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DSEPOWER[®]

DSE7520 MK1 Mains Control Module

Document Number 057-090

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DSE Model 7520MK1 AMF controller operator manual

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Amendments since last publication

Amd. No.	Comments
1	Converted 5520 V8 manual to 7520 V10
2	Update to wiring diagrams (issue10.1)

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, could result in damage or destruction of equipment.



WARNING!

Indicates a procedure or practice, which could result in injury to personnel or loss of life if not followed correctly.

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1 BIBLIOGRAPHY

This document refers to and is referred to by the following DSE publications which can be obtained from the DSE website www.deepseapl.com

DSE PART	DESCRIPTION
053-053	DSE7520 installation instructions
057-004	Electronic Engines and DSE wiring manual
057-078	DSE7500 Series Configuration Suite manual
057-046	DSE Guide to Synchronising and Load Sharing Part 2 – Governor and AVR Interfacing
056-047	Load Share Design and Commissioning
053-055	DSE850 installation instructions
053-040	DSE157 expansion relay board installation instructions
051-157	DSE130 input expansion module installation instructions

Additionally this document refers to the following third party publications

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 INTRODUCTION

This document details the installation and operation requirements of the DSE7500 Series modules, part of the DSEPower® range of products.

The manual forms part of the product and should 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*. You will not be automatically informed of updates. Any future updates of this document will be included on the DSE website at www.deepeatplc.com

The DSE7520 Mk1 controller is an update to the popular DSE5520. It maintains all the functions and flexibility of the DSE5520 while being packaged in DSE7000 series styling bringing with it the advantages of the DSE7000 series terminal compatibility easing system upgrades.

The DSE7520 is NOT for use in a multiple generator load share system.

The **DSE 7520MK1** Module allows the OEM to meet demand for increased capability within the industry. It allows the user to start and stop the generator and if required, transfer the load to the generator either manually or automatically. The user also has the facility to view the system operating parameters via the LCD display.

Utilising the inbuilt synchronising, volts matching and paralleling functions, the controller is able to parallel with the mains supply for peak.

The **DSE 7520MK1** module also monitors the engine, indicating the operational status and fault conditions, automatically shutting down the engine. Exact failure mode information is indicated by the LCD display on the front panel.

The powerful Microprocessor contained within the module allows for many features to be incorporated as standard;

- *Full Multilingual LCD display (including non-western character fonts).*
- *True R.M.Ss. voltage monitoring.*
- *Power measurement.*
- *Communications capability (RS485 or RS232)*
- *Check Sync capability*
- *Automatic Sync capability*
- *Load control capability*
- *Fully configurable inputs for use as alarms or a range of different functions also available on P130 expansion inputs (optional)*
- *Extensive range of output functions using built in relay outputs or relay expansion available.*
- *Instrumentation and diagnostics from electronic engines when connected to an engine ECU.*

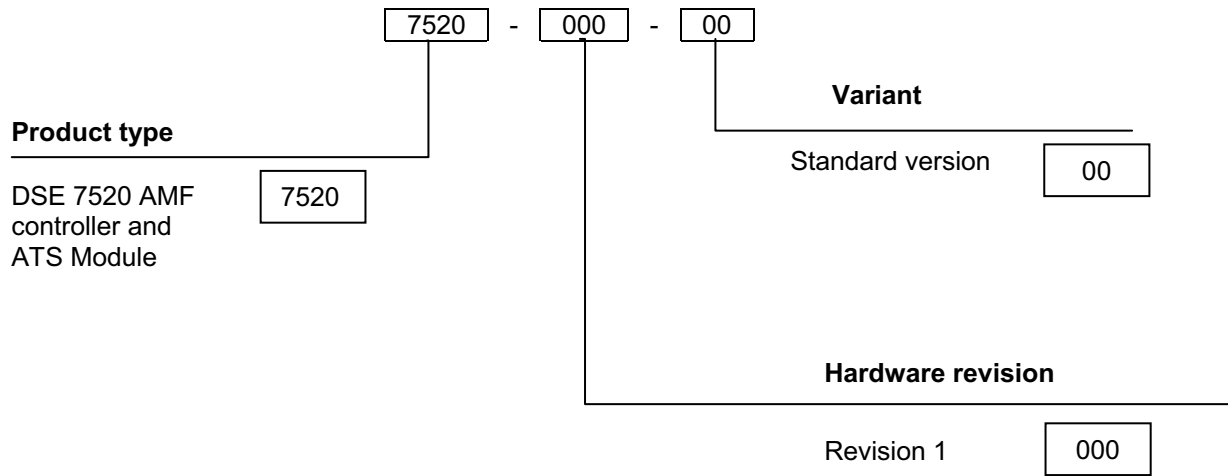
Selective operational sequences, timers and alarm trips can be altered by the customer via a PC using the 75xx For Windows™ software and 810 interface or via the integral front panel configuration editor.

Access to critical operational sequences and timers for use by qualified engineers, can be protected by a security code. Module access can also be protected by PIN code. Selected parameters can be 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.

3 SPECIFICATIONS

3.1 PART NUMBERING



At the time of this document production, there have been no revisions to the module hardware.

3.1.1 SHORT NAMES

Short name	Description
DSE7000	All modules in the DSE7000 Series
DSE7500	All modules in the DSE7500 sync/load share range
DSE7520	DSE7520 module

3.1 POWER SUPPLY REQUIREMENTS

Minimum supply voltage	8V continuous
Cranking dropouts	Able to survive 0V for 50mS providing the supply was at least 10V before the dropout and recovers to 5V afterwards.
Maximum supply voltage	35V continuous (60V protection)
Reverse polarity protection	-35V continuous
Maximum operating current	TBAmA at 24V TBAmA at 12V
Maximum standby current	TBAmA at 24V TBAmA at 12V

Plant supply instrumentation display

Range	0V-60V DC (note Maximum continuous operating voltage of 35V DC)
Resolution	0.1V
Accuracy	1% full scale

3.2 TERMINAL SPECIFICATION

Connection type	Screw terminal, rising clamp, no internal spring
Min cable size	0.5mm ² (AWG 24)
Max cable size	2.5mm ² (AWG 10)

3.3 GENERATOR VOLTAGE / FREQUENCY SENSING

Measurement type	True RMS conversion
Sample Rate	5KHz or better
Harmonics	Up to 10 ^m or better
Input Impedance	300K Ω ph-N
Phase to Neutral	15V to 333V AC (max)
Phase to Phase	25V to 576V AC (max)
Common mode offset from Earth	100V AC (max)
Resolution	1V AC phase to neutral 2V AC phase to phase
Accuracy	$\pm 1\%$ of full scale phase to neutral $\pm 2\%$ of full scale phase to phase
Minimum frequency	3.5Hz
Maximum frequency	75.0Hz
Frequency resolution	0.1Hz
Frequency accuracy	$\pm 0.2\text{Hz}$

3.4 INPUTS

3.4.1 DIGITAL INPUTS

Number	9
Arrangement	Contact between terminal and ground
Low level threshold	40% of DC supply voltage
High level threshold	60% of DC supply voltage
Maximum input voltage	DC supply voltage positive terminal
Minimum input voltage	DC supply voltage negative terminal
Contact wetting current	2.5mA @12V typical 5mA @ 24V typical
Open circuit voltage	Plant supply

3.4.2 CHARGE FAIL INPUT

Minimum voltage	0V
Maximum voltage	35V (plant supply)
Resolution	0.2V
Accuracy	± 1% of max measured voltage
Excitation	Active circuit constant power output
Output Power	2.5W Nominal @12V and 24V
Current at 12V	210mA
Current at 24V	105mA

3.4.3 MAGNETIC PICKUP

Type	Single ended input, capacitive coupled
Minimum voltage	0.5V RMS
Max common mode voltage	±2V
Maximum voltage	Clamped to ±70V by transient suppressers, dissipation not to exceed 1W.
Maximum frequency	10,000Hz
Resolution	6.25 RPM
Accuracy	±25 RPM
Flywheel teeth	10 to 500

3.5 OUTPUTS

3.5.1 OUTPUTS A & B (FUEL AND START)

Type	Fuel (A) and Start (B) outputs. Supplied from DC supply terminal 2.
Rating	3A @ 35V
Protection	Protected against over current & over temperature. Built in load dump feature.

3.5.2 CONFIGURABLE OUTPUTS C & D (LOAD SWITCHING)

Type	Fully configurable volts free relays. Output C – Normally Closed, Output D – Normally Open
Rating	8A @ 230V AC
Protection	Protected against over current & over temperature. Built in load dump feature.

3.5.3 CONFIGURABLE OUTPUTS E, F & G

Type	Fully configurable, supplied from DC supply terminal 2.
Rating	3A @ 35V
Protection	Protected against over current & over temperature. Built in load dump feature.

3.6 COMMUNICATION PORTS

810 port	For connection to the DSE810 interface only
Expansion port	For connection to DSE130, DSE157, DSE545, DSE548 expansion modules only
DSENet	DSE7510 Mk1 controller does not have DSENet expansion capability
CAN Port	Engine CAN Port Standard implementation of 'Slow mode', up to 250K bits/s Non Isolated. Internal Termination provided (120Ω)
RS485 Serial	Isolated Data connection 2 wire + common Half Duplex Data direction control for Transmit (by s/w protocol) Max Baud Rate 19200 External termination required (120R) Max common mode offset 70V (on board protection transorb) Max distance 1.2km (¾ mile)

3.7 ACCUMULATED INSTRUMENTATION



NOTE : When an accumulated instrumentation value exceeds the maximum number as listed below, it will reset and begin counting from zero again.

Engine hours run	Maximum 99999 hrs 59 minutes (approximately 11yrs 4months)
Number of starts	1,000,000 (1 million)

3.8 SOUNDER

DSE7000 Series features an internal sounder to draw attention to warning, shutdown and electrical trip alarms.

Sounder level	84db @ 1m
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3.9 DIMENSIONS AND MOUNTING

DIMENSIONS

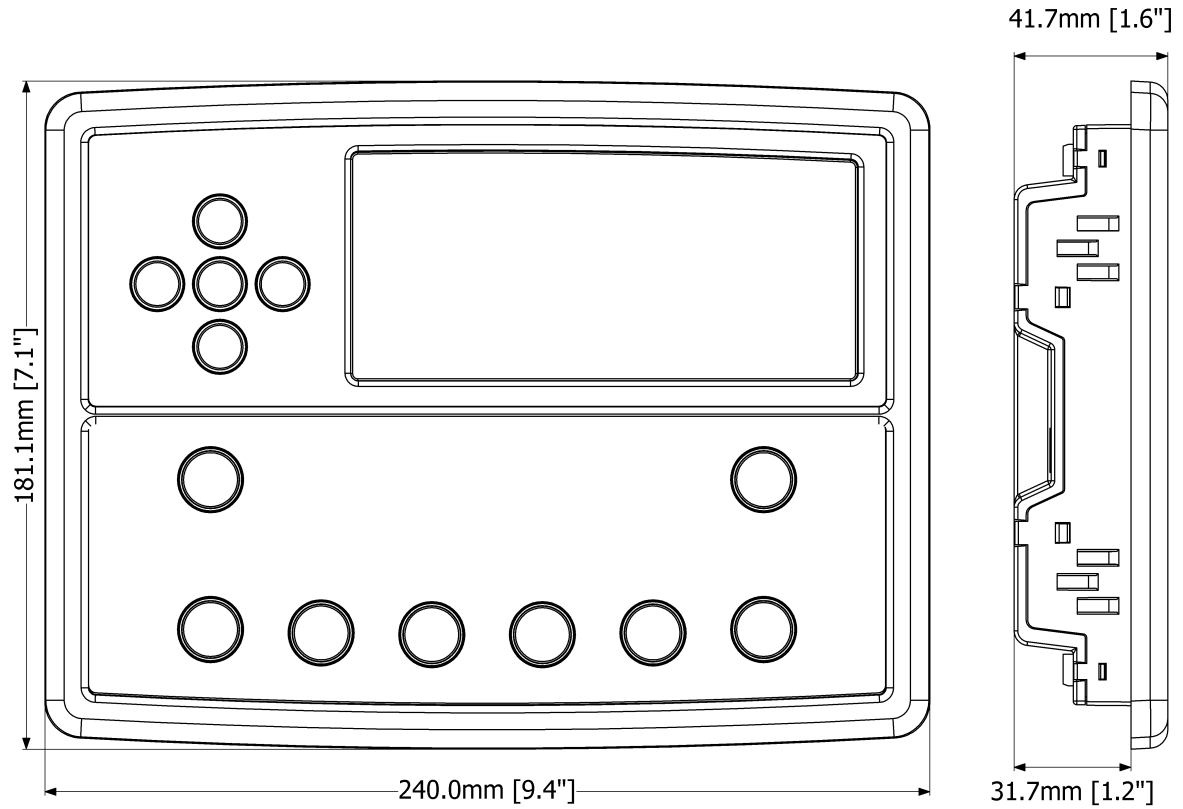
240.0mm x 181.1mm x 41.7mm (9.4" x 7.1" x 1.6")

