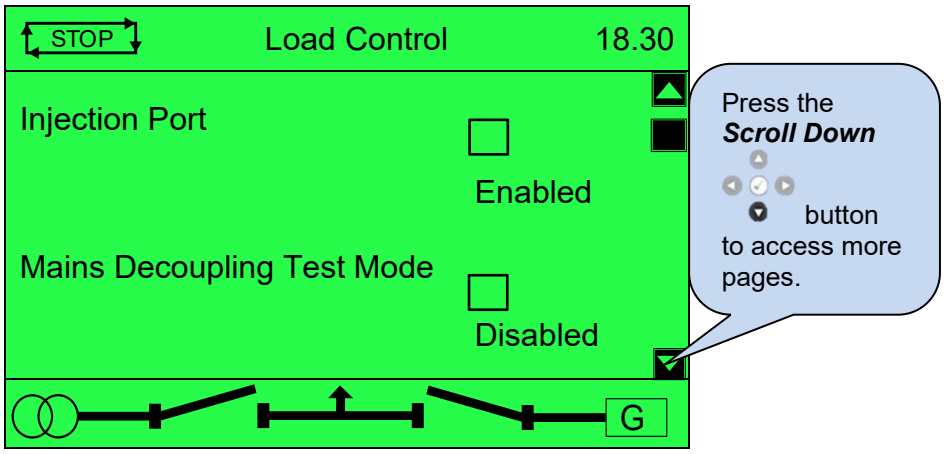
Press the ***Tick*** button again to save the setting

5.3.13.3 LOAD CONTROL

The Load Control pages give an overview of the instrumentation Load Control parameters.

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 DSEG8600 Configuration Suite PC Software Manual.

NOTE: The *Mains Supervision Timer* is ignored in *Mains Decoupling Test Mode*.



Press the ***Tick*** button and then using the ***Next Page*** button to enable the selection.

Injection Port

The Simulation Injection Testing tool of the DSE Configuration Suite PC Software allows testing the generator's frequency response and check its performance for the Power Control curves. For details on how to test the Simulation Injection on the DSE module refer to DSE Publication: *056-123 Simulation Injection Testing* document.
The Injection Port must be enabled in the DSE module from the Running Editor to be able to accept the injecting control.

Mains Decoupling Test Mode

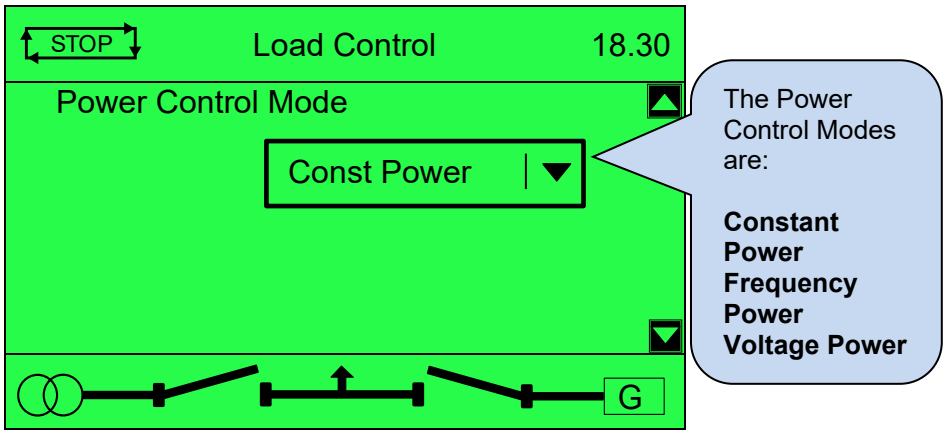
The Test Mode is designed to facilitate the testing of mains decoupling functions without transitioning into parallel operation. Typically, the Mains Decoupling Alarms are activated once the system has entered parallel operation Mains (Utility) with the Bus/Generator after the Mains Decoupling Supervision Timer has elapsed.

The test mode is activated as follows:

- Ensure that the Mains breaker is open, and no alarms are present.
- Access a Digital Input and verify the Digital outputs, specifically *Mains Decoupling Test Mode Input* and *Mains Decoupling Test Mode Active*."
- In the *Running Editor* (under *Load Control*), select the appropriate button and use the right arrow to change the setting from disabled to enabled.

Proceed to simulate the Mains Decoupling Test and confirm that the action and alarms are functioning as expected. (Utilising the Simulation Injection Testing function may be beneficial during this testing process.

Power Control Mode



Press the ***Tick*** button and then using the ***Next Page*** button to reveal the other language options.

Use the ***Scroll*** buttons to select the language option and press the ***Tick*** button again to save the setting.

Press the ***Tick*** button again to save the setting.

- **Constant Active Power Mode (Default)**

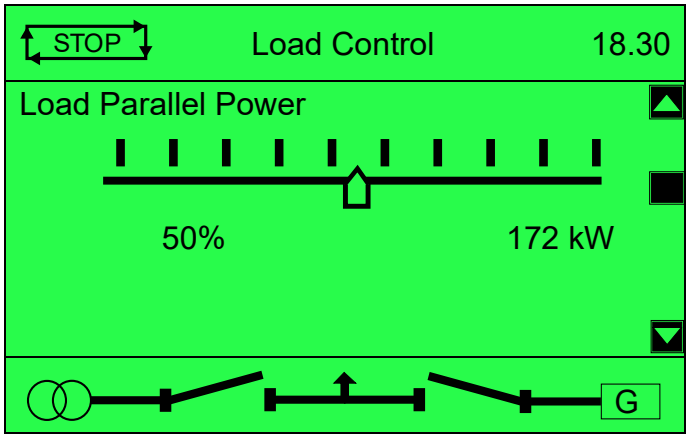
  This is the default mode when in parallel with the mains (utility); where the DSE load share controller holds the amount of active power produced at a constant level. The amount of active power produced by the generator is irrespective of the load level or any other parameter.
  The amount of power produced is defined as *Maximum kW Level* and is set using either the *DSE Configuration Suite PC Software*, *Front Panel Running Editor*, in PLC Functions, or via Modbus messages.

- **Frequency - Active Power Mode**

  In this mode of exporting power to the mains (utility); the DSE load share controller varies the amount of active power produced with regards to the *Control Curve* depending on the measured mains (utility) frequency.
  This mode allows the generator to support the mains (utility) frequency stability by monitoring the frequency and changing the amount of active power produced.

- **Voltage – Active Power Mode**

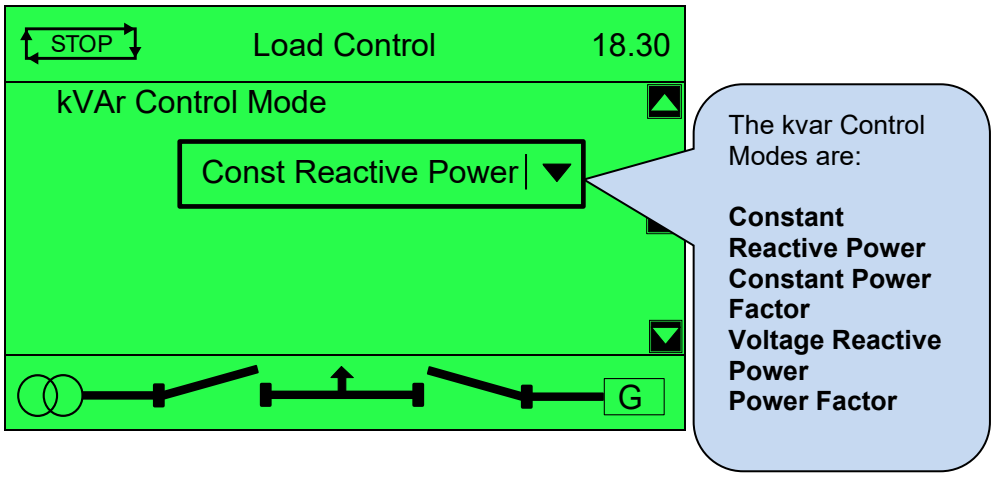
  In this mode of exporting power to the mains (utility); the DSE load share controller varies the amount of active power produced with regards to the *Control Curve* depending on the measured mains (utility) voltage.
  This mode allows the generator to support the mains (utility) voltage stability by monitoring the voltage and changing the amount of active power produced.



Press the ***Tick*** button and then using the ***Next or Previous*** buttons adjust the Setting.

Press the ***Tick*** button again to save the setting.

kvar Control Mode



Press the ***Tick*** button and then using the ***Next Page*** button to reveal the other options.

Use the ***Scroll*** buttons to select the language option and press the ***Tick*** button again to save the setting.

Press the ***Tick*** button again to save the setting.

- **Constant Reactive Power Mode (Default)**

  This is the default mode of exporting power to the mains (utility); where the DSE load share controller holds the amount of reactive power produced at a constant level. The amount of reactive power produced by the generator is irrespective of the load level or any other parameter.
  The amount of reactive power produced is defined as *Maximum kvar Level* and is set using either the *DSE Configuration Suite PC Software*, *Front Panel Running Editor*, in PLC Functions, or via Modbus messages.

- **Constant Power Factor Mode**

  In this mode of exporting power to the mains (utility); the DSE load share controller varies the amount of reactive power produced with regards to maintaining the required power factor. This mode allows the generator to maintain a constant export power factor if so required.
  The required power factor is set using either the *DSE Configuration Suite PC Software*, *Front Panel Running Editor*, in PLC Functions, or via Modbus messages.

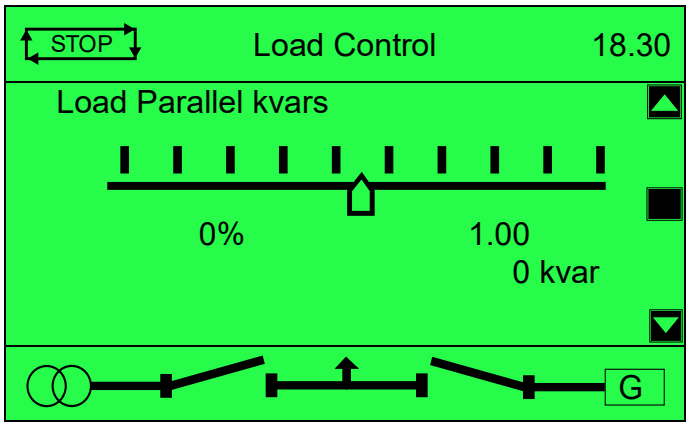
- **Voltage - Reactive Power Mode**

  In this mode of exporting power to the mains (utility); the DSE load share controller varies the amount of reactive power produced with regards to the *Control Curve* depending on the measured voltage.
  This mode allows the generator to support the mains (utility) voltage stability by monitoring the voltage and changing the amount of reactive power produced.

- **Power - Power Factor Mode**

  In this mode of exporting power to the mains (utility); the DSE load share controller varies the amount of reactive power produced with regards to maintaining the required power factor. This power factor is derived from the averaged power using the *Control Curve.*
  This mode allows the generator to support the mains (utility) stability by varying the power factor depending on the produced active power.

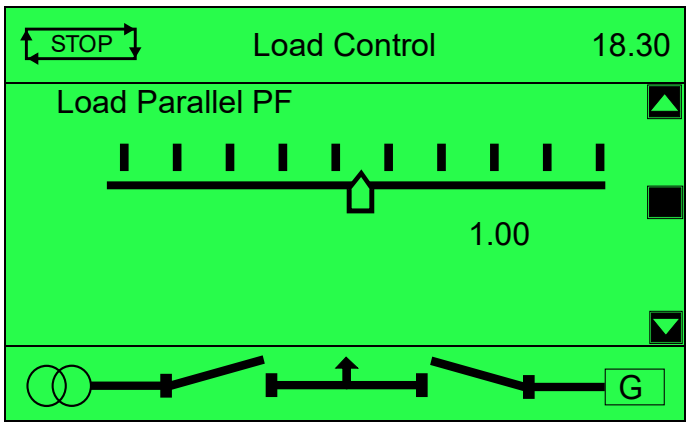
Load Parallel kvars



Press the ***Tick*** button and then using the ***Next or Previous*** buttons adjust the Setting.

Press the ***Tick*** button again to save the setting

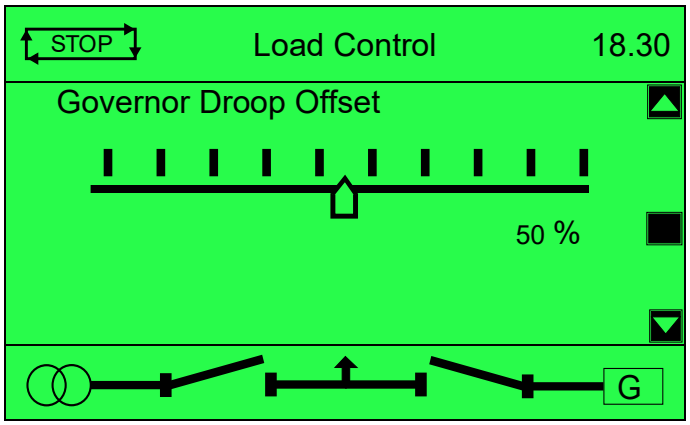
Load Parallel PF



Press the ***Tick*** button and then using the ***Next or Previous*** buttons adjust the Setting.

Press the ***Tick*** button again to save the setting

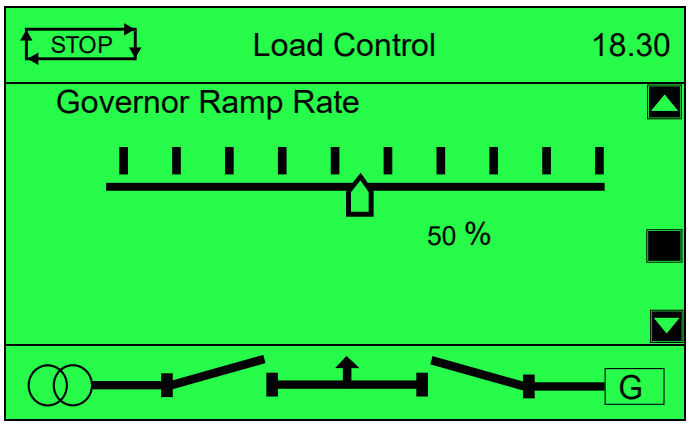
Governor Droop Offset



Press the ***Tick*** button and then using the ***Next or Previous*** buttons adjust the Setting.

Press the ***Tick*** button again to save the setting

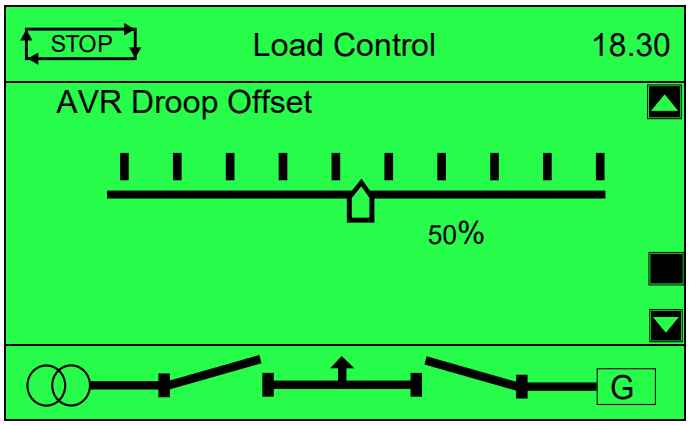
Governor Ramp Rate



Press the ***Tick*** button and then using the ***Next or Previous*** buttons adjust the Setting.

Press the ***Tick*** button again to save the setting

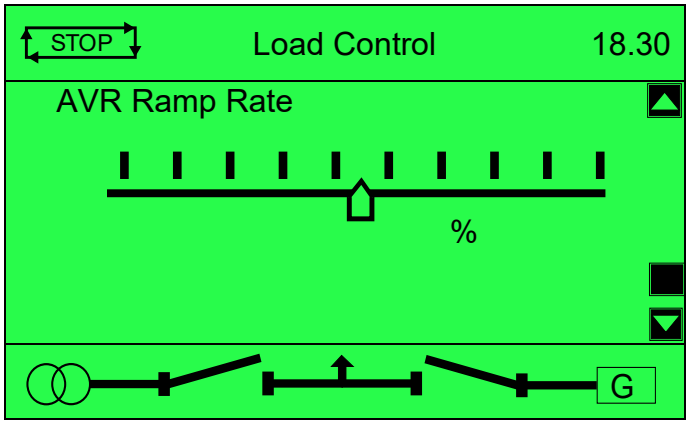
AVR Droop Offset



Press the ***Tick*** button and then using the ***Next or Previous*** buttons adjust the Setting.

Press the ***Tick*** button again to save the setting

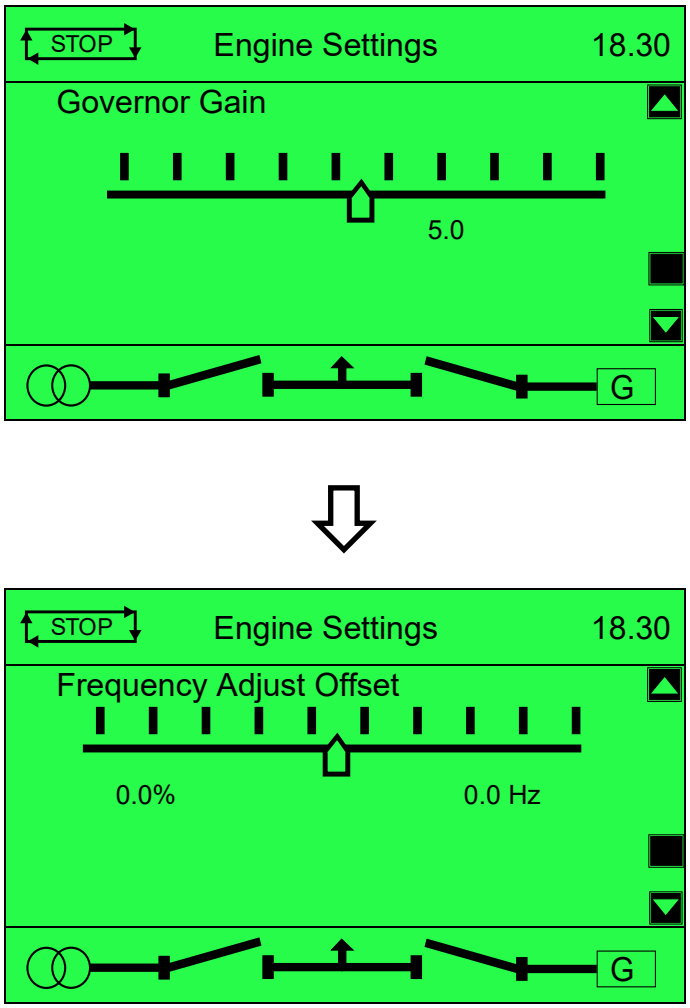
AVR Ramp Rate



Press the ***Tick*** button and then using the ***Next or Previous*** buttons adjust the Setting.

Press the ***Tick*** button again to save the setting

5.3.13.4 ENGINE SETTINGS

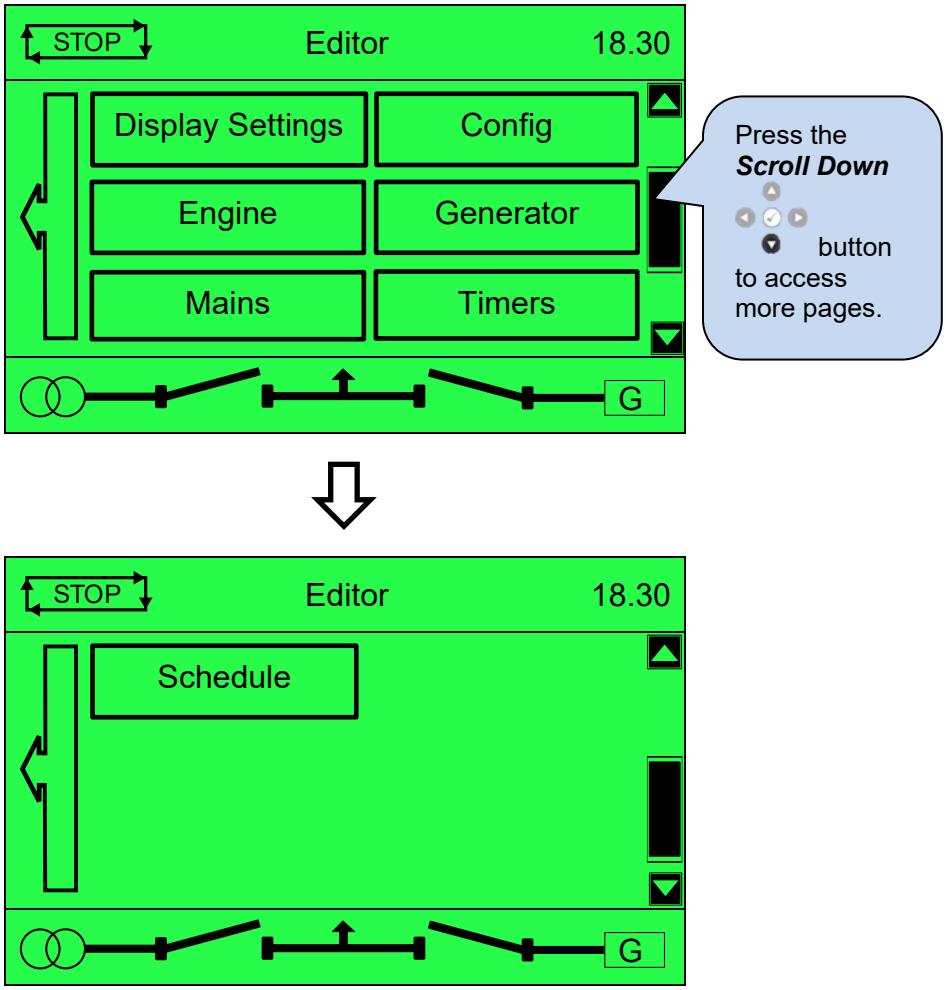


5.3.14 EDITOR

NOTE: Depending upon the module's configuration, some display pages may be disabled. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*

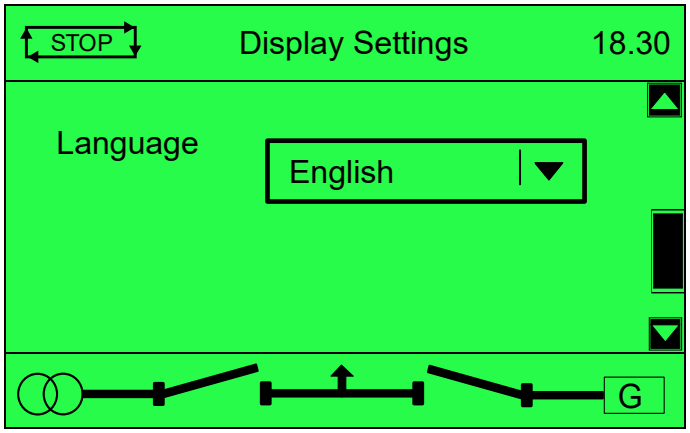
Contains a selection of parameters selected by the system integrator that may be edited from the facia without having to enter the module's *Front Panel Editor.* For further details refer to section 8.1.

Press the ***Scroll*** buttons to scroll through the ***Editor*** parameters if configured.



5.3.14.1 DISPLAY SETTINGS

Language



Press the ***Tick*** button and then using the ***Next Page*** button to reveal the 6 other language options.

Use the ***Scroll*** buttons to select the language option and press the ***Tick*** button again to save the setting.

NOTE: The Language Editor in Config Suite may be required to load languages into the module. For further details, refer to DSE Publication: 057-322 *G8600 Configuration Suite PC Software Manual.*

Current Date & Time

The current date and time are adjusted starting with the 'Day' using the scroll buttons.

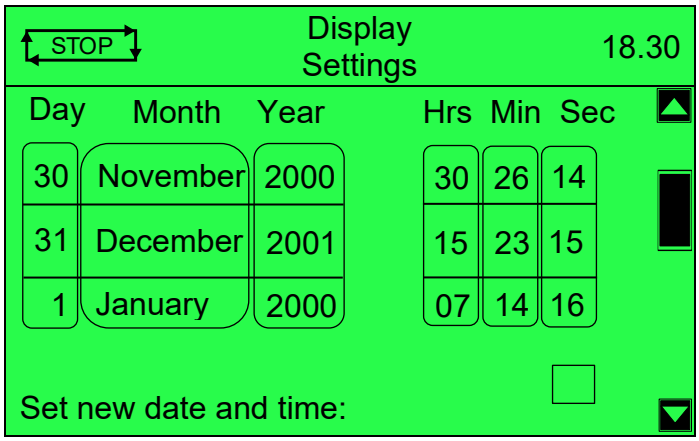
Press the ***Tick***  button to highlight Day

Use the ***Scroll***  buttons to select the desired Day.

Repeat with Month, Year, Hrs, Min, Sec.

Press the ***Tick***  button to highlight ***Set new date and time*** box

Press the ***Next Page***  button to set.



Platform Mode

The current platform mode (also known as Application Mode) is displayed.
To make a selection see the section entitled *Viewing The Instrument Pages* elsewhere in this document.

Press the ***Tick*** button to highlight and use the ***Scroll*** buttons to change the selection.

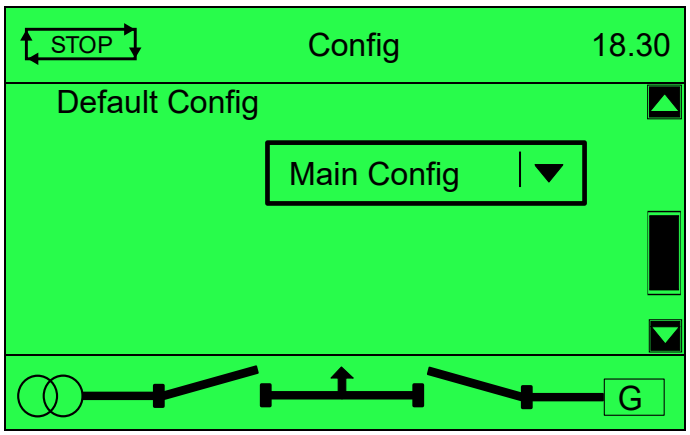
Once a selection has been made press the ***Tick*** button to confirm.

NOTE: The action is delayed by 5 seconds, this allows the user to correct a mistake before the breakers automatically change state. A mode change (auto/manual) cancels this request.

5.3.14.2 ALTERNATIVE CONFIG SELECTION

Press the ***Tick*** button and using the ***Next or Previous*** buttons to adjust

Press the ***Tick*** button again to save the setting

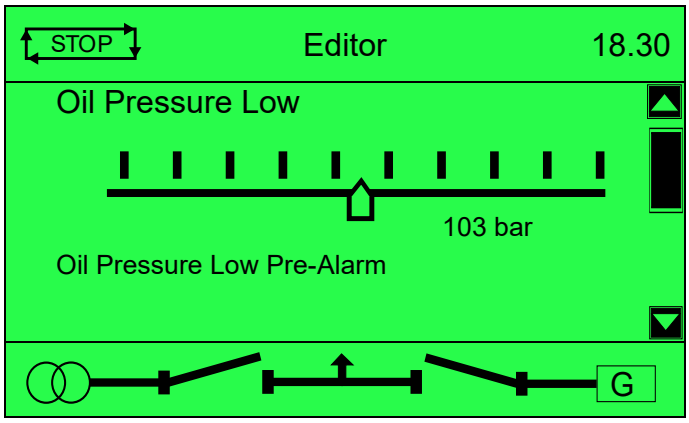


Press the ***Tick*** button and then using the ***Next Page*** button to reveal the other options.

Use the ***Scroll*** buttons to select the option and press the ***Tick*** button again to save the setting.

5.3.14.3 ENGINE

The Engine page gives an overview of the instrumentation engine parameters.



Press the ***Tick*** button and using the ***Next or Previous*** buttons to adjust

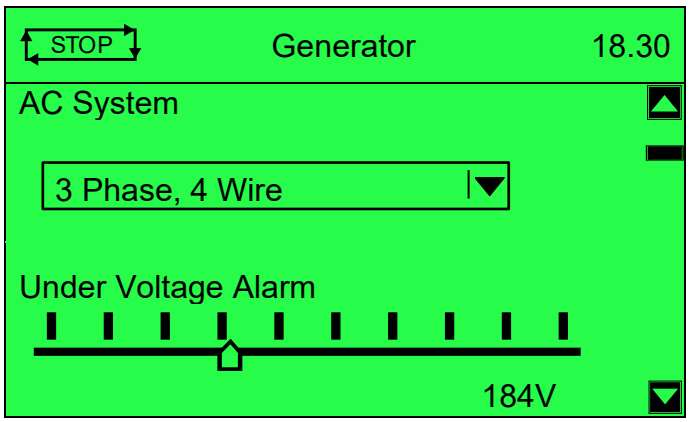
Press the ***Tick*** button again to save the setting

The list of available parameters are:

- Oil Pressure Low Shutdown
- Coolant Temp High Pre- Alarm
- Pre Heat Temp
- Heater Control On
- Fan Overrun Timer
- Running Rate
- Start Attempts
- Periodic Wakeup Time
- Droop Enable
- Gas Choke
- Ignition off
- Crank Disconnect – Engine Speed
- Crank Disconnect – Generator Voltage
- Idle Ramp Up
- Under Speed Alarm
- Under Speed Pre-Alarm
- Over Speed Pre-Alarm
- Over Speed Alarm Trip
- Overshoot Delay
- Battery Under Voltage Alarm
- Battery Under Voltage Pre-Alarm
- Battery Under Voltage Delay
- Battery Over Voltage Alarm
- Charge Alt. Pre-Alarm Trip
- Charge Alt. Pre-Alarm Delay
- Inlet Temp Pre-Alarm
- Oil Pressure Low Pre-Alarm
- Oil Pressure Low Pre-Alarm Return
- Coolant Temp High Alarm
- Pre Heat Timer
- Cooler Control On
- Fuel Pump Trip
- Stopped Rate
- DPF Regen Inhibit
- Engine CAN Termination Disabled
- Droop
- Gas Delay
- Crank Disconnect – Generator Frequency
- Crank Disconnect – Oil Pressure
- Warming at Idle
- Engage attempt
- Under Speed Alarm Trip
- Under Speed Pre-Alarm Trip
- Over Speed Pre-Alarm Trip
- Overspeed Overshoot
- Battery Over Voltage Pre-Alarm
- Battery Over Voltage Delay
- Charge Alt. Alarm Trip
- Charge Alt.Alarm
- Charge Alt.Alarm Delay
- Charge Alt. Pre-Alarm
- Inlet Temp Alarm

5.3.14.4 GENERATOR

The Generator page gives an overview of the instrumentation generator parameters.



Press the ***Tick***  button and then using the ***Next Page***  button to reveal the other AC topologies.

Press the ***Tick***  button again to save the setting.

Use the ***Scroll***  buttons to select the option and press the ***Tick***  button again to save the setting.

Select the AC topology of the generator from the following list:

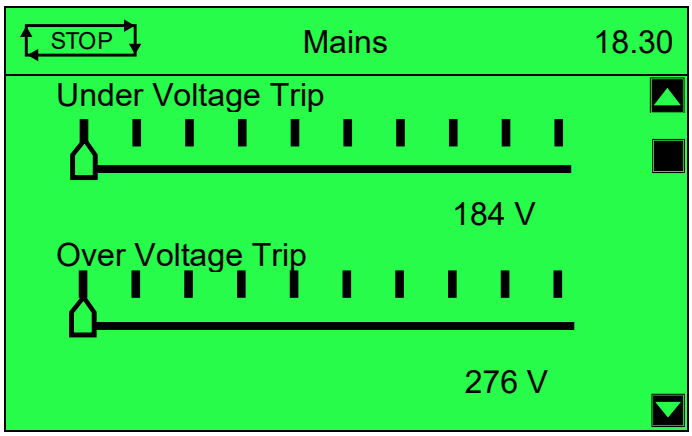
- 2 Phase, 3 Wire L1 – L2
- 3 Phase, 3 Wire
- 3 Phase, 4 Wire
- 3 Phase, 4 Wire Delta L1 – N – L3
- Single Phase, 2 Wire
- Single Phase, 3 Wire L1 – L3
- 2 Phase, 3 Wire L1 – L3
- 3 Phase, 3 Wire NVD
- 3 Phase, 4 Wire Delta L1 – N – L2
- 3 Phase, 4 Wire Delta L2 – N – L3
- Single Phase, 3 Wire L1 – L2

Select the Generator parameters from the following list:

- Under Voltage Alarm
- Under Voltage Pre-Alarm
- Loading Voltage
- Nominal Voltage
- Over Voltage Pre-Alarm Return
- Over Voltage Pre-Alarm
- Over Voltage Alarm
- CT Primary
- CT Secondary
- Full kW Rating
- Full kvar Rating
- Zero Sequence Alarm
- Zero Sequence Alarm Trip
- Zero Sequence Alarm Delay
- Positive Sequence Alarm
- Positive Sequence Trip
- Positive Sequence Alarm Delay
- Negative Sequence Alarm
- Negative Sequence Alarm Trip
- Negative Sequence Alarm Delay
- Asymmetry Alarm
- Asymmetry Alarm Trip
- Asymmetry Alarm Delay
- Under Frequency Alarm
- Under Frequency Pre-Alarm
- Loading Frequency
- Nominal Frequency
- Over Frequency Pre-Alarm Return
- Over Frequency Pre-Alarm
- Over Frequency Alarm
- Over Frequency Overshoot
- Over frequency Delayed
- Full Load Rating
- Earth CT Primary
- IDMT Alarm
- Overcurrent Alarm
- Overcurrent Time Multiplier
- Negative Phase Sequence Trip
- Negative Phase Sequence Delay
- Short Circuit Alarm
- Short Circuit Alarm Trip
- Earth Fault Alarm
- Earth Fault Alarm Trip
- Overload Protection Pre-Alarm
- Overload Protection Alarm
- Overload Protection Alarm Delay
- Reverse Power Alarm Trip
- Reverse Power Alarm Delay
- Ramp Up Rate
- Ramp Down Rate
- Insufficient Capacity Action
- Insufficient Capacity Delay
- Loss of Excitation Pre- Alarm
- Loss of Excitation Alarm
- Loss of Excitation Alarm Delay

5.3.14.5 MAINS (SINGLE SET)

Contains electrical values of the mains (utility), measured, or derived from the module's (that controls the mains (utility) switch) voltage and current inputs.



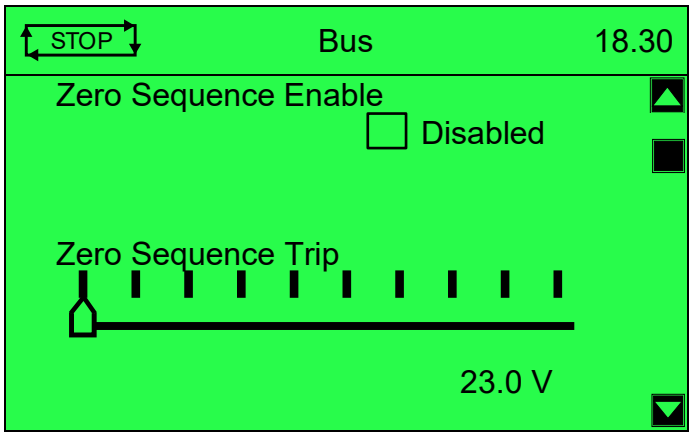
Press the ***Tick***  button and then using the  ***Next or Previous*** buttons adjust the Setting.

Press the ***Tick***  button again to save the setting

The list of available parameters are:

- Under Voltage Trip
- Under Voltage Pre-Alarm Return
- Over Voltage Pre-Alarm Return
- Over Voltage Trip
- Zero Sequence Enable
- Zero Sequence Trip
- Zero Sequence Alarm Delay
- Positive Sequence Enable
- Positive Sequence Trip
- Positive Sequence Alarm Delay
- Negative Sequence Enable
- Negative Sequence Trip
- Negative Sequence Alarm Delay
- Asymmetry Enable
- Asymmetry Trip
- Asymmetry Alarm Delay
- Under Frequency Alarm Trip
- Under Frequency Pre-Alarm Return
- Over Frequency Alarm Trip
- CT Primary
- CT Secondary
- Full Load Rating
- Full kvar Rating

5.3.14.6 BUS (MULTISET)

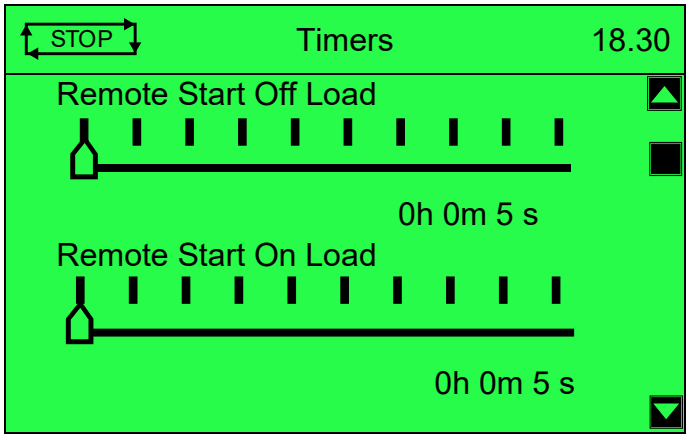


The list of available parameters are:

- Zero Sequence Enable
- Zero Sequence Trip
- Zero Sequence Alarm Delay
- Positive Sequence Enable
- Positive Sequence Alarm Trip
- Positive Sequence Alarm Delay
- Negative Sequence Enable
- Negative Sequence Trip
- Negative Sequence Alarm Delay
- Asymmetry Enable
- Asymmetry Trip
- Asymmetry Alarm Delay

5.3.14.7 TIMERS

Contains a selection of Timer parameters which are adjustable.



The list of available parameters are:

- Remote Start Off Load
- Remote Start On Load
- Telemetry Start
- Mains Fail
- Mains Transient Delay
- Engage Attempt
- Engage Rest
- Delay Crank
- Cranking
- Cranking Rest
- Safety On Delay
- Warming
- MPU Fail Delay
- Breaker Close Pulse
- Breaker Trip Pulse
- Cooling
- ETS Solenoid
- Fail To Stop Delay
- Start Form AMSC Client
- Page Timer

5.3.14.8 SCHEDULER

NOTE: For further details on the operation of the inbuilt scheduler feature, refer to the section entitled *Scheduler* in the *Operation* section elsewhere in this document.

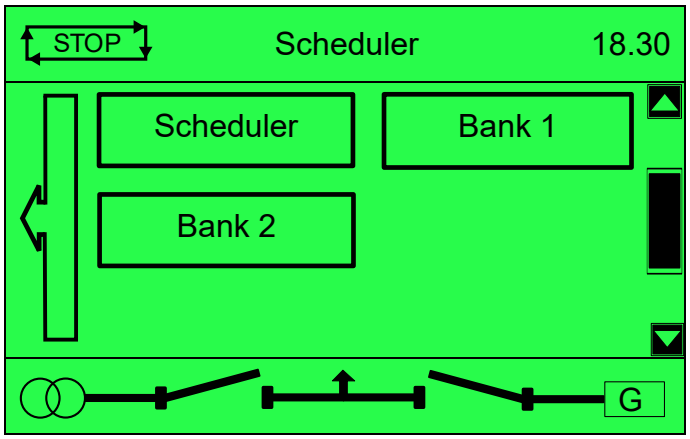
NOTE: For further details of module configuration, refer to DSE Publication: 057-322 DSEG8600 Configuration Suite PC Software Manual.

NOTE: The run modes available are dependent on which Application mode (Multi Set or Single Set) is selected.