PANEL CUTOUT

220mm x 160mm (8.7" x 6.3")

WEIGHT

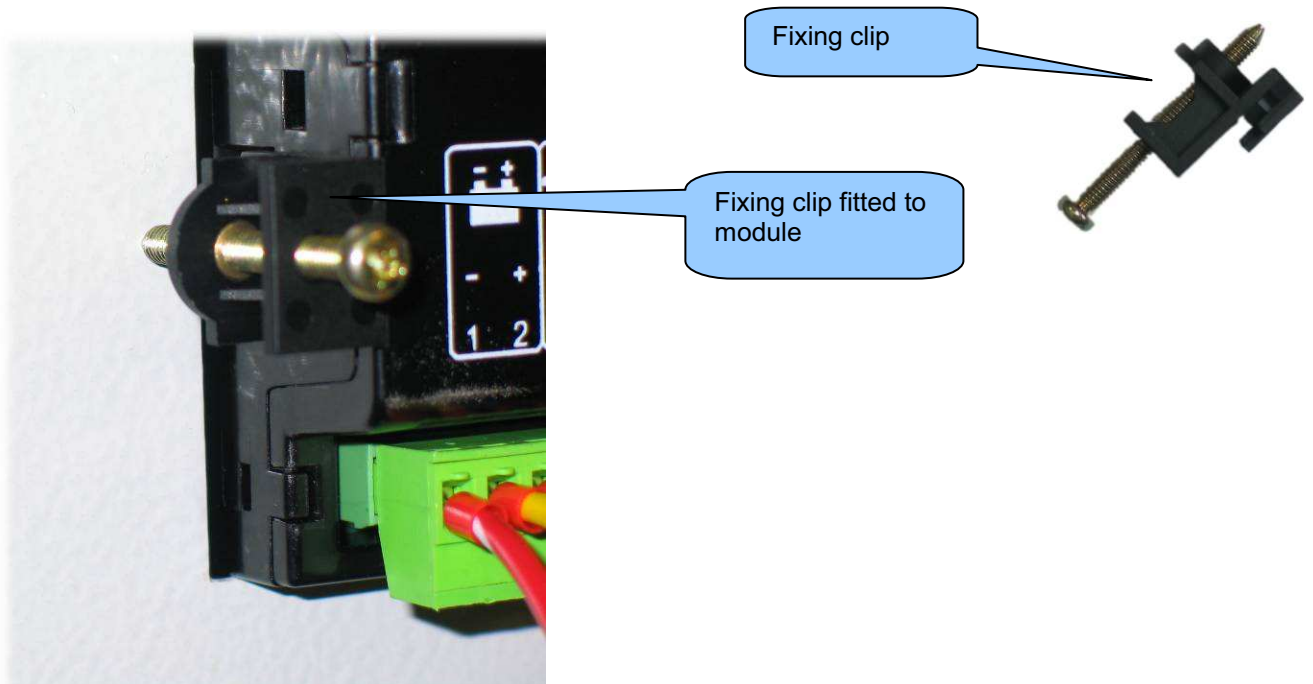
0.7kg (1.4lb)



3.9.1 FIXING CLIPS

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 7000 series 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 make contact with the panel fascia.
- Turn the screws a little more to secure the module into the panel fascia. Care should be taken not to over tighten the fixing clip screws.



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

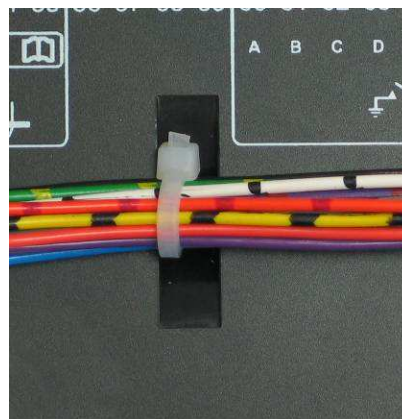
3.9.2 CABLE TIE FIXING POINTS

Integral 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, thus reducing the chance of future connection failures.

Care should 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



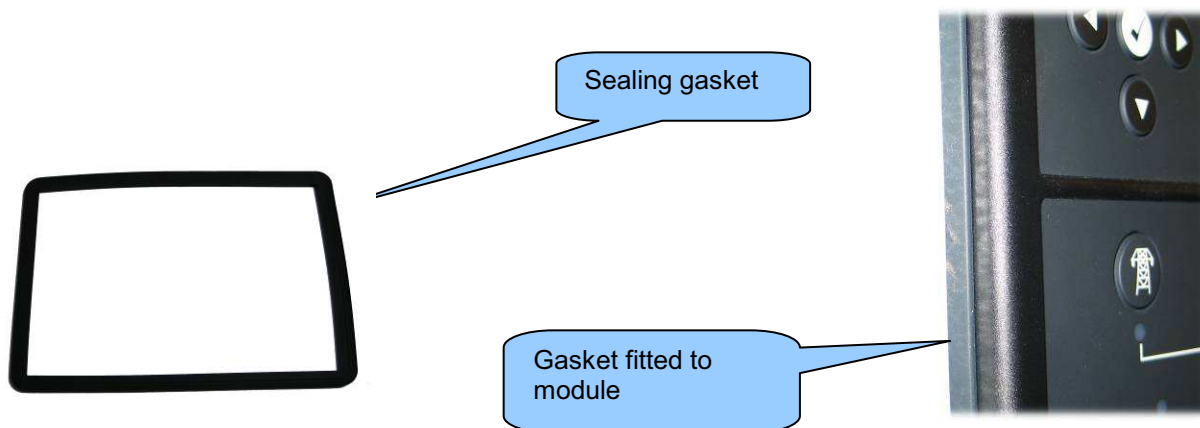
With cable and tie in place

3.9.3 SILICON SEALING GASKET

The supplied silicon gasket provides improved sealing between the 7000 series module and the panel fascia.

The gasket is fitted to the module before installation into the panel fascia.

Take care to ensure the gasket is correctly fitted to the module to maintain the integrity of the seal.



3.10 APPLICABLE STANDARDS

BS 4884-1	This document conforms to BS4884-1 1992 Specification for presentation of essential information.
BS 4884-2	This document conforms to BS4884-2 1993 Guide to content
BS 4884-3	This document conforms to BS4884-3 1993 Guide to presentation
BS EN 60068-2-1 (Minimum temperature)	-30°C (-22°F)
BS EN 60068-2-2 (Maximum temperature)	+70°C (158°F)
BS EN 60950	Safety of information technology equipment, including electrical business equipment
BS EN 61000-6-2	EMC Generic Immunity Standard (Industrial)
BS EN 61000-6-4	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 supplied 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 supplied 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)	<p>Under the scope of IEEE 37.2, <i>function numbers can also be used to represent functions in microprocessor devices and software programs.</i> The 7000 series controller is device number 11L-7000 (Multifunction device protecting Line (generator) – 7000 series module).</p> <p>As the module is configurable by the generator OEM, the functions covered by the module will vary. Under the module's factory configuration, the device numbers included within the module are :</p> <p>2 – Time delay starting or closing relay 27AC – AC undervoltage relay 27DC – DC undervoltage relay 30 – annunciator relay 42 – Running circuit breaker 50 – instantaneous overcurrent relay 51 – ac time overcurrent relay 52 – ac circuit breaker 59AC – AC overvoltage relay 59DC – DC overvoltage relay 62 – time delay stopping or opening relay 74– alarm relay 81 – frequency relay 86 – lockout relay</p>

In line with our policy of continual development, Deep Sea Electronics, reserve the right to change specification without notice.

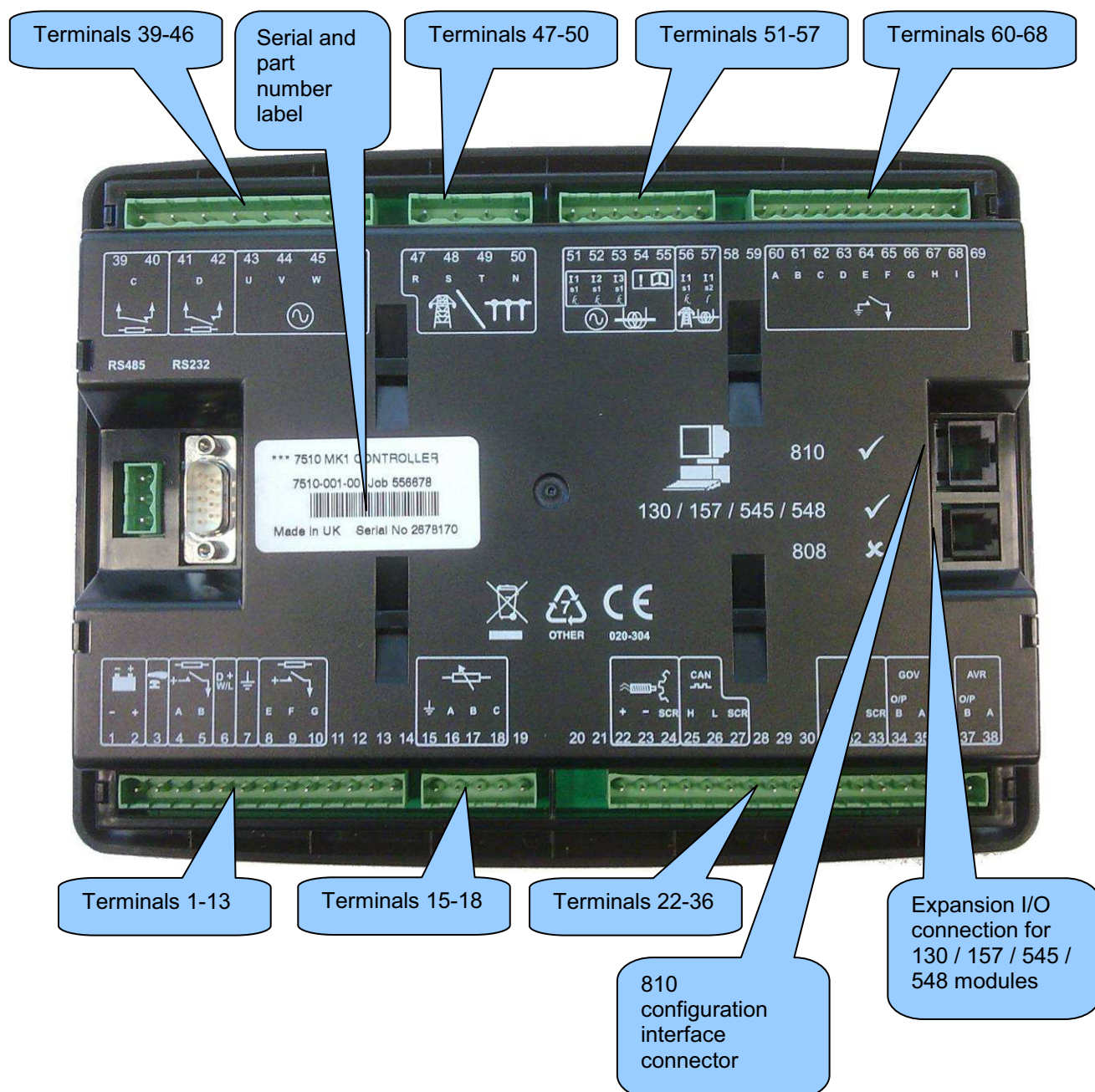
4 INSTALLATION

The DSE7000 Series module is designed to be mounted on the panel fascia. For dimension and mounting details, see the section entitled *Specification, Dimension and mounting* elsewhere in this document.







4.1 USER CONNECTIONS

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.


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




4.1.1 DC SUPPLY, FUEL AND START OUTPUTS, OUTPUTS E,F,G

	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	1	DC Plant Supply Input (Negative)	2.5mm ² AWG 13	
	2	DC Plant Supply Input (Positive)	2.5 mm ² AWG 13	(Recommended Maximum Fuse 15A anti-surge) Supplies the module (2A anti-surge requirement) and Output relays E,F,G & H
	3	Emergency Stop Input	2.5mm ² AWG 13	Plant Supply Positive. Also supplies outputs 1 & 2. (Recommended Maximum Fuse 20A)
	4	Output relay A (FUEL)	2.5mm ² AWG 13	Plant Supply Positive from terminal 3. 15 Amp rated. Fixed as FUEL relay if electronic engine is not configured.
	5	Output relay B (START)	2.5mm ² AWG 13	Plant Supply Positive from terminal 3. 15 Amp rated. Fixed as START relay if electronic engine is not configured.
	6	Charge fail / excite	2.5mm ² AWG 13	Do not connect to ground (battery negative). If charge alternator is not fitted, leave this terminal disconnected.
	7	Functional Earth	2.5mm ² AWG 13	Connect to a good clean earth point.
	8	Output relay E	1.0mm ² AWG 18	Plant Supply Positive from terminal 2. 3 Amp rated.
	9	Output relay F	1.0mm ² AWG 18	Plant Supply Positive from terminal 2. 3 Amp rated.
	10	Output relay G	1.0mm ² AWG 18	Plant Supply Positive. from terminal 2. 3 Amp rated.

 **NOTE:-** Terminals 11 to 14 are not fitted to the DSE7510 MK1 controller.

 **NOTE:-** When the module is configured for operation with an electronic engine, FUEL and START output requirements may be different. Refer to *Electronic Engines and DSE Wiring* for further information. Part No. 057-004.



4.1.2 ANALOGUE SENSOR

	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	15	Sensor Common Return	0.5mm ² AWG 20	Return feed for sensors*
	16	Oil Pressure Input	0.5mm ² AWG 20	Connect to Oil pressure sensor
	17	Coolant Temperature Input	0.5mm ² AWG 20	Connect to Coolant Temperature sensor
	18	Fuel Level input	0.5mm ² AWG 20	Connect to Fuel Level sensor
	19	Flexible sensor (not available on 7200 series controller)	0.5mm ² AWG 20	Connect to additional sensor (user configurable)

 **NOTE:-** Terminals 19 to 21 are not fitted to the DSE7510 MK1 controller.


 **NOTE*:-** If using single terminal sensors refer to the Appendix section entitled “Sensor wiring recommendations” elsewhere in this manual.


4.1.3 MAGNETIC PICKUP, CAN AND EXPANSION

	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	22	Magnetic pickup Positive	0.5mm ² AWG 20	Connect to Magnetic Pickup device
	23	Magnetic pickup Negative	0.5mm ² AWG 20	Connect to Magnetic Pickup device
	24	Magnetic pickup screen	Shield	Connect to ground at one end only
	25	CAN port H	0.5mm ² AWG 20	Use only 120Ω CAN approved cable
	26	CAN port L	0.5mm ² AWG 20	Use only 120Ω CAN approved cable
	27	CAN port Common	0.5mm ² AWG 20	Use only 120Ω CAN approved cable




 **NOTE:-** Terminals 28 to 30 are not fitted to the DSE7510 MK1 controller

 **NOTE:-** Screened cable must be used for connecting the Magnetic Pickup, ensuring that the screen is earthed at one end **ONLY**.

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


 **NOTE:-** When the module is configured for CAN operation, terminals 22, 23 & 24 should be left unconnected. Engine speed is transmitted to the 7000 series controller on the CAN link.
Refer to *Electronic Engines and DSE Wiring* for further information. Part No. 057-004.

4.1.4 LOAD SWITCHING AND GENERATOR VOLTAGE SENSING

	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	39	Output relay C	1.0mm AWG 18	Normally configured to control mains contactor coil (Recommend 10A fuse)
	40	Output relay C	1.0mm AWG 18	Normally configured to control mains contactor coil
	41	Output relay D	1.0mm AWG 18	Normally configured to control generator contactor coil (Recommend 10A fuse)
	42	Output relay D	1.0mm AWG 18	Normally configured to control generator contactor coil
	43	Generator L1 (U) voltage monitoring	1.0mm ² AWG 18	Connect to generator L1 (U) output (AC) (Recommend 2A fuse)
	44	Generator L2 (V) voltage monitoring input	1.0mm ² AWG 18	Connect to generator L2 (V) output (AC) (Recommend 2A fuse)
	45	Generator L3 (W) voltage monitoring input	1.0mm ² AWG 18	Connect to generator L3 (W) output (AC) (Recommend 2A fuse)
	46	Generator Neutral (N) input	1.0mm ² AWG 18	Connect to generator Neutral terminal (AC)

 **NOTE:-** The above table describes connections to a three phase, four wire alternator. For alternative wiring topologies, please see the **ALTERNATIVE AC TOPOLOGIES** section of this manual.

4.1.5 BUS / MAINS VOLTAGE SENSING

	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	47	Mains L1 (R) voltage monitoring	1.0mm AWG 18	Connect to Mains L1 (R) incoming supply (AC) (Recommend 2A fuse)
	48	Mains L2 (S) voltage monitoring	1.0mm AWG 18	Connect to Mains L1 (S) incoming supply (AC) (Recommend 2A fuse)
	49	Mains L3 (T) voltage monitoring	1.0mm AWG 18	Connect to Mains L1 (T) incoming supply (AC) (Recommend 2A fuse)
	50	Mains Neutral (N) input	1.0mm AWG 18	Connect to Mains N incoming supply (AC)

4.1.6 GENERATOR CURRENT TRANSFORMERS



WARNING!:- Do not disconnect this plug when the CTs are carrying current. Disconnection will open circuit 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 DSE7510 MK1 module has a burden of 0.5VA on the CT. Ensure the CT is rated for the burden of the DSE7510 MK1 controller, the cable length being used and any other equipment sharing the CT. If in doubt, consult your CT supplier.

	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	51	CT Secondary for Gen L1	2.5mm ² AWG 13	Connect to s1 secondary of L1 monitoring CT
	52	CT Secondary for Gen L2	2.5mm ² AWG 13	Connect to s1 secondary of L2 monitoring CT
	53	CT Secondary for Gen L3	2.5mm ² AWG 13	Connect to s1 secondary of L3 monitoring CT

Connection to terminals 54 & 55

The function of terminals 54 and 55 change position depending upon wiring topology as follows :

Type	Topology	Pin No	Description	CABLE SIZE
	7500 series	54	DO NOT CONNECT	
			Common for CTs connected to L1,L2,L3	2.5mm ² AWG 13
	Restricted earth fault measuring	54	Common for CTs connected to L1,L2,L3,N	2.5mm ² AWG 13
		55	Connect to CT on the neutral conductor	2.5mm ² AWG 13
	Un-restricted earth fault measuring (Earth fault CT is fitted in the neutral to earth link)	54	Connect to CT on the neutral to earth link	
		55	Common for CTs connected to L1,L2,L3	2.5mm ² AWG 13

4.1.7 MAINS CURRENT TRANSFORMERS

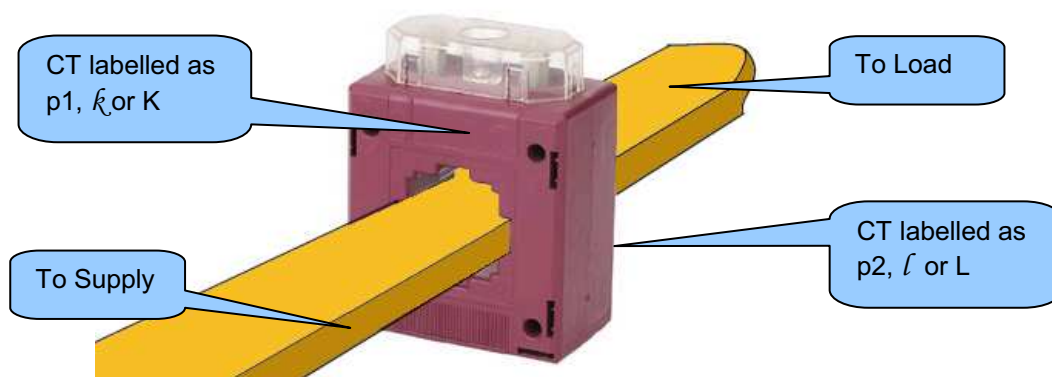
	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	56	CT Secondary for Mains L1	2.5mm ² AWG 13	Connect to s1 secondary of L1 monitoring CT
	57	CT Secondary for Mains L2	2.5mm ² AWG 13	Connect to s2 secondary of L2 monitoring CT




NOTE:- Terminals 58 and 59 are not fitted to the DSE7520Mk1 controller.



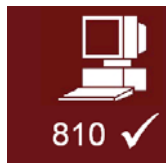
NOTE:- Take care to ensure correct polarity of the CT primary as shown overleaf. If in doubt, check with the CT supplier.

CT CONNECTIONS**4.1.8 CONFIGURABLE DIGITAL INPUTS**

	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	60	Configurable digital input A	0.5mm ² AWG 20	Switch to negative
	61	Configurable digital input B	0.5mm ² AWG 20	Switch to negative
	62	Configurable digital input C	0.5mm ² AWG 20	Switch to negative
	63	Configurable digital input D	0.5mm ² AWG 20	Switch to negative
	64	Configurable digital input E	0.5mm ² AWG 20	Switch to negative
	65	Configurable digital input F	0.5mm ² AWG 20	Switch to negative
	66	Configurable digital input G	0.5mm ² AWG 20	Switch to negative
	67	Configurable digital input H	0.5mm ² AWG 20	Switch to negative
	68	Configurable digital input I	0.5mm ² AWG 20	Switch to negative

 **NOTE:- Terminal 69 is not fitted to the DSE7520 MK1 controller.**

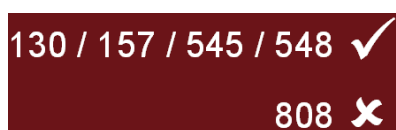
4.1.9 PC CONFIGURATION INTERFACE CONNECTOR



8-way connector allows connection to PC via 810 configuration interface. Module can then be re-configured utilising the 5xxx for Windows™ software.

! CAUTION! This socket must not be used for any other purpose.

4.1.10 EXPANSION INTERFACE CONNECTOR



4-way connector allows connection to the P130 input expansion, P157 relay expansion module or 545/548 LED expansion modules.