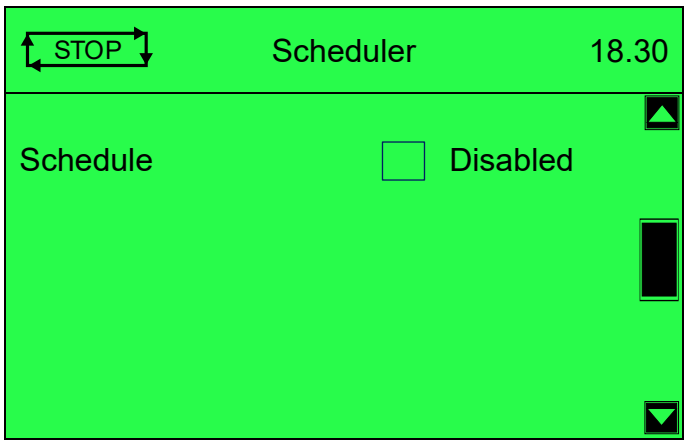
The controller contains an inbuilt exercise run scheduler, capable of automatically starting and stopping the set or inhibiting the set from starting. Up to 16 scheduled (in two banks of 8) start/stop/inhibiting start sequences can be configured to repeat on a 7-day or 28-day cycle.

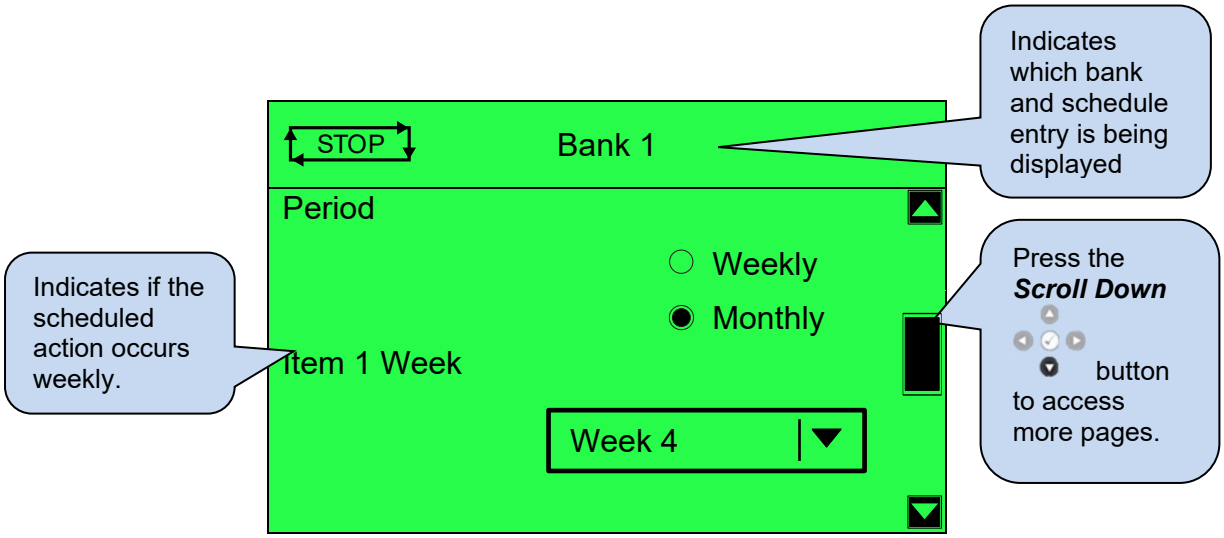
Scheduled runs may be on load or off load depending upon module configuration.

This section of the module's display shows how exactly the scheduler (if enabled) is configured. Under default factory settings the Schedule is not viewable. It is enabled by the system designer using the DSE Configuration Suite software.



Press the ***Tick***  button and then using the ***Next Page***  button to enable or disable the Schedule..





6 OPERATION

NOTE: The following descriptions detail the sequences followed by a module containing the standard 'factory configuration.' Always refer to the configuration source for the exact sequences and timers observed by any module in the field.

6.1 QUICKSTART GUIDE

This section provides a quick start guide to the module's operation.

6.1.1 STARTING THE ENGINE

To manually start the generator, press the start button once to put the module into manual mode, and then a second time to start the generator.

6.1.2 STOPPING THE ENGINE

The engine is stopped by pressing the Stop button.

6.2 STOP/RESET MODE

NOTE: If a digital input configured to *Panel Lock* is active, changing module modes and entering editors is not possible. Viewing the instruments and event logs is NOT affected by *Panel Lock*.

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 DSEG8600 Configuration Suite PC Software Manual.

Stop/Reset Mode is activated by pressing the ***Stop/Reset Mode*** button.
The LED adjacent to the ***Stop/Reset Mode*** button illuminates to indicate an alarm indication.

In ***Stop/Reset Mode***, the module removes the generator from load and the generator is cooled down (depending on Cooldown timer) before stopping.

If the generator does not stop when requested, the *Fail To Stop* alarm is activated (subject to the setting of the *Fail to Stop* timer). To detect the engine at rest the following must occur:

- Engine speed is zero as detected by the CAN ECU
- Generator AC Voltage and Frequency must be zero.
- Engine Charge Alternator Voltage must be zero.
- Oil pressure sensor must indicate low oil pressure

When the engine has stopped and the module is in the ***Stop/Reset Mode***, it is possible to send configuration files to the module from DSE Configuration Suite PC software and to enter the Front Panel Editor to change parameters.

Any latched alarms are cleared and reset when ***Stop/Reset Mode*** is entered.

The engine is not started when in ***Stop/Reset Mode***. If start signals are given, the input is ignored until ***Auto Mode*** AUTO is entered.

When left in ***Stop/Reset Mode*** with no presses of the fascia buttons, no form of communication active and configured for *Power Save Mode,* the module enters *Power Save Mode*. To 'wake' the module, press any fascia control buttons.

Power Save Mode in the DSE Configuration Suite Software

6.2.1 ECU OVERRIDE

NOTE: ECU Override function is only applicable when the controller is configured for a CAN engine.

NOTE: Depending upon system design, the ECU may be powered or unpowered when the module is in STOP mode. ECU override is only applicable if the ECU is unpowered when in STOP mode.

NOTE: Depending upon system design, the ECU may be powered or unpowered when the module is in STOP mode. ECU override is only applicable if the ECU is unpowered when in STOP mode.

When the ECU powered down (as is normal when in STOP mode), it is not possible to read the diagnostic trouble codes or instrumentation. Additionally, it is not possible to use the engine manufacturers' configuration tools.

As the ECU is usually unpowered when the engine is not running, it must be turned on manually as follows:

- In ***Stop/Reset Mode*** pressing the **Start/*Manual Mode*** button puts the module into ***Manual Mode***.
- The ECU Override is triggered and remains powered until ***Manual Mode*** is exited to either stop or Auto mode is selected (Test Mode Single Set).

This is useful if the engine manufacturer's tools need to be connected to the engine, for instance to configure the engine as the ECU needs to be powered up to perform this operation, also to check the status of the CAN communication and to prime the fuel system.

6.3 MANUAL MODE

NOTE: If a digital input configured to Panel Lock is active, changing module modes is not possible. Viewing the instruments and event logs is NOT affected by panel lock.

NOTE: The ECU is continually powered in manual mode.

Manual Mode is activated by pressing the ***Manual Mode*** button.
The LED next to the ***Manual Mode*** MANUAL button flashes to indicate ***Manual Mode*** MANUAL

In ***Manual Mode*** MANUAL the generator does not start automatically
To begin the starting sequence, press the ***Start*** button. The LED next to the ***Manual Mode*** button stops flashing and illuminates.

6.3.1 STARTING SEQUENCE

NOTE: There is no *Start Delay* in this mode of operation.

NOTE: If the unit has been configured for CAN, compatible ECUs receives the start command via CAN.

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 DSEG8600 Configuration Suite PC Software Manual.

The fuel relay is energised, and the engine is cranked.

If the engine fails to fire during this cranking attempt, then the starter motor is disengaged for the *Crank Rest Timer* duration after which the next start attempt is made. If this sequence continues beyond the set *Number Of Attempts*, the start sequence is terminated, and the display shows *Fail to Start.*

The starter motor is disengaged when the engine fires. Speed detection is factory configured to be derived from the AC alternator output frequency but can additionally be measured from a Magnetic Pickup mounted on the flywheel or from the CANbus link to the engine ECU depending on module configuration.

Additionally, rising oil pressure is used to disconnect the starter motor (but cannot detect underspeed or overspeed).

After the starter motor has disengaged, the *Safety On Delay* timer activates, allowing Oil Pressure, High Engine Temperature, Under-speed, Charge Fail and any delayed Auxiliary fault inputs to stabilise without triggering the fault.

NOTE: The 'safety on' is state in the supervisor state machine, when an input is armed from safety on it can carry out its action from the end of the 'Safety on' state (timer expired) to the end of 'cooling at normal speed' state. Digital and Analogue Inputs that are armed using *From Safety On* are only available as a User Configured function.

6.3.2 ENGINE RUNNING

NOTE: The generator output remains inactive until the generator is available. This prevents excessive wear on the engine and alternator.

NOTE: For further information on enabling Manual Breaker Control, refer to DSE Publication: 057-322 DSEG8600 Configuration Suite PC Software Manual.

When in ***Manual Mode*** MANUAL, the generator does not synchronise and close its load switch unless a 'loading request' is made. The possible sources for 'loading requests' are limited dependant on the state of the *Manual Breaker Control* function.

6.3.2.1 MANUAL BREAKER CONTROL DISABLED

A loading request may come from any of the following sources:

- Press the ***Transfer to Generator*** button.
- Failure of mains (utility) supply
- Activation of an auxiliary input that has been configured to *Remote Start On Load, Transfer To Generator / Open Mains* or *Auxiliary Mains Fail.*
- Activation of the inbuilt exercise scheduler if configured for 'Parallel' or 'Island' runs.
- Instruction from external remote telemetry devices using the RS485 or Ethernet interface.

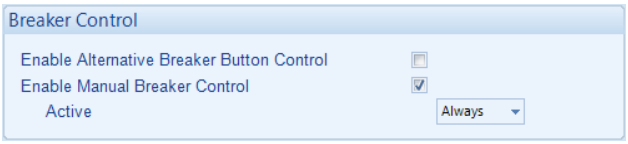
Once the generator has been instructed to synchronise and placed on load, it does not automatically get removed. Depending on loading request state, one of the following methods is used to manually open the load switch:

- If the loading request has been removed:
-
    - Press the ***Transfer to Mains*** button.
    - Activation of an auxiliary input that has been configured to *Transfer To Mains / Open Generator.*
    - Press the ***Mode*** MODE button to return to automatic mode.

      The set observes all ***Auto Mode*** AUTO start requests and stopping timers before beginning the *Auto Mode Stopping Sequence*.

- If the loading request remains active:
    - Press the ***Stop/Reset Mode*** button to remove load and stop the generator.
    - Activation of an auxiliary input that has been configured to *Generator Load Inhibit* (no ramping occurs).

6.3.2.2 MANUAL BREAKER CONTROL ENABLED



Loading request sources are limited to:

- Press the ***Transfer to Generator*** button.
- Activation of an auxiliary input that has been configured to *Transfer To Generator / Open Mains.*

Once the generator is placed on load, it does not automatically get removed. Any one of the following methods are used to manually open the load switch:

- Press the ***Transfer to Mains*** button
- Activation of an auxiliary input that has been configured to *Transfer To Mains / Open Generator.*
- Press the ***Mode*** button to return to automatic mode.

  The set observes all ***Auto Mode*** AUTO start requests and stopping timers before beginning the *Auto Mode Stopping Sequence*.
- Press the ***Stop/Reset Mode*** button to remove load and stop the generator.
- Activation of an auxiliary input that has been configured to *Generator Load Inhibit* (no ramping occurs).

6.3.3 STOPPING SEQUENCE

In ***Manual Mode*** MANUAL the set continues to run until either:

- The ***Stop/Reset Mode*** button is pressed. The delayed load outputs are de-activated immediately and the set immediately stops.
- If the ***Mode*** *button is pressed and* ***Auto Mode*** AUTO is selected.

  The set observes all ***Auto Mode*** AUTO start requests and stopping timers before beginning the *Auto Mode Stopping Sequence*.

6.4 TEST MODE

This button places the module into its ***Test Mode*** this allows an on-load test of the generator.

Once in ***Test Mode***, the module responds to the **Start/*Manual Mode*** button to start the generator.
Once the set has started and becomes available, it is automatically placed on load ('Close Generator Output' becomes active), synchronising to the mains (utility) if required. Depending upon module configuration, the generator remains in constant parallel with the mains (utility) or proceeds to run in island operation ('Close Mains Output' becomes inactive).

The generator remains on load until either the ***Stop/Reset Mode*** or ***Auto Mode*** AUTO is selected.

6.5 AUTOMATIC MODE

NOTE: If a digital input configured to external *Panel Pock* is active, changing module modes is not possible. Viewing the instruments and event logs is NOT affected by *Panel Lock*.

Auto Mode is activated by pressing the ***Mode*** button.
The LED next to the ***Mode*** button illuminates to indicate ***Auto Mode*** AUTO operations.

Auto Mode AUTO allows the generator to operate fully automatically, starting and stopping as required with no user intervention.

6.5.1 WAITING IN AUTO MODE

If a starting request is made, the starting sequence begins.
Starting requests may be from the following sources:

- Failure of mains (utility) supply
- High mains (utility) load (when the module is in Single Set mode and configured for mains (utility))
- Activation of an auxiliary input that has been configured to *Remote Start* function.
- Activation of an auxiliary input that has been configured to *Auxiliary Mains Failure.*
- Activation of the inbuilt exercise scheduler if configured for *Parallel, Island*, or *Off Load* operation.
- Instruction from external remote telemetry devices using the RS485 or Ethernet interface.

6.5.2 STARTING SEQUENCE

NOTE: If the unit has been configured for CAN, compatible ECUs receive the start command via CAN and transmit the engine speed to the DSE controller.

NOTE: For further details of module configuration, refer to DSE Publication: 057-322 DSEG8600 Configuration Suite PC Software Manual.

To allow for 'false' start requests, the *Start Delay* timer begins.
If all start requests are removed during the *Start Delay* timer, the unit returns to a stand-by state.
If a start request is still present at the end of the *Start Delay* timer, the fuel relay is energised, and the engine is cranked.

If the engine fails to fire during this cranking attempt, then the starter motor is disengaged for the *Crank Rest* duration after which the next start attempt is made. If this sequence continues beyond the *Set Number Of Attempts*, the start sequence is terminated, and the display shows *Fail to Start.*

The starter motor is disengaged when the engine fires. Speed detection is factory configured to be derived from the AC alternator output frequency but can additionally be measured from a Magnetic Pickup mounted on the flywheel or from the CAN link to the engine ECU depending on module.

Additionally, rising oil pressure, or charge alternator, or generator voltage is used to disconnect the starter motor (but cannot detect underspeed or overspeed).

After the starter motor has disengaged, the *Safety On Delay* timer activates, allowing Oil Pressure, High Engine Temperature, Under-speed, Charge Fail and any delayed Auxiliary fault inputs to stabilise without triggering the fault.

6.5.3 ENGINE RUNNING

NOTE: The load transfer signal remains inactive until the generator is available. This prevents excessive wear on the engine and alternator.

The generator synchronises to the mains (utility) and is placed on load if configured to do so.

If all start requests are removed, the *Stopping Sequence* begins.

6.5.4 LOADING THE GENERATOR

Once the generator closes its load switch, the generator is seen as available, and the generator LED illuminates.

In ***Auto Mode*** AUTO, the generator load switch is closed automatically (if instructed too) when the generator is seen as available. A loading request can come from several sources:

- Failure of mains (utility) supply
- High mains (utility) load (when the module is configured for *Mains Mode*)
- Activation of an auxiliary input that has been configured to *Remote Start On Load* or *Remote Start In Island Mode* function.
- Activation of an auxiliary input that has been configured to *Auxiliary Mains Failure.*
- Activation of the inbuilt exercise scheduler if configured for *Parallel* or *Island* operation.
- Instruction from external remote telemetry devices using the RS485 or Ethernet interface.

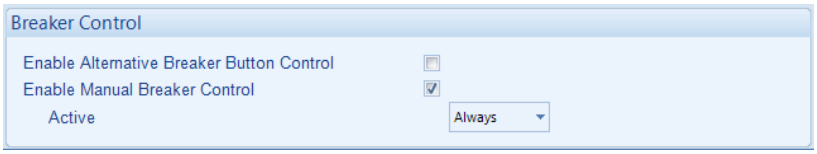
The generator is then instructed to go into continuous parallel with the mains (utility) or into island operation, for further details see the sections entitled *Continuous Parallel Operation* and/or *Island Operation* elsewhere in this document.

Before closing the generator breaker, the generator is synchronised to the bus (if required) and is placed on load by ramping load (if required) onto the generator from the bus.

6.5.5 UNLOADING THE GENERATOR

To instruct the generator to ramp its load off and open its load switch:

- Press the ***Mode*** button. The module observes all ***Auto Mode*** AUTO start requests and stopping timers before beginning the *Auto Mode Stopping Sequence*.
- Press the ***Stop/Reset Mode*** button to open the generator load switch and to stop the generator.
- Activation of an auxiliary input that has been configured to *Generator Load Inhibit* (no ramping occurs) or *Generator Load Inhibit With Ramping.*
- With *Manual Breaker Control* enabled, the following unloading requests take effect.



- Press the ***Manual Mode*** MANUAL button followed by the ***Transfer to Mains*** button. The operation of ***Transfer to Mains*** button is dependent on module configuration, for further details see the section entitled *Control Push Buttons* elsewhere in this document.

6.5.6 STOPPING SEQUENCE

A *Return Delay* is observed before the gen breaker is opened, then another may be observed if the set has been required to run off load. The *Return Delay* timer operates to ensure that the starting request has been permanently removed and is not just a short-term removal. If another start request is made during the cooling down period, the set returns on load.

If there are no starting requests at the end of the *Return Delay* timer, the generator ramps its load off and open its load switch, the *Cooling Down* timer is initiated.

The *Cooling Down* timer allows the set to run off load and cool sufficiently before being stopped. This is particularly important where turbo chargers are fitted to the engine. Running the generator at idle and disconnecting it from its load helps to cool it down quicker, depending on the model. Maintaining the minimum amount of electrical load significantly decreases the time it takes to cool when shut down.

After the *Cooling* down timer and/or the *Cooling at Idle* has expired, the set is stopped.

6.6 MULTI SET PARALLEL CONFIGURATION

6.6.1 ISOCHRONOUS

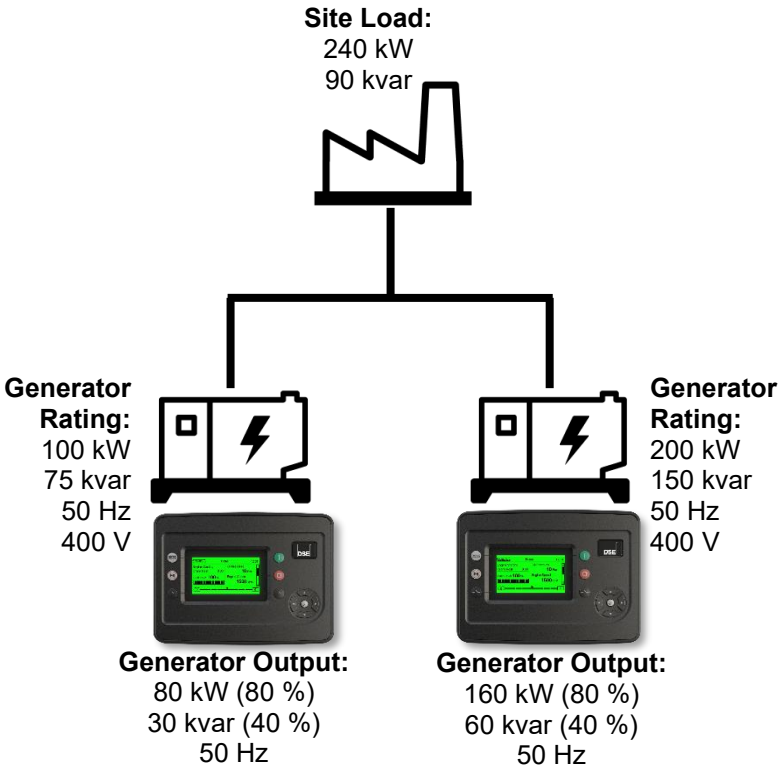
NOTE: For further details on *the Load Demand Scheme* (automatic starting/stopping of generators based on load), refer to the section entitled *Load Demand Scheme* elsewhere in this document.

When generators are running in parallel isochronously (zero droop), the amount of power they produce to the load has to be controlled to ensure it is shared amongst them whilst still running at nominal frequency and voltage.

It is the job of the DSEG8600 (Multi-Set) to make precise changes to the amount of power supplied to the resistive element (*Active Power*) and capacitive/inductive element (*Reactive Power*) by each generator. The *Active Power* (kW) sharing is achieved by controlling the engine's governing system. This is done to alter the amount of fuel supplied to the engine and then monitor the amount of *Active Power* (kW) supplied by the generator. The *Reactive Power* (kvar) sharing is achieved by controlling the alternator's AVR. This is done to alter the amount of field excitation supplied to the alternator and then monitor the amount of *Reactive Power* (kvar) supplied by the generator.

The DSEG8600 (Multi Set) controllers communicate with one another using the AMSC link, passing information and instructions between themselves regarding the amount of power to produce. This information is also used to automatically bring in or drop off other generating sets as load changes using the *Load Demand Scheme.*

Whilst generators are in parallel, the DSEG8600 (Multi Set) controllers instruct the generators to produce an equal percentage of the generators rating. In the example below, one generator is twice the size of the other though both generators as instructed to produce 80 % of their kW rating and 40 % of their kvar rating. This ensures that one generator is not being overworked, preventing excessive wear.



6.6.2 DROOP

NOTE: The *Load Demand Scheme* is not available whilst operating in *Droop*.

When generators are running in parallel in *Droop* only, the amount of power they produce to the load has to be controlled to ensure it is shared between the generators, by varying the frequency and voltage the system is running at.

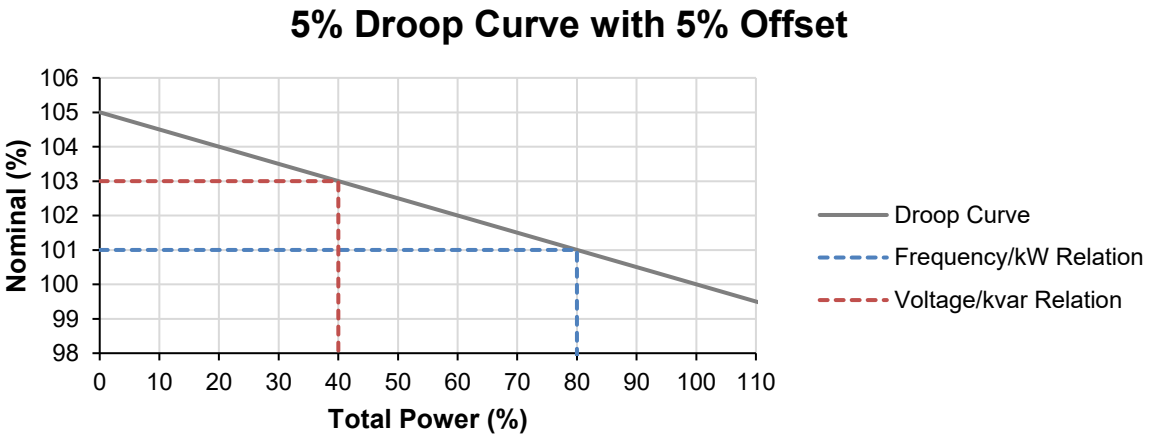
It is the job of the DSEG8600 *Droop* functions to minimise the generators power production using the configured *Droop Curve*. Typically, the *Droop Curve* on each generator is identical to ensure the generators are producing an even percentage of *Active Power* (kW) / *Reactive Power* (kvar), as they each try to produce the minimum power.

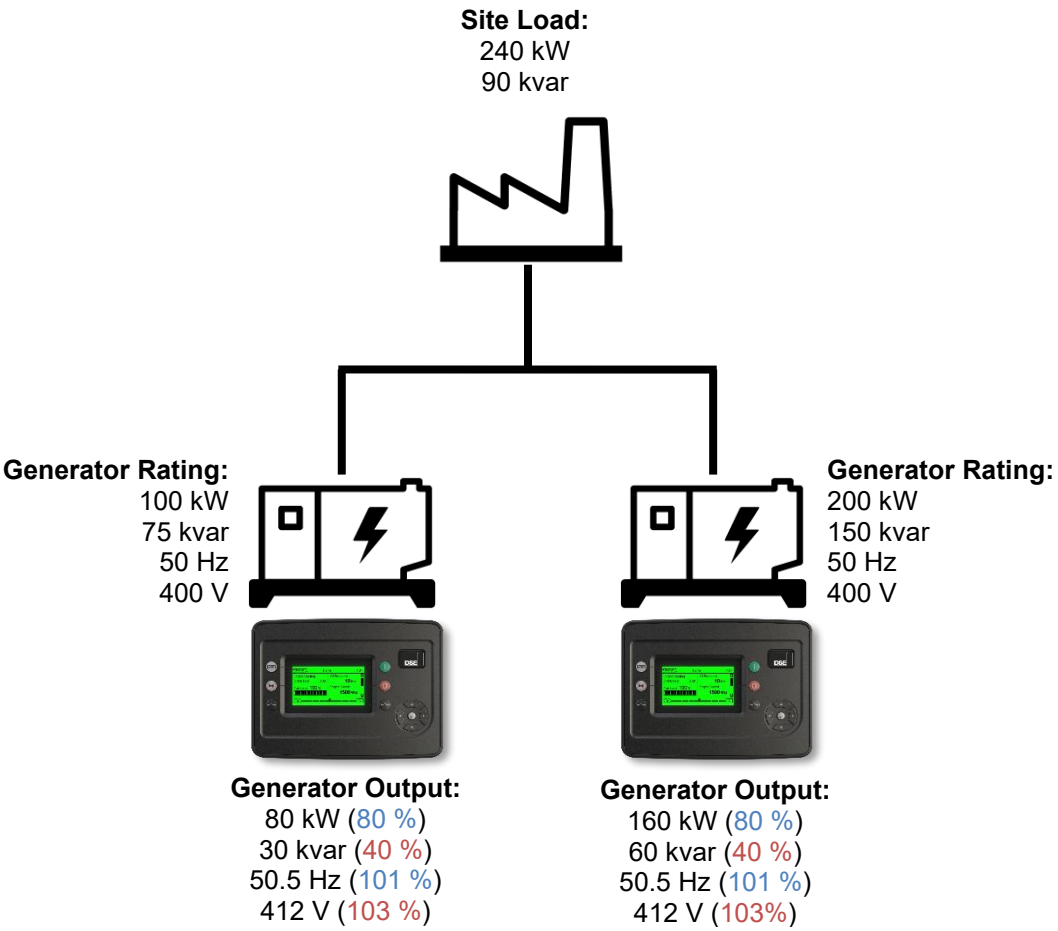
The *Active Power* (kW) sharing is achieved by the *Frequency Droop*. This is done by monitoring the *Active Power* (kW) the generator produces and altering the amount of fuel supplied to the engine to adjust the *Frequency* in accordance with the *Droop Curve*.

The *Reactive Power* (kvar) sharing is achieved by the *Voltage Droop*. This is done by monitoring the *Reactive Power* (kvar) the generator produces and altering the field excitation supplied to the alternator to adjust the *Voltage* in accordance with the *Droop Curve*.

Droop based load sharing is possible between generators/inverters that are not fitted with DSE modules that also have *Droop* enabled. However, the AMSC link is still available to automatically bring in or drop off other DSE controlled generating sets as load changes using the *Load Demand Scheme*.

Whilst the generators are in parallel, the DSEG8600 controllers instruct the generators to run at a certain frequency/voltage dependant on the active power (kW)/reactive power (kvar) the generator is producing. In the example below, both generators have the same *Droop Curve* configured for the *Frequency Droop* and *Voltage Droop*. Even though one generator is twice the size of the other, both generators are producing 80 % of their kW rating at 50.5 Hz and 40 % of their kvar rating at 412 V. This occurred as the *Droop Curve* for the *Frequency Droop* and *Voltage Droop* was configured the same in both generators.




Site Load:
240 kW
90 kvar
Generator Rating:
100 kW
75 kvar
50 Hz
400 V
Generator Rating:
200 kW
150 kvar
50 Hz
400 V
Generator Output:
80 kW (80 %)
30 kvar (40 %)
50.5 Hz (101 %)
412 V (103 %)
Generator Output:
160 kW (80 %)
60 kvar (40 %)
50.5 Hz (101 %)
412 V (103%)

6.6.3 LOAD DEMAND SCHEME

NOTE: For further details on *the Load Demand Scheme*, refer to DSE Publication: 056-013 *Load Demand Scheme.*

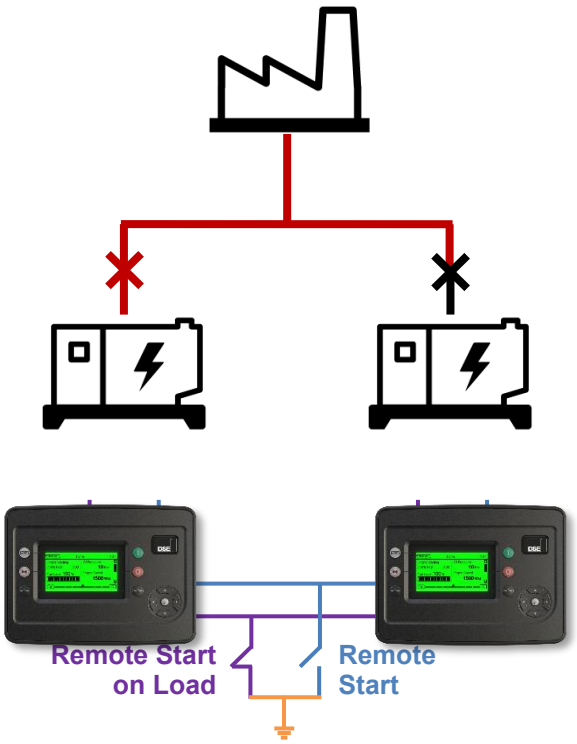
NOTE: The V6 software AMSC is not compatible with the previous module versions. For more information contact DSE Technical Support support@deepseaelectronics.com

The module is included in the *Load Demand Scheme* by activating a digital input configured as *Remote Start on Load Demand.* Every DSEG8600 module connected on the AMSC link which is required to run in the *Load Demand Scheme* must have a digital input configured for *Remote Start on Load Demand* and be activated. Having this input on each DSEG8600 enables a specific generator to be taken out of the *Load Demand Scheme* for service for maintenance (by de-activating the input) whilst allowing the remainder of the system to operate.

Upon activation of the *Remote Start on Load Demand* input, all the generators in the system start. The first generator to become available closes onto the dead bus, communicating with the other generators to instruct them to synchronise onto the now live bus, before closing in parallel. If too much generator capacity is available to supply the load, the generators that are not required begin their Return Delay timers, after which they ramp off the bus and stop.

Whilst one or more generators are already available in *Load Demand Scheme*, it may be required to make all the generators in the system available to provide power to the load. For instance, this may be necessary prior to switching on a large load that the currently available generators are not able to supply. To provide this function, a digital input on each DSEG8600 module in the system must be configured to *Remote Start on Load*. Activating this input causes DSEG8600 module to start its generator, synchronise with the bus, and close in parallel.

The generators continue to provide power until the *Remote Start on Load* input is de-activated. Providing the *Remote Start on Load Demand* input is still active on all the DSEG8600 modules, the *Load Demand Scheme* ramps the un-required generators off the bus, depending upon the total load level.

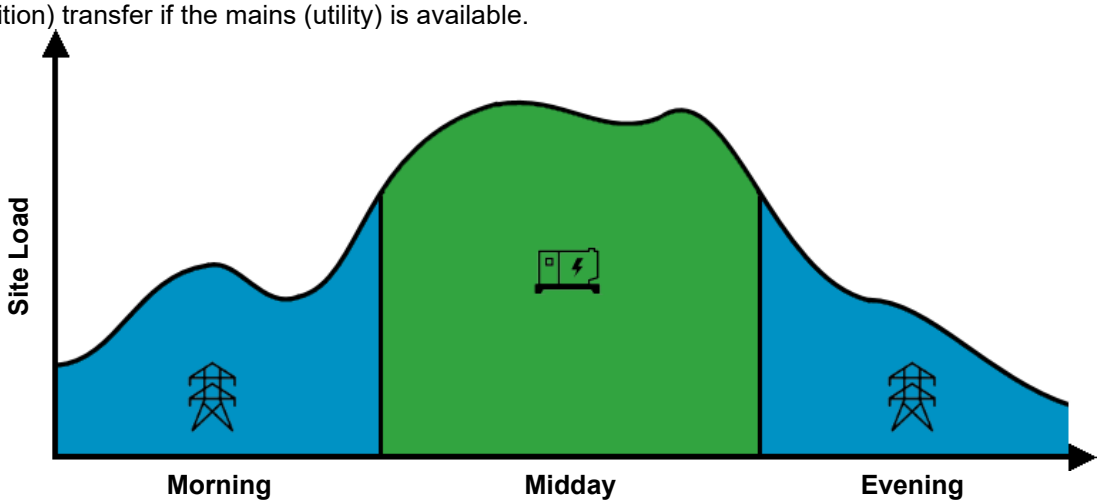


6.7 ISLAND OPERATION

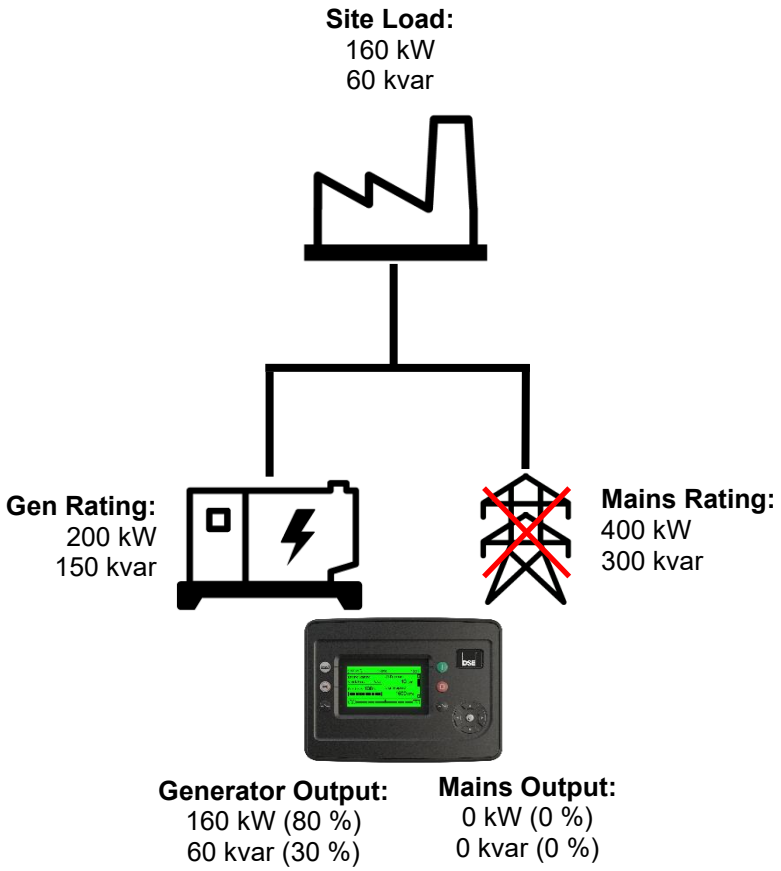
The generator may be started during a mains (utility) failure or activation of *Remote Start in Island Mode*. The generator in this case must be capable of supplying the entire load during this time. The generator is then used to power the load by:

- Performing a *No-Break (Closed Transition)* changeover by synchronising if the mains (utility) is available.
- Performing a *Break (Open Transition)* changeover if the mains (utility) is not available.

This leaves the generator running in *Island Operation*, suppling the load entirely on its own. This is the case until the load is transferred back to the mains (utility) using a synchronising no break (close transition) transfer if the mains (utility) is available.



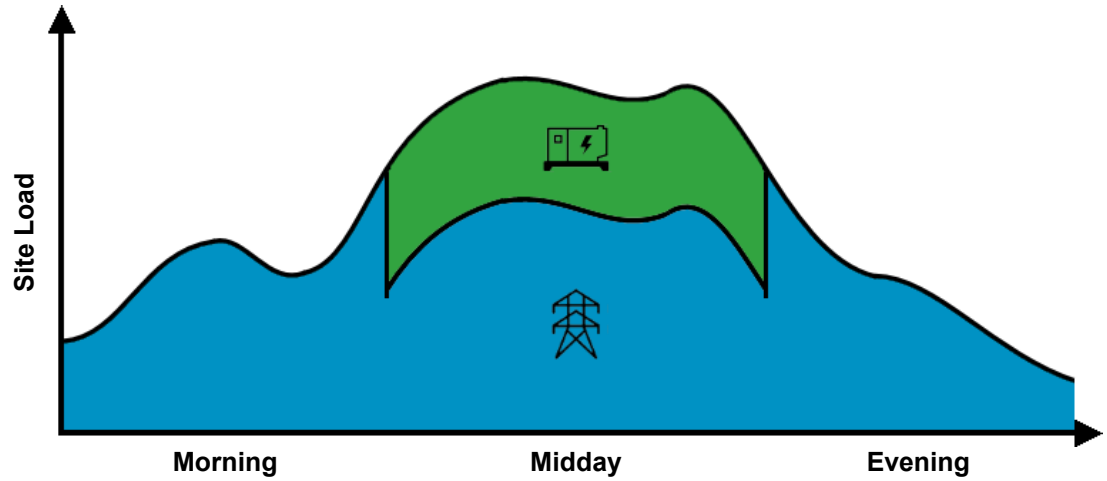
When the generators in Island Operation, the amount of power it produces is governed by the demand of the load.



6.8 CONTINOUS PARALLEL OPERATION

6.8.1 GENERATOR MODE (FIXED EXPORT / BASE LOAD)

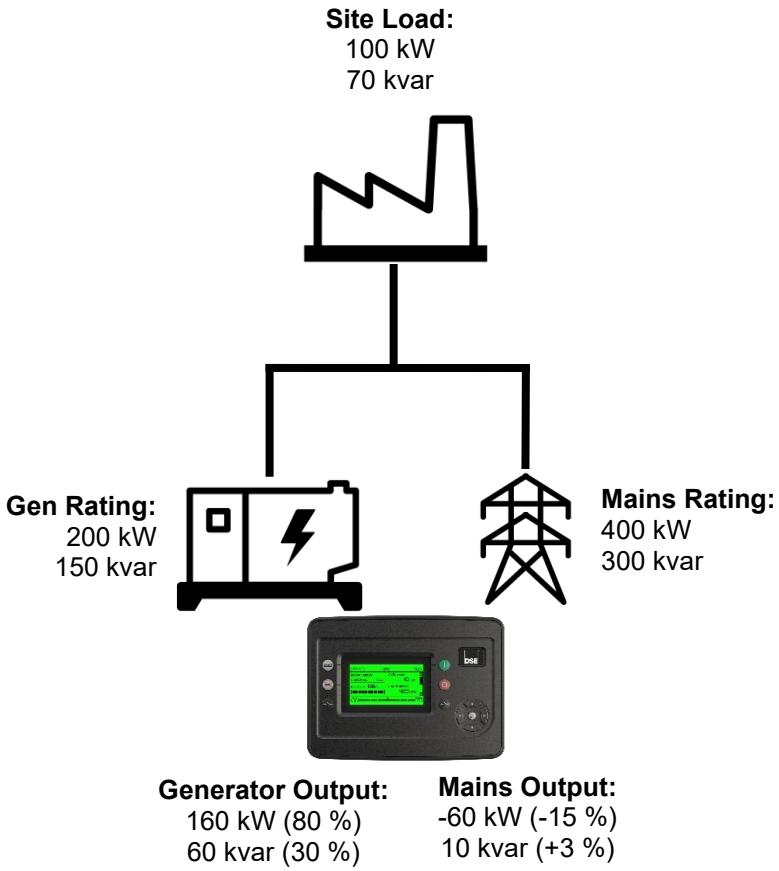
During specified times of the day, the generator is started and parallel to the mains (utility) using the *Remote Start on Load* input to the DSEG8600. When the DSEG8600 is set to *Generator Mode,* this causes the generator to produce a fixed (base) level of power against the mains (utility), synchronising to the mains (utility) before closing the generator bus breaker.
This leaves the generator running in *Continuous Fixed Export (Base Load) Parallel Operation*. The fixed (base) level of power produced by the generator supplies the local load and any excess is exported to the mains (utility). This is the case until the *Remote Start on Load* signal is removed from the DSEG8600 module (Single Set Mode).