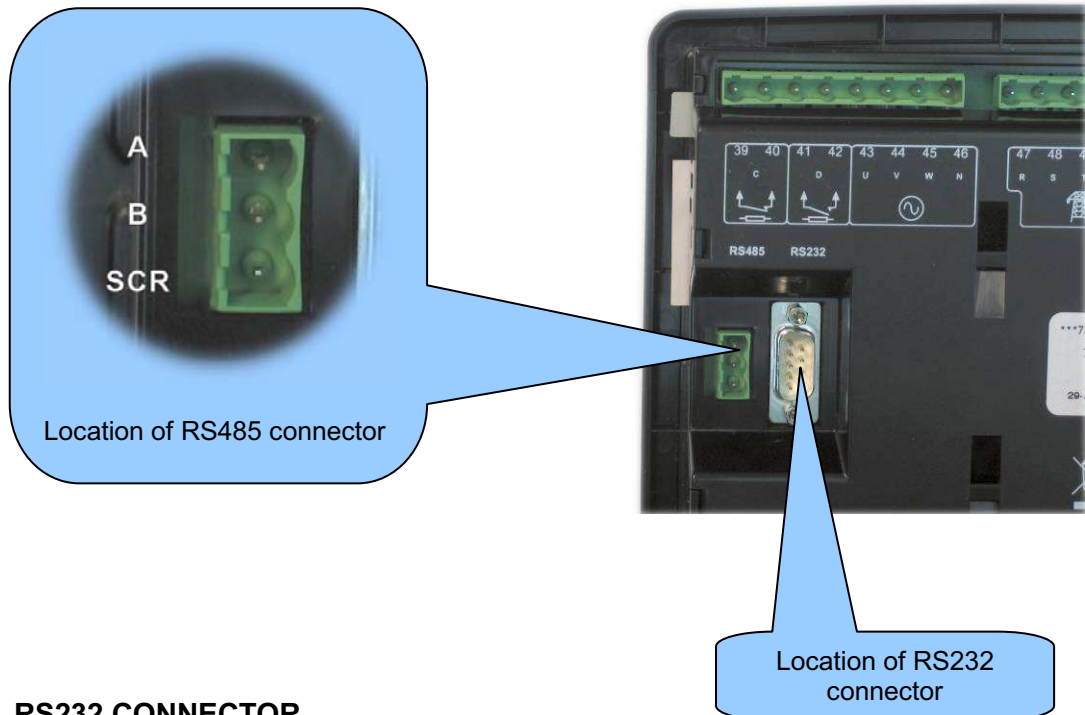
A maximum of 2 relay or LED expansion modules may be connected in series to this port.

! CAUTION! - Do not connect the 808 configuration interface to this port, as it is not possible to use the 808 software to configure the 7520MK1 module.

! CAUTION! This socket must not be used for any other purpose.

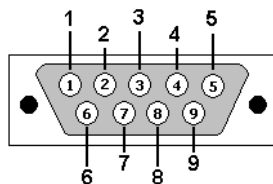
4.1.11 RS485 CONNECTOR

PIN No	NOTES
A	Two core screened twisted pair cable. 120Ω impedance suitable for RS485 use. Recommended cable type - Belden 9841 Max distance 1000m (1km) when using Belden 9841 or direct equivalent.
B	
SCR	



4.1.12 RS232 CONNECTOR

PIN No	NOTES
1	Received Line Signal Detector (Data Carrier Detect)
2	Received Data
3	Transmit Data
4	Data Terminal Ready
5	Signal Ground
6	Data Set Ready
7	Request To Send
8	Clear To Send
9	Ring Indicator



View looking into the male connector on the 7000 series module

4.1.13 ENGINE CONTROL UNIT INTERFACE

The module is capable of interfacing with the ECU fitted to electronically controlled engines. Different manufacturers of engines utilise various different interfaces and protocols. As this is a rapidly developing area, we recommend checking with DSE Support as to which engines are currently supported.

The module will monitor the engines operating parameters such as engine speed, oil pressure, engine temperature (among others) in order to closely monitor and control the engine. The data gathered by the engine controller is transmitted via an industry standard communications interface. This allows generator controllers such as the DSE 75xxMK1 range to access these engine parameters with no physical connection to the sensor device.

Utilising the technology present on the engine in this way gives fewer connections to the engine, higher reliability and better diagnosis of engine related problems.



NOTE:- For further details for connections to electronic engines refer to the manual CAN and DSE Wiring. Part No. 057-004

4.1.14 LED INDICATORS AND LOGO INSERT

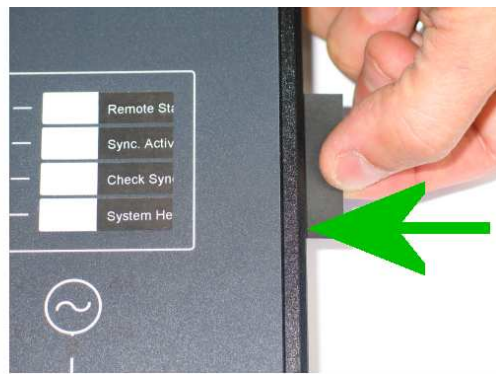
USER CONFIGURABLE LED's

These LEDs can be configured by the user to indicate any one of **100+ different functions** based around the following:-

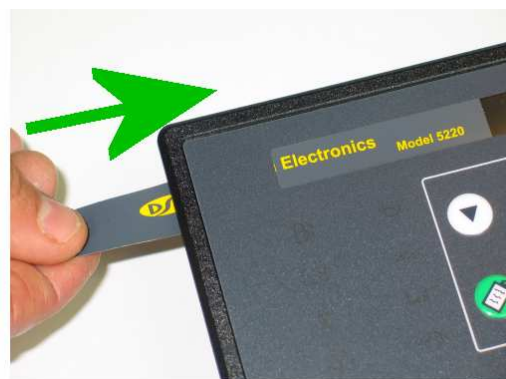
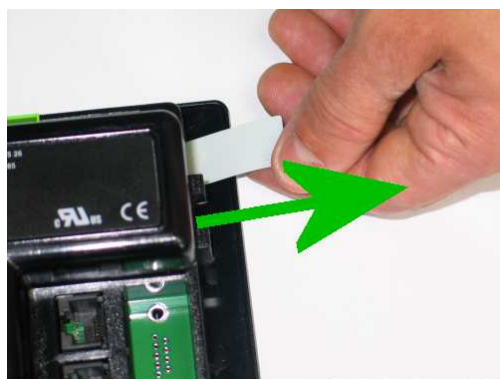
- **INDICATIONS** - Monitoring of a digital input and indicating associated functioning user's equipment - *Such as Battery Charger On or Louvre Open, etc.*
- **WARNINGS and SHUTDOWNS** - Specific indication of a particular warning or shutdown condition, backed up by LCD indication - *Such as Low Oil Pressure Shutdown, Low Coolant level, etc.*
- **STATUS INDICATIONS** - Indication of specific functions or sequences derived from the modules operating state - *Such as Safety On, Pre-heating, Panel Locked, Generator Available, etc.*

These LEDs are annunciated using a removable insert card. Additionally the module's logo can be changed to suit generator manufacturer's requirements. This can be used for instance to give custom branding to the module, or even include the service telephone number.

DSE have produced the 'insert card creator' software, shipped with the DSE SoftwareCD to ease the production of text and logo insert cards to suit your application.



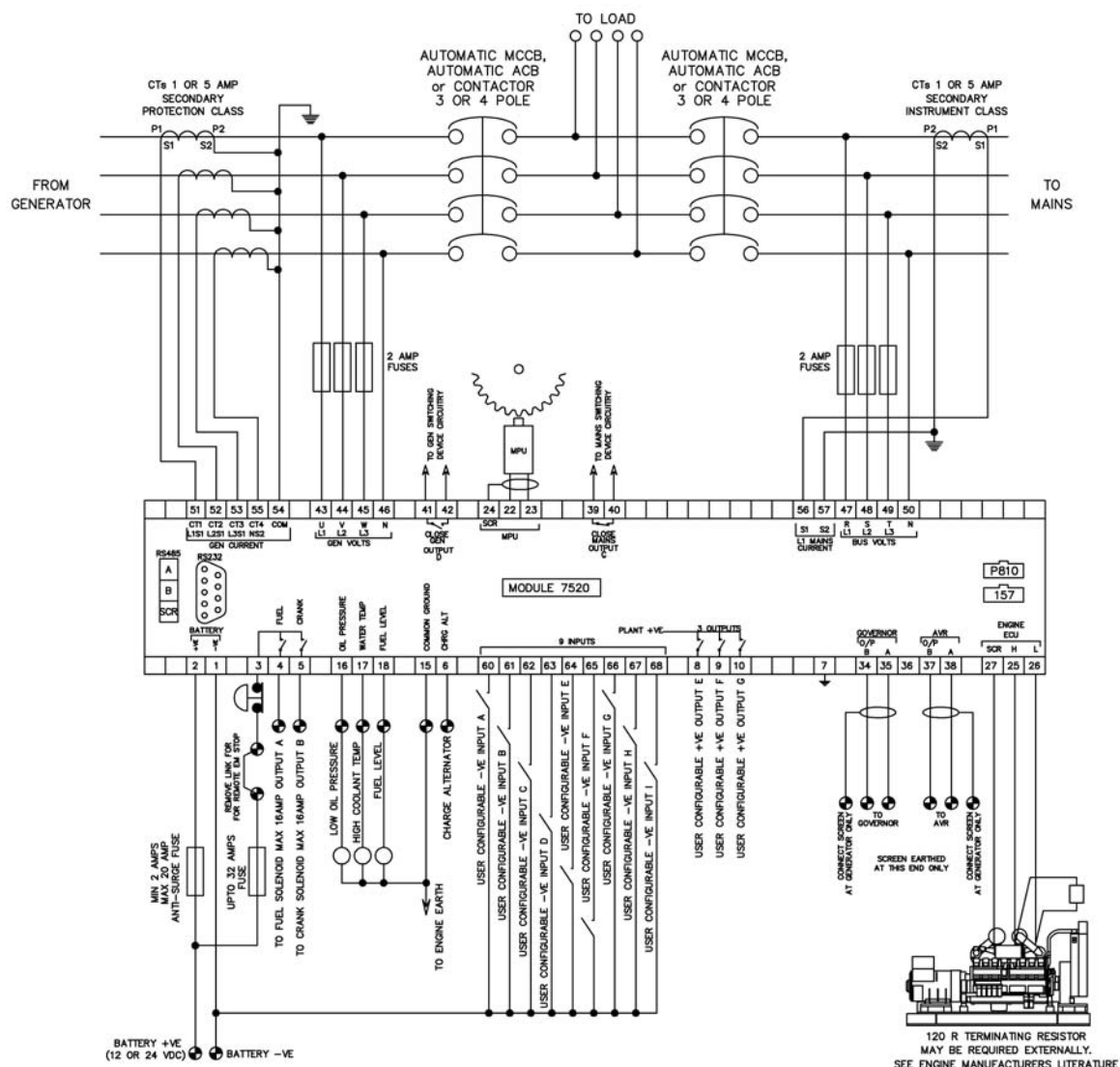
Removal and insertion of the LED text insert card



Removal and insertion of the Logo insert card

4.2 TYPICAL WIRING DIAGRAMS

4.2.1 3 PHASE, 4 WIRE WITH RESTRICTED EARTH FAULT PROTECTION



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)

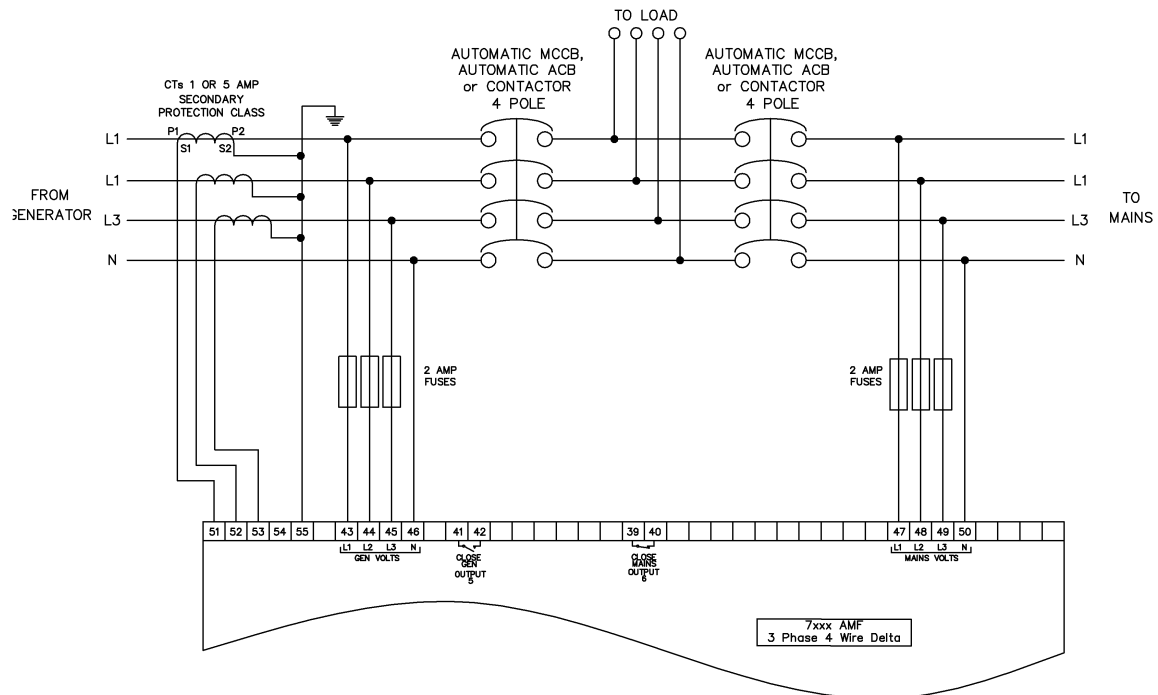
NOTE:- The MAINS CT is only required on for 'true' peak lop systems where the mains is held at a constant level and the generator provides variable power to the load.