When the generator is running in parallel with the mains (utility) isochronously (zero droop) in *Continuous Parallel Operation*, the amount of power it produces must be controlled.

It is the job of the DSEG8600 to make precise changes to the amount *Active Power* (kW) and *Reactive Power* (kvar) produced by the generator. The *Active Power* (kW) regulation is achieved by controlling the engine's governing system. This is done to alter the amount of fuel supplied to the engine and then monitor the amount of *Active Power* (kW) produced by the generator. The *Reactive Power* (kvar) regulation is achieved by controlling the alternator's AVR. This is done to alter the amount of field excitation supplied to the alternator and then monitor the amount of *Reactive Power* (kvar) supplied by the generator.

When the generator is paralleled to the mains (utility), the DSEG8600 instructs its generator to produce the pre-set percentage of its rating. This pre-set percentage is changeable whilst the generator is running via a multitude of different interfaces. In the example below, the generator is instructed to produce 80 % of its kW rating and 30 % of its kvar rating. This results in 60 kW being exported to the mains (utility) and the mains (utility) only producing 10 kvar as the local site load consumes most of the power produced by the generator.


Site Load:
100 kW
70 kvar
Gen Rating:
200 kW
150 kvar
Mains Rating:
400 kW
300 kvar
Generator Output:
160 kW (80 %)
60 kvar (30 %)
Mains Output:
-60 kW (-15 %)
10 kvar (+3 %)

6.8.2 POWER MODES

NOTE: The *Frequency and Active Power Control* modes and *Voltage and Reactive Power Control* modes are to be used in conjunction with the following documents:
- COMMISSION REGULATION (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators
- P1547 - IEEE Draft Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces

NOTE: For further details of the configuration for the different power modes, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*

It is sometimes required that when a generator is placed in parallel with the mains (utility), that it does not simply produce a fixed amount of *Active Power (kW)* or *Reactive Power (kvar)*. It may be required that the generator automatically varies the amount of *Active Power (kW)* or *Reactive Power (kvar)* to stabilise the localised mains (utility) voltage and frequency. For these requirements, the DSE modules have the option to change the mode of operation whilst in parallel with the mains (utility).

6.8.2.1 FREQUENCY AND ACTIVE (KW) POWER MODES

Constant Active Power Mode (Default)

This is the default mode of exporting power to the mains (utility); where the DSE load share controller holds the amount of active power produced at a constant level. The amount of active power produced by the generator is irrespective of the load level or any other parameter.
The amount of power produced is defined as *Maximum kW Level* and is set using either the *DSE Configuration Suite PC Software*, *Front Panel Running Editor*, in PLC Functions, or via Modbus messages.

Frequency - Active Power Mode

In this mode of exporting power to the mains (utility); the DSE load share controller varies the amount of active power produced with regards to the *Control Curve* depending on the measured mains (utility) frequency.
This mode allows the generator to support the mains (utility) frequency stability by monitoring the frequency and changing the amount of active power produced.

Voltage – Active Power Mode

In this mode of exporting power to the mains (utility); the DSE load share controller varies the amount of active power produced with regards to the *Control Curve* depending on the measured mains (utility) voltage.
This mode allows the generator to support the mains (utility) voltage stability by monitoring the voltage and changing the amount of active power produced.

6.8.2.2 VOLTAGE AND REACTIVE (KVAR) POWER CONTROL

Constant Reactive Power Mode (Default)

This is the default mode of exporting power to the mains (utility); where the DSE load share controller holds the amount of reactive power produced at a constant level. The amount of reactive power produced by the generator is irrespective of the load level or any other parameter.
The amount of reactive power produced is defined as *Maximum kvar Level* and is set using either the *DSE Configuration Suite PC Software*, *Front Panel Running Editor*, in PLC Functions, or via Modbus messages.

The user has the option to limit the amount of reactive power the generator produces to within their power factor depending on the amount of active power produced. Regardless of this option, the generator does not produce more than its rated reactive power.

Constant Power Factor Mode

In this mode of exporting power to the mains (utility); the DSE load share controller varies the amount of reactive power produced with regards to maintaining the required power factor.
This mode allows the generator to maintain a constant export power factor if so required.
The required power factor is set using either the *DSE Configuration Suite PC Software*, *Front Panel Running Editor*, in PLC Functions, or via Modbus messages.

Voltage - Reactive Power Mode

In this mode of exporting power to the mains (utility); the DSE load share controller varies the amount of reactive power produced with regards to the *Control Curve* depending on the measured voltage.
This mode allows the generator to support the mains (utility) voltage stability by monitoring the voltage and changing the amount of reactive power produced.

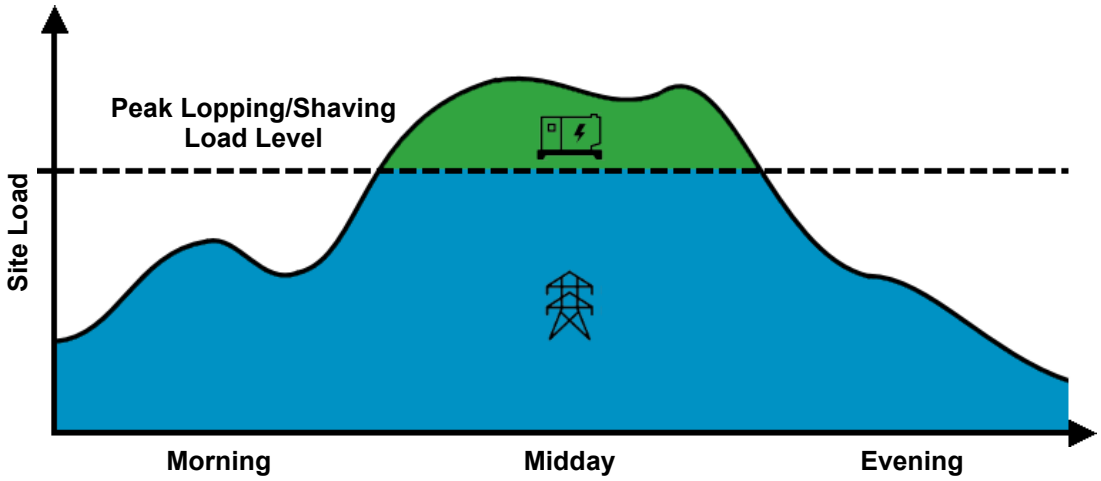
Power - Power Factor Mode

In this mode of exporting power to the mains (utility); the DSE load share controller varies the amount of reactive power produced with regards to maintaining the required power factor. This power factor is derived from the averaged power using the *Control Curve.*
This mode allows the generator to support the mains (utility) stability by varying the power factor depending on the produced active power.

6.8.3 MAINS MODE (PEAK LOPPING/SHAVING)

During specified times of the day, the generator is started and paralleled to the mains (utility) using the *Remote Start on Load* input to the DSEG8600. When the DSEG8600 is set to *Mains Mode,* this causes the generator to only start and synchronise to the mains (utility) when the load level rises above a pre-defined mains (utility) load level.

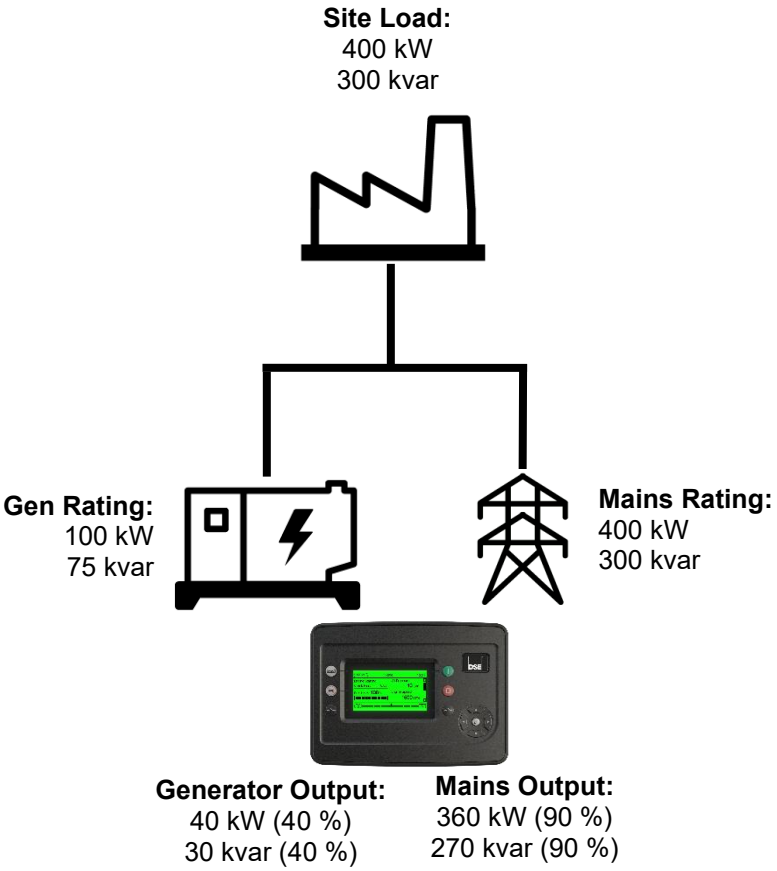
This leaves the generator running in *Continuous Peaking Lopping/Shaving Parallel Operation*. The amount of power produced by the generator whilst in parallel with the mains (utility) is constantly varied to maintain the mains (utility) at the pre-defined load level. This is the case until the *Remote Start on Load* signal is removed from the DSEG8600 module or the total site load falls below the *Peak Lopping/Shaving* level settings.



When a generator is running in parallel with the mains (utility) isochronously (zero droop) in *Continuous Parallel Operation*, the amount of power they produces must be controlled.

It is the job of the DSEG8600 to make precise changes to the amount *Active Power* (kW) and *Reactive Power* (kvar) produced by the generator. The *Active Power* (kW) regulation is achieved by controlling the engine's governing system. This is done to alter the amount of fuel supplied to the engine and then monitor the amount of *Active Power* (kW) produced by the generator. The *Reactive Power* (kvar) regulation is achieved by controlling the alternator's AVR. This is done to alter the amount of field excitation supplied to the alternator and then monitor the amount of *Reactive Power* (kvar) supplied by the generator.

When the generator is paralleled to the mains (utility), the DSG8600 instructs its generator to produce a certain amount of power to maintain the mains (utility) at the pre-set percentage. This pre-set percentage is changeable whilst the generator is running via a multitude of different interfaces. In the example below, the main's pre-set percentages are set to 90%. The generator is then instructed to produce the excess requirement from the load. The generator produces 40 % of its kW rating and 40 % of its kvar rating. This results in the mains (utility) power being maintained at 360 kW and 270 kvar whilst only the generator produces the additional 40 kW and 30 kvar to the load.



6.9 SCHEDULER

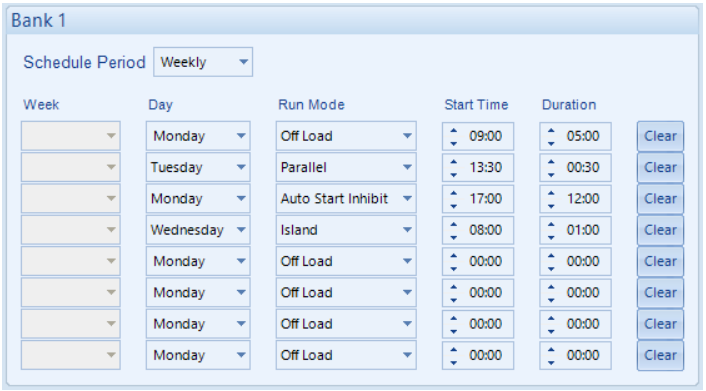
The controller contains an inbuilt exercise run scheduler, capable of automatically starting and stopping the set or inhibiting the set from starting. Up to 16 scheduled (in two banks of 8) start/stop/inhibiting start sequences are able to be configured to repeat on a 7-day or 28-day cycle.

Scheduled runs may be on load or off load depending upon module configuration.

Example:

Screen capture from DSE Configuration Suite Software showing the configuration of the Exercise Scheduler.

In this example the set starts at 09:00 on Monday and run for 5 hours off load, then start at 13:30 on Tuesday and run for 30 minutes on load, the set is inhibited from automatically starting on Monday from 17:00 for 12 hours and runs in Island mode at 8:00 on Wednesday and runs for an hour.



6.9.1 STOP MODE

- Scheduled runs do not occur when the module is in ***Stop/Reset Mode***.

6.9.2 MANUAL MODE

- Scheduled runs do not occur when the module is in ***Manual Mode*** MANUAL waiting for a start request.

6.9.3 AUTO MODE

- Scheduled runs operate only if the module is in ***Auto Mode*** AUTO with no *Shutdown* or *Electrical Trip* alarm active.
- If the module is in ***Stop/Reset Mode*** or ***Manual Mode*** MANUAL when a scheduled run begins, the engine is not started. However, if the module is moved into ***Auto Mode*** AUTO during a scheduled run, the engine is called to start.
- Depending upon configuration by the system designer, an external input may be used to inhibit a scheduled run.
- If the engine is running *Off Load* in ***Auto Mode*** AUTO and a scheduled run configured to 'On Load' begins, the set is placed *On Load* for the duration of the Schedule.

6.10 ALTERNATIVE CONFIGURATIONS

Depending upon the configuration of the system by the generator supplier, the system may have selectable configurations (for example to select between 50 Hz and 60 Hz). If this has been enabled, the generator supplier advises the person configuring the module on how this selection is made (usually by operating an external selector switch or by selecting the required configuration file in the module's front panel configuration editor).

6.11 DUMMY LOAD / LOAD SHEDDING CONTROL

If the load is low, 'dummy loads' (typically resistive load banks) are introduced to ensure the engine is not too lightly loaded. Conversely, as the load increases towards the maximum rating of the set, non-essential loads are shed to prevent overload of the generator.

6.11.1 DUMMY LOAD CONTROL

The *Dummy Load Control* feature (if enabled) allows for a maximum of five dummy load steps. When the set is first started, all configured *Dummy Load Control* outputs are de-energised. Once the generator is placed onto load, the generator loading is monitored by the *Dummy Load Control* scheme.

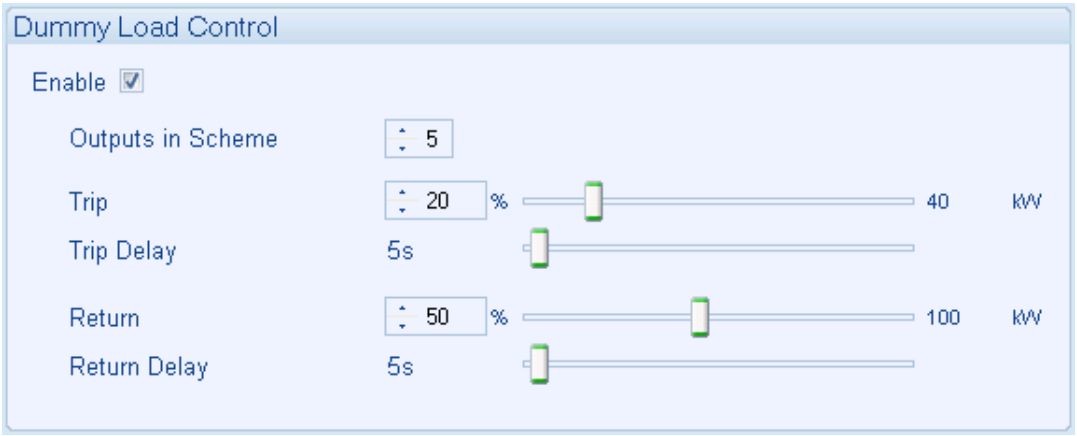
If the generator loading falls below the *Dummy Load Control Trip* setting (kW), the *Dummy Load Control Trip Delay* begins. If the generator loading remains at this low level for the duration of the timer, the first *Dummy Load Control* output is energised. This is used to energise external circuits to switch in a resistive load bank.

The first dummy load has increased the generator loading. Again, the generator loading is monitored. This continues until all configured *Dummy Load Control* outputs are energised.

When the generator loading rises above the *Dummy Load Return* level, the *Dummy Load Return Delay* begins. If the generator loading remains at these levels after the completion of the timer, the 'highest' active *Dummy Load Control* output is de-energised. This continues until all *Dummy Load Control* outputs have been de-energised.

When the generator enters a stopping sequence for any reason, all the *Dummy Load Control* outputs de-energise at the same time as the generator load switch is signalled to open.

Example screen shot of *Dummy Load Control* setup in the DSE Configuration Suite



6.11.2 LOAD SHEDDING CONTROL

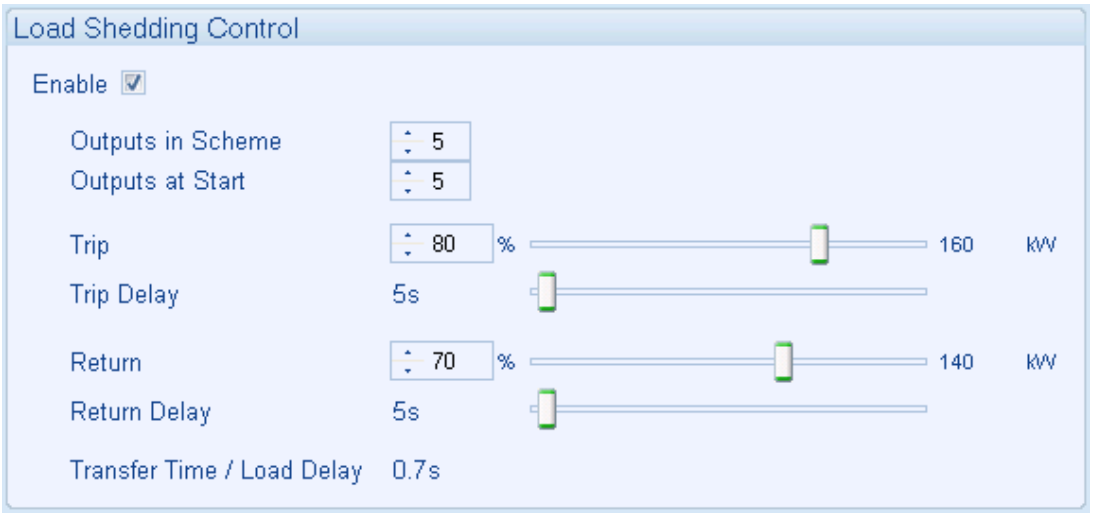
The *Load Shedding Control* feature (if enabled) allows for a maximum of five load shedding steps. When the generator is about to take load, the configured number of *Load Shedding Control Outputs at Start* energises. This allows certain none-essential loads to be removed prior to the generator's load switch being closed. This is used to ensure the initial loading of the generator is kept to a minimum, below the *Load Acceptance* specification of the generator.

The generator is then placed on load. The *Load Shedding Control* scheme begins.
When the generator loading exceeds the *Load Shedding Trip* level the *Trip Delay* timer starts. If the generator loading is still high when the timer expires, the first *Load shedding Control* output energises. When the generator loading been above the trip level for the duration of the timer the 'next' *Load Shedding Control* output energises and so on until all *Load Shedding Control* outputs are energised.

When the generator loading falls below the *Load Shedding Return* level, the *Return Delay Time* starts. If the generator load remains below the *Load Shedding Return* level when the timer has expired, the 'highest' *Load Shedding Control* output de-energises. This process continues until all outputs have been de-energised.

When the generator enters a stopping sequence for any reason, all the *Load Shedding Control* outputs de-energise at the same time as the generator load switch is signalled to open.

Example screen shot of *Load Shedding Control* setup in the DSE Configuration Suite:



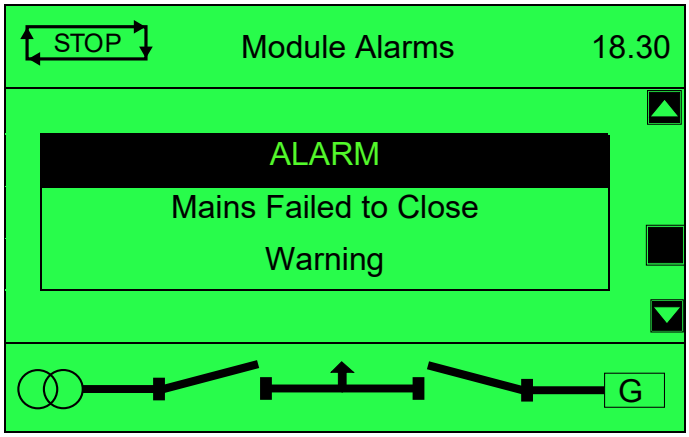
7 PROTECTIONS

7.1 ALARMS

When an alarm is active, the *Internal Audible Alarm* sounds and the *Common Alarm* output if configured, activates.

A pop-up screen is also displayed in-front of the *Home* menu.

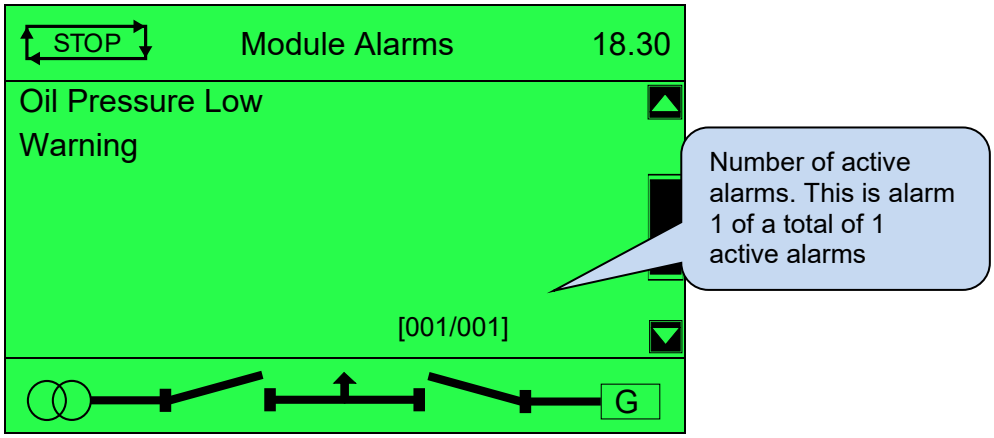
Example



Pressing the ***Tick***  button removes the pop-up.

The audible alarm is silenced by pressing the ***Alarm Mute / Lamp Test***  button.

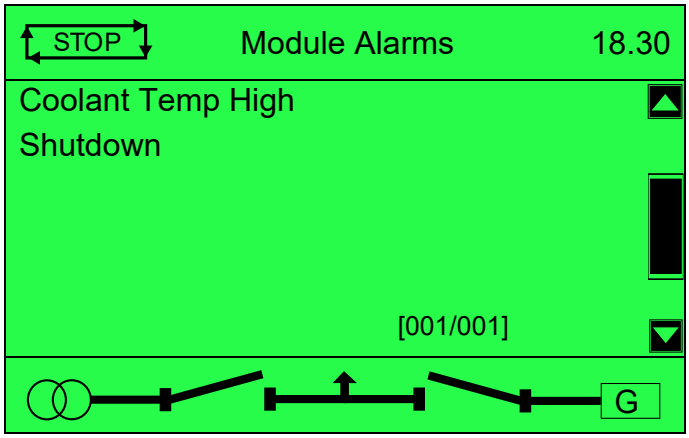
Navigating to the *Alarms* page shows a list of current alarms.



The LCD displays multiple alarms such as "*Coolant Temperature High*," "*Emergency Stop*" and "*Low Coolant Warning*." These are listed in the order that they occurred or the ***Scroll***  buttons may be used to scroll through *them* manually.

In the event of an alarm, the LCD displays the appropriate text. If an additional alarm, then occurs, the module displays the appropriate text.

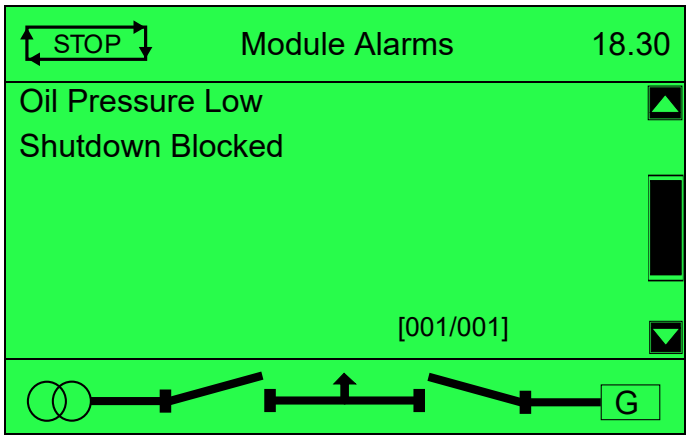
Example:


STOP
Module Alarms
18.30
Coolant Temp High
Shutdown
[001/001]
G

7.1.1 PROTECTIONS DISABLED

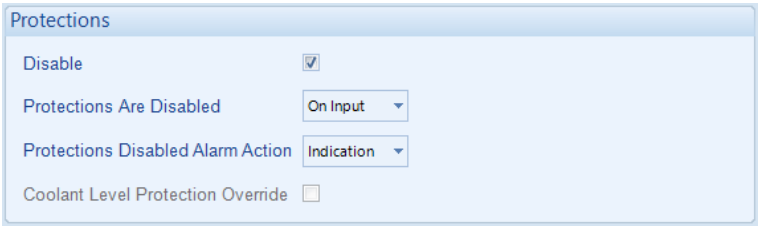
Configuration is possible to prevent *Shutdown* and *Electrical Trip* alarms from stopping the generator. When this feature is active, the controller does not shut the engine down if a problem occurs.

Example:



When configuring this feature in the PC software, the module operator chooses to make the feature permanently active or only active upon operation of an external switch.

Example screen shot of *Protections Disabled* setup in the DSE Configuration Suite:



The location of the protection switch varies depending upon manufacturer; however, it normally takes the form of a key operated switch to prevent inadvertent activation. Depending upon configuration, a warning alarm may be generated when the switch is operated.

The feature is configurable in the PC configuration software for the module. Writing a configuration to the controller that has “Protections Disabled” configured, results in a warning message appearing on the PC screen for the user to acknowledge before the controller’s configuration is changed. This prevents inadvertent activation of the feature.

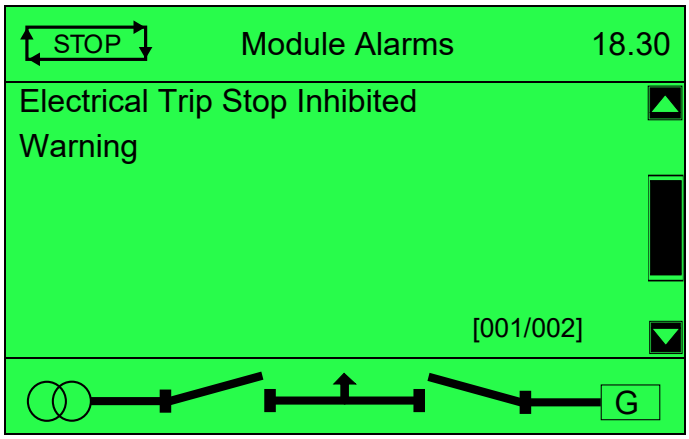
CAUTION!: Enabling this feature can lead to destruction of the Generator equipment whilst maintaining the electricity supply.

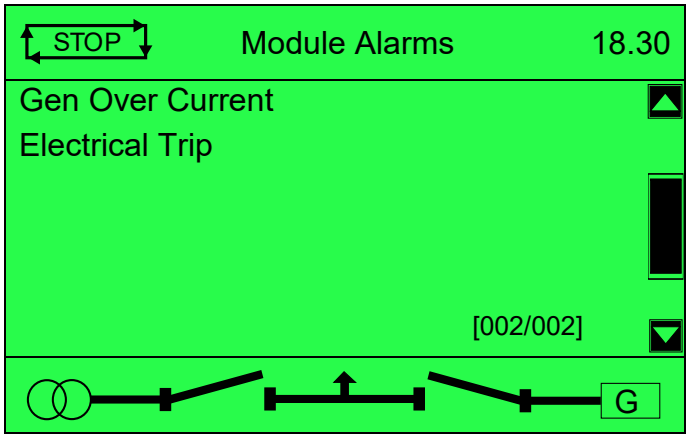
7.1.2 RESET ELECTRICAL TRIP

Configuration is possible to enable the operator to reset the *Electrical Trip* alarm a configurable number of times before the generator has stopped. This is to allow the generator to go back on load without having to perform a cooling run first.

It is also possible to prevent an *Electrical Trip* alarm from stopping the generator. Under such conditions, the *Electrical Trip Stop Inhibited Warning* alarm appears on the module display to inform the operator. *Electrical Trip* alarms still appear however, the operator is just informed the generator is inhibited from stopping.

Example:

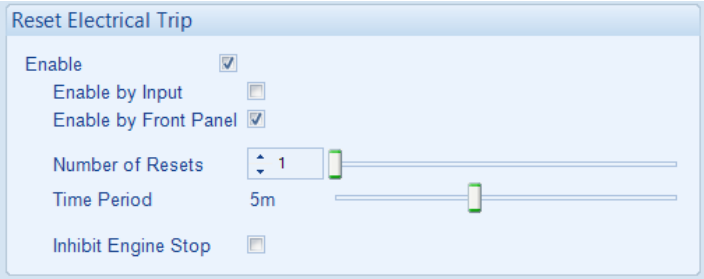




This feature is provided to ensure the generator (if running) can take load again after the alarm has been reset. Depending upon configuration, the generator may go into a cooling run or be inhibited from stopping after the *Electrical Trip* alarm activates.

When configuring this feature in the PC software, the system designer chooses to make the *Electrical Trip* alarms resettable by using a switch connected to an input configured for *Reset Electrical Trip* and/or by pressing the ***Transfer to Generator*** button.

Example screen shot of *Reset Electrical Trip* setup in the DSE Configuration Suite:



The system designer provides this switch (not DSE), so its location varies depending upon manufacturer, however it normally takes the form of a key operated switch to prevent inadvertent activation.
If the DSE module is in the ***Manual Mode*** MANUAL ,a further press of the ***Transfer to Generator*** button is required to place the generator on load if no other on load request is active.

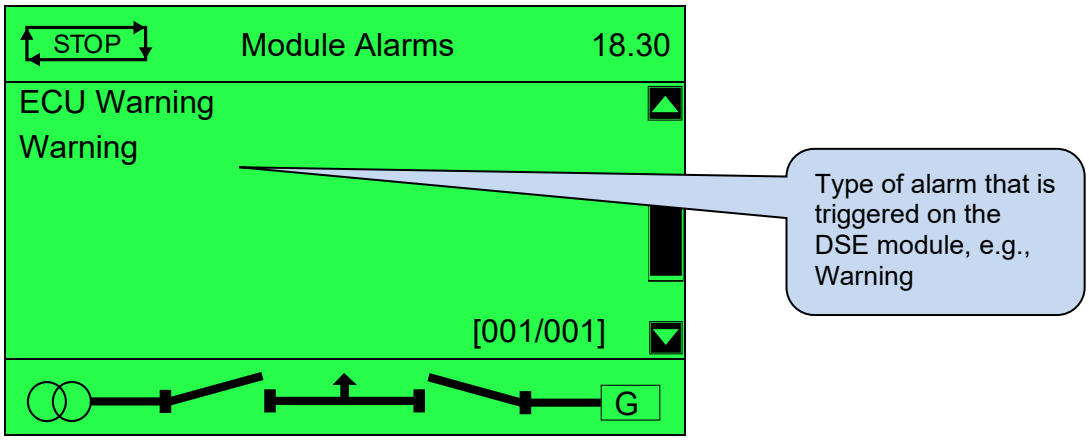
The feature is configurable in the PC configuration software for the module. Writing a configuration to the controller that has *Reset Electrical Trip* enabled, results in a warning message appearing on the PC screen for the user to acknowledge before the controller's configuration is changed. This prevents inadvertent activation of the feature.

7.1.3 ECU ALARMS (CAN FAULT CODES / DTC)

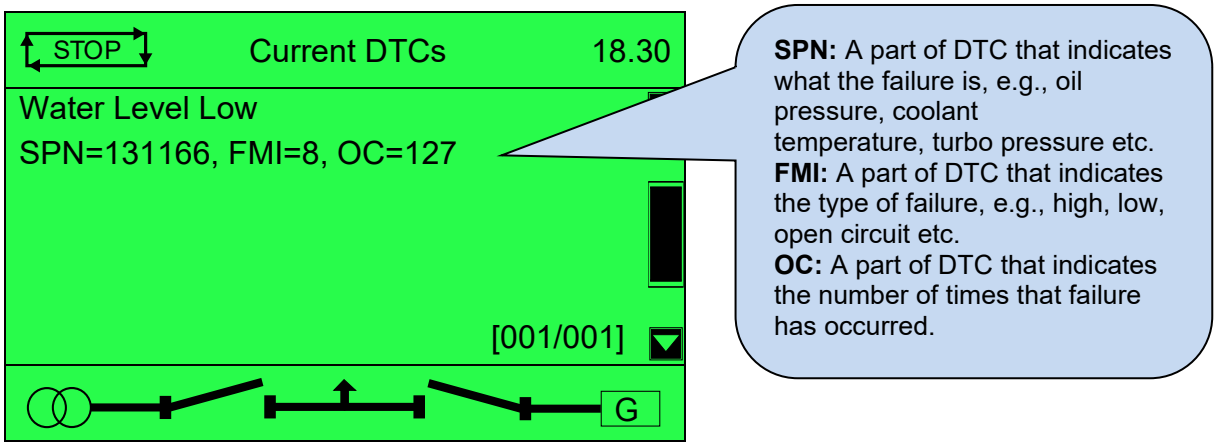
NOTE: For details on these code meanings, refer to the ECU instructions provided by the engine manufacturer, or contact the engine manufacturer for further assistance.

NOTE: For further details on connection to electronic engines, refer to DSE Publication: *057-004 Electronic Engines And DSE Wiring*

When connected to a suitable CAN engine, the controller displays alarm status messages from the ECU in the *Alarms* section of the display.

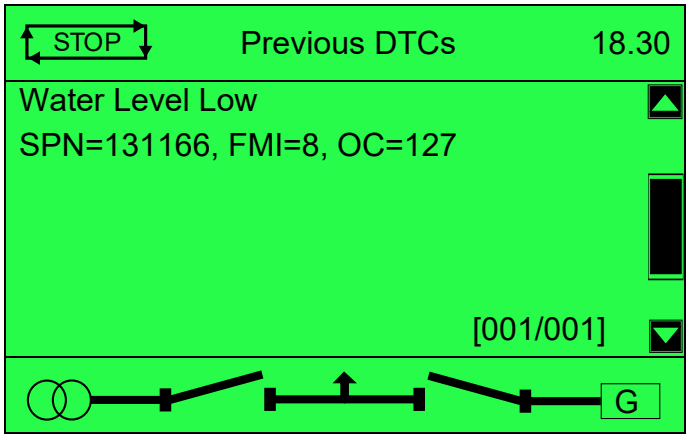


Press the ***Previous Page*** button to access the *Alarms* section. Select the *Current DTC* section by pressing Press the ***Next or Previous Page*** buttons to show the list of *ECU Current DTCs* (Diagnostic Trouble Codes) from the ECU which are DM1 messages.



The DM1 DTC is interpreted by the module and is shown on the module's display as a text message. In addition to this, the manufacturer's DTC is shown below.

Press the ***Previous Page*** button and use the ***Next or Previous Page*** buttons to access the list of *ECU Previous DTCs* (Diagnostic Trouble Codes) from the ECU which are DM2 messages.



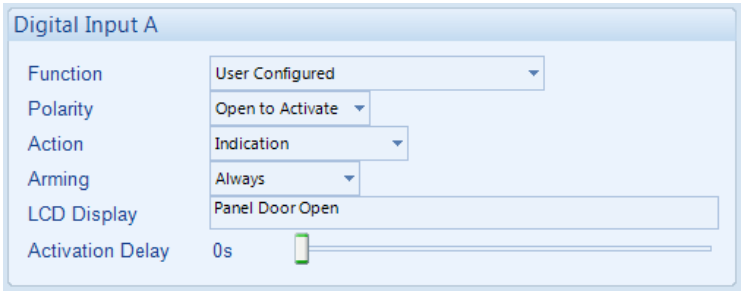
The DM2 DTC is interpreted by the module and is shown on the module's display as a text message. In addition to this, the manufacturer's DTC is shown below.

7.2 INDICATIONS

Indications are non-critical and often status conditions which activate digital outputs.

Example:

- Input configured for indication.
- The LCD text appears on the modules display



7.2.1 FRONT PANEL STATUS LEDS

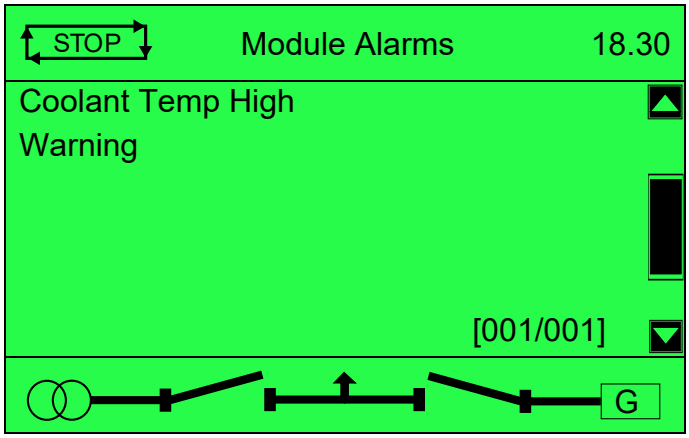
The LED indicators on the front panel adjacent to each button illuminate to draw the operator's attention to an event that has occurred.

Button	LED Indication
Mode	Illuminated When *Auto Mode* selected
Alarm Mute / Lamp Test	Illuminated when the alarm sounder is active. Pressing the button illuminates all facia LEDS (Lamp Test).
Transfer to Mains	Illuminated when a mains (utility) supply is available
Transfer to Generator	Illuminated when a generator is available to take load
Start	Flashed once every second to indicate the module is in Manual Mode, illuminated when the set is running in manual mode.
Stop	Flashes for warning alarms, Illuminated for electrical trip and shutdown alarms.

7.3 WARNING ALARMS

Warnings are non-critical alarm conditions and do not affect the operation of the engine system, they serve to draw the operator's attention to an undesirable condition.

Example:



module's display as a warning alarm.

In the event of an alarm, the alarm is displayed on the alarms page.

By default, warning alarms are self-resetting when the fault condition is removed. However, enabling *All Warnings Are Latched* causes warning alarms to latch until reset manually. This is enabled using the DSE Configuration Suite in conjunction with a compatible PC.

If the module is configured for **CAN** and receives an "error" message from the ECU, 'ECU Warning" is shown on the

Fault	Description
2130 ID 1 to 4 Analogue Input E to H High	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2130 had risen above the *Flexible Sensor High Pre-Alarm Trip* level.
2130 ID 1 to 4 Analogue Input E to H Low	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2130 had fallen below the *Flexible Sensor Low Pre-Alarm Trip* level.
2130 ID1 to 4 Digital Input A to H	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that a digital input configured to create a fault condition on a DSE2130 expansion module became active and the appropriate LCD message displayed.
2131 ID 1 to 4 Analogue Input A to J High	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2131 had risen above the Flexible Sensor High Pre-Alarm Trip level.