4.3 ALTERNATIVE TOPOLOGIES

The 7000 controller is factory configured to connect to a 3 phase, 4 wire Star connected alternator. This section details connections for alternative AC topologies. Ensure to configure the 7000 series controller to suit the required topology.

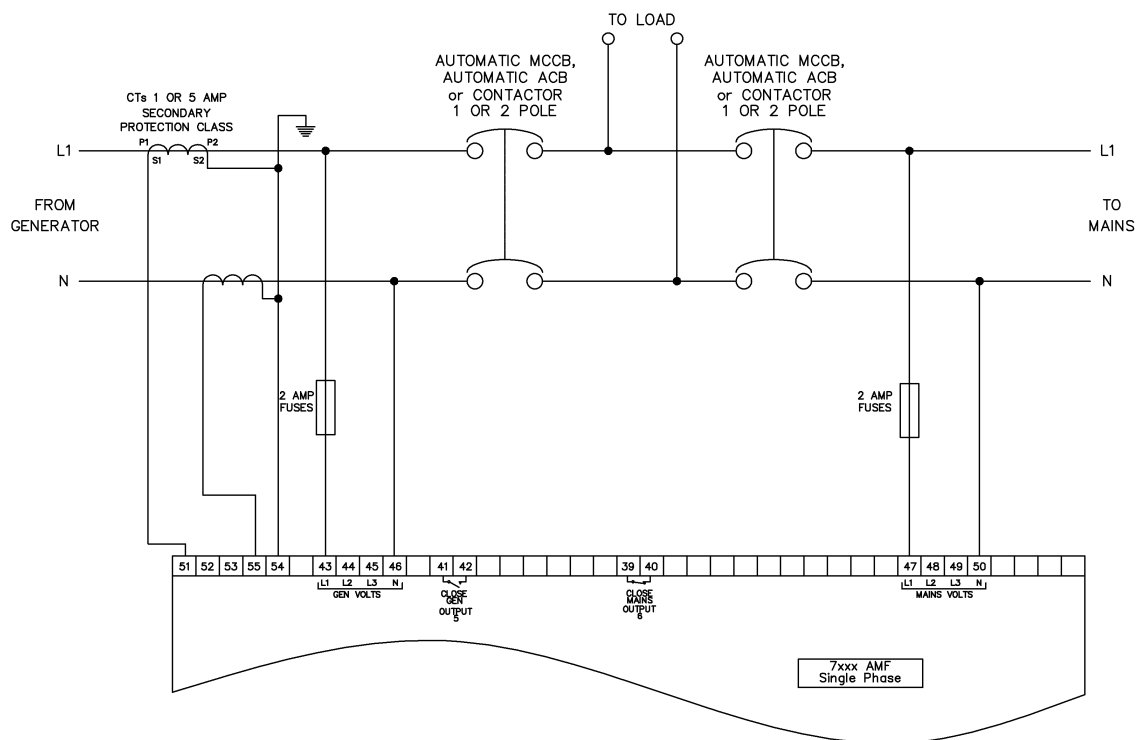
NOTE:- Further details of module configuration are contained within the DSE7000 Series configuration software manual (DSE part number 057-078)

4.3.1 3 PHASE, 4 WIRE WITHOUT EARTH FAULT PROTECTION

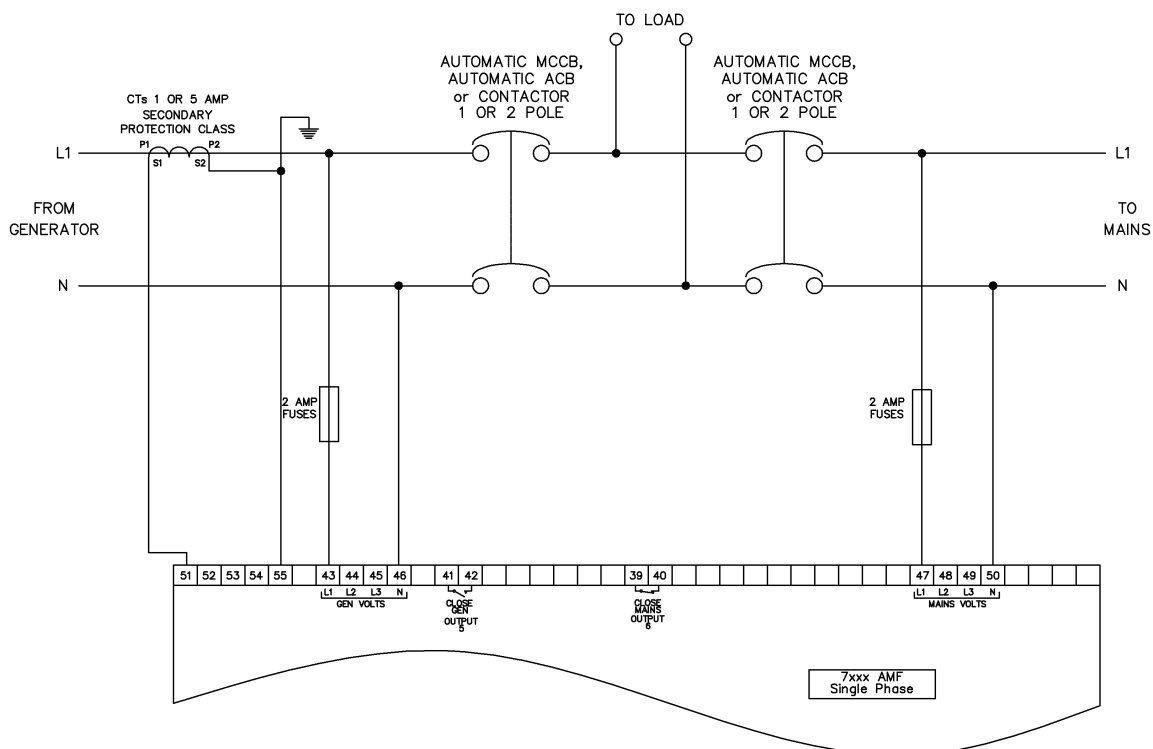


4.3.2 SINGLE PHASE WITH RESTRICTED EARTH FAULT

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)

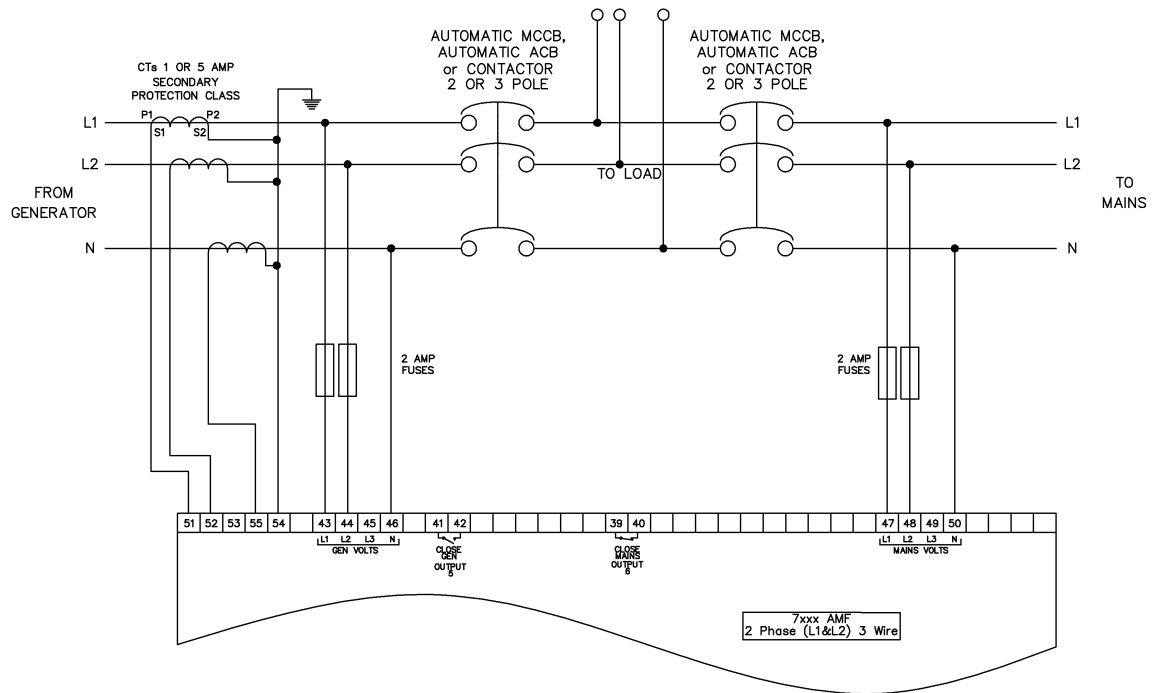


4.3.3 SINGLE PHASE WITHOUT EARTH FAULT

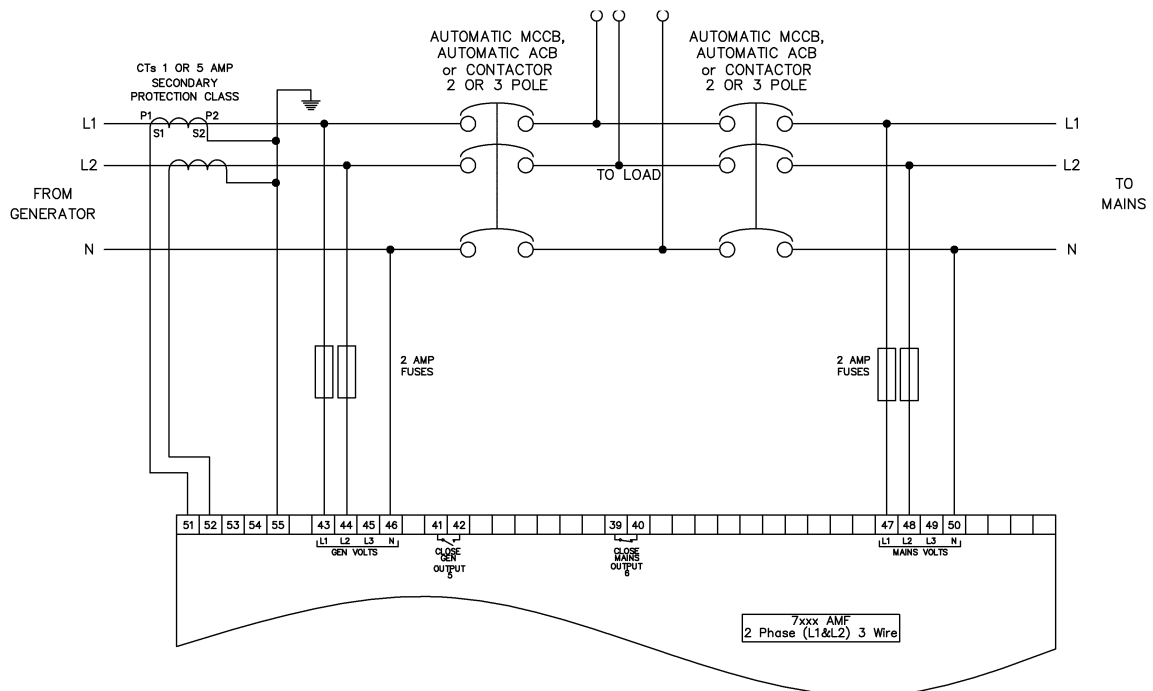


4.3.4 2 PHASE (L1 & L2) 3 WIRE WITH RESTRICTED EARTH FAULT

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)

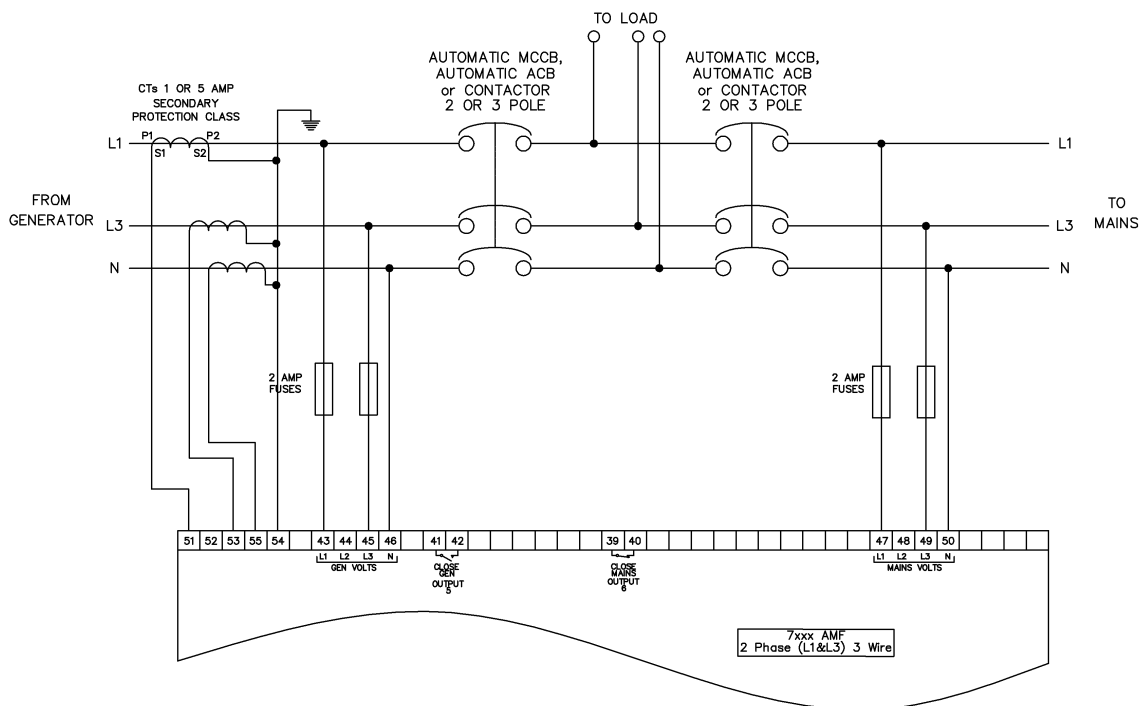


4.3.5 2 PHASE (L1 & L2) 3 WIRE WITHOUT EARTH FAULT

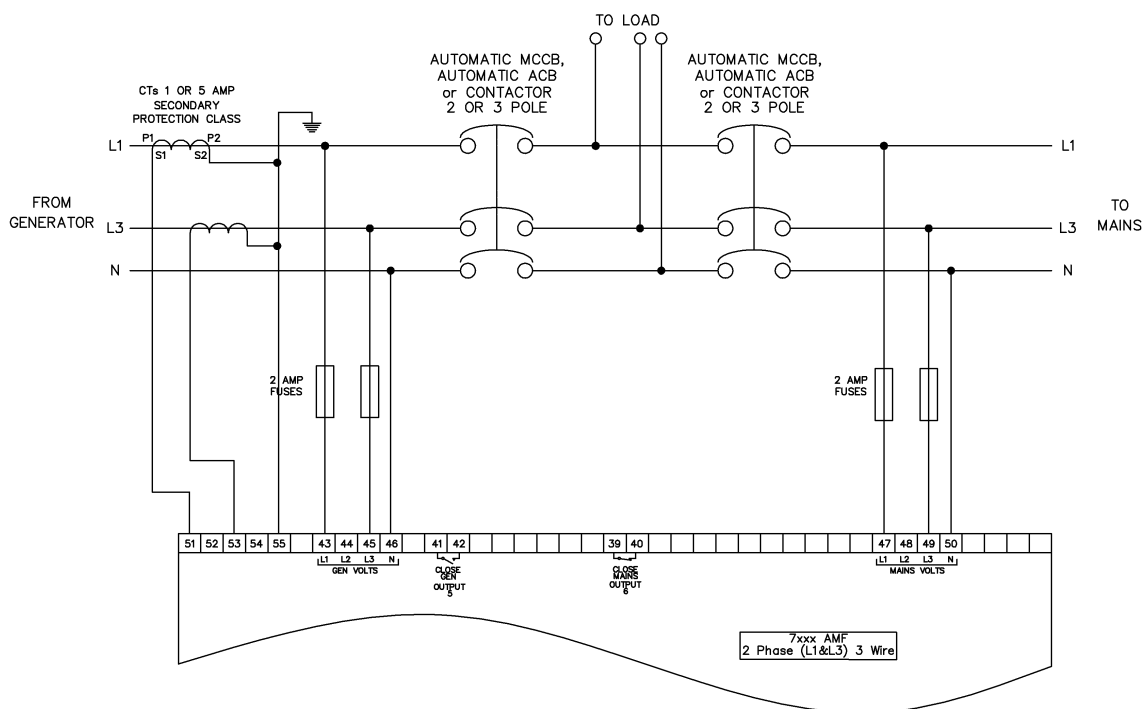


4.3.6 2 PHASE (L1 & L3) 3 WIRE WITH RESTRICTED EARTH FAULT

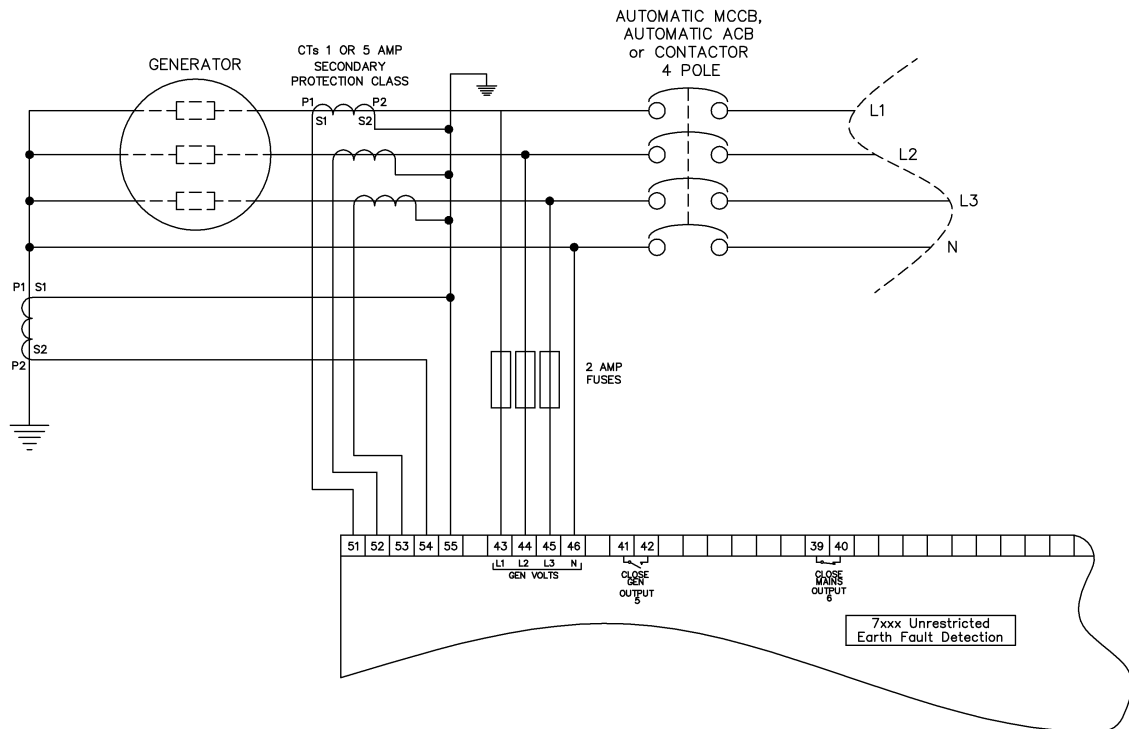
NOTE:- Earthing the neutral conductor 'before' the neutral CT allows the module to read earth faults 'after' the CT only (Restricted to load / downstream of the CT)
 Earthing the neutral conductor 'after' the neutral CT allows the module to read earth faults 'before' the CT only (Restricted to generator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



4.3.7 2 PHASE (L1 & L3) 3 WIRE WITHOUT EARTH FAULT MEASURING



4.3.8 3 PHASE 4 WIRE WITH UNRESTRICTED EARTH FAULT MEASURING



5 OPERATION

5.1 CONTROL

Control of the **DSE7520 MK1** module is via push buttons mounted on the front of the module with **STOP/RESET**, **MANUAL**, **TEST**, **AUTO**, **ALARM MUTE** and **START** functions. For normal operation, these are the only controls which need to be operated. The smaller push buttons are used to access further information such as mains voltage or to change the state of the load switching devices when in manual mode. Details of their operation are provided later in this document.

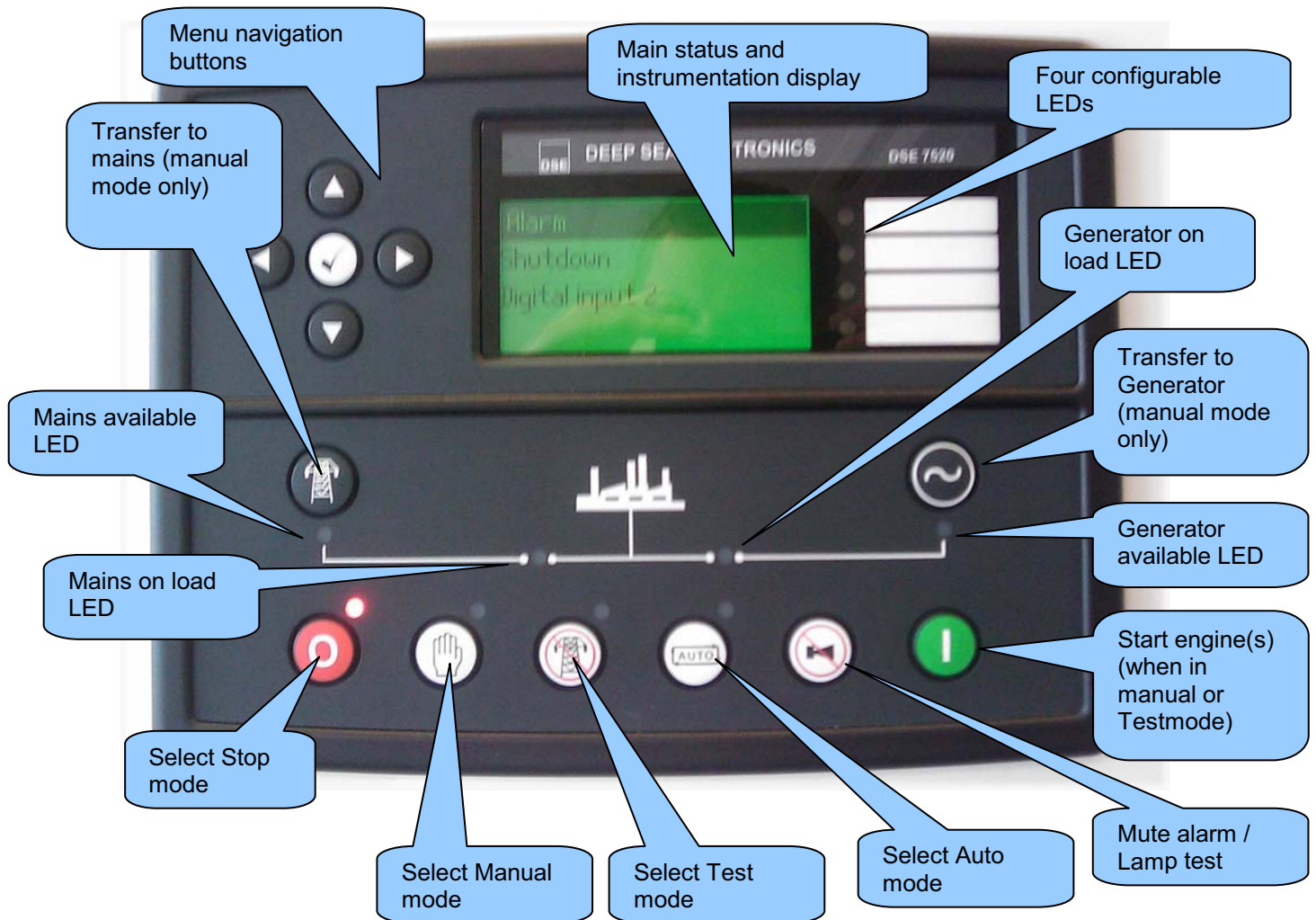
The following descriptions detail the sequences followed by a module containing the standard 'factory configuration'. Always refer to your configuration source for the exact sequences and timers observed by any particular module in the field.