Parameter descriptions are continued overleaf…

Fault	Description
2131 ID 1 to 4 Analogue Input A to J Low	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2131 had fallen below the *Flexible Sensor Low Pre-Alarm Trip* level.
2131 ID 1 to 4 Analogue Input A to J	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that a digital input configured to create a fault condition on a DSE2131 expansion module became active and the appropriate LCD message displayed.
2133 ID 1 to 4 Analogue Input A to H High	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2133 had risen above the *Flexible Sensor High Pre-Alarm Trip* level.
2133 ID 1 to 4 Analogue Input A to H Low	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 I Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2133 had fallen below the *Flexible Sensor Low Pre-Alarm Trip* level.
Analogue Input A to D (Digital)	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input configured as a digital input to create a fault condition became active and the appropriate LCD message is displayed.
Battery Detect Failure	A battery charger connected by DSENet® had issued a *Battery Detect Failure* alarm.
Battery Failure Detection Output 1	A battery charger connected by DSENet® had issued a *Battery Failure Detection* alarm on its Output 1.
Battery Failure Detection Output 2	A battery charger connected by DSENet® had issued a *Battery Failure Detection* alarm on its Output 2.
Battery High Current Output 1	A battery charger connected by DSENet® had issued a *Battery High Current* alarm on its Output 1.
Battery High Current Output 2	A battery charger connected by DSENet® had issued a *Battery High Current* alarm on its Output 2.

Parameter descriptions are continued overleaf…

Fault	Description
Battery High Temperature Output 1	A battery charger connected by DSENet® had issued a *Battery High Temperature* alarm on its Output 1.
Battery High Temperature Output 2	A battery charger connected by DSENet® had issued a *Battery High Temperature* alarm on its Output 2.
Battery High Voltage Output 1	A battery charger connected by DSENet® had issued a *Battery High Voltage* alarm on its Output 1.
Battery High Voltage Output 2	A battery charger connected by DSENet® had issued a *Battery High Voltage* alarm on its Output 2.
Battery Low Voltage Output 1	A battery charger connected by DSENet® had issued a *Battery Low Voltage* alarm on its Output 1.
Battery Low Voltage Output 2	A battery charger connected by DSENet® had issued a *Battery Low Voltage* alarm on its Output 2.
Battery Temperature Sensor Fail Output 1	A battery charger connected by DSENet® had issued a *Battery Temperature Fail* alarm on its Output 1.
Battery Temperature Sensor Fail Output 2	A battery charger connected by DSENet® had issued a *Battery Temperature Fail* alarm on its Output 2.
AVR Maximum Trim Limit	The module's AVR output has reached its limit whilst attempting to control the generator to produce more kvars whilst in parallel. This indicates a fault with either the AVR (including connection error), setting of SW2, or that the alternator has reached its maximum capacity.
Battery High Voltage IEEE 37.2 – 59 DC Overvoltage Relay	The module detected that its DC supply voltage had risen above the *Plant Battery Overvolts Warning Trip* level for the configured delay timer.
Battery Low Voltage IEEE 37.2 – 27 DC Undervoltage Relay	The module detected that its DC supply voltage had fallen below the *Plant Battery Undervolts Warning Trip* level for the configured delay timer.
Calibration Lost	The module detected that its internal calibration has failed. The unit must be sent back to DSE to be investigated and repaired. Contact DSE Technical Support for more details.
Charge Alt Failure IEEE 37.2 – 27 DC Undervoltage Relay	The module detected that the output voltage of the charge alternator had fallen below the *Charge Alternator Warning Trip* level for the configured delay timer.
Charger Fan Locked	The module detected that a battery charger connected by DSENet® had a *Charger Failure* alarm.
Charger High Temperature	The module detected that a battery charger connected by DSENet® had a High Temperature alarm.
Charger Mains High Current	The module detected that a battery charger connected by DSENet® had a *Mains High Current* alarm.
Charger ID 0 to 3 Common Warning	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that a battery charger connected by DSENet® had issued a *Common Warning Alarm*.

Parameter descriptions are continued overleaf…

Fault	Description
Charger Mains High Voltage	The module detected that a battery charger connected by DSENet® had a *Mains High Voltage* alarm.
Charger Mains Low Voltage	The module detected that a battery charger connected by DSENet® had a *Mains Low Voltage* alarm.
Charger Voltage Drop Charging Cable Output 1	The module detected that a battery charger connected by DSENet® had issued a *Voltage Drop Charging Cable* alarm on its Output 1.
Charger Voltage Drop Charging Cable Output 2	The module detected that a battery charger connected by DSENet® had issued a *Voltage Drop Charging Cable* alarm on its Output 2.
Coolant Temp High IEEE C37.2 – 26 Apparatus Thermal Device	The module detected that the engine coolant temperature had risen above the *High Coolant Temperature Pre-Alarm Trip* level after the *Safety On Delay* timer had expired.
DEF Level Low	The module received a fault condition from the engine ECU alerting about the DEF level.
Coolant Temp High IEEE C37.2 – 26 Apparatus Thermal Device	The module detected that the engine coolant temperature had risen above the *High Coolant Temperature Pre-Alarm Trip* level after the *Safety On Delay* timer had expired.
DEF Level Low	The module received a fault condition from the engine ECU alerting about the DEF level.
Digital Input A to L	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that a digital input configured to create a fault condition became active and the appropriate LCD message is displayed.
DPTC Filter	The module received a fault condition from the engine ECU alerting that the DPF/DPTC had activated.
Earth Fault IEEE C37.2 – 51G or 51N Generator IDMT Earth Fault Relay	**NOTE: For more details, see the section entitled *Earth Fault IDMT Alarm* elsewhere in this document.** The module detected that the generator earth fault current had risen above the *Earth Fault Trip Level* for the duration of the IDMT function.
ECU Amber	The module received an amber fault condition from the engine ECU.
ECU Data Fail	The module is configured for CAN operation but has not detected data being sent from the engine's ECU.
ECU Malfunction.	The module received a malfunction fault condition from the engine ECU.
ECU Protect	The module received a protect fault condition from the engine ECU.
ECU Red	The module received a red fault condition from the engine ECU.
Electrical Trip Stop Inhibited	The module created an electrical trip alarm due to a fault, but the generator is prevented from stopping. This is due to the Reset Electrical Trip Inhibit Engine Stop being enabled. To stop the generator, remove the starting request or press the Stop/Reset Mode button.

Parameter descriptions are continued overleaf…

Fault	Description
Engine Over Speed Delayed IEEE C37.2 - 12 Overspeed Device	The module detected that the engine speed had risen above the *Over Speed Trip* level but was below the *Over Speed Overshoot Trip* for the configured *Overshoot Delay* timer during starting.
Engine Under Speed IEEE C37.2 - 14 Underspeed Device	The module detected that the engine speed had fallen below the *Under Speed Pre-Alarm Trip* level for the configured delay timer after the *Safety On Delay* timer had expired.
Exp. Unit Failure	The module detected communication to one of the DSENet® expansion modules had been lost.
Fail To Reach Loading Frequency	The module detected that the generator output voltage had not risen above the *Generator Loading Frequency* setting after the *Warming Up* timer had expired.
Fail To Reach Loading Voltage	The module detected that the generator output voltage had not risen above the *Generator Loading Voltage* setting after the *Warming Up* timer had expired.
Fail to Synchronise	The module failed to synchronise the generator before the *Fail to Sync Delay* timer had expired. The generator continues to synchronise until it is either achieved or runs out of fuel.
Flexible Sensor A to D High	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value had risen above the *Flexible Sensor High Pre-Alarm Trip* level.
Flexible Sensor A to D Low	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value had fallen below the *Flexible Sensor Low Pre-Alarm Trip* level.
Fuel Level High IEEE C37.2 - 71 Liquid Level Switch	The module detected that the engine fuel level had risen the *High Fuel Level Pre-Alarm* level for the configured delay.
Fuel Level Low IEEE C37.2 - 71 Liquid Level Switch	The module detected that the engine fuel level had fallen below the *Low Fuel Level Pre-Alarm* level for the configured delay
Fuel Level Low Switch IEEE C37.2 - 71 Liquid Level Switch	The module detected that the engine low fuel level switch had activated.
Fuel Tank Bund Level High IEEE C37.2 - 71 Liquid Level Switch	The module detected that the fuel tank bund level switch had activated.
Fuel Usage IEEE C37.2 – 80 Flow Switch	The module detected that the fuel consumption was more than the configured *Running Rate* or *Stopped Rate*.
Gen Earth Fault IEEE C37.2 – 51G or 51N Generator IDMT Earth Fault Relay	**NOTE: For more details, see the section entitled *Earth Fault IDMT Alarm* elsewhere in this document.** The module detected that the generator earth fault current had risen above the *Earth Fault Trip Level* for the duration of the IDMT function.
Gen Failed to Open IEEE C37.2 – 52b AC Circuit Breaker Position (Contact Open when Breaker Closed)	The module detected that the generator load switch had failed to open as the *Generator Closed Auxiliary* input stayed activate for the Generator Fail to Open Delay time after the Open Gen Output activated.

Parameter descriptions are continued overleaf…

Fault	Description
Gen Over Current IEEE C37.2 – 50 Instantaneous Overcurrent Relay IEEE C37.2 – 51 IDMT Overcurrent Relay	**NOTE: For more details, see the section entitled *Over Current Alarm* elsewhere in this document.** The module detected that the generator output current had risen above the *Generator Over Current Trip*.
Gen Over Frequency IEEE C37.2 – 81 Frequency Relay	The module detected that the generator output frequency had risen above the *Over Frequency Pre-Alarm Trip* level for the configured delay timer.
Gen Over Frequency Delayed IEEE C37.2 – 81 Frequency Relay	The module detected that the generator output frequency had risen above the *Over Frequency Trip* level but was below the *Over Frequency Overshoot Trip* for the configured *Overshoot Delay* timer during starting.
Gen Over Voltage IEEE C37.2 – 59 AC Overvoltage Relay	The module detected that the generator output voltage had risen above the *Over Voltage Pre-Alarm Trip* level for the configured delay timer.
Gen Reverse Power IEEE C37.2 – 32 Directional Power Relay	The module detected that the generator output kW had fallen below the *Reverse Power Trip* for the configured delay timer.
Gen Short Circuit IEEE C37.2 – 51 IDMT Short Circuit Relay	**NOTE: For more details, see the section entitled *Short Circuit IDMT Alarm* elsewhere in this document.** The module detected that the generator output current had risen above the *Short Circuit Trip* for the duration of the IDMT function.
Gen Under Frequency IEEE C37.2 – 81 Frequency Relay	The module detected that the generator output frequency had fallen below the *Under Frequency Pre-Alarm Trip* level for the configured delay timer after the *Safety On Delay* timer had expired.
Gen Under Voltage IEEE C37.2 – 27 AC Undervoltage Relay	The module detected that the generator output voltage had fallen below the *Under Voltage Pre-Alarm Trip* level for the configured delay timer after the *Safety On Delay* timer had expired.
HEST Active	The module received a fault condition from the engine ECU alerting that the HEST had activated.
Inlet Temperature	The module detected that the engine's ECU measurement of inlet temperature had risen above the *Inlet Temperature Pre-Alarm Trip* level.
Insufficient Capacity	The module's governor output has reached its limit whilst attempting to control the generator to produce more kW whilst in parallel. This indicates a fault with either the governor (including connection error), setting of SW2, or that the engine has reached its maximum capacity.
kW Overload IEEE C37.2 – 32 Directional Power Relay	The module detected that the generator output (kW) had risen above the *Overload Protection Trip* for the configured delay timer
Loss Of Excitation	The module detected that the generator output kvar had fallen below the *Loss of Excitation Pre-Alarm Trip* level.
Loss of Mag-PU	The module detected that the magnetic pick up was not producing a pulse output after the required *Crank Disconnect* criteria had been met.

Parameter descriptions are continued overleaf…

Fault	Description
Low Coolant Warning	The module detected that the engine coolant temperature had fallen below the *Low Coolant Temperature Pre-Alarm Trip* level.
Maintenance Due	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that one of the configured maintenance alarms is due as its configured maintenance interval has expired.
Mains Asymmetry High	The module detected the mains (utility) voltage asymmetry had risen above the configurable *Trip* level for the configured delay timer.
Mains Decoupling High Frequency	If the module detects the mains (utility) frequency increase when in parallel with the generator(s) more than the configure value. The LCD indicates *Mains Decoupling High Frequency*.
Mains Decoupling High Voltage	If the module detects the mains (utility) voltage increase when in parallel with the generator(s) more than the configure value. The LCD indicates *Mains Decoupling High Voltage*.
Mains Decoupling Low Frequency	If the module detects the mains (utility) frequency decreases when in parallel with the generator(s) below the configure value. The LCD indicates *Mains Decoupling Low Frequency.*
Mains Decoupling Low Voltage	If the module detects the mains (utility) voltage decreases when in parallel with the generator(s) below the configure value. The LCD indicates *Mains Decoupling Low Voltage*.
Mains Decoupling ROCOF	If the module detects the mains (utility) frequency changing when in parallel with the generator(s) more than the configure value in a time frame. The LCD indicates *Mains Decoupling ROCOF.*
Mains Decoupling Vector Shift	If the module detects the mains (utility) phase angle changing when in parallel with the generator(s) more than the configure value in a time frame. The LCD indicates *Mains Decoupling Vector Shift.*
Mains Failed To Close	If the mains breaker fails to close, a warning is initiated. The LCD indicates *Mains Failed To Close.*
Mains Failed To Open	If the mains breaker fails to open, a warning is initiated. The LCD indicates *Mains Failed To Open.*
Mains Over Negative Sequence	The module detected the mains (utility) voltage negative sequence had risen above the configurable *Trip* level for the configured delay timer.
Mains Over Zero Sequence	The module detected the mains (utility) voltage zero sequence had risen above the configurable *Trip* level for the configured delay timer.
Mains Reverse Power IEEE C37.2 – 32 Directional Power Relay	If the module detects that the generator bus is exporting more than the configured limit, the LCD indicates *Mains Reverse Power*
Mains Under Positive Sequence	The module detected the mains (utility) voltage positive sequence had fallen below the configurable *Trip* level for the configured delay timer.
Negative Phase Sequence IEEE C37.2 - 46 Phase-Balance Current Relay	The module detected that there was an imbalance of current across the generator phases greater than the *Negative Phase Sequence Trip Level* percentage setting.
Oil Pressure Low IEEE C37.2 - 63 Pressure Switch	The module detected that the engine oil pressure had fallen below the *Low Oil Pressure Pre-Alarm Trip* level after the *Safety On Delay* timer had expired.

Parameter descriptions are continued overleaf…

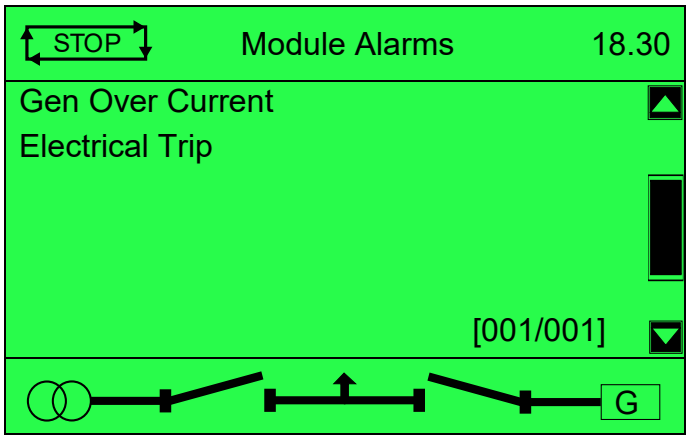
Fault	Description
Protections Disabled	The module detected that an input configured for Protections Disable became active.
SCR Inducement	The module received a fault condition from the engine ECU alerting about the SCR Inducement.
Water in Fuel	The module received a fault condition from the engine ECU alerting that water in the fuel had been detected or that the *Water in Fuel* input switch had activated.
Wet Stacking	The module detected that the generator output kW had fallen below the *Low Load Alarm Trip* level for the configured delay timer.

7.4 ELECTRICAL TRIP ALARMS

NOTE: The fault condition must be resolved before the alarm is reset. If the fault condition remains, it is not possible to reset the alarm (the exception to this is the *Coolant Temp High* alarm and similar *Active From Safety On* alarms, as the coolant temperature may be high with the engine at rest).

Electrical Trip Alarms are latching and stop the Generator but in a controlled manner. On initiation of the electrical trip condition the module de-activates the ***Close Gen Output*** outputs to remove the load from the generator. Once this has occurred the module starts the *Cooling Timer* and allows the engine to cool off-load before shutting down the engine. To restart the generator the fault must be cleared, and the alarm reset.

Example:



In the event of an alarm, the alarm is displayed on the alarms page.

Electrical Trip Alarms are latching alarms and to remove the fault, press the ***Stop/Reset Mode*** button on the module.

Fault	Description
2130 ID 1 to 4 Analogue Input E to H High	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2130 had risen above the *Flexible Sensor High Alarm Trip* level.
2130 ID 1 to 4 Analogue Input E to H Low	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2130 had fallen below the *Flexible Sensor Low Alarm Trip* level.
2130 ID1 to 4 Digital Input A to H	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that a digital input configured to create a fault condition on a DSE2130 expansion module became active and the appropriate LCD message displayed.

Parameter descriptions are continued overleaf…

Fault	Description
2131 ID 1 to 4 Analogue Input A to J High	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2131 had risen above the *Flexible Sensor High Alarm Trip* level.
2131 ID 1 to 4 Analogue Input A to J Low	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2131 had fallen below the *Flexible Sensor Low Alarm Trip* level.
2131 ID1 to 4 Digital Input A to J	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that a digital input configured to create a fault condition on a DSE2131 expansion module became active and the appropriate LCD message displayed.
2133 ID 1 to 4 Analogue Input A to H High	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2133 had risen above the *Flexible Sensor High Alarm Trip* level.
2133 ID 1 to 4 Analogue Input A to H Low	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2133 had fallen below the *Flexible Sensor Low Alarm Trip* level.
Analogue Input A to D (Digital)	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** **The module detected that an analogue input configured as a digital input to create a fault condition became active and the appropriate LCD message is displayed.**

Parameter descriptions are continued overleaf…

Fault	Description
AVR Maximum Trim Limit	The module's AVR output has reached its limit whilst attempting to control the generator to produce more kvars whilst in parallel. This indicates a fault with either the AVR (including connection error), setting of SW2, or that the alternator has reached its maximum capacity.
Charger ID 0 to 3 Common Electrical Trip	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that a battery charger connected by DSENet® had issued a *Common Electrical Trip Alarm*. This also may be an indication of mains (utility) failure.
Combined Mains Decoupling	The module detected that the mains (utility) supply failed when the generator was in parallel with it.
Coolant Temp High IEEE C37.2 – 26 Apparatus Thermal Device	The module detected that the engine coolant temperature had risen above the *High Coolant Temperature Electrical Trip* level after the *Safety On Delay* timer had expired.
DEF Level Low	The module received a fault condition from the engine ECU alerting about the DEF level.
Digital Input A to L	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that a digital input configured to create a fault condition became active and the appropriate LCD message is displayed.
DPTC Filter	The module received a fault condition from the engine ECU alerting that the DPF/DPTC had activated.
ECU Amber	The module received an amber fault condition from the engine ECU.
ECU Data Fail	The module is configured for CAN operation but has not detected data being sent from the engine's ECU.
ECU Malfunc.	The module received a malfunction fault condition from the engine ECU.
ECU Protect	The module received a protect fault condition from the engine ECU.
ECU Red	The module received a red fault condition from the engine ECU.
Engine Under Speed IEEE C37.2 - 14 Underspeed Device	The module detected that the engine speed had fallen below the *Under Speed Alarm Trip* level for the configured delay timer after the *Safety On Delay* timer had expired.

Parameter descriptions are continued overleaf…

Fault	Description
Exp. Unit Failure	The module detected communication to one of the DSENet® expansion modules had been lost.
Fail To Reach Loading Frequency	The module detected that the generator output voltage had not risen above the *Generator Loading Frequency* setting after the *Warming Up* timer had expired.
Fail To Reach Loading Voltage	The module detected that the generator output voltage had not risen above the *Generator Loading Voltage* setting after the *Warming Up* timer had expired.
Fail to Synchronise	The module failed to synchronise the generator before the *Fail to Sync Delay* timer had expired.
Flexible Sensor A to D High	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value had risen above the *Flexible Sensor High Alarm Trip* level.
Flexible Sensor A to D Low	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value had fallen below the *Flexible Sensor Low Alarm Trip* level.
Fuel Level High IEEE C37.2 - 71 Liquid Level Switch	The module detected that the engine fuel level had risen the *High Fuel Level Alarm* level for the configured delay.
Fuel Level Low IEEE C37.2 - 71 Liquid Level Switch	The module detected that the engine fuel level had fallen below the *Low Fuel Level Alarm* level for the configured delay
Fuel Level Low Switch IEEE C37.2 - 71 Liquid Level Switch	The module detected that the engine low fuel level switch had activated.
Fuel Tank Bund Level High IEEE C37.2 - 71 Liquid Level Switch	The module detected that the fuel tank bund level switch had activated.
Fuel Usage IEEE C37.2 – 80 Flow Switch	The module detected that the fuel consumption was more than the configured Running Rate or Stopped Rate.
Gen Earth Fault IEEE C37.2 – 51G or 51N Generator IDMT Earth Fault Relay	**NOTE: For more details, see the section entitled Earth Fault IDMT Alarm elsewhere in this document.** The module detected that the generator earth fault current had risen above the *Earth Fault Trip Level* for the duration of the IDMT function.
Gen Failed to Close IEEE C37.2 – 52b AC Circuit Breaker Position (Contact Open when Breaker Closed)	The module detected that the generator load switch had failed to close as the *Generator Closed Auxiliary* input did not activate within the *Generator Fail to Close Delay* time after the *Close Gen Output* activated.
Gen Over Current IEEE C37.2 – 51 IDMT Overcurrent Relay	**NOTE: For more details, see the section entitled Over Current Alarm elsewhere in this document.** The module detected that the generator output current had risen above the Generator Over Current Trip for the duration of the IDMT function.

Parameter descriptions are continued overleaf…

Fault	Description
Gen Phase Seq Wrong IEEE C37.2 – 47 Phase Sequence Relay	The module detected that the phase rotation of the generator was different to the configured Generator Phase Rotation Alarm setting.
Gen Reverse Power IEEE C37.2 – 32 Directional Power Relay	The module detected that the generator output kW had fallen below the *Reverse Power Trip* for the configured delay timer.
Gen Short Circuit IEEE C37.2 – 51 IDMT Short Circuit Relay	**NOTE: For more details, see the section entitled *Short Circuit IDMT Alarm* elsewhere in this document.** The module detected that the generator output current had risen above the *Short Circuit Trip* for the duration of the IDMT function.
Inlet Temperature	The module detected that the engine's ECU measurement of inlet temperature had risen above the *Inlet Temperature Alarm Trip* level.
Insufficient Capacity	The module's governor output has reached its limit whilst attempting to control the generator to produce more kW whilst in parallel. This indicates a fault with either the governor (including connection error), setting of SW2, or that the engine has reached its maximum capacity.
kW Overload IEEE C37.2 – 32 Directional Power Relay	The module detected that the generator output (kW) had risen above the Overload Protection Trip for the configured delay timer.
Loss of Excitation	The module detected that the generator output kvar had fallen below the *Loss of Excitation Alarm Trip* level for the configured delay.
Loss of Mag-PU	The module detected that the magnetic pick up was not producing a pulse output after the required Crank Disconnect criteria had been met.
Mains Asymmetry High	The module detected the mains (utility) voltage asymmetry had risen above the configurable *Trip* level for the configured delay timer.
Mains Decoupling OF	The module detected that the mains (utility) frequency had risen above the *Mains Decoupling Over Frequency Trip* level when the generator was in parallel with the mains (utility).
Mains Decoupling OV	The module detected that the mains (utility) voltage had risen above the *Mains Decoupling Over Voltage Trip* level when the generator was in parallel with the mains (utility).
Mains Decoupling UF	The module detected that the mains (utility) frequency had fallen below the *Mains Decoupling Under Frequency Trip* level when the generator was in parallel with the mains (utility).
Mains Decoupling UV	The module detected that the mains (utility) voltage had risen above the *Mains Decoupling Under Voltage Trip* level when the generator was in parallel with the mains (utility).
Mains Over Negative Sequence	The module detected the mains (utility) voltage negative sequence had risen above the configurable *Trip* level for the configured delay timer.
Mains Over Zero Sequence	The module detected the mains (utility) voltage zero sequence had risen above the configurable *Trip* level for the configured delay timer.
Mains Phase Sequence Wrong	The module detected a mains (utility) phase rotation error, an electrical trip is initiated. The LCD indicates *Mains Phase Seq Wrong*.
Mains (utility) Reverse Power IEEE C37.2 – 32 Directional Power Relay	The module detected that the generator bus is exporting more than the configured limit, the LCD indicates *Mains Reverse Power*
Mains ROCOF	The module detected that the mains (utility) frequency had changed at a rate larger than the *Mains ROCOF Alarm Trip* level when the generator was in parallel with the mains (utility).

Parameter descriptions are continued overleaf…

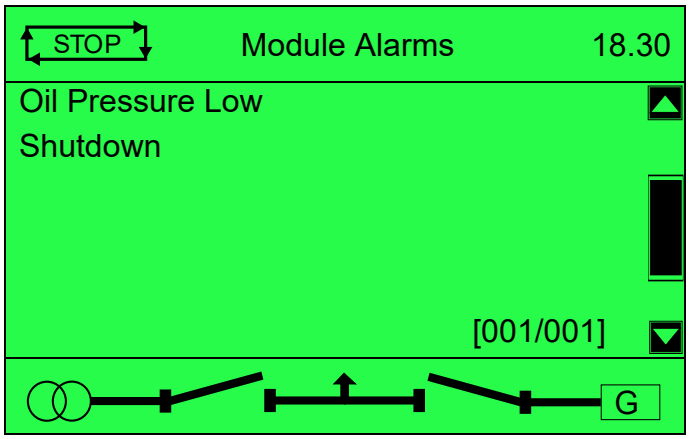
Fault	Description
Mains Under Positive Sequence	The module detected the mains (utility) voltage positive sequence had fallen below the configurable *Trip* level for the configured delay timer.
Mains Vector Shift	The module detected that the mains (utility) voltage waveform's vector had shifted more than the *Mains Vector Shift Alarm Trip* level when the generator was in parallel with the mains (utility).
Maintenance Due	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that one of the configured maintenance alarms is due as its configured maintenance interval has expired.
Negative Phase Sequence IEEE C37.2 - 46 Phase-Balance Current Relay	The module detected that there was an imbalance of current across the generator phases greater than the *Negative Phase Sequence Trip Level* percentage setting.
Out Of Sync Generator	**NOTE: For further details, refer to DSE Publication: *056-047 Out of Sync and Failed to Close Training Document*.** The module detected that the generator voltage has drifted out of sync from the mains (utility). This is caused by some form of external logic tripping open the generator load switch without it informing the DSE module.
Out Of Sync Mains	**NOTE: For further details, refer to DSE Publication: *056-047 Out of Sync and Failed to Close Training Document*.** The module detected that the mains (utility) voltage has drifted out of sync when from the generator. This is caused by some form of external logic tripping open the mains (utility) load switch without it informing the DSE module.
SCR Inducement	The module received a fault condition from the engine ECU alerting about the SCR Inducement.
Water in Fuel	The module received a fault condition from the engine ECU alerting that water in the fuel had been detected or that the *Water in Fuel* input switch had activated.

7.5 SHUTDOWN ALARMS

NOTE: The fault condition must be resolved before the alarm is reset. If the fault condition remains, it is not possible to reset the alarm (the exception to this is the *Oil Pressure Low* alarm and similar *Active From Safety On* alarms, as the oil pressure is low with the engine at rest).

Shutdown Alarms are latching and immediately stop the Generator. Once this has occurred, the module shuts the generator set down immediately to prevent further damage. The module also de-activates the Close Gen Output outputs to remove the load from the generator. To restart the generator the fault must be cleared, and the alarm reset.

Example:



In the event of an alarm, the alarm is displayed on the alarms page.

Shutdown Alarms are latching alarms and to remove the fault, press the ***Stop/Reset Mode*** button on the module.

Fault	Description
2130 ID 1 to 4 Analogue Input E to H High	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2130 had risen above the *Flexible Sensor High Alarm Trip* level.
2130 ID 1 to 4 Analogue Input E to H Low	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2130 had fallen below the *Flexible Sensor Low Alarm Trip* level.
2130 ID1 to 4 Digital Input A to H	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that a digital input configured to create a fault condition on a DSE2130 expansion module became active and the appropriate LCD message displayed.

Parameter descriptions are continued overleaf…

Fault	Description
2131 ID 1 to 4 Analogue Input A to J High	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2131 had risen above the *Flexible Sensor High Alarm Trip* level.
2131 ID 1 to 4 Analogue Input A to J Low	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2131 had fallen below the *Flexible Sensor Low Alarm Trip* level.
2131 ID1 to 4 Digital Input A to J	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that a digital input configured to create a fault condition on a DSE2131 expansion module became active and the appropriate LCD message displayed.
2133 ID 1 to 4 Analogue Input A to H High	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2133 had risen above the *Flexible Sensor High Alarm Trip* level.
2133 ID 1 to 4 Analogue Input A to H Low	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value of a DSE2133 had fallen below the *Flexible Sensor Low Alarm Trip* level.
Analogue Input A to D (Digital)	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input configured as a digital input to create a fault condition became active and the appropriate LCD message is displayed.
Air Flap Closed	The module detected that a digital input configured for *Air-Flap Closed Auxiliary* became active.

Parameter descriptions are continued overleaf…

Fault	Description
Auto Sense Fail	The module detected that the output voltage of the generator had risen above the *Over Voltage During Auto Sensing Trip* level during starting whilst attempting to detect which alternative configuration to use.
AVR Maximum Trim Limit	The module's AVR output has reached its limit whilst attempting to control the generator to produce more kvars whilst in parallel. This indicates a fault with either the AVR (including connection error), setting of SW2, or that the alternator has reached its maximum capacity.
Battery Temp	The module detected that a battery charger connected by DSENet® had issued a *Battery Temperature* alarm
Calibration Fault	The module detected that its internal calibration has failed. The unit must be sent back to DSE to be investigated and repaired. Contact DSE Technical Support for more details.
Charge Alt Failure IEEE C37.2 – 27DC Undervoltage Relay	The module detected that the output voltage of the charge alternator had risen above the *Charge Alternator Shutdown Trip* level for the configured delay timer.
Charger Failure	The module detected that a battery charger connected by DSENet® had a *Charger Failure* alarm.
Charger Fan Locked	The module detected that a battery charger connected by DSENet® had a *Charger Failure* alarm.
Charger High Temperature	The module detected that a battery charger connected by DSENet® had a *High Temperature* alarm.
Charger Input Fuse Fail	The module detected that a battery charger connected by DSENet® had an *Input Fuse Fail* alarm.
Charger ID 0 to 3 Common Shutdown	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that a battery charger connected by DSENet® had issued a *Common Shutdown Alarm*.
Charger Mains High Current	The module detected that a battery charger connected by DSENet® had a *Mains High Current* alarm.
Charger Mains High Voltage	The module detected that a battery charger connected by DSENet® had a *Mains High Voltage* alarm.
Charger Mains Low Voltage	The module detected that a battery charger connected by DSENet® had a *Mains Low Voltage* alarm.
Charger Reverse Polarity	The module detected that a battery charger connected by DSENet® had a *Reverse Polarity* alarm.
Charger Short Circuit	The module detected that a battery charger connected by DSENet® had a *Short Circuit* alarm.
Charger Short Circuit / Reverse Polarity	The module detected that a battery charger connected by DSENet® had a combined *Short Circuit* and *Reverse Polarity* alarm.
Coolant Temp High IEEE C37.2 – 26 Apparatus Thermal Device	The module detected that the engine coolant temperature had risen above the *High Coolant Temperature Shutdown Trip* level after the *Safety On Delay* timer had expired.
Coolant Temp High Switch IEEE C37.2 – 26 Apparatus Thermal Device	The module detected that the high engine coolant temperature switch had activated after the *Safety On Delay* timer had expired.
DEF Level Low	The module received a fault condition from the engine ECU alerting about the DEF level.

Parameter descriptions are continued overleaf…

Fault	Description
Digital Input A to L	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that a digital input configured to create a fault condition became active and the appropriate LCD message is displayed.
DPTC Filter	The module received a fault condition from the engine ECU alerting that the DPF/DPTC had activated.
ECU Amber	The module received an amber fault condition from the engine ECU.
ECU Data Fail	The module is configured for CAN operation but has not detected data being sent from the engine's ECU.
ECU Malfunc.	The module received a malfunction fault condition from the engine ECU.
ECU Protect	The module received a protect fault condition from the engine ECU.
ECU Red	The module received a red fault condition from the engine ECU.
Emergency Stop IEEE C37.2 - 5 Stopping Device	The module detected that emergency stop button had been pressed removing a positive voltage supply from the emergency stop input terminal. This input is failsafe (normally closed to emergency stop) and immediately stops the generator when the signal is removed.
Engine Over Speed IEEE C37.2 - 12 Overspeed Device	The module detected that the engine speed had risen above the *Over Speed Alarm Trip* level for the configured delay timer.
Engine Over Speed Run Away	This is the highest RPM value that the engine is expected to run at before triggering an immediate shutdown. This alarm is active always and cannot be disabled. It is possible to damage the engine if a sudden increase in RPM trips the *Over Speed* alarm but does not exceed the trip level delay. For this reason, the Run Away Trip alarm exists.
Engine Over Speed Overshoot IEEE C37.2 - 12 Overspeed Device	The module detected that the engine speed had risen above the *Over Speed Overshoot Trip* during the configured *Overshoot Delay* timer whilst starting.
Engine Under Speed IEEE C37.2 - 14 Underspeed Device	The module detected that the engine speed had fallen below the *Under Speed Alarm Trip* level for the configured delay timer after the *Safety On Delay* timer had expired.
Exp. Unit Failure	The module detected communication to one of the DSENet® expansion modules had been lost.
Fail To Reach Loading Frequency	The module detected that the generator output voltage had not risen above the *Generator Loading Frequency* setting after the *Warming Up* timer had expired.
Fail To Reach Loading Voltage	The module detected that the generator output voltage had not risen above the *Generator Loading Voltage* setting after the *Warming Up* timer had expired.
Failed to Start IEEE C37.2 - 48 Incomplete Sequence Relay	The module detected that the generator had failed to start as it did not meet the required Crank Disconnect criteria during the configured number of Crank Attempts.

Parameter descriptions are continued overleaf…

Fault	Description
Failed to Stop IEEE C37.2 - 48 Incomplete Sequence Relay	**NOTE: *Fail to Stop* may indicate a faulty oil pressure sensor. If engine is at rest, check the oil pressure sensor wiring and configuration.** The module detects a condition that indicates the generator is running when the DSE module has instructed it to stop.
Flexible Sensor A to D High	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value had risen above the *Flexible Sensor High Alarm Trip* level.
Flexible Sensor A to D Low	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that an analogue input value had fallen below the *Flexible Sensor Low Alarm Trip* level.
Fuel Level High IEEE C37.2 - 71 Liquid Level Switch	The module detected that the engine fuel level had risen the *High Fuel Level Alarm* level for the configured delay.
Fuel Level Low IEEE C37.2 - 71 Liquid Level Switch	The module detected that the engine fuel level had fallen below the *Low Fuel Level Alarm* level for the configured delay
Fuel Level Low Switch IEEE C37.2 - 71 Liquid Level Switch	The module detected that the engine low fuel level switch had activated.
Fuel Sensor Fault	The module detected that circuit to the engine fuel level sensor had become open circuit.
Fuel Tank Bund Level High IEEE C37.2 - 71 Liquid Level Switch	The module detected that the fuel tank bund level switch had activated.
Fuel Usage IEEE C37.2 – 80 Flow Switch	The module detected that the fuel consumption was more than the configured Running Rate or Stopped Rate.
Gen Earth Fault IEEE C37.2 – 51G or 51N Generator IDMT Earth Fault Relay	**NOTE: For more details, see the section entitled Earth Fault IDMT Alarm elsewhere in this document.** The module detected that the generator earth fault current had risen above the *Generator Earth Fault Trip Level* for the duration of the IDMT function.
Gen Over Current IEEE C37.2 – 51 IDMT Overcurrent Relay	**NOTE: For more details, see the section entitled Over Current Alarm elsewhere in this document.** The module detected that the generator output current had risen above the *Generator Over Current Trip* for the duration of the IDMT function.
Gen Over Frequency IEEE C37.2 – 81 Frequency Relay	The module detected that the generator output frequency had risen above the *Over Frequency Alarm Trip* level for the configured delay timer.
Gen Over Frequency Overshoot IEEE C37.2 – 81 Frequency Relay	The module detected that the generator output frequency had risen above the *Over Frequency Overshoot Trip* during the configured *Overshoot Delay* timer whilst starting.

Parameter descriptions are continued overleaf…

Fault	Description
Gen Over Frequency Runaway IEEE C37.2 – 81 Frequency Relay	In the event of the generator output frequency rising above the configured Trip value, the Run Away Shutdown alarm is immediately triggered.
Gen Over Voltage IEEE C37.2 – 59 AC Overvoltage Relay	The module detected that the generator output voltage had risen above the *Over Voltage Alarm Trip* level for the configured delay timer.
Gen Phase Seq Wrong IEEE C37.2 – 47 Phase Sequence Relay	The module detected that the phase rotation of the generator was different to the configured *Generator Phase Rotation Alarm* setting.
Gen Reverse Power IEEE C37.2 – 32 Directional Power Relay	The module detected that the generator output kW had fallen below the *Reverse Power Trip* for the configured delay timer.
Gen Short Circuit IEEE C37.2 – 51 IDMT Short Circuit Relay	**NOTE: For more details, see the section entitled *Short Circuit IDMT Alarm* elsewhere in this document.** The module detected that the generator output current had risen above the *Short Circuit Trip* for the duration of the IDMT function.
Gen Under Frequency IEEE C37.2 – 81 Frequency Relay	The module detected that the generator output frequency had fallen below the *Under Frequency Alarm Trip* level for the configured delay timer after the *Safety On Delay* timer had expired.
Gen Under Voltage IEEE C37.2 – 27 AC Undervoltage Relay	The module detected that the generator output voltage had fallen below the *Under Voltage Alarm Trip* level for the configured delay timer after the *Safety On Delay* timer had expired.
Inlet Temperature	The module detected that the engine's ECU measurement of inlet temperature had risen above the *Inlet Temperature Alarm Trip* level.
Insufficient Capacity	The module's governor output has reached its limit whilst attempting to control the generator to produce more kW whilst in parallel. This indicates a fault with either the governor (including connection error), setting of SW2, or that the engine has reached its maximum capacity.
kW Overload IEEE C37.2 – 32 Directional Power Relay	The module detected that the generator output kW had risen above the Overload Protection Trip for the configured delay timer.
Loss of Excitation	The module detected that the generator output kvar had fallen below the *Loss of Excitation Alarm Trip* level for the configured delay.
Loss of Mag-PU	The module detected that the magnetic pick up was not producing a pulse output after the required Crank Disconnect criteria had been met.
Mag-PU Fault	The module detected that circuit to the magnetic pick-up sensor had become open circuit.
Maintenance Alarm	**NOTE: Due to module configuration the alarm message that appears on the display may be different. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*** The module detected that one of the configured maintenance alarms is due as its configured maintenance interval has expired.
Negative Phase Sequence IEEE C37.2 - 46 Phase-Balance Current Relay	The module detected that there was an imbalance of current across the generator phases greater than the *Negative Phase Sequence Trip Level* percentage setting.
Oil Press Sender Fault	The module detected that circuit to the engine oil pressure sensor had become open circuit.

Parameter descriptions are continued overleaf…

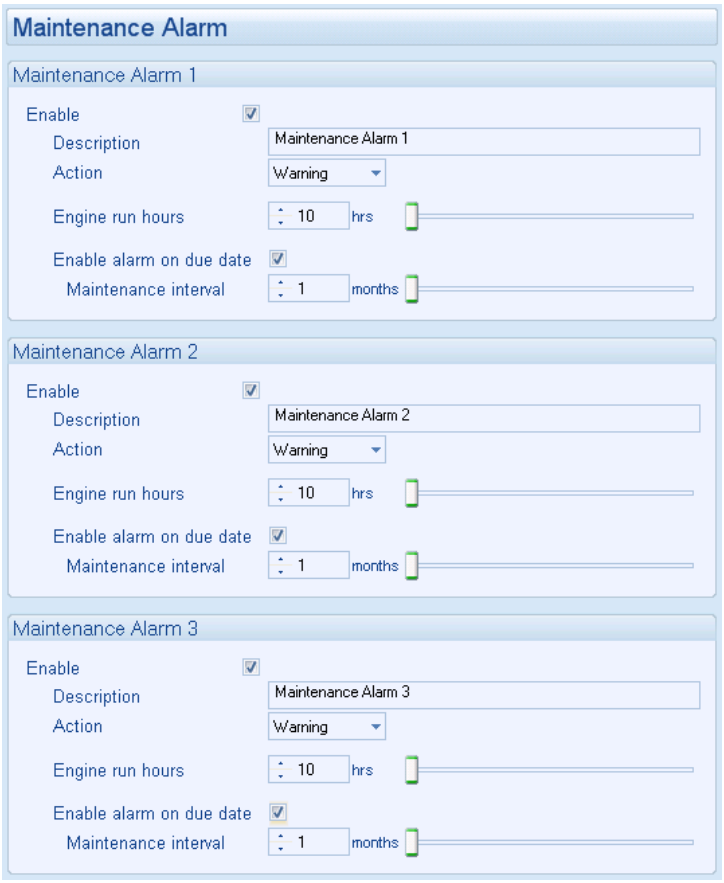
Fault	Description
Oil Pressure Low IEEE C37.2 - 63 Pressure Switch	The module detected that the engine oil pressure had fallen below the *Low Oil Pressure Shutdown Trip* level after the *Safety On Delay* timer had expired.
Oil Pressure Low Switch IEEE C37.2 - 63 Pressure Switch	The module detected that the low oil pressure switch had activated after the *Safety On Delay* timer had expired.
SCR Inducement	The module received a fault condition from the engine ECU alerting about the SCR Inducement.
Temp. Sender Fault	The module detected that circuit to the engine coolant temperature sensor had become open circuit.
Water in Fuel	The module received a fault condition from the engine ECU alerting that water in the fuel had been detected or that the *Water in Fuel* input switch had activated.

7.6 MAINTENANCE ALARMS

Depending upon module configuration one or more levels of engine maintenance alarm may occur based upon a configurable schedule.

Example 1:

Screen capture from DSE Configuration Suite Software showing the configuration of the Maintenance Alarm for 1, 2 and 3.



When activated, the maintenance alarm is either a **warning** (set continues to run) or **shutdown** (running the set is not possible).

Resetting the maintenance alarm is normally actioned by the site service engineer after performing the required maintenance.
The method of reset is either by:

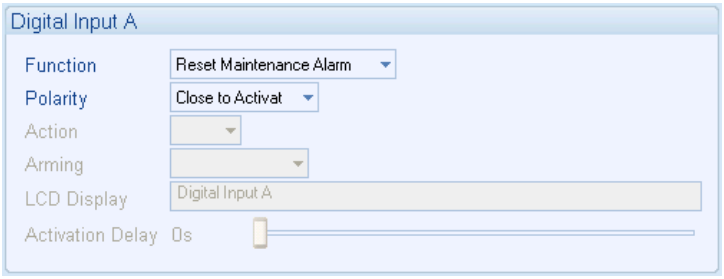
Activating an input that has been configured to Maintenance Reset Alarm 1, 2 or 3.

Pressing the maintenance reset button in the DSE Configuration Suite, Maintenance section.

Pressing and holding the ***Stop/Reset Mode*** button for 10 seconds on the desired Maintenance Alarm status page. This may be protected by a PIN number.

Example 2:

Screen capture from DSE Configuration Suite Software showing the configuration of a digital input for Reset Maintenance Alarm.

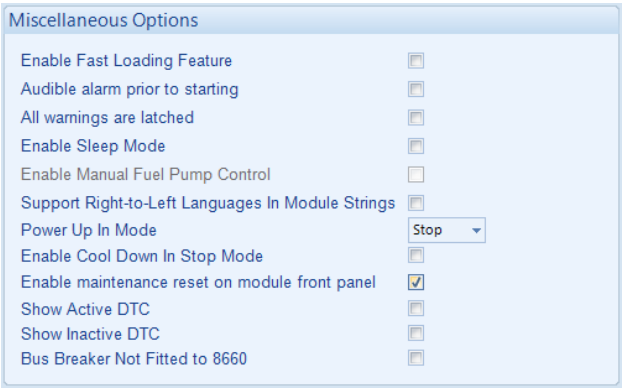


Example 3:

Screen capture from DSE Configuration Suite Software showing the Maintenance Alarm Reset 'button' in the DSE Configuration Suite SCADA | MAINTENANCE section.

Example 4:

Screen capture from DSE Configuration Suite Software showing the configuration holding stop button to reset the maintenance alarm.



7.7 MAINS DECOUPLING ALARMS

NOTE: These protections only operate only when the mains and generator bus are in parallel, or on a mains parallel input on a Multi Set application. It is disabled at all other times.

When generator is in parallel with the mains (utility), the module monitors for a Mains failure by detecting ROCOF, Vector Shift or any other alarm in the mains (utility) decoupling section (UV, OV, UF, OF stage 1 or 2) which are set in the module's configuration.

If either of these alarms operate, the module performs an electrical trip of the generator breaker. This operation must be manually reset by:

- Pressing the ***Stop/Reset Mode*** button.
- Activation of a digital input configured to ***Clear Mains Decoupling Alarms*** if it has been configured.

7.8 OVER CURRENT ALARM

The *Over Current Alarm* combines a simple warning trip level with a fully functioning IDMT curve for thermal protection.

7.8.1 IMMEDIATE WARNING

If the *Immediate Warning* is enabled, the controller generates a *warning alarm* as soon as the *Trip* level is reached. The alarm automatically resets once the generator loading current falls below the *Trip* level (unless *All Warnings Are Latched* is enabled).

7.8.2 INVERSE DEFINITE MINIMUM TIME (IDMT) ALARM

If the *Over Current IDMT Alarm* is enabled, the controller begins following the IDMT 'curve' when the current on any phase passes the *Trip* setting.

If the *Trip* is surpassed for an excess amount of time, the *IDMT Alarm* triggers (*Shutdown* or *Electrical Trip* as selected in *Action*).

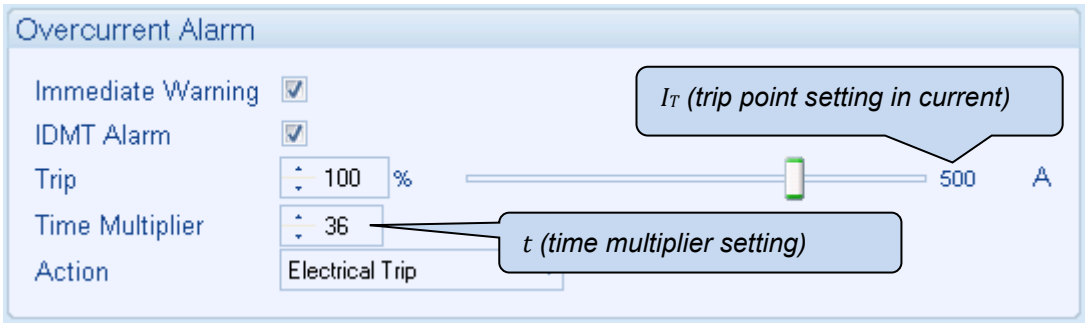
The larger the over circuit fault, the faster the trip. The speed of the trip is dependent upon the fixed formula:

$$T = \frac{t}{\left(\frac{I_A}{I_T} - 1\right)^2}$$

Where:

T is the tripping time in seconds
I_A is the actual measured current of the most highly loaded line (L1, L2 or L3)
I_T is the delayed trip point setting in current
t is the time multiplier setting and represents the tripping time in seconds at twice full load (when $^{I_A}/_{I_T} = 2$).

The settings shown in the example below are a screen capture of the DSE factory settings, taken from the DSE Configuration Suite PC Software for a brushless alternator.



These settings provide for normal running of the generator up to 100% full load. If full load is surpassed, the *Immediate Warning* alarm is triggered, and the set continues to run.

The effect of an overload on the generator is that the alternator windings begin to overheat; the aim of the *IDMT Alarm* is to prevent the windings being overload (heated) too much. The amount of time that the alternator is safely overloaded is governed by how high the overload condition is.

The default settings as shown above allow for an overload of the alternator to the limits of the *Typical Brushless Alternator* whereby 110% overload is permitted for 1 hour or 200% overload is permitted for 36 seconds.

If the alternator load reduces, the controller then follows a cooling curve. This means that a second overload condition may trip soon after the first as the controller knows if the windings have not cooled sufficiently.

For further details on the *Thermal Damage Curve* of the alternator, refer to the alternator manufacturer and generator supplier.

7.8.2.1 CREATING A SPREADSHEET FOR THE OVER CURRENT IDMT CURVE

The formula used:

$$T = \frac{t}{\left(\frac{I_A}{I_T} - 1\right)^2}$$

Where:

T is the tripping time in seconds
I_A is the actual measured current of the most highly loaded line (L1, L2 or L3)
I_T is the delayed trip point setting in current
t is the time multiplier setting and represents the tripping time in seconds at twice full load (when $^{I_A}/_{I_T} = 2$).

The equation is simplified for addition into a spreadsheet. This is useful for 'trying out' different values of t *(time multiplier setting)* and viewing the results, without testing this on the generator.

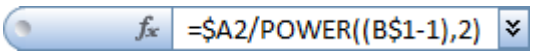
	A	B	C	D	E	F
1		1.01	1.02	1.03	1.05	1.06
2	36	360000	90000	40000	14400	10000

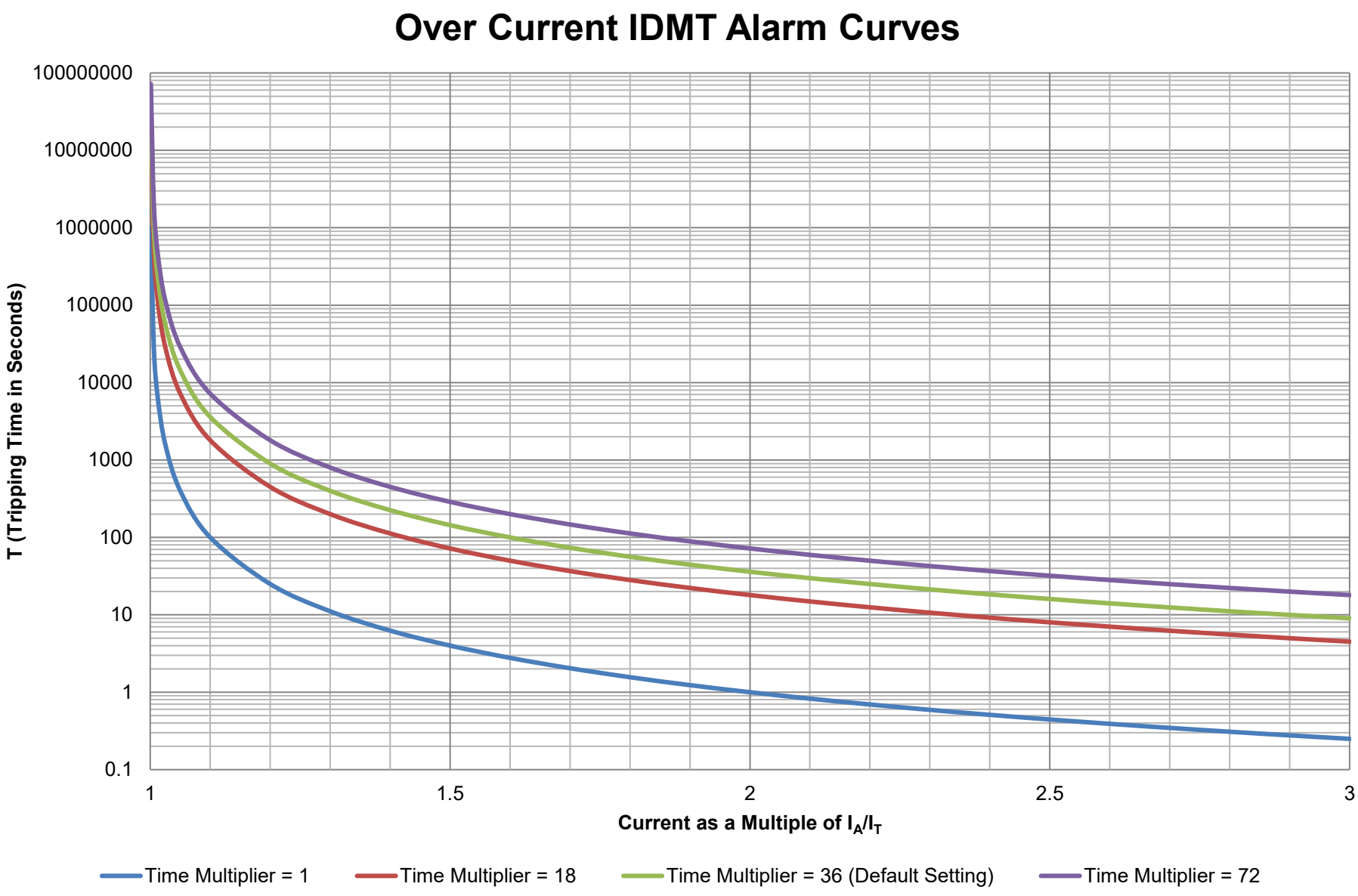
$^{I_A}/_{I_T}$ *(multiple of the Trip setting from 1.01 to 3.0 in steps of 0.1)*

t *(time multiplier setting)*

T *(tripping time in seconds)*

The formula for the *Tripping Time* cells is:




Over Current IDMT Alarm Curves
T (Tripping Time in Seconds)
100000000
10000000
1000000
100000
10000
1000
100
10
1
0.1
1
1.5
2
2.5
3
Current as a Multiple of I_A/I_T
Time Multiplier = 1
Time Multiplier = 18
Time Multiplier = 36 (Default Setting)
Time Multiplier = 72

7.9 SHORT CIRCUIT IDMT ALARM

If the *Short Circuit Alarm* is enabled, the controller begins following the IDMT 'curve' when the current on any phase passes the *Trip* setting.

If the *Trip* is surpassed for an excess amount of time, the *IDMT Alarm* triggers (*Shutdown* or *Electrical trip* as selected in *Action*).

The larger the short circuit fault, the faster the trip. The speed of the trip is dependent upon the fixed formula:

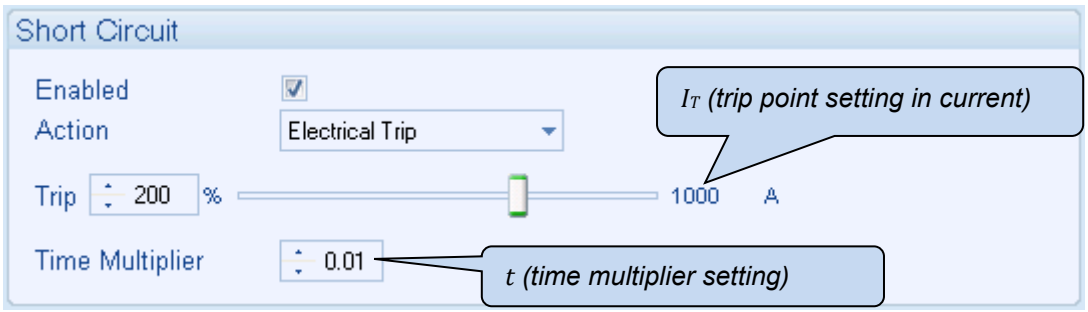
$$T = \frac{t \times 0.14}{\left(\left(\frac{I_A}{I_T}\right)^{0.02} - 1\right)}$$

Where:

T is the tripping time in seconds (accurate to +/- 5% or +/- 50 ms (whichever is greater))
I_A is the actual measured current
I_T is the trip point setting in current
t is the time multiplier setting

The settings shown in the example below are a screen capture of the DSE factory settings, taken from the DSE Configuration Suite software.

NOTE: Due to large inrush currents from certain loads, such as motors or transformers, the default settings for the *Short Circuit* alarm may need adjusting to compensate.



The effect of a short circuit on the generator is that the alternator stator and rotor begin to overheat; the aim of the *IDMT alarm* is to prevent the stator and rotor being overload (heated) too much. The duration for which the alternator is safely overloaded depends on the severity of the short circuit condition.

For further details on the *Thermal & Magnetic Damage Curve* of the alternator, refer to the alternator manufacturer and generator supplier.

7.9.1 CREATING A SPREADSHEET FOR THE SHORT CIRCUIT IDMT CURVE

The formula used:

$$T = \frac{t \times 0.14}{\left(\left(\frac{I_A}{I_T}\right)^{0.02} - 1\right)}$$

Where:

T is the tripping time in seconds (accurate to +/- 5% or +/- 50 ms (whichever is greater))
I_A is the actual measured current
I_T is the trip point setting in current
t is the time multiplier setting

The equation is simplified for addition into a spreadsheet. This is useful for 'trying out' different values of t *(time multiplier setting)* and viewing the results, without testing this on the generator.

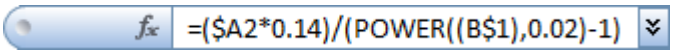
	A	B	C	D	E	F
1		1.01	1.02	1.03	1.05	1.06
2	0.01	7.034242	25	11.11111	4	2.777778

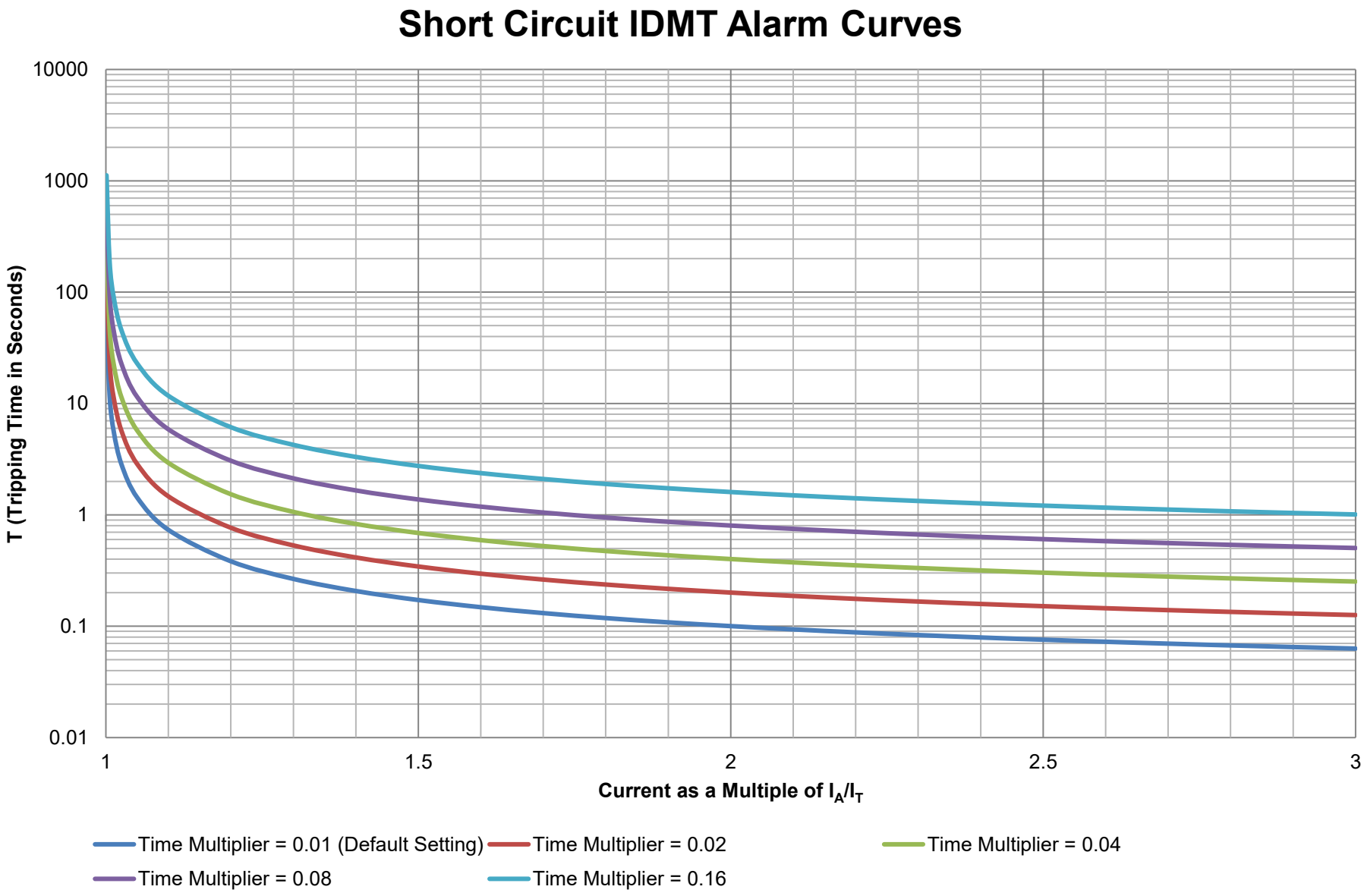
I_A/I_T (multiple of the Trip setting from 1.01 to 3.0 in steps of 0.1)

t (time multiplier setting)

T (tripping time in seconds)

The formula for the *Tripping Time* cells is:




Short Circuit IDMT Alarm Curves
10000
1000
100
10
1
0.1
0.01
T (Tripping Time in Seconds)
1
1.5
2
2.5
3
Current as a Multiple of I_A/I_T
Time Multiplier = 0.01 (Default Setting)
Time Multiplier = 0.02
Time Multiplier = 0.04
Time Multiplier = 0.08
Time Multiplier = 0.16

7.10 EARTH FAULT IDMT ALARM

When the module is suitably connected using the 'Earth Fault CT.' The module measures Earth Fault and can optionally be configured to generate an alarm condition (shutdown or electrical trip) when a specified level is surpassed.

If the *Earth Fault Alarm* is enabled, the controller begins following the IDMT 'curve' when the earth fault current passes the *Trip* setting.

If the *Trip* is surpassed for an excess amount of time, the *IDMT Alarm* triggers (*Shutdown* or *Electrical Trip* as selected in *Action*).

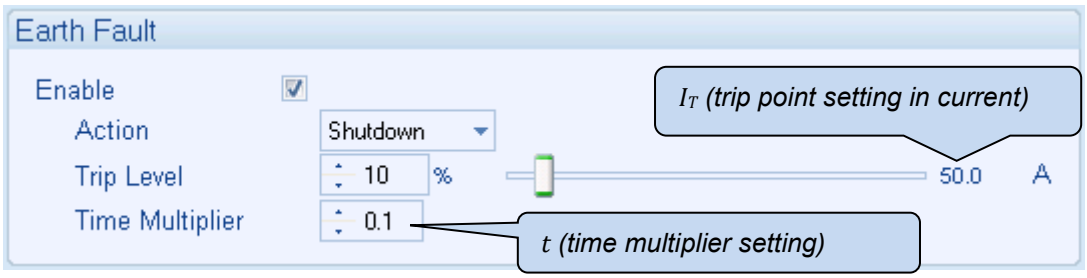
The larger the earth fault, the faster the trip. The speed of the trip is dependent upon the fixed formula:

$$T = \frac{t \times 0.14}{\left(\left(\frac{I_A}{I_T}\right)^{0.02} - 1\right)}$$

Where:

T is the tripping time in seconds (accurate to +/- 5% or +/- 50ms (whichever is the greater))
I_A is the actual measured current
I_T is the trip point setting in current
t is the time multiplier setting

The settings shown in the example below are a screen capture of the DSE factory settings, taken from the DSE Configuration Suite software.



7.10.1 CREATING A SPREADSHEET FOR THE EARTH FAULT IDMT CURVE

The formula used:

$$T = \frac{t \times 0.14}{\left(\left(\frac{I_A}{I_T}\right)^{0.02} - 1\right)}$$

Where:

T is the tripping time in seconds (accurate to +/- 5% or +/- 50 ms (whichever is greater))
I_A is the actual measured current
I_T is the trip point setting in current
t is the time multiplier setting

The equation is simplified for addition into a spreadsheet. This is useful for 'trying out' different values of t *(time multiplier setting)* and viewing the results, without testing this on the generator.

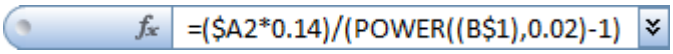
	A	B	C	D	E	F
1		1.01	1.02	1.03	1.05	1.06
2	0.1	70.34242	250	111.1111	40	27.77778

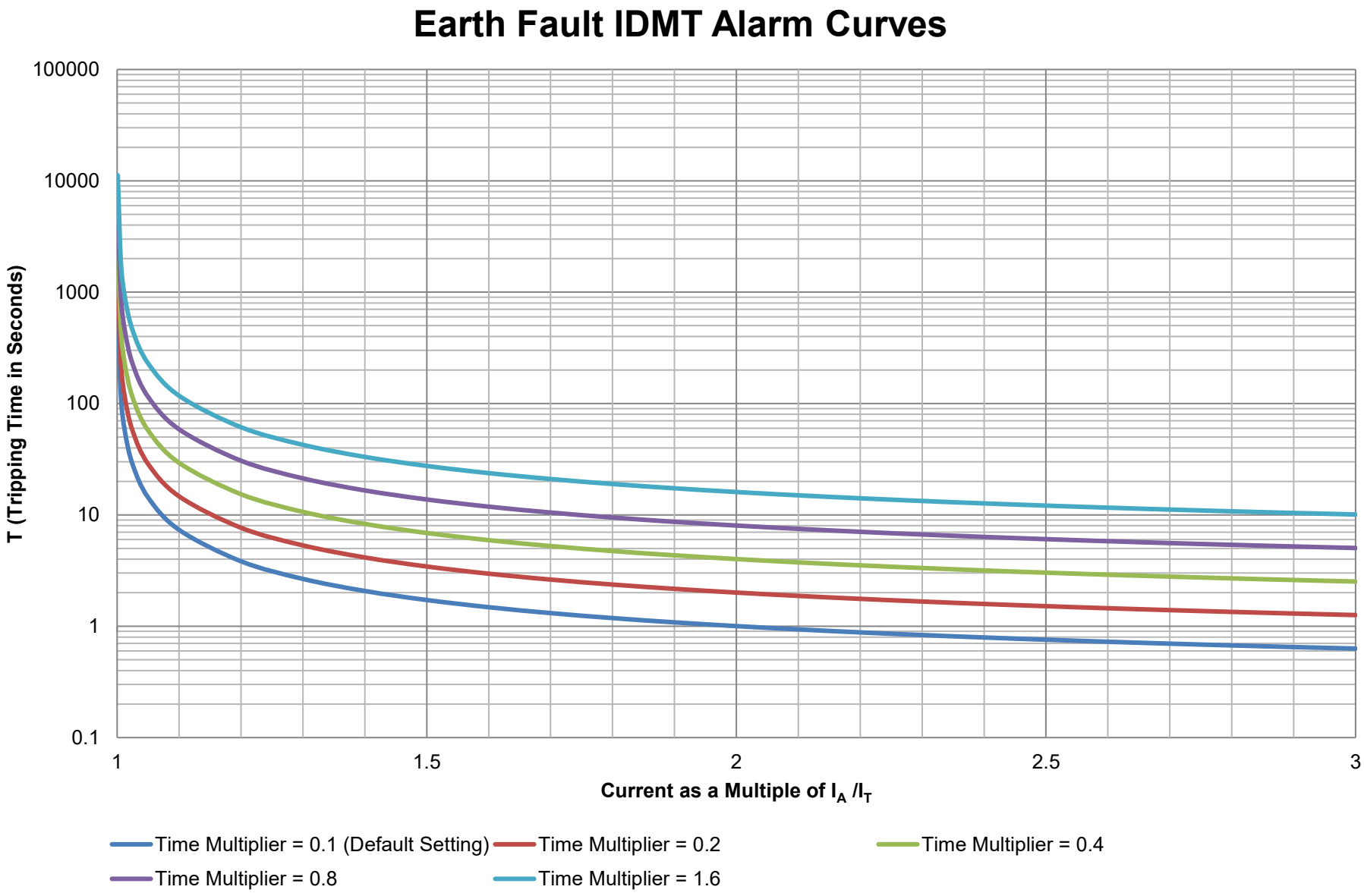
I_A/I_T (multiple of the Trip setting from 1.01 to 3.0 in steps of 0.1)

t (time multiplier setting)

T (tripping time in seconds)

The formula for the *Tripping Time* cells is:




Earth Fault IDMT Alarm Curves
100000
10000
1000
100
10
1
0.1
T (Tripping Time in Seconds)
1
1.5
2
2.5
3
Current as a Multiple of I_A /I_T
Time Multiplier = 0.1 (Default Setting)
Time Multiplier = 0.2
Time Multiplier = 0.4
Time Multiplier = 0.8
Time Multiplier = 1.6

7.11 DEFAULT CURRENT PROTECTION TRIPPING CHARACTERISTICS

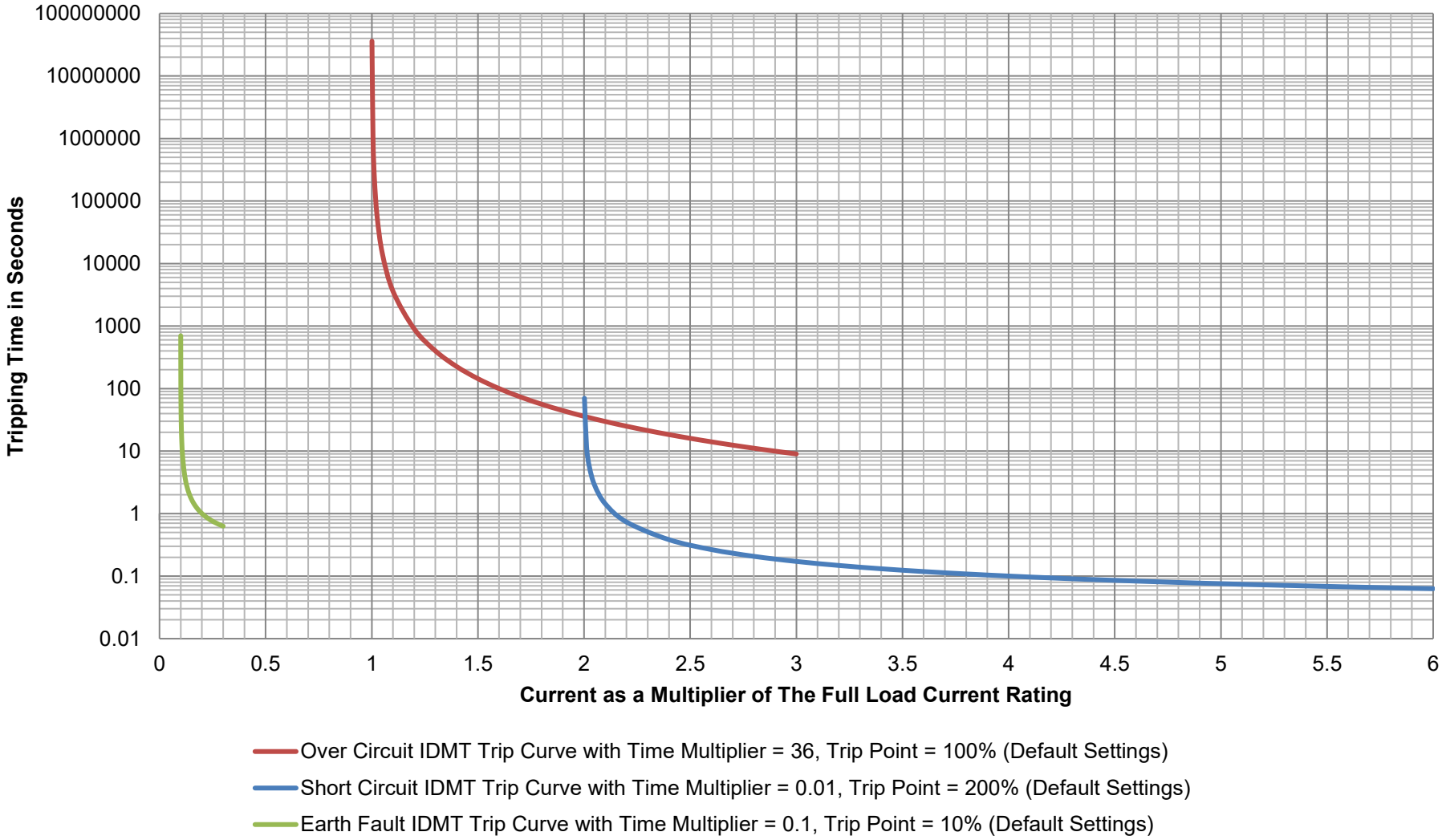
The graph on the following page shows the default settings for the IDMT tripping curves for the *Over Current, Short Circuit* and *Earth Fault* protections.

The default setting for the *Over Current* alarm allows for an overload of an alternator to the limits of the *Typical Brushless Alternator* whereby 110% overload is permitted for 1 hour or 200% overload is permitted for 36 seconds. In an over current situation, the alternator begins to overheat. The aim of the *Over Current IDMT Alarm* is to prevent the windings being overload (heated) too much. The amount of time that the alternator is safely overloaded is governed by how high the overload condition is.

The default setting for the *Short Circuit* alarm allows for an alternator to supply a high current caused by a genuine short circuit or an inrush current of a motor/transformer. Whereby 300% overload is permitted for 0.17 seconds, or 600% overload is permitted for 0.06 seconds. In a short circuit situation, the alternator begins to overheat to the point the insulation breaks down, potentially causing a fire. The aim of the *Short Circuit IDMT Alarm* is to prevent the insulation from melting due to excessive heat. The amount of time that the alternator is safely in a short circuit condition is governed by the alternator's construction.

The default setting for the *Earth Fault* alarm allows for an alternator to supply a fault current caused by an imbalanced load, a high impedance short to earth or motor drives. Whereby anything less than 10% is considered normal (caused by imbalanced loads) and permitted, 12% fault current is permitted for 3.83 second or 20% fault current is permitted for 1 second.

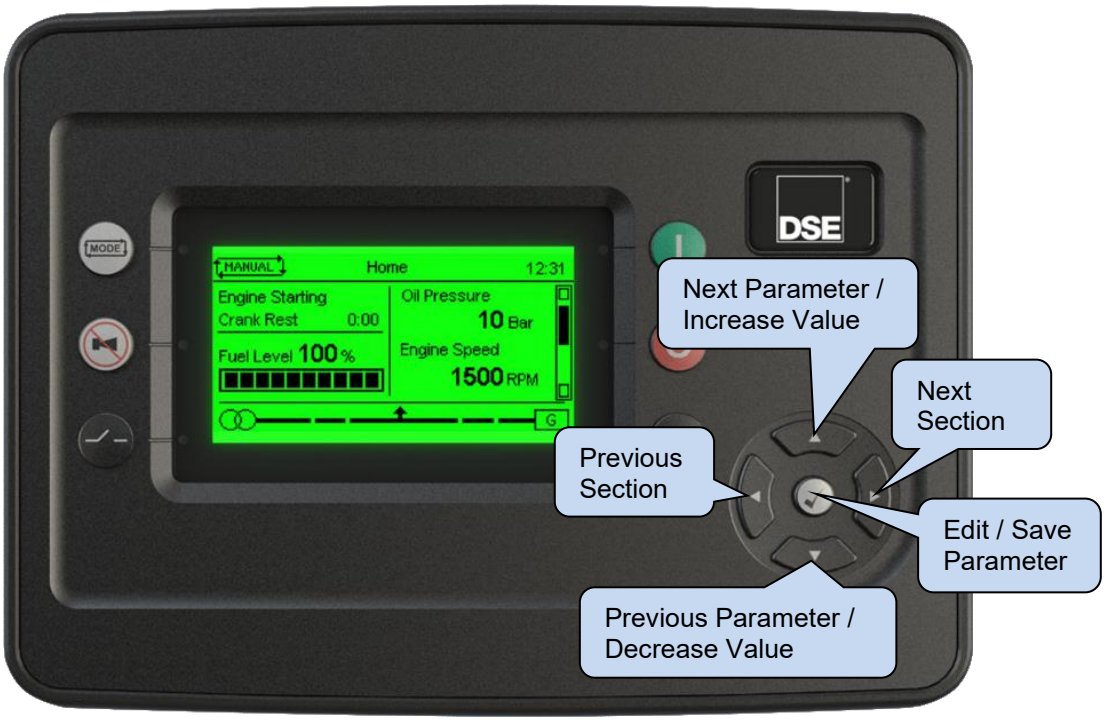
DSE Default Configratuion of Over Current, Short Circuit & Earth Fault IDMT Alarm Curves



8 FRONT PANEL CONFIGURATION

This configuration mode allows the operator to configure parts of the module through its display without the use of the DSE Configuration Suite PC Software.

Use the module's facia buttons to traverse the menu and make value changes to the parameters:



8.1 FRONT PANEL EDITOR

8.1.1 ACCESSING THE FRONT PANEL EDITOR

NOTE: More comprehensive module configuration is possible via PC configuration software. For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*

NOTE: Depending upon module configuration, some parameters in the Main Editor may not be available. For more information refer to DSE publication *057-322 DSEG8600 Configuration Suite PC Software Manual* available from www.deepseaelectronics.com

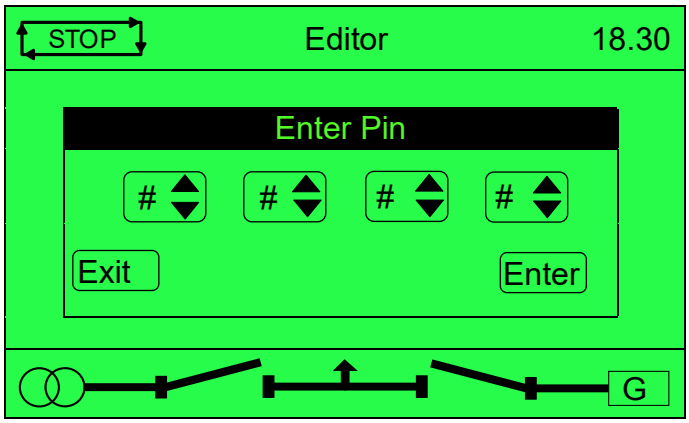
- Ensure the engine is at rest and the module by pressing the ***Stop/Reset Mode*** button.
- Press the Press the ***Next Page*** button followed by either the ***Up*** or ***Down*** buttons or the ***Next Page*** or ***Previous Page*** buttons to locate the *Editor* page.

8.1.2 ENTERING PIN

NOTE: The PIN is not set by DSE when the module leaves the factory. If the module has a PIN code set, the generator supplier has entered this. Contact the generator supplier if the code is required. If the code has been 'lost' or 'forgotten,' the module must be returned to the DSE factory to have the PIN removed. A charge is made for this procedure. This procedure cannot be performed away from the DSE factory.

NOTE: The PIN is automatically reset when the editor is exited manually or when the *Page Timer* expires (default 5 min) to ensure security.

- If a module security PIN has been set, the PIN request is then shown.



- Press the ***Tick***  button, the first '#' changes to '0'. Press the ***Scroll***  buttons to adjust it to the correct value.

- Press the ***Next Page***  button when the first digit is correctly entered. The digit previously entered now shows as '#' for security.

- Repeat this process for the other digits of the PIN number. Press the ***Previous Page***  button to move back to adjust one of the previous digits.

- When the ***Tick***  button is pressed after editing the final PIN digit, the PIN is checked for validity. If the number is not correct, the PIN must be re-entered.

- If the PIN has been successfully entered (or the module PIN has not been enabled), the editor is displayed.