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.





5.1.1 DESCRIPTION OF CONTROLS

The following section details the function and meaning of the various controls on the module.



6 CONTROL PUSH-BUTTONS



<p>STOP/RESET</p> <p>This push-button places the module into its Stop/reset mode. This will clear any alarm conditions for which the triggering criteria have been removed. If the engine is running and this push-button is operated, the module will automatically instruct the generator contactor/breaker to unload the generator. The fuel supply will be removed and engine will be brought to a standstill. Should a remote start signal be present while operating in the mode, a remote start will <u>not</u> occur.</p>	
<p>MANUAL</p> <p>This push-button is used to allow manual control of the generator functions. Entering this mode from another mode will initially not cause any change of operating state, but allows further push-buttons to be used to control the generator operation. For example, once in Manual mode it is possible to start the engine by using the 'START' push-button. If the engine is running, off-load in the Manual mode and a remote start signal becomes present, the module will automatically instruct the generator contactor/breaker device to place the generator on load. Should the remote start signal then be removed the generator will remain on load until either the 'STOP/RESET' or 'AUTO' push-buttons are operated.</p>	
<p>START</p> <p>This push-button is used to start the engine. The module must first be placed in the 'MANUAL' mode of operation. The 'START' button should then be operated. The engine will then automatically attempt to start. Should it fail on the first attempt it will re-try until either the engine fires or the pre-set number of attempts have been made. To stop the engine the 'STOP/RESET' button should be operated. It is also possible to configure the module such that the start push-button must be held to maintain engine cranking.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p> NOTE:- Different modes of operation are possible - Please refer to your configuration source for details.</p> </div>	
<p>AUTO</p> <p>This push-button places the module into its 'Automatic' mode. This mode allows the module to control the function of the generator automatically. The module will monitor the remote start input and once a start condition is signalled the set will be automatically started and placed on load. If the starting signal is removed, the module will automatically transfer the load from the generator and shut the set down observing the stop delay timer and cooling timer as necessary. The module will then await the next start event. <i>For further details, please see the more detailed description of 'Auto Operation' earlier in this manual.</i></p>	
<p>ALARM MUTE</p> <p>This push-button is used to silence the internal alarm sounder and also any external sounder devices fed from the audible alarm output. Any further alarm conditions will reactivate the sounder. Once the alarm has been muted and investigated, it may then be cleared. <i>Refer to the 'Protections' section of this manual for details.</i></p> <p>When the Alarm Mute is operated a Lamp test function will also be implemented and all LED indicators will be illuminated.</p>	
<p>OPEN GENERATOR</p> <p>This push button is used to control the opening of the generator load switching device :</p>	


<p>1. Pressing this button when the generator is running on load, and in MANUAL mode, the generator load switch is opened. Further presses of this button will have no effect.</p> <p> NOTE:- This button is only active in MANUAL mode.</p>	
<p>CLOSE GENERATOR</p> <p>This push button is used to control the closure of the generator load switching device and has two modes of operation :</p> <ol style="list-style-type: none"> 1. Synchronising is NOT enabled. Pressing this button when the generator is running off load and in MANUAL mode, the generator load switch is closed. Further presses of this button will have no effect. 2. Synchronising is enabled. Pressing this button when the generator is running and in MANUAL mode, the 7510MK1 controller, will volts match and synchronise with the Bus. The generator load switch is then closed in parallel with the Bus. <p> NOTE:- This button is only active in MANUAL mode.</p> <p> NOTE:- If the generator is live when the manual button is pressed, synchronising will take place before the load switch is closed.</p>	

6.1 AUTOMATIC OPERATION

6.1.1 MAINS FAILURE

This mode of operation is used to ensure continuity of supply to critical loads during a mains failure condition. This is the normal mode of operation when installed on a standby generator.

 **NOTE:** - If a digital input configured to panel lock is active, changing module modes will not be possible. Viewing the instruments  and event log are NOT affected by panel lock. If panel lock is active the Panel lock indicator (if configured) illuminates.


This mode is activated by pressing the  pushbutton. An LED indicator beside the button will illuminate to confirm this operation.

Should the mains (utility) supply fall outside the configurable limits for longer than the period of the mains transient delay timer, the mains (utility) available GREEN indicator LED extinguishes.

To allow for short term mains supply transient conditions, the Start Delay timer is initiated. After this delay, if the pre-heat output option is selected then the pre-heat timer is initiated and the corresponding auxiliary output (if configured) will energise.

 **NOTE:** - If the mains supply returns within limits during the Start Delay timer, the unit will return to a stand-by state.

After the above delays have expired the **Fuel Solenoid (or enable ECU output if configured)** is energised, then one second later, the **Starter Motor** is engaged.

 **NOTE:** - If the unit has been configured for CAN Bus, compatible ECU's will receive the start command via CAN Bus. Refer to the Manual CAN and DSE Wiring. Part No. 057-004 for more information on utilising DSE modules with electronically controlled engines.

The engine is cranked for a pre-set time. If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the pre-set rest period. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and **Fail to Start** fault will be displayed.

Alarm
Shutdown
Fail to start

When the engine fires, the starter motor is disengaged and locked out at a pre-set frequency measured from the alternator output. Alternatively, a Magnetic Pickup mounted on the flywheel housing can be used for speed detection (This is selected by PC using the 75xx series configuration software). Rising oil pressure can also be used to disconnect the starter motor; however it cannot be used for underspeed or overspeed detection.

 **NOTE:** - If the unit has been configured for CAN Bus, speed sensing is via CAN Bus.

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

Once the engine is running, the **Warm Up** timer, if selected is initiated, allowing the engine to stabilise before accepting the load.

After the **Warm-up** timer has expired then the module will transfer the load from the failed mains supply to the generator output. It will observe the following sequence. The **Mains Contactor/Breaker** will be instructed to open and after a short delay (**transfer delay**), the **Generator Contactor/Breaker** will be instructed to close.


The generator will then supply the requirements of the load.


 **NOTE:-A load transfer will not be initiated until the Oil Pressure has risen. This prevents excessive wear on the engine.**

When the mains supply returns, the **Stop** delay timer is initiated. Once it has expired, the set is synchronised and paralleled with the mains supply. The system remains in this condition until expiry of the **Parallel run** timer. Once this has expired, the module will ramp the remaining load from the generator to mains supply. The Generator Contact/Breaker will open and the **Cooling** timer is then initiated, allowing the engine a cooling down period off load before shutting down. Once the **Cooling** timer expires, the **Fuel Solenoid** is de-energised, bringing the generator to a stop.

During the parallel run, the module can be configured to either run at a fixed level output, or to maintain an output in relation to the load level on the mains. For full details of these mode please refer to the manual 'The Guide to sync and load share Pt1'



Should the mains supply fall outside limits once again the set will return on load.

 **NOTE: - When synchronising is enabled, the mains supply is checked before closing any load switching device. If the supply is live, synchronising will take place before any closure takes place.**

 **NOTE: - Synchronising can be disabled if the application does not require this function. Contact your genset supplier in the first instance for further details.**

6.1.2 REMOTE START IN ISLAND MODE

This mode of operation is used to start the set in response to an external start requirement from another device. It may also be used to provide continuity of supply during expected black out events.

 **NOTE:-** If a digital input configured to panel lock is active, changing module modes will not be possible. Viewing the instruments  and event log are NOT affected by panel lock. If panel lock is active the Panel lock indicator (if configured) illuminates.


This mode is activated by pressing the  pushbutton. An LED indicator beside the button will illuminate to confirm this operation.

If the *remote start in island mode* input activates, the **Remote Start Active** indicator (if configured) illuminates.

To allow for false remote start signals, the Start Delay timer is initiated. After this delay, if the pre-heat output option is selected then the pre-heat timer is initiated and the corresponding auxiliary output (if configured) will energise.

 **NOTE:-** If the Remote Start signal is removed during the Start Delay timer, the unit will return to a stand-by state.

After the above delays, the **Fuel Solenoid (or enable ECU** output if configured) is energised, and then one second later, the **Starter Motor** is engaged.

 **NOTE: -** If the unit has been configured for CAN Bus, compatible ECU's will receive the start command via CAN Bus. Refer to the Manual CAN and DSE Wiring. Part No. 057-004 for more information on utilising DSE modules with electronically controlled engines.

The engine is cranked for a pre-set time. If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the pre-set rest period. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and **Fail to Start** fault will be displayed.


Alarm
Shutdown
Fail to start

When the engine fires, the starter motor is disengaged and locked out at a pre-set frequency measured from the alternator output. Alternatively, a Magnetic Pickup mounted on the flywheel housing can be used for speed detection (This is selected by PC using the 5xxx series configuration software). Rising oil pressure can also be used to disconnect the starter motor; however, it cannot be used for underspeed or overspeed detection.

 **NOTE: -** If the unit is configured for CAN Bus, speed sensing is via CAN Bus.

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

Once the engine is running, the **Warm Up** timer, if selected is initiated, allowing the engine to stabilise before accepting the load.

 **NOTE: - A load transfer will not be initiated until the Oil Pressure has risen. This prevents excessive wear on the engine.**

The Generator will first be instructed to **synchronise** with the mains supply before closing the **Generator Contact/Breaker** and transferring load from mains to generator until the generator is supplying the required amount of power (adjustable using 75xx configuration software).

When the supplies have been in parallel for the duration of the **parallel run time**, the load will ramp off the mains supply and onto the generator. The **Mains Contactor/Breaker** will be instructed to open.


The generator will then supply the requirements of the load.


When the remote start signal is removed, the **Stop** delay timer is initiated. Once it has expired, the set is synchronised and paralleled with the mains supply.

The system remains in this condition until expiry of the **Parallel run** timer. Once this has expired, the module will ramp the remaining load from the generator to mains supply.

The **Generator Contact/Breaker** will open and the **Cooling** timer is then initiated, allowing the engine a cooling down period off load before shutting down.



Once the **Cooling** timer expires, the **Fuel Solenoid** is de-energised, bringing the generator to a stop.

 **NOTE: - Synchronising can be disabled if the application does not require this function. Contact your generating set supplier in the first instance for further details.**

 **NOTE: - The internal 'Scheduler' can be configured to operate the system in the same manner as described for the Remote start input. Please refer to the 75xx Configuration Software manuals for full details on the feature.**

6.1.3 REMOTE START ON LOAD


This mode of operation is used to start the set in response to rising load levels on the mains supply (if configured).

 **NOTE:** - If a digital input configured to panel lock is active, changing module modes will not be possible. Viewing the instruments  and event log are NOT affected by panel lock. If panel lock is active the Panel lock indicator (if configured) illuminates.


This mode is activated by pressing the  pushbutton. An LED indicator beside the button will illuminate to confirm this operation.