8.1.3 EDITING A PARAMETER

NOTE: Pressing and holding the *Menu Navigation*  **buttons provide the auto-repeat functionality. Values are changed quickly by holding the navigation buttons for a prolonged period.**

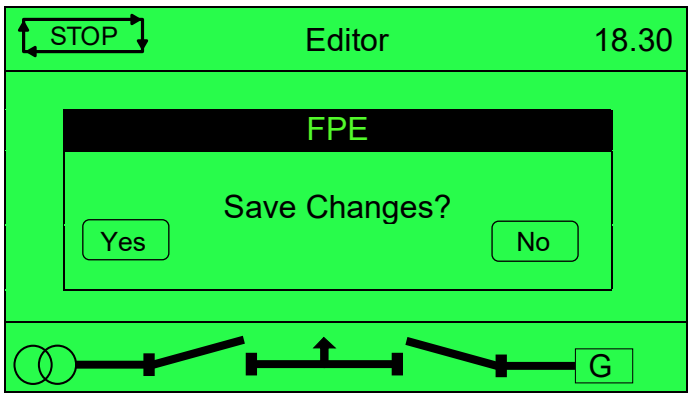
- Press the ***Next Page*** or ***Previous Page***  buttons to cycle to the section to view/change.
- Press the ***Scroll***  buttons to select the parameter to view/change within the currently selected section.
- To edit the parameter, press the ***Tick***  button to enter edit mode. The parameter is highlighted to indicate editing.
- Press the ***Scroll***  buttons or ***Next Page*** or ***Previous Page***  buttons to change the parameter to the required value.

- Press the ***Tick***  button to save the value. The parameter ceases flashing to indicate that it has been saved.

8.1.4 EXITING THE FRONT PANEL EDITOR

NOTE: The editor automatically exits after a configuration has been written or when the *Page Timer* has expired (default 5 minutes) to ensure security.

- Press the ***Previous Page*** button to move back to the editor menu and once again to exit the editor.
- Press the ***Next Page*** or ***Previous Page*** buttons to select *Yes* or *No*
- Press and hold the ***Tick*** button to exit the editor and save the changes.



8.1.5 MAIN CONFIGURATION EDITOR PARAMETERS

Section	Parameter As Shown On Display	Values
Display	Contrast	0%
	Language	English, Other.
	Current Date and Time	DD:MM:YY, hh:mm:ss
Alt Config	Default Config	Default Config / Alternative Config
Engine	Oil Pressure Low Shutdown	0.00 bar
	Oil Pressure Low Pre Alarm	0.00 bar
	Coolant Temperature Low Warning	0 ºC
	Coolant Temp High Pre Alarm	0 ºC
	Coolant Temp High Shutdown	0 ºC
	Start Delay Off Load	0 h 0 m 0 s
	Start Delay On Load	0 h 0 m 0 s
	Start Delay Mains Fail	0 h 0 m 0 s
	Start Delay Telemetry	0 h 0 m 0 s
	Pre Heat Temp	0 ºC
	Pre Heat Timer	0 h 0 m 0 s
	Post Heat Temp	0 ºC
	Post Heat Timer	0 h 0 m 0 s
	Cranking	0 m 0 s
	Cranking Rest	0 m 0 s
	Safety On Delay	0 m 0 s
	Smoke Limiting	0 m 0 s
	Smoke Limiting Off	0 m 0 s
	Warming	0 h 0 m 0 s
	Cooling	0 h 0 m 0 s
	Under Speed Shutdown	Active / Inactive
	Under Speed Shutdown	0 RPM
	Under Speed Warning	Active / Inactive
	Under Speed Warning	0 RPM
	Over Speed Warning	Active / Inactive
	Over Speed Warning	0 RPM
	Over Speed Shutdown	0 RPM
	Overspeed Overshoot	0 m 0 s
	Overspeed Overshoot	0 %
	Fail To Stop Delay	0 m 0 s
	Battery Under Voltage Warning	Active / Inactive
	Battery Under Voltage Warning Delay	0 h 0 m 0 s
	Battery Under Voltage Warning	0.0 V
	Battery Over Voltage Warning	Active / Inactive
	Battery Over Voltage Warning Delay	0 h 0 m 0 s
	Battery Over Voltage Warning	0.0 V
	Charge Alternator Failure Warning	Active / Inactive
	Charge Alternator Failure Warning	0.0 V
	Charge Alternator Warning Delay	0 h 0 m 0 s
	Charge Alternator Failure Shutdown	Active / Inactive
	Charge Alternator Failure Shutdown	0.0 V
	Charge Alternator Shutdown Delay	0 h 0 m 0 s
	Droop (CAN Engine Only)	Active / Inactive
	Droop (CAN Engine Only)	0 %
	Fuel Usage Running Rate	0 %
	Fuel Usage Stopped Rate	0 %
	DPF Auto Regen Inhibit	Active / Inactive
	Specific Gravity	0.80 to 1.00
	CAN Termination (CAN Engine Only)	Active / Inactive

Parameter descriptions are continued overleaf…

Section	Parameter As Shown On Display	Values
Generator	Under Voltage Shutdown	0 V
	Under Voltage Pre-Alarm	0 V
	Loading Voltage	0 V
	Nominal Voltage	0 V
	Over Voltage Pre-Alarm	0 V
	Over Voltage Shutdown	0 V
	Under Frequency Shutdown	0.0 Hz
	Under Frequency Pre-Alarm	0.0 Hz
	Loading Frequency	0.0 Hz
	Nominal frequency	0.0 Hz
	Over Frequency Pre-Alarm	0.0 Hz
	Over Frequency Shutdown	0.0 Hz
	Full Load Rating	0 A
	kW Overload Trip	0 %
	Delayed Over Current	Active / Inactive
	Gen Over Current Trip	0 %
	AC System	3 Phase, 4 Wire
	CT Primary	0 A Power Cycle After Exit
	CT Secondary	0 A Power Cycle After Exit
	Short Circuit Trip	0 %
	Earth CT Primary	0 A
	Earth Fault Trip	Active / Inactive
	Earth Fault Trip	0 %
	Transient Delay	0.0 s
	Gen Reverse Power Delay	0.0 s
	Full kW Rating	0 kW
	Full kvar Rating	0 kvar
	Ramp Up Rate	0 %
	Ramp Down Rate	0 %
	Load Level For More Sets	0 %
	Load Level For Less Sets	0 %
	Load Demand Priority	1
	Gen Reverse Power Trip	0 kW
	Insufficient Capacity Delay	0 m 0 s
	Insufficient Capacity Action	None / Indication / Warning / Shutdown / Electrical Trip
	Reactive Load Control Mode	None / VAr Share / VAr Fixed Export
	Load Parallel Power	0 kW In Mains Parallel Mode
	Load Power Factor	0 % In Mains Parallel Mode
	Gen Over Zero Seq Volt	Active / Inactive
	Gen Over Zero Seq Volt	0.0 V
	Gen Under Pos Seq Volt	Active / Inactive
	Gen Under Pos Seq Volt	0.0 V
	Gen Over Neg Seq Volt	Active / Inactive
	Gen Over Neg Seq Volt	0.0 V
	Gen Asymmetry High	Active / Inactive
	Gen Asymmetry High	0.0 V

Parameter descriptions are continued overleaf…

Section	Parameter As Shown On Display	Values
Mains	Under Voltage Trip	0 V
	Over Voltage Trip	0 V
	Under Frequency Trip	0 Hz
	Over Frequency Trip	0 Hz
	Transient Delay	0.0 s
	CT Primary	0 A Power Cycle After Exit
	CT Secondary	0 A Power Cycle After Exit
	Full kW Rating	0 kW
	Full kvar Rating	0 kvar
	Mains Over Zero Seq Volt	Active / Inactive
	Mains Over Zero Seq Volt	0 V
	Mains Under Pos Seq Volt	Active / Inactive
	Mains Under Pos Seq Volt	0 V
	Mains Over Neg Seq Volt	Active / Inactive
	Mains Over Neg Seq Volt	0 V
	Mains Asymmetry High	Active / Inactive
	Mains Asymmetry High	0 V
Timers	LCD Page Delay	0 h 0 m 0 s
	LCD Scroll Delay	0 h 0 m 0 s
	Engine Pre Heat Timer	0 h 0 m 0 s
	Engine Post Heat Timer	0 h 0 m 0 s
	Engine Cranking	0 m 0 s
	Engine Cranking Rest	0 m 0 s
	Engine Safety On Delay	0 m 0 s
	Engine Smoke Limiting	0 m 0 s
	Engine Smoke Limiting Off	0 m 0 s
	Engine Warming	0 h 0 m 0 s
	Engine Cooling	0 h 0 m 0 s
	Engine Overspeed Overshoot	0 m 0 s
	Engine Fail To Stop Delay	0 m 0 s
	Battery Under Voltage Warning Delay	0 h 0 m 0 s
	Battery Over Voltage Warning Delay	0 h 0 m 0 s
	Return Delay	0 h 0 m 0 s
	Mains Transient Delay	0 s
	Mains Transfer Time	0 s
	Mains Over Zero Seq Volt Delay	0.0 s
	Mains Under Pos Seq Volt Delay	0.0 s
	Mains Over Neg Seq Volts Delay	0.0 s
	Mains Asymmetry High Delay	0.0 s
	Gen Over Zero Seq Volt Delay	0.0 s
	Gen Under Pos Seq Volt Delay	0.0 s
	Gen Over Neg Seq Volts Delay	0.0 s
	Gen Asymmetry High Delay	0.0 s
Schedule	Schedule	Active / Inactive
	Schedule Bank 1 Period	Weekly / Monthly,
	Island / Parallel / Off Load / Auto Start Inhibit, Week, Start Time, Run Time, and Day. Selection (1 to 8)	Press the ***Tick*** ✓ button to begin editing then up or down when selecting the different parameters.
	Schedule Bank 2 Period	Weekly / Monthly,
	Island / Parallel / Off Load / Auto Start Inhibit, Week, Start Time, Run Time, and Day. Selection (1 to 8)	Press the ***Tick*** ✓ button to begin editing then up or down when selecting the different parameters.

8.2 'RUNNING' CONFIGURATION EDITOR

8.2.1 ACCESSING THE 'RUNNING' CONFIGURATION EDITOR

NOTE: Depending upon module configuration, some parameters in the 'Running' Editor may not be available. For more information refer to DSE publication *057-322 DSEG8600 Configuration Suite PC Software Manual* available from www.deepseaelectronics.com

- The *'Running' Configuration Editor* is accessible without stopping the engine. All protections remain active whilst using the '*'Running' Configuration Editor*.
- Press the ***Next Page***  button to access the Main Menu page.
- Press the ***Previous Page***  button followed by either the ***Scroll***  buttons or the ***Next Page*** or ***Previous Page***  buttons to locate the *'Running' Configuration Editor.*

8.2.2 ENTERING PIN

Even if a module security PIN has been set, the PIN is not requested whilst entering the *'Running' Configuration Editor*

8.2.3 EDITING A PARAMETER

NOTE: Pressing and holding the *Menu Navigation* buttons provides the auto-repeat functionality. Values are changed quickly by holding the navigation buttons for a prolonged period.

- Press the ***Next Page*** or ***Previous Page***  buttons to cycle to the section to view/change.
- Press the ***Scroll***  buttons to select the parameter to view/change within the currently selected section.
- To edit the parameter, press the ***Tick***  button to enter edit mode. The parameter begins to flash to indicate editing.
- Press the ***Scroll***  buttons to change the parameter to the required value.
- Press the ***Tick***  button to save the value. The parameter ceases flashing to indicate that it has been saved.

8.2.4 EXITING THE 'RUNNING' CONFIGURATION EDITOR

NOTE: The editor automatically exits after the *Page Timer* expires (default 5 minutes) to ensure security.

- Press and hold the ***Tick***  button to exit the editor and save the changes.

8.2.5 'RUNNING' CONFIGURATION EDITOR PARAMETERS

Section	Parameter As Shown On Display	Values
Display Settings	Contrast	75 %
	Units Pressure	kPa, bar, psi
	Units Temperature	°C, ° F
	Units Volume	Litres. Imp gal. Us gal
	Language	English, Other
Synchronising	Commissioning Screen	Active / Inactive
	Override Starting Alarms	Active / Inactive
	Voltage Adjust (Manual Mode Only With Generator Running and Breaker Open)	0 %
	Frequency Adjust (Manual Mode Only With Generator Running and Breaker Open)	0 %
Load Control	Injection Port	Activity Timer Countdown (1 Hour) / Inactive
	Mains Decoupling Test Mode	Active / Inactive
	Power Control Mode	Constant Power / Frequency-Power / Voltage-Power
	Load Parallel Power	0 %
	kvar Control Mode	Constant Power Factor / Voltage-Reactive Power / Power-Power Factor / Constant Reactive Power
	Load Parallel kvars	0 %
	Load Parallel PF	0.00 pf
	Governor Droop Offset	0%
	Governor Ramp Rate	0%
	AVR Droop Offset	0%
	AVR Ramp Rate	0%
	Load Priority	1-64

9 COMMISSIONING

NOTE: If satisfactory operation cannot be achieved, despite repeated checking of the connections between the module and the system, then contact DSE Technical Support Department: support@deepseaelectronics.com

9.1 BASIC CHECKS

NOTE: If Emergency Stop feature is not required, link the input to the DC Positive.

Before the system is started, it is recommended that the following checks are made:

1. The unit is adequately cooled and all the wiring to the module is of a standard and rating compatible with the system. Check all mechanical parts are fitted correctly and that all electrical connections (including earths) are sound.

2. The unit DC supply is fused and connected to the battery and that it is of the correct polarity.

3. The Emergency Stop input is wired to an external normally closed switch connected to DC positive.

4. To check the start cycle operation, take appropriate measures to prevent the engine from starting (disable the operation of the fuel solenoid). After a visual inspection to ensure it is safe to proceed, connect the battery supply. Press the ***Start*** button the unit start sequence commences.

5. The starter engages and operates for the pre-set crank period. After the starter motor has attempted to start the engine for the pre-set number of attempts, the LCD displays *Failed to Start*. Press the ***Stop/Reset Mode*** button to reset the unit.

6. Restore the engine to operational status (reconnect the fuel solenoid). Press the ***Start*** button. This time the engine is expected to start, and the starter motor is expected to disengage automatically. If not then check that the engine is fully operational (fuel available, etc.) and that the fuel solenoid is operating. The engine must now run up to operating speed. If not, and an alarm is present, check the alarm condition for validity, then check input wiring. The engine is expected to continue running for an indefinite period. It is possible currently to view the engine and alternator parameters - refer to the 'Description of Controls' section of this manual.

7. Press the ***Mode*** button to run ***Auto Mode*** AUTO, the engine is expected to run for the pre-set cooling down period and then stop. The generator is expected to stay in standby mode. If it does not, check that the *Remote Start* input is not active.

8. Initiate an automatic start by supplying the remote start signal (if configured). The start sequence commences, and the engine runs up to operational speed. Once the generator is available the delayed load outputs (after *Load Timer* delay) activate, and the Generator accepts the load. If not, check the wiring to the delayed load output contactors. Check the Warming timer has timed out.

9. Remove the remote start signal. The return sequence begins. After the return delay time, the generator is unloaded. The generator then runs for the pre-set cooling down period, then shutdown into its standby mode.

10. Set the modules internal clock/calendar to ensure correct operation of the scheduler and event logging functions. For details of this procedure see the section entitled *Front Panel Configuration* elsewhere in this document.

9.2 DSE 4 STEPS TO SUCCESSFUL SYNCHRONISING SINGLE SET MODE

Synchronising and load sharing is often considered to be a complex subject. In fact, it is quite simple when broken down into smaller steps.

After following the *Commissioning* section of this manual, the *DSE 4 Steps* **must** be followed before any parallel operation is attempted.

The following information covers the DSE 4 Steps to Successful Synchronising in full detail and must be completed on the generator.

Once in parallel, further commissioning may be required to fine tune the Gain (P), Stability (I) and Derivative (D) of the governor/AVR and DSE module.

9.2.1 CONTROL

CAUTION!: Failure to perform the *Control* steps results in poor control over the engine and alternator. This causes long and unstable synchronising as well as unstable kW and kvar load sharing.

NOTE: For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*

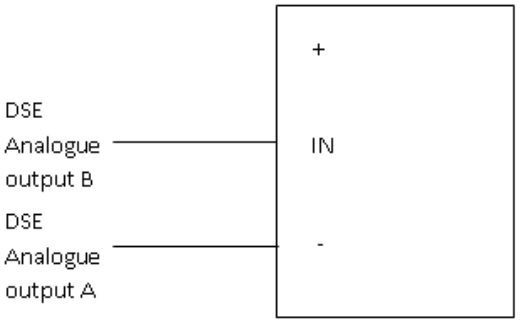
Continued overleaf…

9.2.1.1 DETERMINING CONNECTIONS AND SETTINGS FOR GOVERNORS

Setting up the Governor (Adjustment of SW1 and SW2)

Preparation Steps

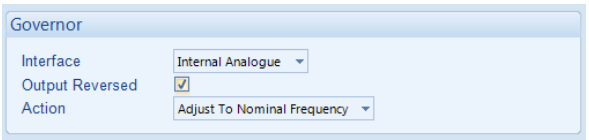
1. Ensure inputs are configured for "*Mains Load Inhibit*" and "*Generator Load Inhibit*."
2. Ensure that the generator is connected to a **dead bus bar with no loads** connected, and the mains breaker is open.
3. With the generator breaker open, set the generator to run at the **Nominal Frequency** without the DSE module connected to the Governor. To achieve this, the settings on the governor require adjusting.
4. Connect the DSE module to the Governor once completed. The DSE controller connects only to the "-" and "IN" terminals and provides the varying DC voltage to simulate the turning of a potentiometer. The Analogue output terminals of the DSE controller are connected as follows. Note that the "+" terminal of the governor is left unconnected.



5. With the generator stationary, adjust the Governor SW1 setting to 10 and measure the voltage across the "-" and "IN" governor terminals. Assuming the sensing probes had the correct polarity, a reading of +5 V needs to be present across the "-" and "IN" governor terminals. If this is not the case, check the polarity of the wiring and sensing probes.
6. Once successful, reset the Governor SW1 setting back to 0.

Adjustment of Governor SW1 (Sync Options)

7. **Ensure the inputs configured for "*Mains Load Inhibit*" and "*Generator Load Inhibit*" are active.**
8. Start the generator and ensure that the breaker is left open.
9. Check the direction of drive by increasing and decreasing SW1. If the frequency increases whilst SW1 is being decreased tick the option 'Output Reversed'. If moving SW1 does not change the frequency, check the wiring to the governor for faults or, ensure the *Enhanced J1939* option is enabled, and the *CAN Source Address* is correct within the module when connected to an ECU.

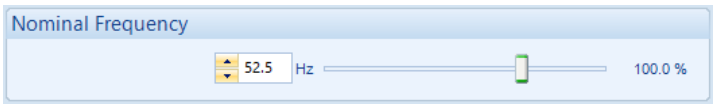


10. Adjust the SW1 setting for the Governor until the generator runs at **Nominal Frequency (50 Hz or 60 Hz)**
11. Stop the generator. SW1 is now complete and must not be adjusted further.

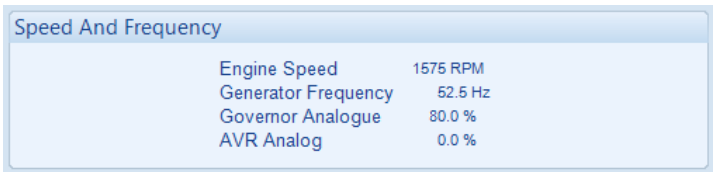
Adjustment of Governor SW2

NOTE: If it is not possible to achieve ±2.5 Hz adjustment with the governor, contact DSE Technical Support for further advice: support@deepseaelectronics.com

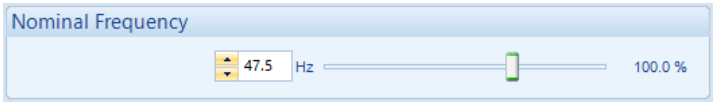
12. **Ensure the input configured for "*Mains Load Inhibit*" is active, but the input configured for "*Generator Load Inhibit*" is not active.**
13. Increase the setting of the Nominal Frequency by **2.5 Hz** (52.5 Hz or 62.5 Hz).



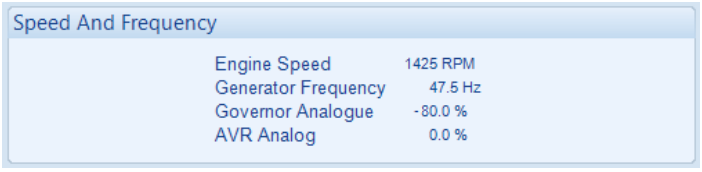
14. Start the generator. With the breaker open, the generator runs at the setting of SW1 (50 Hz or 60 Hz).
15. Once the generator is detected as available, close the generator breaker onto a **DEAD BUS BAR WITH NO LOADS** connected. The generator frequency shall start to increase towards the new Nominal Frequency setting (52.5 Hz or 62.5 Hz); however, it may not achieve this.
16. Adjust SW2 until the frequency increases to the new Nominal Frequency (52.5 Hz or 62.5 Hz).
17. Keep adjusting SW2 further to ensure Governor Drive reads between **75% to 85%**, the sign of the drive (+ or - percentage) does not matter. If the Governor Drive is between 100% and 85%, increase the SW2 setting until the Governor Drive reads ideally 80%. If the Governor Drive is between 75% and 0%, decrease the SW2 setting until the Governor Drive reads ideally 80%.



18. Open the generator breaker and stop the generator.
19. Decrease the setting of the Nominal Frequency by **2.5 Hz** (47.5 Hz or 57.5 Hz).



20. Start the generator. With the breaker open, the generator runs at the setting of SW1 (50 Hz or 60 Hz).
21. Once the generator is detected as available, close the generator breaker onto a **DEAD BUS BAR WITH NO LOADS** connected. The generator frequency shall start to decrease towards the new Nominal Frequency (47.5 Hz or 57.5 Hz).
22. SW2 is then adjusted further to ensure Governor Drive reads within **75% to 85%**, the sign of the drive (+ or - percentage) does not matter. If the Governor Drive is between 100% and 85%, increase the SW2 setting until the Governor Drive reads ideally 80%. If the Governor Drive is between 75% and 0%, decrease the SW2 setting until the Governor Drive reads ideally 80%.
    NOTE: Any change made to the driving down percentage changes the driving up percentage. For example, if the driving down percentage is increased by 5% (70% to 75%), the driving up percentage increases by 5% (80% to 85%).



23. Change the setting of the Nominal Frequency back to the actual Nominal Frequency (50 Hz or 60 Hz).

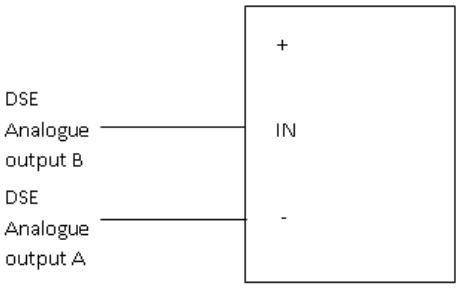
9.2.1.2 DETERMINING CONNECTIONS AND SETTINGS FOR AVRS

NOTE: Determining the settings of SW1 and SW2 for the AVR MUST only be done once the setup for SW1 and SW2 for the governor has been complete. Changing engine speed affects the level of voltage produced.

Setting up the AVR (Adjustment of SW1 and SW2)

Preparation Steps

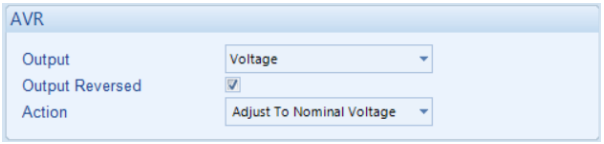
1. **Ensure inputs are configured for "*Mains Load Inhibit*" and "*Generator Load Inhibit*."**
2. Ensure that the generator is connected to a **DEAD BUS BAR WITH NO LOADS** connected, and the Mains breaker is open.
3. With the generator breaker open, set the generator to run at the **Nominal Voltage** without the DSE module connected to the AVR. The settings on the AVR require adjusting for this to be achieved.
4. Stop the generator and connect the DSE module to the AVR. The DSE controller connects only to the "-" and "IN" terminals and provides the varying DC voltage to simulate the turning of a potentiometer. The Analogue output terminals of the DSE controller are connected as follows. Note that the "+" terminal of the AVR is left unconnected.



5. With the generator stationary, adjust the AVR SW1 setting to 10 and measure the voltage across the "-" and "IN" AVR terminals. Assuming the sensing probes had the correct polarity, a reading of +5 V needs to be present across the "-" and "IN" governor terminals. If this is not the case, check the polarity of the wiring and sensing probes.
6. Once successful, reset the AVR SW1 setting back to 0.

Adjustment of AVR SW1 (Sync Options)

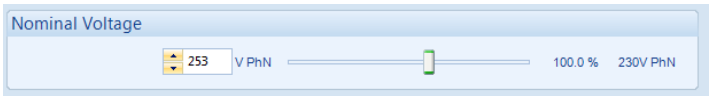
7. **Ensure the inputs configured for "*Mains Load Inhibit*" and "*Generator Load Inhibit*" are active.**
8. Start the generator and ensure that the breaker is left open.
9. Check the direction of drive by increasing and decreasing SW1. If the voltage increases whilst SW1 is being decreased tick the option 'Output Reversed'. If moving SW1 does not change the voltage, check the wiring to the AVR for faults.



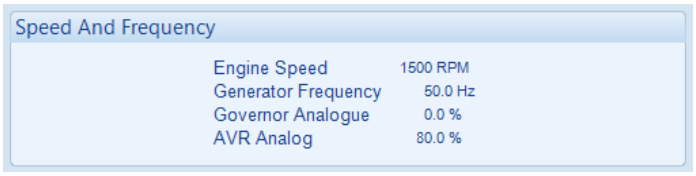
10. Adjust the SW1 setting for the AVR until the generator runs at **Nominal Voltage (230V for example).**
11. Stop the generator. SW1 is now complete and must not be adjusted further.

Adjustment of AVR SW2

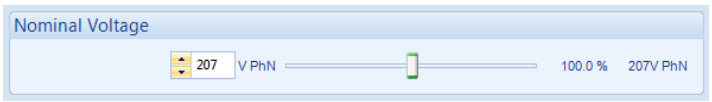
12. **Ensure the input configured for "*Mains Load Inhibit*" is active, but the input configured for "*Generator Load Inhibit*" is not active.**
13. Increase the setting of the Nominal Voltage by 10% (230 V to 253 V for example).



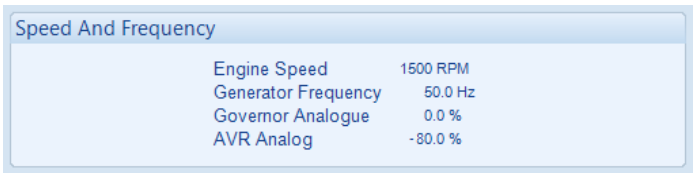
14. Once the generator is detected as available, close the generator breaker onto a **DEAD BUS BAR WITH NO LOADS** connected. The generator voltage shall start to increase towards the new Nominal Voltage setting (+10% [253 V for example]), however it may not achieve this.
15. Adjust SW2 to until the voltage increases to the new Nominal Frequency ((+10% [253 V for example]).
16. Keep adjusting SW2 further to ensure AVR Drive reads between **75% to 85%**, the sign of the drive (+ or - percentage) does not matter. If the AVR Drive is between 100% and 85%, increase the SW2 setting until the AVR Drive reads ideally 80%. If the AVR Drive is between 75% and 0%, decrease the SW2 setting until the AVR Drive reads ideally 80%.



17. Open the generator breaker and stop the generator.
18. Decrease the setting of the Nominal Voltage by **10%** (230 V to 207 V for example).



19. Start the generator. With the breaker open the generator runs at setting of SW1 (230V for example).
20. Once the generator is detected as available, close the generator breaker onto a **DEAD BUS BAR WITH NO LOADS** connected. The generator voltage shall start to decrease towards the new Nominal Voltage ((-10% [207 V for example])
21. SW2 is then adjusted further to ensure AVR Drive reads within **75% to 85%**, the sign of the drive (+ or - percentage) does not matter. If the AVR Drive is between 100% and 85%, increase the SW2 setting until the AVR Drive reads ideally 80%. If the AVR Drive is between 75% and 0%, decrease the SW2 setting until the AVR Drive reads ideally 80%.
    NOTE: Any change made to the driving down percentage changes the driving up percentage. For example, if the driving down percentage is increased by 5% (70% to 75%), the driving up percentage increases by 5% (80% to 85%).



22. Change the setting of the Nominal Voltage back to the actual Nominal Voltage (230 V for example).

9.2.2 METERING

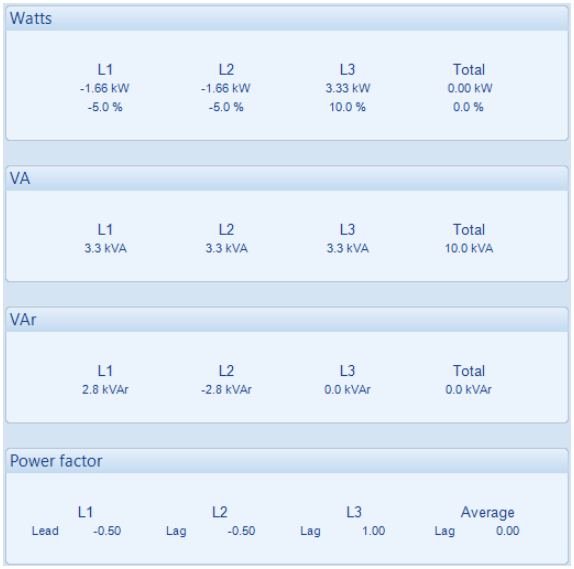
WARNING!: Do not disconnect the CT wires from the DSE module when the CTs are carrying current. Disconnection open circuits the secondary of the CT's and dangerous voltages may then develop. Always ensure the CTs are not carrying current and the CTs are short circuit connected before making or breaking connections to the module.

CAUTION!: Failure to perform the Metering steps results in incorrect power factor and kW calculations leading to problems with kW and kvar load sharing if not corrected.

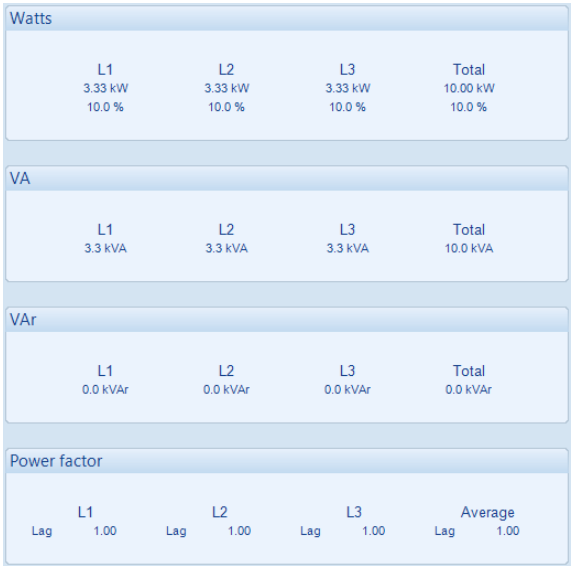
9.2.2.1 GENERATOR CTS ON THE RIGHT PHASE

Check to ensure that the CTs on L1, L2 & L3 are connected to their respective connection on the DSE module.

1. Ensure that bus is not live, the mains breaker is open, and the *Mains Load Inhibit* digital input is active.
2. Start the generator and once available, close the generator breaker.
3. Apply purely resistive load (around 10% of the generator's size) across the three phases.
4. If the CTs on L1, L2 & L3 are wired to the correct terminals on the module, it displays unity power factor (1.0 pf) across all three phases. If unity power factor (1.0 pf) is not displayed across all three phases, the CTs have been wired to the wrong phases on the module.



Cables from the CTs on L1 and L2 are swapped over at the module's terminals.



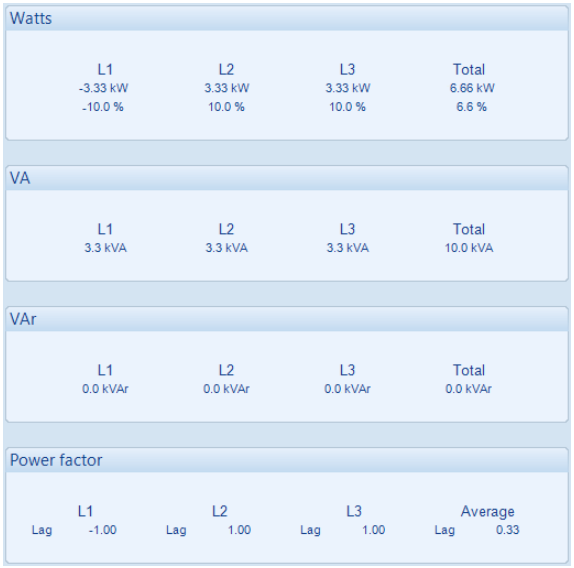
Cables from the CTs on L1 and L2 are connected correctly to module's terminals.

9.2.2.2 GENERATOR CTS IN THE RIGHT DIRECTION

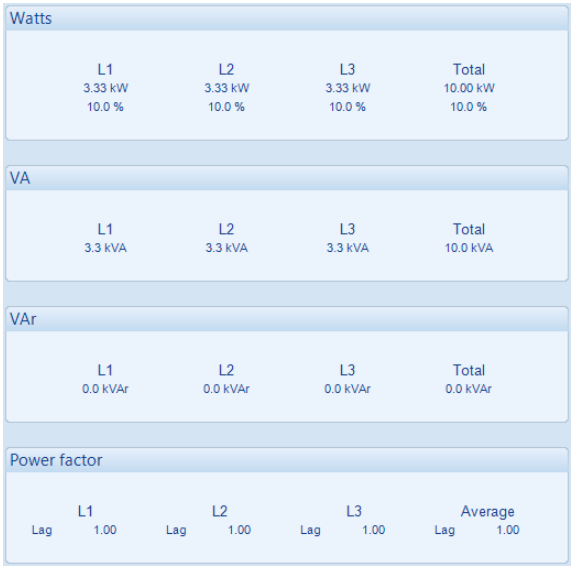
NOTE: Checking that the CTs are on the right phase MUST be completed prior to checking if the CTs are in the correct direction. CTs on the wrong phase also cause negative kWs.

Check to ensure that the CTs on L1, L2 & L3 have been mounted for the correct orientation for current flow and that the S1 and S2 have not been swapped over.

1. Ensure that the CTs are connected on the correct phase by performing the previous test.
2. Ensure that bus is not live, the mains breaker is open, and the *Mains Load Inhibit* digital input is active.
3. Start the generator and once available, close the generator breaker.
4. Apply purely resistive load (around 10% of the generator's size) across the three phases.
5. If the CT's S1 and S2 are wired correctly to the DSE module, it displays positive kW. If negative kWs is displayed, the CTs' s1 and s2 have been swapped around.



The CT on L1 has been mounted with the incorrect orientation, or the s1 and s2 connections on the CT have been swapped over.

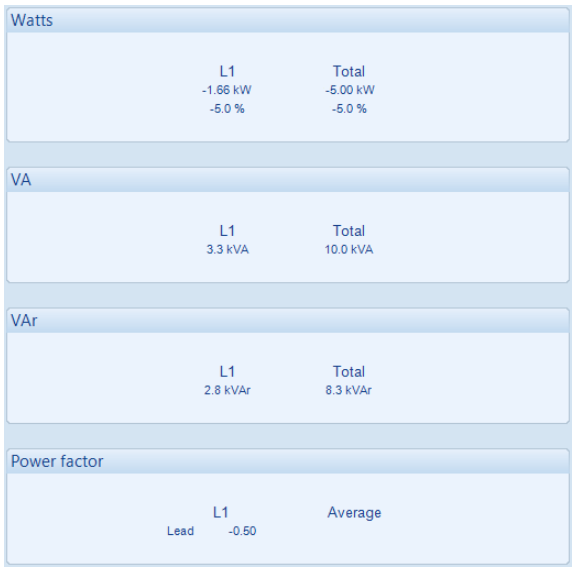


The CT on L1 has been mounted and wired correctly.

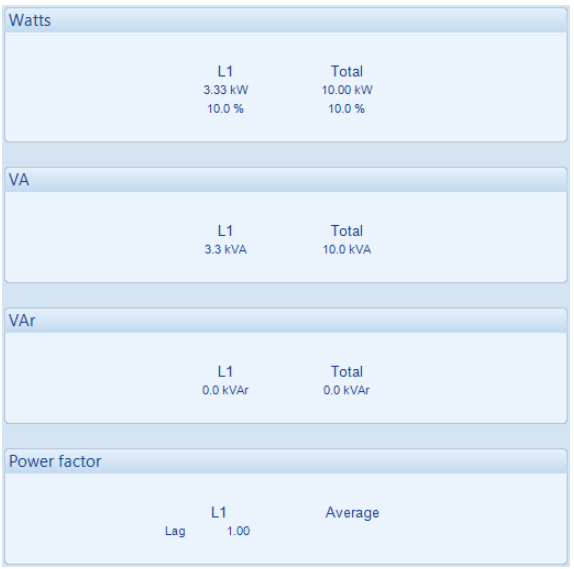
9.2.2.3 MAINS CT ON THE RIGHT PHASE (SINGLE SET ONLY)

Check to ensure that the Mains CT is on phase L1 of the mains (utility) supply.

1. Ensure that generator breaker is open, close the mains breaker when it is available.
2. Apply purely resistive load across the three phases of the mains (utility).
3. If the Mains CT is on L1 and wired correctly on the module, it displays unity power factor (1.0 pf) on L1. If unity power factor (1.0 pf) is not displayed on L1, the CT has been installed on a wrong phase of the mains supply.



The mains CT is on a wrong phase of the mains supply.



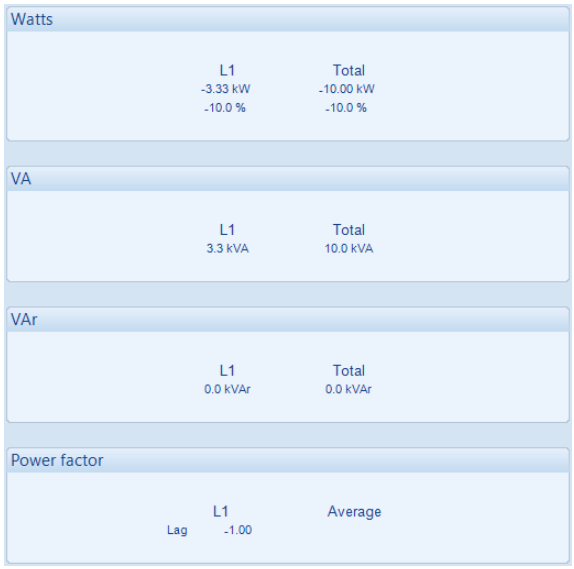
The mains CT is correctly connected to L1 of the mains supply.

9.2.2.4 MAINS CT IN THE RIGHT DIRECTION

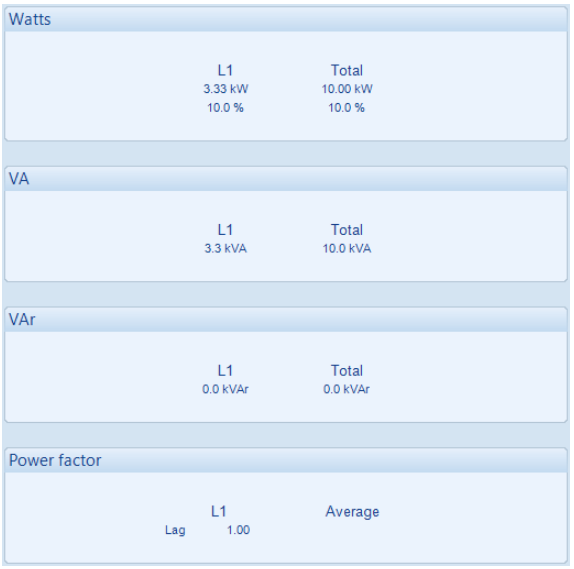
NOTE: Checking that the CT is on the right phase MUST be completed prior to checking if the CT is in the correct direction.

Check to ensure that the Mains CT on L1 has been mounted for the correct orientation for current flow and that the S1 and S2 have not been swapped over.

1. Ensure that the Mains CT is connected on the correct phase (L1) by performing the previous test.
2. Ensure that generator breaker is open.
3. Close the Mains breaker.
4. Apply purely resistive load across L1 phase of the Mains.
5. If the CT's S1 and S2 are wired correctly to the DSE module, it displays positive kW. If negative kW is displayed, the CT' s1 and s2 have been swapped around.



The mains CT on L1 has been mounted with the incorrect orientation, or the s1 and s2 connections on the CT have been swapped over.



The CT on mains L1 has been mounted and wired correctly.

9.2.3 COMMUNICATIONS

NOTE: The Step 3 (Communications) of the *Four Steps to Successful Synchronisation* is not applicable on DSEG8600 modules configured as a Single Set. However, it is applicable to DSEG8600 modules configured as *Multi Set*.

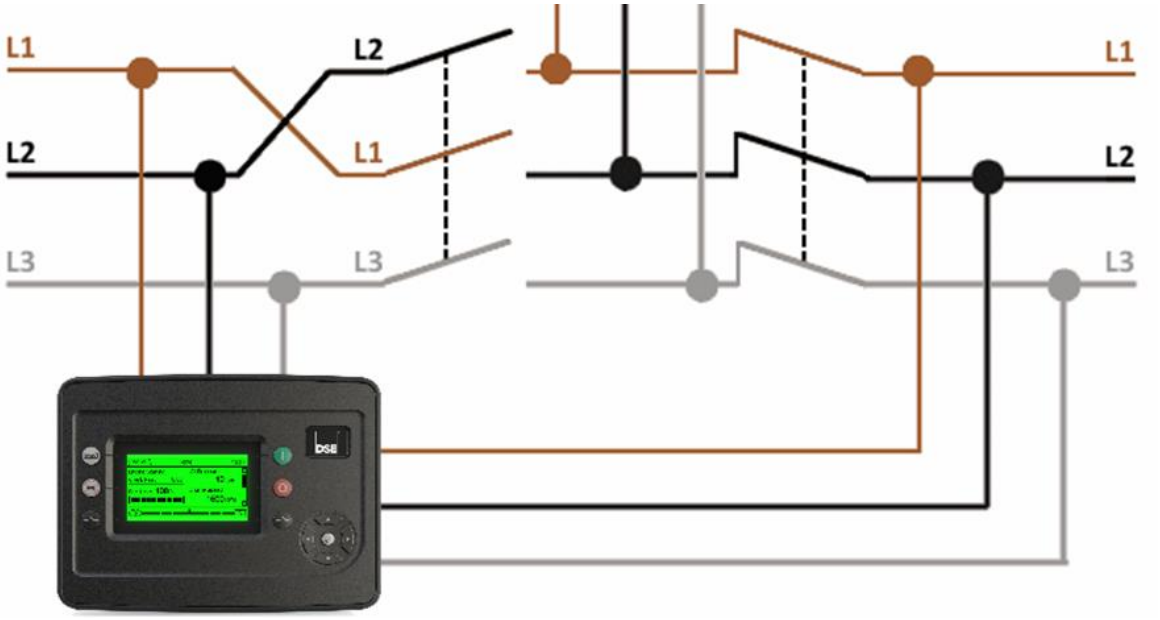
Check to ensure that all the modules are connected are communicating correctly on the AMSC link and Redundant AMSC (if used).

Please refer to the section entitled *AMSC (Multi Set*) elsewhere in this document.

9.2.4 SYNC CHECKS

⚠CAUTION!: Failure to perform the Sync Check steps results in severe damage to the system (breakers, bus bars, alternators, engines etc) caused by out of sync closures.

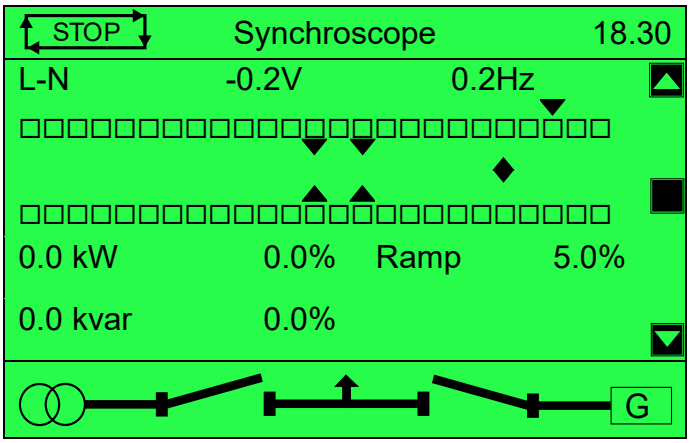
Check to ensure that all the module's sensing cables have been connected to the correct phases and that the generator's load switch has been correctly connected. Failing to perform such tests may lead to the DSE module sensing both sides of the breaker as in sync

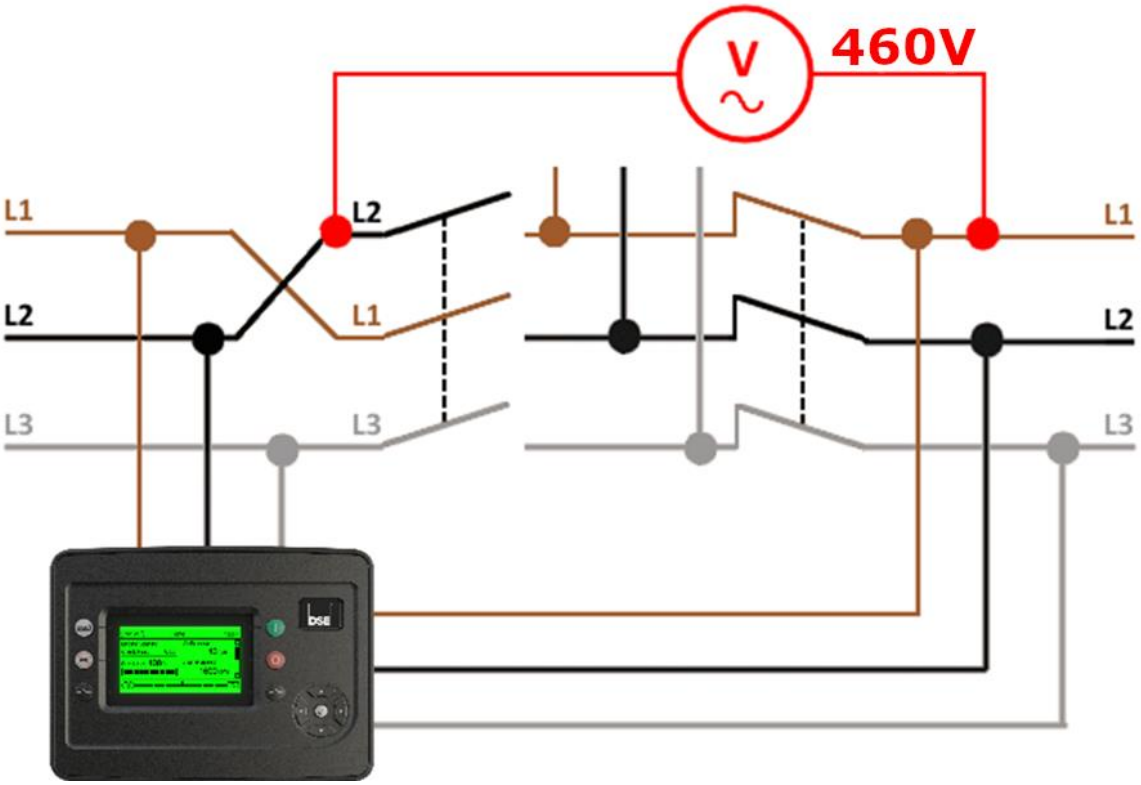


This is tested by starting the generator with the DSE module and ensuring the generator load switch is left open (activate an input configured for *Generator Load Inhibit*). Then the load side is to be made live, this is achieved by closing the mains load switch. Across the open load switch, connect a voltage meter to measure the AC voltage when the DSE module shows the two supplies in sync.

9.2.4.1 INCORRECTLY WIRED BREAKER

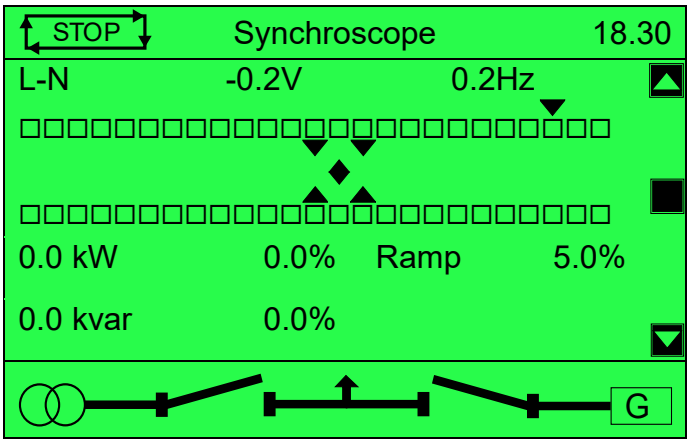
When the DSE module's synchroscope shows the two supplies in sync, if the voltage meter shows a voltage difference, then the breaker is wired incorrectly. This is shown in the example below.

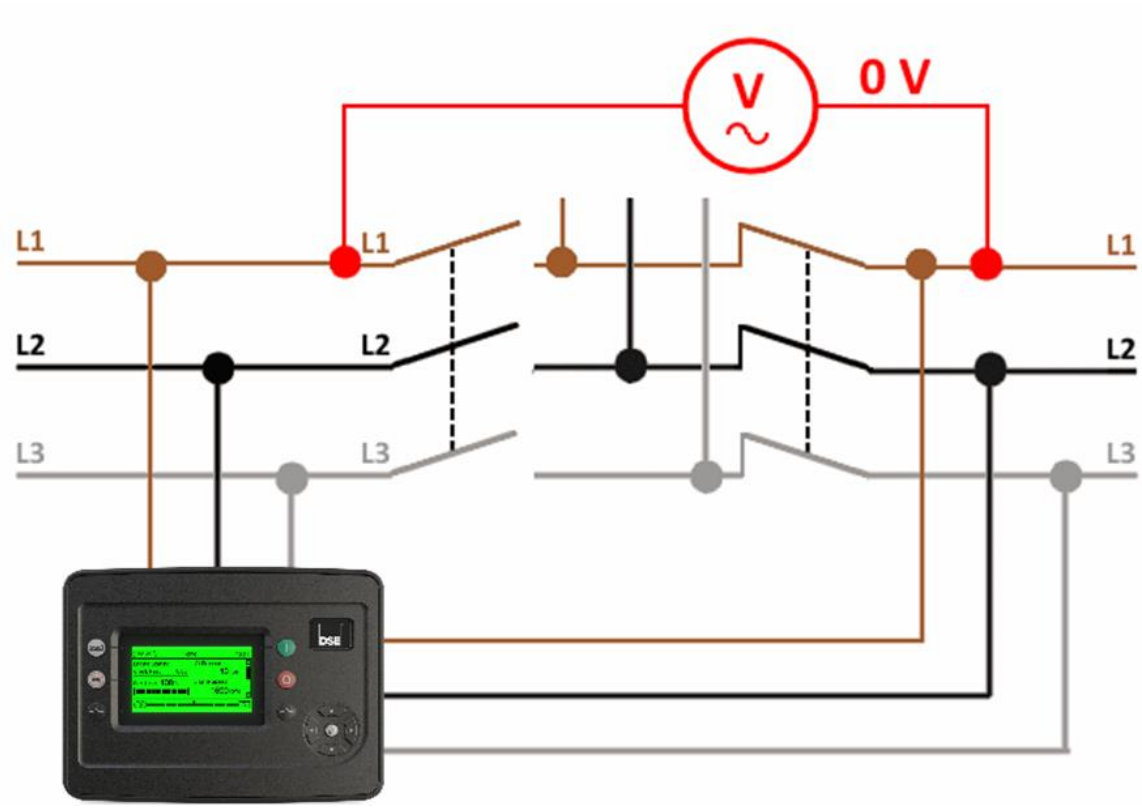




9.2.4.2 CORRECTLY WIRED BREAKER

When the DSE module's synchroscope shows the two supplies in sync, if the voltage meter shows no voltage difference the breaker is wired correctly. This is shown in the example below.





9.3 DSE 4 STEPS TO SUCCESSFUL SYNCHRONISING MULTI SET MODE

Synchronising and load sharing is often considered to be a complex subject. In fact, it is quite simple when broken down into smaller steps.

After following the *Commissioning* section of this manual, the *DSE 4 Steps* **must** be followed before any parallel operation is attempted.

The following information covers the DSE 4 Steps to Successful Synchronising in full detail and must be completed on the generator.

Once in parallel, further commissioning may be required to fine tune the Gain (P), Stability (I) and Derivative (D) of the governor/AVR and DSE module.

9.3.1 CONTROL

CAUTION!: Failure to perform the *Control* steps results in poor control over the engine and alternator. This causes long and unstable synchronising as well as unstable kW and kvar load sharing.

NOTE: For further details of module configuration, refer to DSE Publication: *057-322 DSEG8600 Configuration Suite PC Software Manual.*

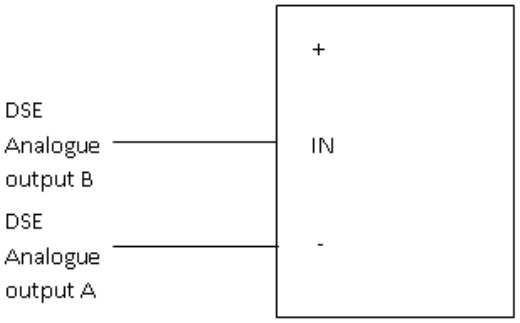
Continued overleaf…

9.3.1.1 DETERMINING CONNECTIONS AND SETTINGS FOR GOVERNORS

Setting up the Governor (Adjustment of SW1 and SW2)

Preparation Steps

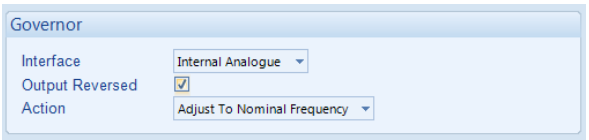
24. Ensure inputs are configured for "*Mains Load Inhibit*" and "*Generator Load Inhibit*."
25. Ensure that the generator is connected to a **dead bus bar with no loads** connected, and the mains breaker is open.
26. With the generator breaker open, set the generator to run at the **Nominal Frequency** without the DSE module connected to the Governor. To achieve this, the settings on the governor require adjusting.
27. Connect the DSE module to the Governor once completed. The DSE controller connects only to the "-" and "IN" terminals and provides the varying DC voltage to simulate the turning of a potentiometer. The Analogue output terminals of the DSE controller are connected as follows. Note that the "+" terminal of the governor is left unconnected.



28. With the generator stationary, adjust the Governor SW1 setting to 10 and measure the voltage across the "-" and "IN" governor terminals. Assuming the sensing probes had the correct polarity, a reading of +5 V needs to be present across the "-" and "IN" governor terminals. If this is not the case, check the polarity of the wiring and sensing probes.
29. Once successful, reset the Governor SW1 setting back to 0.

Adjustment of Governor SW1 (Sync Options)

30. **Ensure the inputs configured for "*Mains Load Inhibit*" and "*Generator Load Inhibit*" are active.**
31. Start the generator and ensure that the breaker is left open.
32. Check the direction of drive by increasing and decreasing SW1. If the frequency increases whilst SW1 is being decreased tick the option 'Output Reversed'. If moving SW1 does not change the frequency, check the wiring to the governor for faults or, ensure the *Enhanced J1939* option is enabled, and the *CAN Source Address* is correct within the module when connected to an ECU.

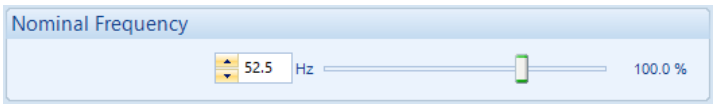


33. Adjust the SW1 setting for the Governor until the generator runs at **Nominal Frequency (50 Hz or 60 Hz)**
34. Stop the generator. SW1 is now complete and must not be adjusted further.

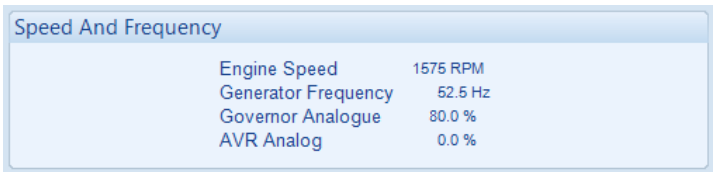
Adjustment of Governor SW2

NOTE: If it is not possible to achieve ±2.5 Hz adjustment with the governor, contact DSE Technical Support for further advice: support@deepseaelectronics.com

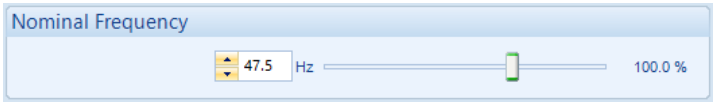
35. **Ensure the input configured for "*Mains Load Inhibit*" is active, but the input configured for "*Generator Load Inhibit*" is not active.**
36. Increase the setting of the Nominal Frequency by **2.5 Hz** (52.5 Hz or 62.5 Hz).



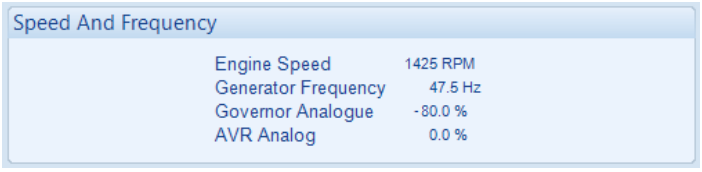
37. Start the generator. With the breaker open, the generator runs at the setting of SW1 (50 Hz or 60 Hz).
38. Once the generator is detected as available, close the generator breaker onto a **DEAD BUS BAR WITH NO LOADS** connected. The generator frequency shall start to increase towards the new Nominal Frequency setting (52.5 Hz or 62.5 Hz); however, it may not achieve this.
39. Adjust SW2 until the frequency increases to the new Nominal Frequency (52.5 Hz or 62.5 Hz).
40. Keep adjusting SW2 further to ensure Governor Drive reads between **75% to 85%**, the sign of the drive (+ or - percentage) does not matter. If the Governor Drive is between 100% and 85%, increase the SW2 setting until the Governor Drive reads ideally 80%. If the Governor Drive is between 75% and 0%, decrease the SW2 setting until the Governor Drive reads ideally 80%.



41. Open the generator breaker and stop the generator.
42. Decrease the setting of the Nominal Frequency by **2.5 Hz** (47.5 Hz or 57.5 Hz).



43. Start the generator. With the breaker open, the generator runs at the setting of SW1 (50 Hz or 60 Hz).
44. Once the generator is detected as available, close the generator breaker onto a **DEAD BUS BAR WITH NO LOADS** connected. The generator frequency shall start to decrease towards the new Nominal Frequency (47.5 Hz or 57.5 Hz).
45. SW2 is then adjusted further to ensure Governor Drive reads within **75% to 85%**, the sign of the drive (+ or - percentage) does not matter. If the Governor Drive is between 100% and 85%, increase the SW2 setting until the Governor Drive reads ideally 80%. If the Governor Drive is between 75% and 0%, decrease the SW2 setting until the Governor Drive reads ideally 80%.
    NOTE: Any change made to the driving down percentage changes the driving up percentage. For example, if the driving down percentage is increased by 5% (70% to 75%), the driving up percentage increases by 5% (80% to 85%).



46. Change the setting of the Nominal Frequency back to the actual Nominal Frequency (50 Hz or 60 Hz).

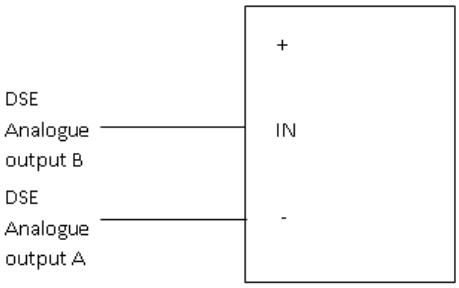
9.3.1.2 DETERMINING CONNECTIONS AND SETTINGS FOR AVRS

NOTE: Determining the settings of SW1 and SW2 for the AVR MUST only be done once the setup for SW1 and SW2 for the governor has been complete. Changing engine speed affects the level of voltage produced.

Setting up the AVR (Adjustment of SW1 and SW2)

Preparation Steps

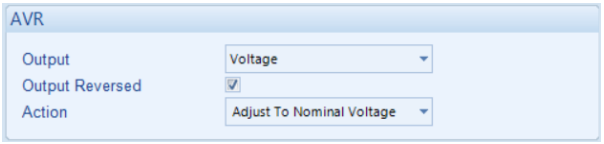
23. **Ensure inputs are configured for "*Mains Load Inhibit*" and "*Generator Load Inhibit*."**
24. Ensure that the generator is connected to a **DEAD BUS BAR WITH NO LOADS** connected, and the Mains breaker is open.
25. With the generator breaker open, set the generator to run at the **Nominal Voltage** without the DSE module connected to the AVR. The settings on the AVR require adjusting for this to be achieved.
26. Stop the generator and connect the DSE module to the AVR. The DSE controller connects only to the "-" and "IN" terminals and provides the varying DC voltage to simulate the turning of a potentiometer. The Analogue output terminals of the DSE controller are connected as follows. Note that the "+" terminal of the AVR is left unconnected.



27. With the generator stationary, adjust the AVR SW1 setting to 10 and measure the voltage across the "-" and "IN" AVR terminals. Assuming the sensing probes had the correct polarity, a reading of +5 V needs to be present across the "-" and "IN" governor terminals. If this is not the case, check the polarity of the wiring and sensing probes.
28. Once successful, reset the AVR SW1 setting back to 0.

Adjustment of AVR SW1 (Sync Options)

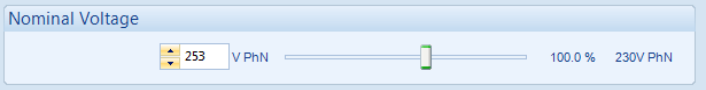
29. **Ensure the inputs configured for "*Mains Load Inhibit*" and "*Generator Load Inhibit*" are active.**
30. Start the generator and ensure that the breaker is left open.
31. Check the direction of drive by increasing and decreasing SW1. If the voltage increases whilst SW1 is being decreased tick the option 'Output Reversed'. If moving SW1 does not change the voltage, check the wiring to the AVR for faults.



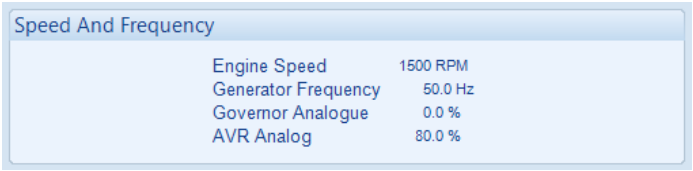
32. Adjust the SW1 setting for the AVR until the generator runs at **Nominal Voltage (230V for example).**
33. Stop the generator. SW1 is now complete and must not be adjusted further.

Adjustment of AVR SW2

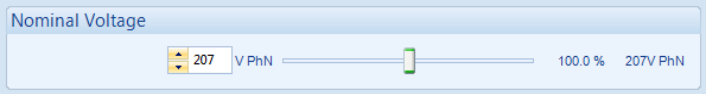
34. **Ensure the input configured for "*Mains Load Inhibit*" is active, but the input configured for "*Generator Load Inhibit*" is not active.**
35. Increase the setting of the Nominal Voltage by 10% (230 V to 253 V for example).



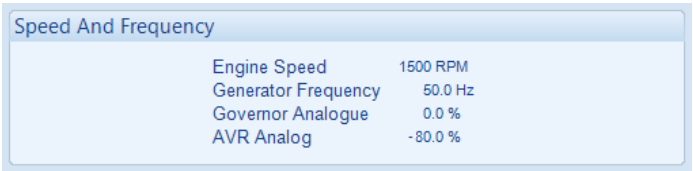
36. Once the generator is detected as available, close the generator breaker onto a **DEAD BUS BAR WITH NO LOADS** connected. The generator voltage shall start to increase towards the new Nominal Voltage setting (+10% [253 V for example]), however it may not achieve this.
37. Adjust SW2 to until the voltage increases to the new Nominal Frequency ((+10% [253 V for example]).
38. Keep adjusting SW2 further to ensure AVR Drive reads between **75% to 85%**, the sign of the drive (+ or - percentage) does not matter. If the AVR Drive is between 100% and 85%, increase the SW2 setting until the AVR Drive reads ideally 80%. If the AVR Drive is between 75% and 0%, decrease the SW2 setting until the AVR Drive reads ideally 80%.



39. Open the generator breaker and stop the generator.
40. Decrease the setting of the Nominal Voltage by **10%** (230 V to 207 V for example).



41. Start the generator. With the breaker open the generator runs at setting of SW1 (230V for example).
42. Once the generator is detected as available, close the generator breaker onto a **DEAD BUS BAR WITH NO LOADS** connected. The generator voltage shall start to decrease towards the new Nominal Voltage ((-10% [207 V for example])
43. SW2 is then adjusted further to ensure AVR Drive reads within **75% to 85%**, the sign of the drive (+ or - percentage) does not matter. If the AVR Drive is between 100% and 85%, increase the SW2 setting until the AVR Drive reads ideally 80%. If the AVR Drive is between 75% and 0%, decrease the SW2 setting until the AVR Drive reads ideally 80%.
    NOTE: Any change made to the driving down percentage changes the driving up percentage. For example, if the driving down percentage is increased by 5% (70% to 75%), the driving up percentage increases by 5% (80% to 85%).



44. Change the setting of the Nominal Voltage back to the actual Nominal Voltage (230 V for example).

9.3.2 METERING

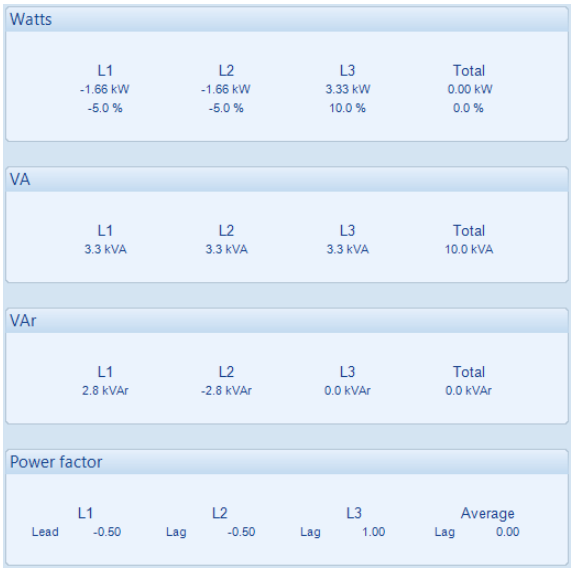
WARNING!: Do not disconnect the CT wires from the DSE module when the CTs are carrying current. Disconnection open circuits the secondary of the CT's and dangerous voltages may then develop. Always ensure the CTs are not carrying current and the CTs are short circuit connected before making or breaking connections to the module.

CAUTION!: Failure to perform the Metering steps results in incorrect power factor and kW calculations leading to problems with kW and kvar load sharing if not corrected.

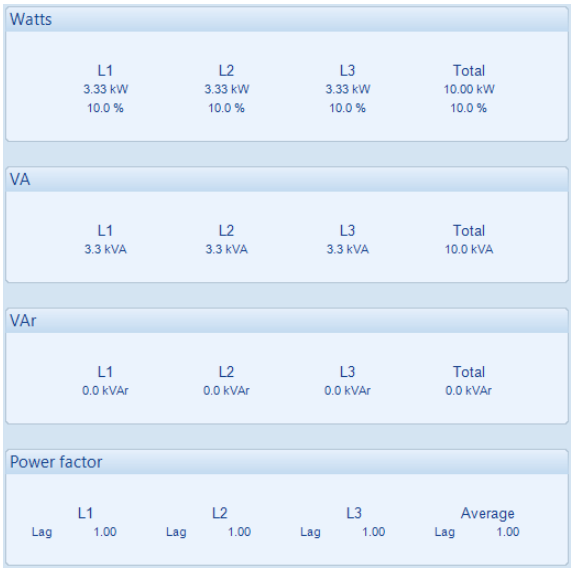
9.3.2.1 CTS ON THE RIGHT PHASE

Check to ensure that the CTs on L1, L2 & L3 are connected to their respective connection on the DSE module.

5. Ensure that generator bus is not live and the other generator's breakers are open.
6. Start the generator and once available, close the generator breaker.
7. Apply purely resistive load (around 10% of the generator's size) across the three phases.
8. If the CTs on L1, L2 & L3 are wired to the correct terminals on the module, it displays unity power factor (1.0 pf) across all three phases. If unity power factor (1.0 pf) is not displayed across all three phases, the CTs have been wired to the wrong phases on the module.



Cables from the CTs on L1 and L2 are swapped over at the module's terminals.



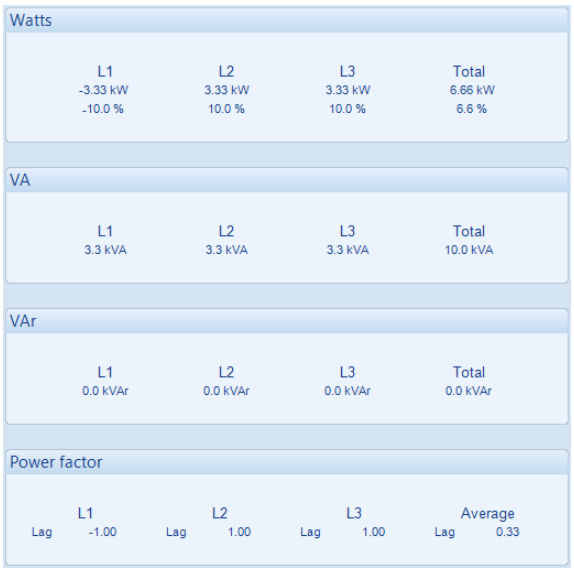
Cables from the CTs on L1 and L2 are connected correctly to module's terminals.

9.3.2.2 CTS IN THE RIGHT DIRECTION

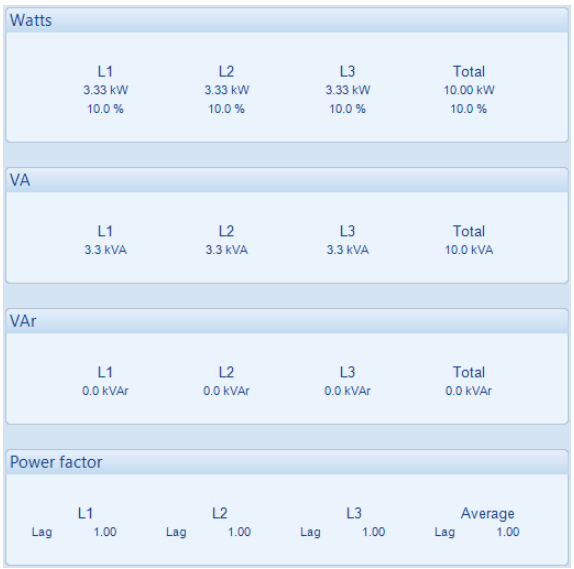
NOTE: Checking that the CTs are on the right phase MUST be completed prior to checking if the CTs are in the correct direction. CTs on the wrong phase also cause negative kWs.

Check to ensure that the CTs on L1, L2 & L3 have been mounted for the correct orientation for current flow and that the s1 and s2 have not been swapped over.

6. Ensure that the CTs are connected on the correct phase by performing the previous test.
7. Ensure that generator bus is not live and the other generator's breakers are open.
8. Start the generator and once available, close the generator breaker.
9. Apply purely resistive load (around 10% of the generator's size) across the three phases.
10. If the CT's S1 and S2 are wired to correctly to the DSE module, it displays positive kW. If negative kWs is displayed, the CTs' s1 and s2 have been swapped around.



The CT on L1 has been mounted with the incorrect orientation, or the s1 and s2 connections on the CT have been swapped over.



The CT on L1 has been mounted and wired correctly

9.3.3 COMMUNICATIONS

NOTE: The Step 3 (Communications) of the *Four Steps to Successful Synchronisation* is not applicable on DSEG8600 modules configured as a Single Set. However, it is applicable to DSEG8600 modules configured as *Multi Set*.

Check to ensure that all the modules are connected are communicating correctly on the AMSC link and Redundant AMSC (if used).

Please refer to the section entitled *AMSC (Multi Set*) elsewhere in this document.

9.3.3.1 SEGMENTING CHECKS

NOTE: Observing both the *Bus Live* LED and the *Bus Sensing Failure Alarm* is crucial during the segmenting checks.

NOTE: When a generator is started and closed onto the bus, only the controllers in the same segment display the Bus Live LED as active. This helps confirm that the segment is correctly isolated and live.

Preparation Steps

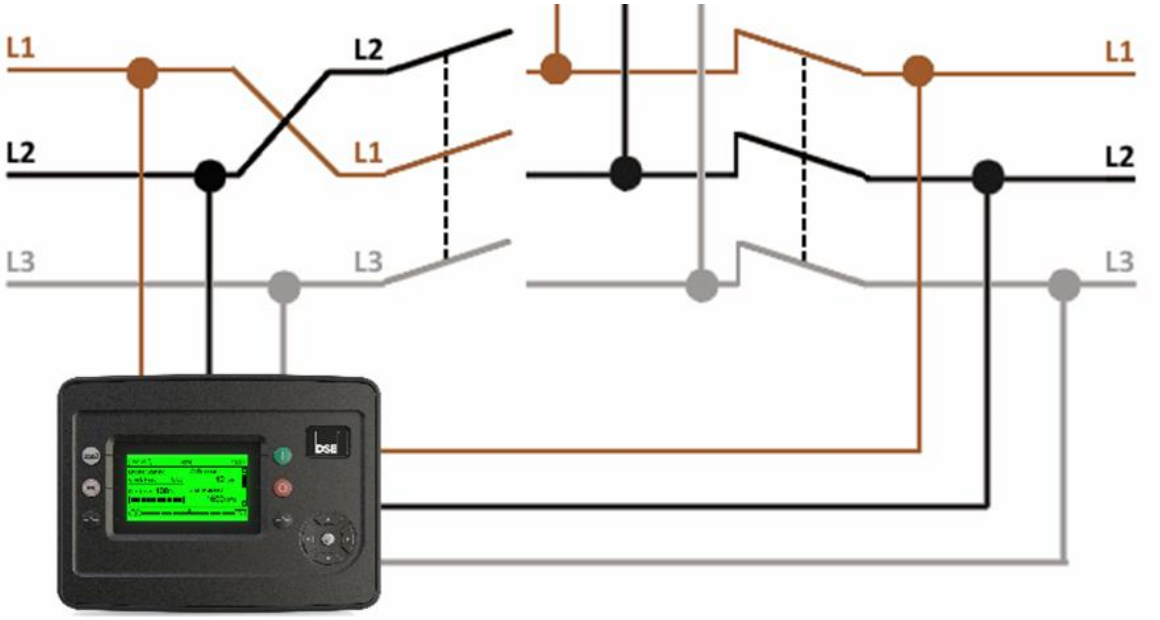
Ensure the entire system is dead, with all switchgear open.

1. Start and close one generator onto the bus. This action makes only a small section of the system live.
2. Check every side of every controller to ensure that only controllers in the same segment are live.
3. Check each controller for a bus sensing failed alarm. This alarm indicates that the controller expects the segment to be live but does not detect voltage.
4. If an alarm is present, it means either the controller has the wrong segment number or another controller with the same segment number is detecting the bus as live.
5. Fix any issues before proceeding.
6. Ensure all connected controllers correctly show the bus voltage.
7. Continue making each segment live in turn. Once a segment is verified as correct, it can be used to make the next segment live.
8. Perform checks for each segment and correct any errors before moving to the next segment.
9. During segment checks, avoid placing sources into parallel. If unavoidable, pause segment checks and perform synchronizing checks on these sources before allowing parallel operation. Resume segment checks after synchronizing checks are completed.

9.3.4 SYNC CHECKS

⚠CAUTION!: Failure to perform the Sync Check steps results in severe damage to the system (breakers, bus bars, alternators, engines etc) caused by out of sync closures.

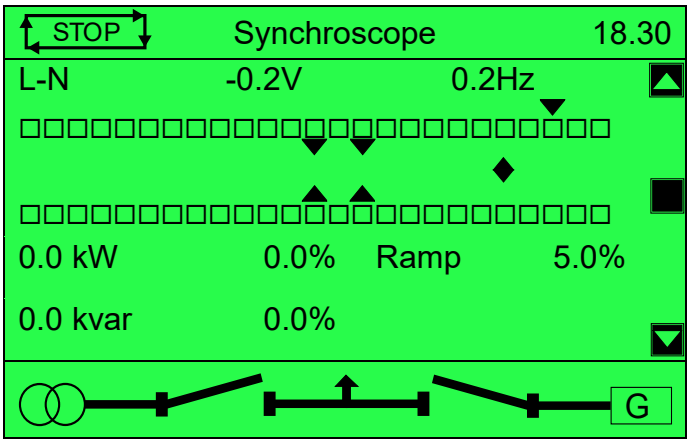
Check to ensure that all the module's sensing cables have been connected to the correct phases and that the generator's load switch has been correctly connected. Failing to perform such tests may lead to the DSE module sensing both sides of the breaker as in sync

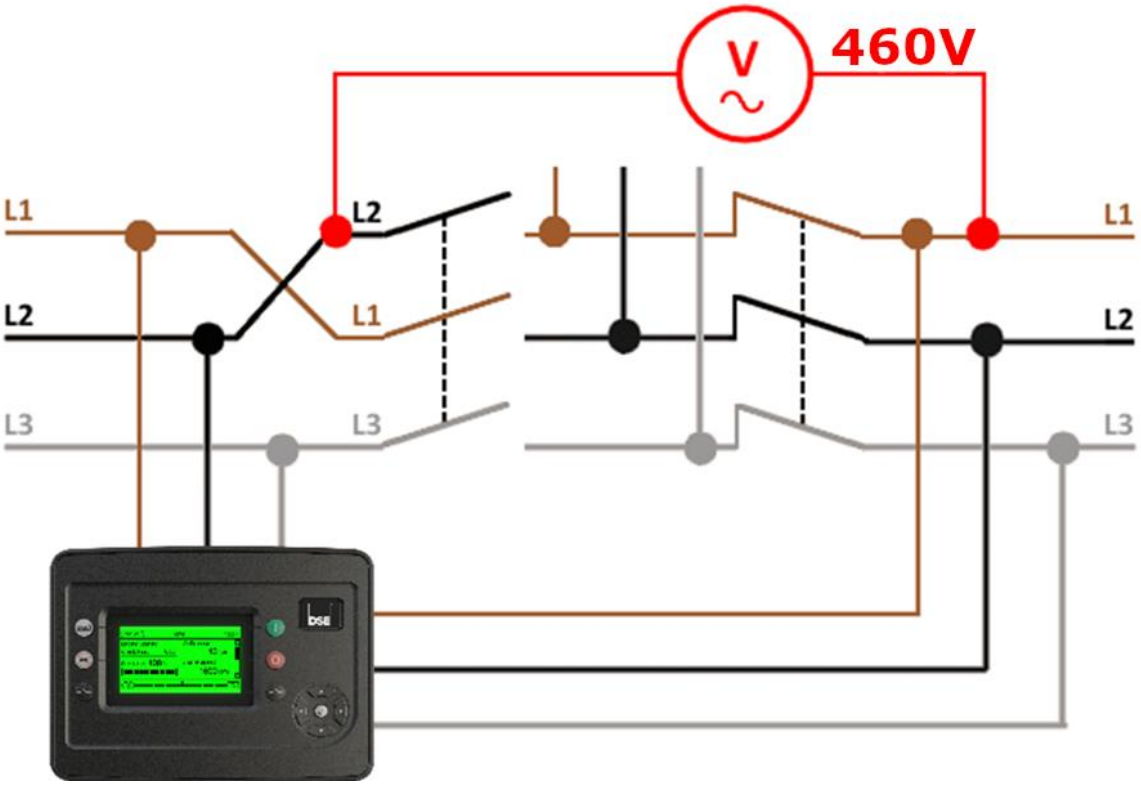


This is tested by starting the generator with the DSE module and ensuring the generator load switch is left open (activate an input configured for *Generator Load Inhibit*). Then the load side is to be made live, this is achieved by closing the mains load switch. Across the open load switch, connect a voltage meter to measure the AC voltage when the DSE module shows the two supplies in sync.

9.3.4.1 INCORRECTLY WIRED BREAKER

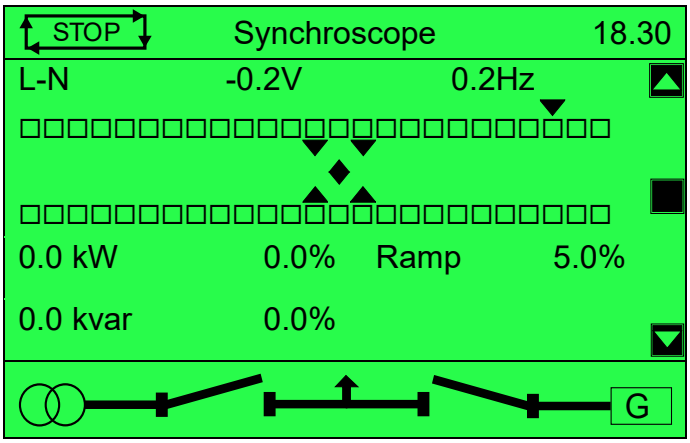
When the DSE module's synchroscope shows the two supplies in sync, if the voltage meter shows a voltage difference, then the breaker is wired incorrectly. This is shown in the example below.

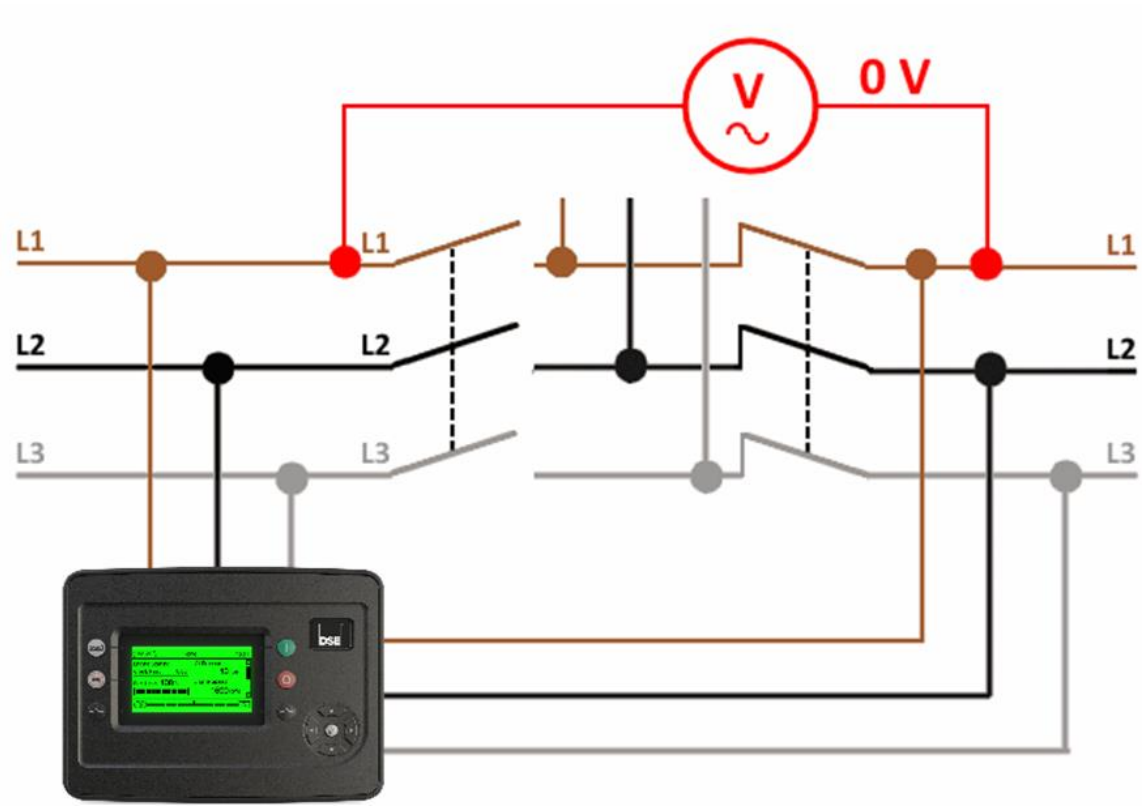




9.3.4.2 CORRECTLY WIRED BREAKER

When the DSE module's synchroscope shows the two supplies in sync, if the voltage meter shows no voltage difference the breaker is wired correctly. This is shown in the example below.





9.4 DSE STEPS TO SUCCESSFUL LOADSHARING

Synchronising and load sharing is often considered to be a complex subject. In fact, it is quite simple when broken down into smaller steps.

Before parallel operation between generators or another electrical supply is attempted, the *DSE Four Steps to Successful Synchronising* **must** be followed and completed on each of the generators.

The following information covers the *DSE Steps to Successful Load sharing*, detailing the procedure to fault find and fine tune load sharing applications.

9.4.1 EXPECTED OPERATION

It is the job of the module to make precise changes to the amount of power supplied to the resistive element (*Active Power (kW)*) and capacitive/inductive element (*Reactive Power (kvar)*) from the generator when in parallel with the mains (utility). The module controls the generator to produce the required amount of power depending on the configured *Mode* and *Load Levels* as set in the *SCADA* | *Generator* | *Load Levels* section of the DSE Configuration Suite Software. This process is displayed on the module's *Commissioning Screen,* found at the bottom of the *Generator* section of the module's display.

9.4.1.1 MAINS MODE (SINGLE SET ONLY)

In this mode, the generator is used to provide a variable amount of active power (kW) and reactive power (kvar), to maintain the mains (utility) import/export levels at the configured *Load Levels* values. The generator starts when the active power (kW) taken from the mains (utility) exceeds the *kW Maximum Level* and a digital input configured for *Remote Start on Load* is active.

In the example below, the *kW Maximum Level* has been configured at 80 % and the *kvar Maximum Level* has been configured at 42 %. Hence, the value of the mains target (tgt) kW is 80% and the value for the mains target (tgt) kvar is 40%. As the active load (kW) has exceeded 80 % of the mains rating, the generator was started. Once in parallel, the module derives a generator target kW and kvar value. The generator target kW and kvar values vary depending on the actual load to ensure the Mains Actual kW and kvar values are held at the Mains Target kW and kvar values.

In a correctly commissioned system with a steady load, the actual kW/kvar percentage would be within ±1 % of the target kW/kvar percentage. The module achieves this by adjusting the *Gov* percentage to affect kWs and the *AVR* percentage to affect kvars. Typical magnitudes of the *Gov* and *AVR* percentage at full load, with the switchgear closed and running in parallel are as follows:

- No more than 10% when there is no external droop enabled
- No more than 30% when external droop is enabled

If the generator target kW/kvar percentage is fluctuating due to a rapidly mains target kW/kvar percentage, it suggests that the *Mains Stability Timer* needs increasing to average out fluctuations in load.

If the generator actual kW/kvar percentage is not within ±1 % of the generator target kW/kvar percentage when they are not changing with a steady load, it suggests that the *Gain (P)* and *Stability (I)* settings need adjusting.

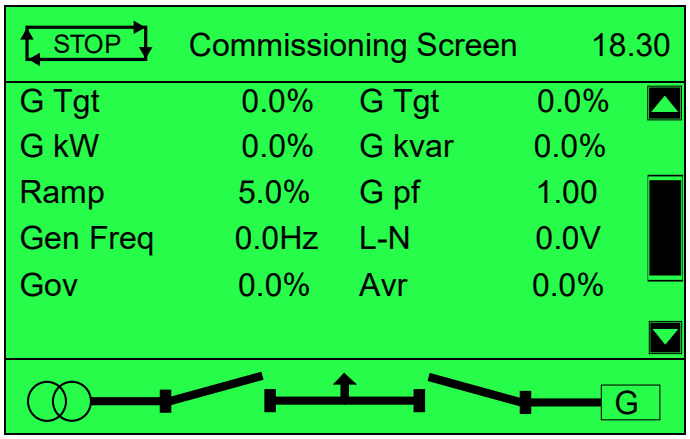
If the generator target kW/kvar percentage is changing rapidly with a steady load, repeat the *DSE Four Steps to Successful Synchronising* as it suggests there is an issue with wiring of the CTs. Refer to the section entitled *DSE Four Steps to Successful Synchronising* elsewhere in this document.

9.4.1.2 GENERATOR MODE

In this mode, the generator is used to provide a base amount of active power (kW) and reactive power (kvar) as configured by the *Load Levels* values. The generator starts when a digital input configured for *Remote Start on Load* is active.

In the example below, the *kW Maximum Level* has been configured at 80 % and the *kvar Maximum Level* has been configured at 42 %. Hence, the value of the generator target (tgt) kW is 80% and the value for the generator target (tgt) kvar is 42%. As the module is in *Generator Mode,* the mains target kW, and mains target kvar are not applicable and appear as #### on the module's display.
The module then regulates its generator's kW and kvar production to match their respective target values. In a correctly commissioned system with a steady load, the actual kW/kvar percentage would be within ±1 % of the target kW/kvar percentage. The module achieves this by adjusting the *Gov* percentage to affect kWs and the *AVR* percentage to affect kvars. Typical magnitudes of the *Gov* and *AVR* percentage at full load, with the switchgear closed and running in parallel are as follows:

- No more than 10% when there is no external droop enabled
- No more than 30% when external droop is enabled



Abbreviation	Description
G Tgt	Generator Target %
G kW	Generator Active power (kw) %
G kvar	Generator Reactive power (kvar) %
Ramp	Ramp Rate %
Gen Freq	Generator Frequency
Gov	Governor %
Avr	Automatic Voltage Regulator %
G pf	Generator Power Factor
L-N	Line & Neutral Voltage

If the actual kW/kvar percentage is not within ±1 % of the target kW/kvar percentage, and the target kW/kvar percentage is not changing with a steady load, it suggests that the *Gain (P)* and *Stability (I)* settings need adjusting. Refer to the section entitled *Adjusting Gain (P)* and *Stability (I)* elsewhere in this document.

If the actual kW/kvar percentage is changing rapidly with a steady load, repeat the *DSE Four Steps to Successful Synchronising* as it suggests there is an issue with wiring of the CTs. Refer to the section entitled *DSE Four Steps to Successful Synchronising* elsewhere in this document.

9.4.2 ADJUSTING GAIN (P) AND STABILITY (I)

9.4.2.1 INITIAL SETUP

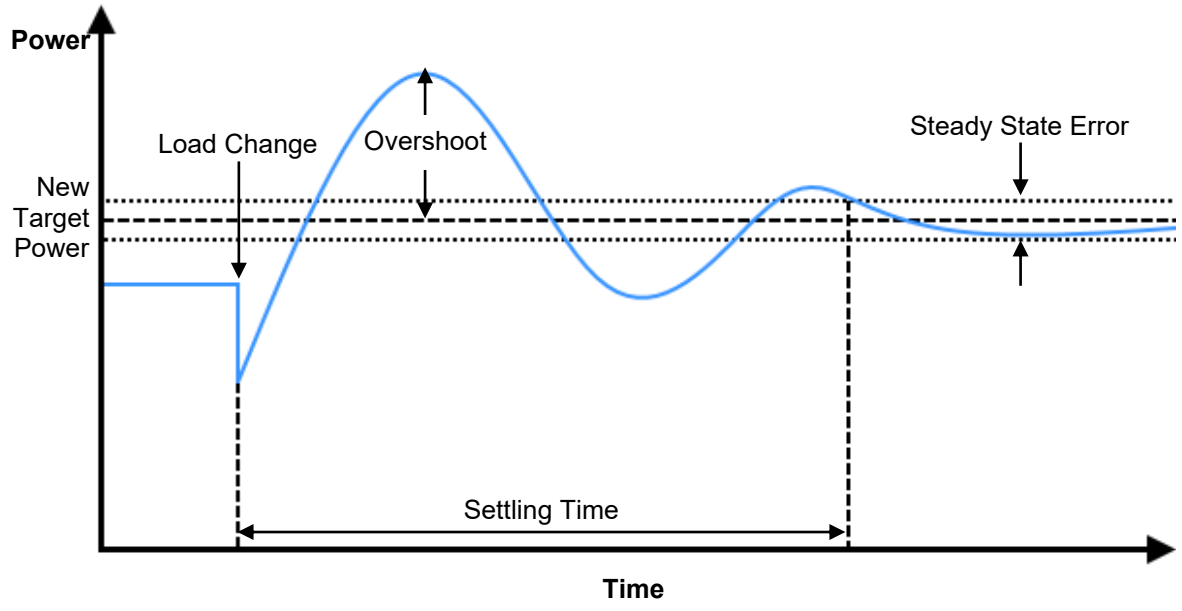
In most cases the DSE factory settings of 20% for *Gain (P)* and *Stability (I)* are suitable for most systems. This is because the DSE module's control is limited by the *Gain (P)* and *Stability (I)* settings of the engine's governor / alternator's AVR. Before adjusting the DSE module's settings, adjust the *Gain (P)* and *Stability (I)* settings of the engine's governor / alternator's AVR in accordance with the manufacturer's recommendations.

9.4.2.2 CALIBRATION

If the power control of the generator is not satisfactory after adjusting the *Gain (P)* and *Stability (I)* settings of the engine's governor / alternator's AVR, then start to adjust the DSE's settings by:

1. Starting with the *Gain (P)* and *Stability (I)* at 5 %. Place the generator in parallel with the mains (utility).
2. Gradually increase the *Gain (P)* setting until the generator power production becomes unstable. Very slowly decrease the *Gain (P)* setting, until the power production stabilises. Reduce the setting further by approximately 10 %.
3. Gradually increase the *Stability (I)* setting until the generator power production becomes unstable. Very slowly decrease the *Stability (I)* setting, until the power production stabilises.
4. Attempt to 'knock' the governor actuator or change the 'slip frequency' setting to disturb the engine speed and force the controller into making further changes.

The affect the *Gain (P)* and *Stability (I)* settings have on the response of a load step being applied to the generator are shown below.



PID Adjustment	Overshoot	Settling Time	Steady State Error
Increase Gain (P)	Increases	Minimal Effect	Decreases
Increase Stability (I)	Increases	Increases	Eliminates

9.4.2.3 TROUBLESHOOTING

NOTE: An over damped response results in a slower control process. An under damped response (overshooting the target) leads to an unstable control process.
Either case leads to undesirable consequences such as overcurrent or reverse power, resulting in generator shutdown, and loss of supply to the load.

If the load is oscillating quickly between the generators, it suggests that the setting for the *Gain (P)* on the generator(s) is too high or too low. A slow rolling oscillation usually indicates that the *Stability (I)* is too high or too low. These oscillations are caused by incorrect settings on the engine's governor / alternator's AVR and/or the DSE module.

9.4.3 SEGMENTATION OF THE BUS (MULTI SET)

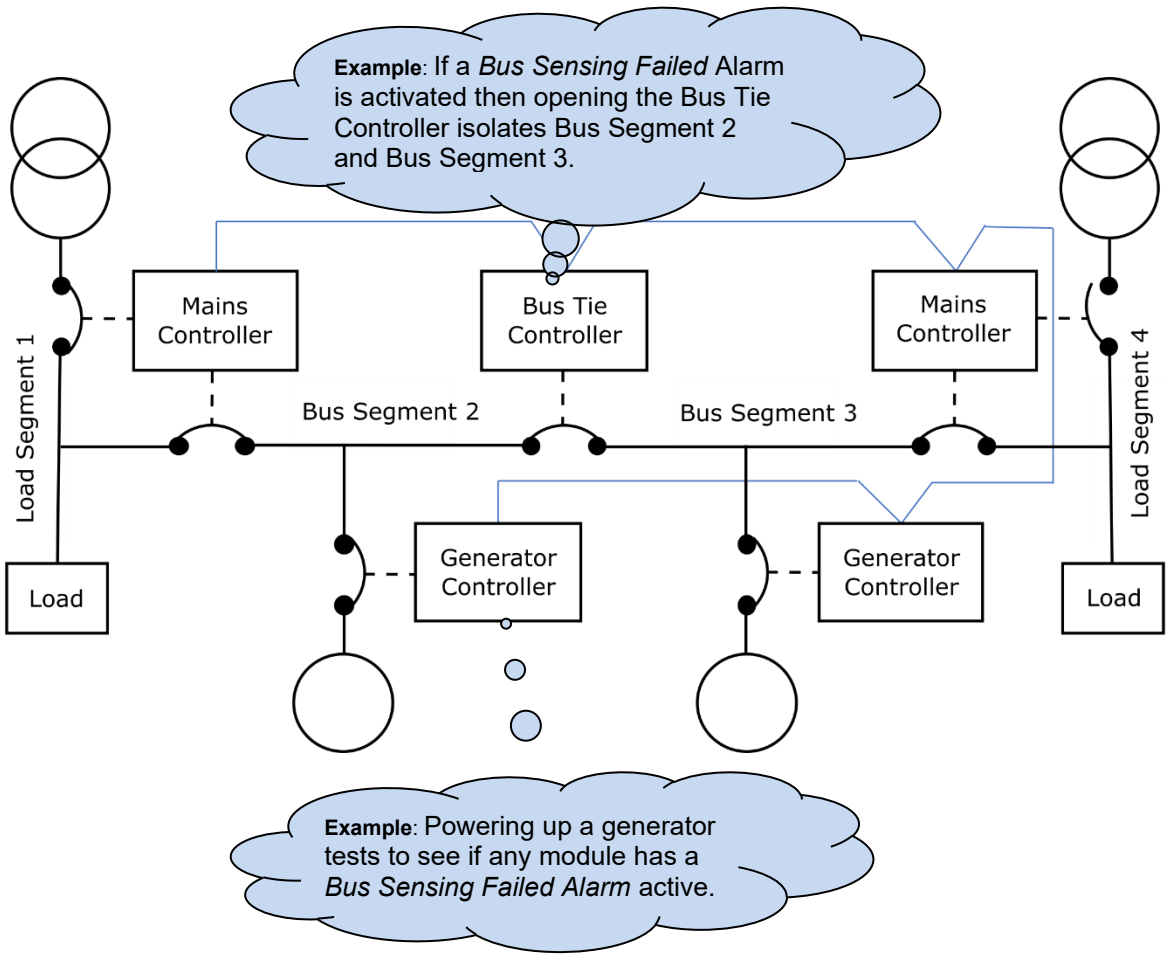
NOTE: Please be advised that running multiple mains in parallel is not possible.

WARNING!: The Bus Segment number and Load Segment number cannot be the same! This is critical for safe control!

The G Series allows the system to act locally and allows each isolated section to work either independently or as part of combined system. For this to be safe it is vitally important that the segmentation is set up correctly.

When a Bus Sensing Failed alarm is activated, it is important that each segment is isolated and that breakers (G8660 bus breakers and G8680 ties) are opened.

Example



To check each segment is live, a generator needs to be powered up to ensure that there are no modules with the Bus Sensing Failed alarm that are active. This ensures that there are no modules on a different segment that have this segment ID. See the section entitled *Bus Segment and Load Segment Numbers* in document 057-324 entitled *DSEG8660 Configuration Suite PC Software Manual* for further information.

The user must then disconnect each module's bus sensing on this segment and check that the alarm occurs, this confirms that the modules on this segment are correctly configured.

10 FAULT FINDING

NOTE: The below fault finding is provided as a guide checklist only. As the module is configurable to provide a wide range of different features, always refer to the source of the module configuration if in doubt.

10.1 STARTING

Symptom	Possible Remedy
Unit is inoperative	Check the battery and wiring to the unit. Check the DC supply. Check the DC fuse.
Unit shuts down	Check DC supply voltage is not above 35 Volts or below 9 Volts Check the operating temperature is not above 70°C. Check the DC fuse.
Fail to Start is activated after pre-set number of attempts to start	Check wiring of fuel solenoid. Check fuel. Check battery supply. Check battery supply is present on the Fuel output of the module. Check the speed-sensing signal is present on the module's inputs. Refer to engine manual.
Continuous starting of generator when in the ***Auto Mode*** AUTO	Check that there is no signal present on the "Remote Start" input. Check configured polarity is correct.
Generator fails to start on receipt of Remote Start signal.	Check Start Delay timer has timed out. Check signal is on "Remote Start" input. Confirm correct configuration of input is configured to be used as "Remote Start." Check that the oil pressure switch or sensor is indicating low oil pressure to the controller. Depending upon configuration, the set does not start if oil pressure is not low. Check that the engine is at rest before the signal is presented, check for active alarms.
Pre-heat inoperative	Check wiring to engine heater plugs. Check battery supply. Check battery supply is present on the Pre-heat output of module. Check pre-heat configuration is correct.
Starter motor inoperative	Check wiring to starter solenoid. Check battery supply. Check battery supply is present on the Starter output of module. Ensure oil pressure switch or sensor is indicating the "low oil pressure" state to the controller.

10.2 LOADING

Symptom	Possible Remedy
Engine runs but generator does not take load	Check Warm up timer has timed out. Ensure generator load inhibit signal is not present on the module inputs. Check connections to the switching device. Note that the set does not take load in ***Manual Mode*** MANUAL unless there is either a user request or auto signals are enabled
Incorrect reading on Engine gauges Fail to stop alarm when engine is at rest	Check engine is operating correctly. Check that sensor is compatible with the module and that the module configuration is suited to the sensor.

10.3 ALARMS

Symptom	Possible Remedy
Oil pressure low fault operates after engine has fired	Check engine oil pressure. Check oil pressure switch/sensor and wiring. Check configured polarity (if applicable) is correct (i.e., Normally Open or Normally Closed) or that sensor is compatible with the module and is correctly configured.
Coolant temp high fault operates after engine has fired.	Check engine temperature. Check switch/sensor and wiring. Check configured polarity (if applicable) is correct (i.e., Normally Open or Normally Closed) or that sensor is compatible with the module.
Shutdown fault operates	Check relevant switch and wiring of fault indicated on LCD display. Check configuration of input.
Electrical Trip fault operates	Check relevant switch and wiring of fault indicated on LCD display. Check configuration of input.
Warning fault operates	Check relevant switch and wiring of fault indicated on LCD display. Check configuration of input.
ECU Amber ECU Red	This indicates a fault condition detected by the engine ECU and transmitted to the DSE controller.
ECU Data Fail	Indicates failure of the CAN data link to the engine ECU. Check all wiring and termination resistors (if required).
Incorrect reading on Engine gauges Fail to stop alarm when engine is at rest	Check engine is operating correctly. Check sensor and wiring paying particular attention to the wiring to terminal 14. Check that sensor is compatible with the module and that the module configuration is suited to the sensor.

10.4 COMMUNICATIONS

Symptom	Possible Remedy
ECU Data Fail	Indicates failure of the CAN data link to the engine ECU. Check all wiring and termination resistors (if required).

10.5 INSTRUMENTS

Symptom	Possible Remedy
Inaccurate generator measurements on controller display	Check that the CT primary, CT secondary and VT ratio settings are correct for the application. Check that the CTs are wired correctly with regards to the direction of current flow (p1,p2 and s1,s2) and additionally ensure that CTs are connected to the correct phase (errors occur if CT1 is connected to phase 2). Remember to consider the power factor (kW = kVA x power factor). The controller is true RMS measuring so gives more accurate display when compared with an ‘averaging’ meter such as an analogue panel meter or some lower specified digital multimeter. Accuracy of the controller is better than 1% of full scale. Generator voltage full scale is 415 V ph-N, accuracy is ±4.15 V (1 % of 415 V).

10.6 SYNCHRONISING & LOAD SHARING

Symptom	Possible Remedy
Synchronising not available	Check Synchronising is enabled in the configuration suite software Generator, Synchronising section
Generator does not load share correctly	Ensure that all the DSE Four Steps to Synchronising have been completed. Check kW Share & kvar Share are enabled, and check generator rating is correctly configured in the DSE configuration suite PC Software.
Synchronising or load sharing is not operating satisfactorily	Follow the DSE “4 Steps To Synchronising” as detailed in the following section.

10.7 MISCELLANEOUS

Symptom	Possible Remedy
Module appears to ‘revert’ to an earlier configuration	When editing a configuration using the PC software it is vital that the configuration is first ‘read’ from the controller before editing it. This edited configuration must then be “written” back to the controller for the changes to take effect. Ensure the module is in Stop Mode prior to writing back any configuration. When editing a configuration using the fascia editor, be sure to press the ***Tick*** ✓ button to save the change before moving to another item or exiting the fascia editor

11 CAN INTERFACE SPECIFICATION (J1939-75)

The ECU port is used for live operational communications between the DSE module and other CAN enabled devices. The specification below details all broadcast messages which are transmitted when the J1939-75 is enabled, and the relevant engine file is selected.

Parameter	Description
Protocol	S.A.E. J1939 with PGNs as listed in the following subsections.
Bit Rate	250 kb/s
Isolation	±2.5 kVrms
Termination	120 Ω termination resistor, with the option for switchable resistor by software.

11.1 BROADCAST MESSAGES J1939-75

NOTE: All broadcast CAN messages are priority 3 by default, it is not possible to change the priority of the configurable CAN messages. For further details of module configuration, refer to DSE Publication: 057-322 *DSEG8600 Configuration Suite PC Software Manual.*

NOTE: SPNs that are not implemented in the module have all bits set to '1'.

NOTE: *PDU Format* and *PDU Specific* are shown in Hexadecimal.

NOTE: Values larger than 8 bits utilise *Little-Endian* format. For example, a 16-bit value, occupying two Bytes has Byte1 as the most significant Byte and Byte2 as the least significant Byte.

Parameter Groups below are broadcast by the module and are detailed in the following subsections.

11.1.1 ACS - AC SWITCHING DEVICE STATUS

PGN 64913

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FD	91	8	250 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0DD9	3545	Generator Breaker Status - This parameter indicates the measured state of the generator circuit breaker	Byte 1 Bits 1 to 3	***000:*** Open ***001:*** Closed ***010:*** Locked Out ***011-101:*** Available for SAE assignment ***110:*** Error ***111:*** Not available	0	N/A
0DDA	3546	Utility Circuit Breaker Status - This parameter indicates the measured state of the utility circuit breaker.	Byte 1 Bits 4 to 6	***000:*** Open ***001:*** Closed ***010:*** Locked Out ***011-101:*** Available for SAE assignment ***110:*** Error ***111:*** Not available	0	N/A

11.1.2 GC1 - GENERATOR CONTROL 1

PGN 64915

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FD	93	8	100 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0DEF	3567	Generator Control Not In Automatic Start State - This parameter indicates whether the generator set is in a condition to automatically start up and provide power. If not, this status parameter is in the ACTIVE state.	Byte 1 Bits 4 to 5	***00:*** Inactive (ready to start automatically) ***01:*** Active (not ready to start automatically) ***10:*** Error ***11:*** Not available	0	N/A

11.1.3 GAAC - GENERATOR AVERAGE BASIC AC QUANTITIES

PGN 65030

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FE	06	8	100 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0988	2440	Generator Avg. L-L AC Voltage	Byte 1 to 2	1	0	V
098C	2444	Generator Avg. L-N AC Voltage	Byte 3 to 4	1	0	V
0984	2626	Generator Avg. AC Frequency	Byte 5 to 6	1/128 Hz/bit	0	Hz
0990	2448	Generator Avg. AC RMS Current	Byte 7 to 8	1	0	A

11.1.4 GPAAC - GENERATOR PHASE A BASIC AC QUANTITIES

PGN 65027

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FE	03	8	100 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0985	2627	Generator Phase A AC Frequency	Byte 5 to 6	128	0	V
0989	2441	Generator Phase A Line Line AC RMS Voltage	Byte 1 to 2	1	0	V
098D	2445	Generator Phase A Line Neutral AC RMS Voltage	Byte 3 to 4	1	0	A
0991	2449	Generator Phase A AC RMS Current	Byte 7 to 8	1	0	Hz

11.1.5 GPAACP - GENERATOR PHASE A AC POWER

PGN 65026

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FE	02	8	100 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0993	2453	Generator Phase A Real Power	Byte 1 to 4	1	$-2*10^9$	W
099D	2461	Generator Phase A Apparent Power	Byte 5 to 8	1	$-2*10^9$	W

11.1.6 GPAACR - GENERATOR PHASE A AC REACTIVE POWER

PGN 65025

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FE	00	8	100 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0999	2457	Generator Phase A Reactive Power	Byte 1 to 4	1	$-2*10^9$	var

11.1.7 GPBAC - GENERATOR PHASE B BASIC AC QUANTITIES

PGN 65024

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FE	00	8	100 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0986	2628	Generator Phase B AC Frequency	Byte 5 to 6	0.0078125	0	Hz
098A	2442	Generator Phase B Line Line AC RMS Voltage	Byte 1 to 2	1	0	V
098E	2446	Generator Phase B Line Neutral AC RMS Voltage	Byte 3 to 4	1	0	V
0992	2450	Generator Phase B AC RMS Current	Byte 7 to 8	1	0	A

11.1.8 GPBACP - GENERATOR PHASE B AC POWER

PGN 65023

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FD	FF	8	100 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0996	2454	Generator Phase B Real Power	Byte 1 to 4	1	$-2*10^9$	W
099E	2462	Generator Phase B Apparent Power	Byte 5 to 8	1	$-2*10^9$	W

11.1.9 GPBACR - GENERATOR PHASE B AC REACTIVE POWER

PGN 65022

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FD	FE	8	100 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
099A	2458	Generator Phase B Reactive Power	Byte 1 to 4	1	$-2*10^9$	var

11.1.10 GPCAC - GENERATOR PHASE C BASIC AC QUANTITIES

PGN 65021

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FD	FD	8	100 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0987	2629	Generator Phase C AC Frequency	Byte 5 to 6	0.0078125	0	Hz
098B	2443	Generator Phase C Line Line AC RMS Voltage	Byte 1 to 2	1	0	V
098F	2447	Generator Phase C Line Neutral AC RMS Voltage	Byte 3 to 4	1	0	V
0993	2451	Generator Phase C AC RMS Current	Byte 7 to 8	1	0	A

11.1.11 GPCACP - GENERATOR PHASE C AC POWER

PGN65020

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FD	FF	8	100 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0997	2455	Generator Phase C Real Power	Byte 1 to 4	1	$-2*10^9$	W
099F	2463	Generator Phase C Apparent Power	Byte 5 to 8	1	$-2*10^9$	W

11.1.12 GPCACR - GENERATOR PHASE C AC REACTIVE POWER

PGN 65019

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FD	FB	8	100 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
099B	2459	Generator Phase C Reactive Power	Byte 1 to 4	1	$-2*10^9$	var

11.1.13 GTACPP - GENERATOR TOTAL AC PERCENT POWER

PGN 64911

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FD	8F	8	250 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0E06	3590	Generator Total Percent kW as a percentage of rated power	Byte 1 to 2	0.0078125	-251	%

11.1.14 GTACE - GENERATOR TOTAL KW HOURS EXPORT

PGN 65018

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FD	FA	8	100 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
09A4	2468	Generator Total kW Hours Export	Byte 1 to 4	1	0	kWh

11.1.15 GTACER - GENERATOR TOTAL AC REACTIVE ENERGY

PGN64910

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FD	8E	8	250 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0E09	3593	Generator Total kvar Hours Export	Byte 1 to 4	1	0	kvarh

11.1.16 GTACP - GENERATOR TOTAL AC POWER

PGN65029

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FE	05	8	100 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0994	2452	Generator Total Real Power	Byte 1 to 4	1	$-2*10^{9}$	W
099C	2460	Generator Total Apparent Power	Byte 5 to 8	1	$-2*10^{9}$	VA

11.1.17 GTACR - GENERATOR TOTAL AC REACTIVE POWER

PGN65028

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FE	04	8	100 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0988	2456	Generator Total Reactive Power	Byte 1 to 4	1	$-2*10^{9}$	var
09A0	2464	Generator Overall Power Factor	Byte 5 to 6	-1	$6.103515625*10^{-5}$	pF
09D6	2518	Generator Overall Power Factor Lagging	Byte 7 to 8	1	0	+/-

11.2 BROADCAST MESSAGES ENGINE INSTRUMENTATION

NOTE: The availability of the Engine Instrumentation PGNs are dependent upon the engine file selected within the DSE module's configuration. Contact DSE technical support: support@deepseaelectronics.com for more information.

11.2.1 DD - DASH DISPLAY

PGN 65276

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FE	FC	8	1000 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
060	96	Ratio of volume of fuel to the total volume of fuel storage container.	Byte 2	0.4	0	%

11.2.2 EC2 - ENGINE CONFIGURATION 2

PGN64895

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FD	7F	8	Request

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0E56	3670	Maximum Crank Attempts per Start Attempt	Byte 1	1	0	N/A

11.2.3 EEC1- ENGINE SPEED

PGN61444

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	F0	04	8	100 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0BE	190	Engine Speed	Byte 4 to 5	0.125	0	RPM

11.2.4 EEC4 - CRANK ATTEMPT COUNT ON PRESENT START ATTEMPT

PGN65214

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FE	FB	8	Request

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0E57	3671	Crank Attempt Count on Present Start Attempt	Byte 6	1	0	N/A

11.2.5 EFL_P1 - OIL PRESSURE

PGN65263

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FE	EF	8	500 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
064	100	Oil Pressure	Byte 4	4	0	kPa

11.2.6 EOI - EMERGENCY STOP

PGN64914

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FD	92	8	250 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0E17	3607	Emergency Stop ***00:*** Off (No Shutdown Requested) ***01:*** On (Shutdown Requested) ***10:*** Reserved ***11:*** Don't care / take no action	Byte 6 Bit 6 to 8	1	0	N/A

11.2.7 ET1 - COOLANT TEMPERATURE

PGN65262

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FE	EE	8	1000 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
06E	110	Engine Coolant Temperature	Byte 1	1	-40	°C

11.2.8 HOURS - ENGINE HOURS REVOLUTIONS

PGN65253

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FE	E5	8	Request

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0F7	247	Engine Total Hours of Operation	Byte 1 to 4	0.05	0	hr

11.2.9 VEP1 - VEHICLE ELECTRICAL POWER

PGN65271

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
3	0	0	FE	F7	8	1000 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
0A7	167	Charge Alternator Voltage	Byte 3 to 4	0.05	0	V
0A8	168	Plant Battery Voltage	Byte 5 to 6	0.05	0	V

11.2.10 DM01 - CONDITIONS ACTIVE DIAGNOSTIC TROUBLE CODES

NOTE: The availability of the Engine Alarm SPN and FMI is dependent upon the engine file selected within the DSE module's configuration. Contact DSE technical support: support@deepseaelectronics.com for more information.

NOTE: If only one DM1 alarm is active the DM1 priority remains as six. If two or more DM1 alarms are active the priority is seven.

PGN65226

Priority	Ext Data Page	Data Page	PDU Format	PDU Specific	Size (Bytes)	Rate
6/7	0	0	FE	CA	8	1000 ms

SPN Hex	SPN Decimal	Instrument	Byte / Bit	Scaling	Offset	Units
04BE	1214	Suspect Parameter Number	Byte 3 Bits 1 to 19	1	0	N/A
04BF	1215	Failure Mode Identifier	Byte 5 Bits 1 to 5	1	0	N/A
06AA	1706	SPN Conversion Method	Byte 6 Bit 7	1	0	N/A

DM1 Conditions

Key	Value
Low Fault - Least Severe	17
High Fault - Least Severe	15
Low Fault - Most Severe	1
High Fault - Most Severe	0
Erratic - Incorrect Data	2

Generator Alarm Condition	SPN	Warning FMI	Shutdown FMI
Generator Average AC Frequency Under	2626	17	1
SPN Generator Average Line-Line AC RMS Voltage Over	2626	15	0
Generator Average Line-Line AC RMS Voltage Under	2440	17	1
Generator Average Line-Line AC RMS Voltage Over	2440	15	0
Generator Average Line-Neutral AC RMS Voltage Under	2444	17	1
Generator Average Line-Neutral AC RMS Voltage Over	2444	15	0
Generator Average AC RMS Current Over	2448	15	0

Parameters continued overleaf…

Engine Alarm Condition	SPN	Warning FMI	Shutdown FMI
Fuel Level Low	96	17	1
Oil Pressure Low (Analogue Sensor)	100	17	1
Oil Pressure Low (Digital Input)	100	17	1
Oil Pressure Sensor Fault	100	2	2
Coolant Temperature High (Analogue Sensor)	110	15	0
Coolant Temperature High (Digital Input)	110	15	0
Coolant Temperature Sensor Fault	110	2	2
Charge Alternator Failed	167	17	1
Plant Battery Voltage High	168	15	0
Plant Battery Voltage Low	168	17	1
Overspeed	190	15	0
Underspeed	190	17	1

12 MAINTENANCE, SPARES, REPAIR AND SERVICING

The controller is *Fit and Forget*. As such, there are no user serviceable parts within the controller. In the case of malfunction, contact the original equipment manufacturer (OEM).

12.1 PURCHASING ADDITIONAL CONNECTOR PLUGS FROM DSE

If additional plugs are required, contact our Sales department using the part numbers below.

12.1.1 PACK OF PLUGS

Module Type	Plug Pack Part Number
DSEG8600	007-1072

12.1.2 INDIVIDUAL PLUGS

Module Terminal Designation	Plug Description	Part No.
1 to 14 **D+ W/L**	14 way 5.08 mm	007-428
15 to 22 **CAN 3**	8 way 5.08 mm	007-164
23 to 39 **CAN 1 CAN2 GOV AVR**	17 way 5.08 mm	007-452
40 to 47 **V1**	8 way 7.62 mm	007-454
48 to 51 **V2**	4 way 7.62 mm	007-171
52 to 58	7 way 5.08 mm	007-447
59 to 77	13 way 5.08 mm	007-166
71 to 76 **RS485 Port 1 Port 2**	6 way 5.08 mm	007-446
	PC Configuration interface lead (USB type A – USB type B)	016-125

12.2 PURCHASING ADDITIONAL FIXING CLIPS FROM DSE

Item	Description	Part No.
	Module Fixing Clips (Packet of 4)	020-294

12.3 DSENET® EXPANSION MODULES

NOTE: A maximum of twenty (20) expansion modules can be connected to the DSEG8600 DSENet® Port

NOTE: DSENet® utilises an RS485 connection. Using Belden 9841 (or equivalent) cable allows for the expansion cable to be extended to a maximum of 1.2 km.
DSE Stock and supply Belden 9841 cable. DSE Part Number 016-030.

Item	Max No. Supported	Description	DSE Part Numbers		
			Model Order Number	Operator Manual	Installation Instructions
	4	Model DSE2130 input module provides additional analogue and digital inputs for use with the controller.	2130-00	055-060	057-082
	4	Model DSE2131 Ratio-metric input expansion module provides additional restive, digital, 0 V to 10 V and 4 mA to 20 mA inputs for use with the controller.	2131-00	055-115	057-139
	4	Model DSE2133 RTD/Thermocouple input expansion module provides additional RTD and thermocouple inputs for use with the controller.	2133-00	055-114	057-140
	4	Model DSE2152 Ratio-metric output expansion module provides additional 0 V to 10 V and 4 mA to 20 mA outputs for use with the controller.	2152-00	055-112	057-141
	10	Model DSE2157 expansion relay module provides eight additional voltage free relays for use with the controller	2157-00	055-061	057-083
	10	Model DSE2548 expansion LED module provides additional LED indications, internal sounder, and remote lamp test/alarm mute for use with the controller.	2548-00	057-084	053-032
	4	DSE Intelligent Battery Charger monitored by the controller	Various DSE Intelligent Battery Chargers are supported, contact DSE Technical Support; support@deepseaelectronics.com for further details.		

13 WARRANTY

DSE Provides limited warranty to the equipment purchaser at the point of sale. For full details of any applicable warranty, refer to the original equipment supplier (OEM)

14 DISPOSAL

14.1 WEEE (WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT)

Users of electrical and electronic equipment must store, collect, treat, recycle, and dispose of WEEE separately from other waste.

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