Should the load level on the mains supply exceed a pre-set level the module will initiate a start sequence.

To allow for short duration load surges, the Start Delay timer is initiated. After this delay, if the pre-heat output option is selected then the pre-heat timer is initiated and the corresponding auxiliary output (if configured) will energise.

 **NOTE:** - If the load level returns below the pre-set level during the Start Delay timer, the unit will return to a stand-by state.

After the above delays, the **Fuel Solenoid (or enable ECU** output if configured) is energised, and then one second later, the **Starter Motor** is engaged.

 **NOTE:** - If the unit has been configured for CAN Bus, compatible ECU's will receive the start command via CAN Bus. Refer to the Manual CAN and DSE Wiring. Part No. 057-004 for more information on utilising DSE modules with electronically controlled engines.

The engine is cranked for a pre-set time. If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the pre-set rest period. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and **Fail to Start** fault will be displayed.

Alarm
Shutdown
Fail to start

When the engine fires, the starter motor is disengaged and locked out at a pre-set frequency measured from the alternator output. Alternatively, a Magnetic Pickup mounted on the flywheel housing can be used for speed detection (This is selected by PC using the 5xxx series configuration software). Rising oil pressure can also be used to disconnect the starter motor; however, it cannot be used for underspeed or overspeed detection.

 **NOTE:** - If the unit is configured for CAN Bus, speed sensing is via CAN Bus.

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

Once the engine is running, the **Warm Up** timer, if selected is initiated, allowing the engine to stabilise before accepting the load.

After the **Warm-up** timer has expired then the module will transfer the load from the mains supply to the generator output. It will observe the following sequence.


The Generator will first be instructed to **synchronise** with the mains supply. Once these are matched, the **Generator Contact/Breaker** will be instructed to close.

The load will then be **ramped** from the Mains to the appropriate level on the generator. The generator will then supply the requirements of the load.


 **NOTE: - A load transfer will not be initiated until the Oil Pressure has risen. This prevents excessive wear on the engine.**

When the *remote start on load* input is removed, the **Stop** delay timer is initiated. Once this timer has expired, the module will ramp the load from the generator to mains supply. The **Generator Contact/Breaker** will open and the **Cooling** timer is then initiated, allowing the engine a cooling down period off load before shutting down. Once the **Cooling** timer expires, the **Fuel Solenoid** is de-energised, bringing the generator to a stop.

During the parallel run, the module can be configured to either run at a fixed level output, or to maintain an output in relation to the load level on the mains.



 **NOTE: - When synchronising is enabled, the mains supply is checked before closing any load switching device. If the supply is live, synchronising will take place before any closure takes place.**

 **NOTE: - Synchronising can be disabled if the application does not require this function. Contact your genset supplier in the first instance for further details.**

 **NOTE: - The load level mode of operation relies on a Current Transformer (CT) fitted to the mains feed of the system. This is then used for measurement of the mains current used in the load level calculations.**

6.2 MANUAL OPERATION

Manual mode is used to allow the operator to control the operation of the generator, and to provide fault finding and diagnostic testing of the various operations normally performed during Automatic mode operation.


 **NOTE:** - If a digital input configured to panel lock is active, changing module modes will not be possible. Viewing the instruments  and event logs and event log is NOT affected by panel lock. If panel lock is active the Panel lock indicator (if configured) illuminates.

MANUAL, mode is selected by pressing the  pushbutton. An LED besides the button will illuminate to confirm this operation. When the **START** () button is operated, the module will initiate the start sequence.

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

If the **pre-heat** output option has been selected, this timer will be initiated and the auxiliary output selected energised.

After the above delay, the **Fuel Solenoid** (or **ECU** output if configured) is energised, and then one second later, the **Starter Motor** is engaged.

 **NOTE:-** If the unit is configured for CAN Bus, compatible ECU's will receive the start command via CAN Bus. Refer to the Manual CAN and DSE Wiring. Part No. 057-004 for more information on utilising DSE modules with electronically controlled engines.

The engine is cranked for a pre-set time. If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the pre-set rest period. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and **Fail to Start** will be displayed.

Alarm
Shutdown
Fail to start


When the engine fires, the starter motor is disengaged and locked out at a pre-set frequency measured from the Alternator output. Alternatively, a Magnetic Pickup mounted on the flywheel housing can be used for speed detection (This is selected by PC using the 5xxx series configuration software). Rising oil pressure can also be used to disconnect the starter motor; however, it cannot be used for underspeed or overspeed detection.

 **NOTE:** - If the unit is configured for CAN Bus, speed sensing is via CAN Bus.

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

Once the engine is running, the **Warm Up** timer (if selected) is initiated, allowing the engine to stabilise before it can be loaded. Once the warm up timer has expired, the generator is then available to go on load and the **Generator Available LED** will illuminate on the front panel.




The generator will run off load unless:

1. The mains supply fails,
2. A **Remote Start on load** signal is applied, or an on-load run is configured in the scheduler.
3. The  **Close Generator** button is pressed.

If any of the above signals are received, the generator is synchronised and paralleled with the mains supply (if available).

During the parallel run, the module can be configured to either run at a fixed level output, or to maintain an output in relation to the load level on the mains. For full details of these mode please refer to the manual 'The Guide to sync and load share Pt1'


Parallel operation:


- If the  **Close Generator** button is pressed again while in parallel, then the module will transfer the load fully to the generators, removing the load from the mains supply. This will be achieved by ramping the load from the parallel operating level to the generator. The Mains Contactor/Breaker will then be opened. Pressing the  **Close Mains** button will cause the module to re-synchronise the generator with the mains supply and then return to parallel operation.
- If the  **Close Mains** button is pressed while in parallel, the module will open the generator load switching device, transferring the load fully to the mains supply.


If **Auto** mode is selected and the mains supply is healthy, and the remote start on load signal not active, and the scheduler is not calling for a run, then the **Return Delay Timer** will start.

Once this has expired then the module will exit **parallel** operation and will ramp the load back to the mains supply. It will then open the **Generator Contactor/Breaker**. The generator will then run **off** load allowing the engine a **cooling** period.

Selecting **STOP (O)** de-energises the **FUEL SOLENOID**, bringing the generator to a stop.



 **WARNING:** - Operation of the **STOP** button in any mode will stop the generator operation and return the load switching system to a safe state. This operation may lead to loss of supply to the load. It is recommended that the **STOP** button is only operated once the generator is **OFF LOAD** and the mains is supplying the load.


 **NOTE:** - Synchronising can be disabled if the application does not require this function. Contact your genset supplier in the first instance for further details. If synchronising is disabled the system will always perform an open transition when switching the load from the mains to the generator or when returning to the mains. The parallel run stages of the sequence are not used when operating in this way.

 **NOTE:** - When synchronising is enabled, the mains supply is checked before closing any load switching device. If the supply is live, synchronising will take place before any closure takes place.

6.3 TEST OPERATION

Test operation is used to perform a full on load test sequence to allow for diagnosis of faults. Alternatively, it may also be used to provide continuity of supply during expected black out events, peak lopping or peak shaving during high tariff periods.


 **NOTE:** - If a digital input configured to panel lock is active, changing module modes will not be possible. Viewing the instruments  and event log is NOT affected by panel lock. If panel lock is active the Panel lock indicator (if configured) illuminates.

TEST mode is initiated by pressing the  pushbutton. An LED besides the button will illuminate to confirm this operation. When the **START** (I) button is operated, the module will initiate the start sequence.

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

If the **pre-heat** output option has been selected, this timer will initiate and the auxiliary output selected will be energised.

After the above delay, the **Fuel Solenoid (or ECU** output if configured) is energised, and then one second later, the **Starter Motor** is engaged.

 **NOTE:** - If the unit has been configured for CAN Bus, compatible ECU's will receive the start command via CAN Bus. Refer to the Manual CAN and DSE Wiring. Part No. 057-004 for more information on utilising DSE modules with electronically controlled engines.

The engine is cranked for a pre-set time. If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the pre-set rest period. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and **Fail to Start** will be displayed.

Alarm
Shutdown
Fail to start

When the engine fires, the starter motor is disengaged and locked out at a pre-set frequency from the Alternator output. Alternatively, a Magnetic Pickup mounted on the flywheel housing can be used for speed detection (This is selected by PC using the 75xx series configuration software). Rising oil pressure can also be used to disconnect the starter motor; however, it cannot be used for underspeed or overspeed detection.

 **NOTE:** - If the unit has been configured for CAN Bus speed sensing is via CAN Bus.

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

Once the engine is running, the **Warm Up** timer, if selected is initiated, allowing the engine to stabilise before accepting the load.

After the **Warm-up** timer has expired then the module will transfer the load from the mains supply to the generator output. It will observe the following sequence.

The Generator will first be instructed to **synchronise** with the mains supply. Once these are matched the **Generator Contact/Breaker** will be instructed to close.

The load will then be **ramped** from the Mains to the appropriate level on the generator.


It will remain in this state whilst in the TEST mode.


If the module has an active *remote start in island mode input* or the internal scheduler has been configured for *island mode* then the **parallel run time** will activate. When this expires, the load will ramp off the mains supply and onto the generator. The **Mains Contactor/Breaker** will be instructed to open

The generator will then supply the requirements of the load.


 **NOTE:-A load transfer will not be initiated until the Oil Pressure has risen. This prevents excessive wear on the engine.**


The system will then remain in this mode of operation until a different mode is selected. It is

recommended that  mode is used to cancel the TEST mode.

When  mode is selected the **Stop** delay timer is initiated. Once it has expired, the set is synchronised and paralleled with the mains supply. The system remains in this condition until expiry of the **Parallel run** timer. Once this has expired the module will ramp the remaining load from the generator to mains supply. The **Generator Contact/Breaker** will open and the **Cooling** timer is then initiated, allowing the engine a cooling down period off load before shutting down. Once the **Cooling** timer expires the **Fuel Solenoid** is de-energised, bringing the generator to a stop.

During the parallel run the module can be configured to either run at a fixed level output, or to maintain an output in relation to the load level on the mains. For full details of these mode please refer to the manual 'The Guide to sync and load share Pt1'

 **NOTE:- When synchronising is enabled, the mains supply is checked before closing any load switching device. If the supply is live, synchronising will take place before any closure takes place.**

 **NOTE:- Synchronising can be disabled if the application does not require this function. Contact your genset supplier in the first instance for further details.**

7 PROTECTIONS

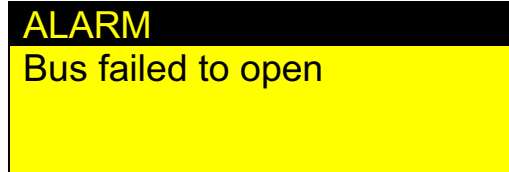
The module will indicate that an alarm has occurred in several ways;

The Audible Alarm will sound. This can be silenced by pressing the '**Mute**' button.

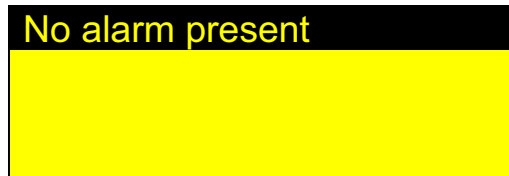


The LCD display will jump from the 'Status page' to display the Alarm.



The LCD will then display :
Followed by the appropriate alarm text.



If no alarms are present, the LCD will display the following message and will then return to the '**Status Display**' page.



The LCD will display multiple alarms E.g. "Bus fail to open", "Fail to synchronise" and "Mains fail to close" alarms have been triggered. These will automatically scroll round in the order that they occurred.

It is also possible to scroll to display the different alarms using the scroll buttons  

7.1 WARNINGS

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

BATTERY LOW VOLTAGE, if the module detects that the systems DC supply has fallen below the low volts setting level , the module will display '**WARNING LOW BATTERY VOLTAGE**' on the LCD. The **COMMON ALARM LED** will illuminate.

BATTERY HIGH VOLTAGE, if the module detects that the system DC supply has risen above the high volts setting level, the module will display '**WARNING HIGH BATTERY VOLTAGE**' on the LCD. The **COMMON ALARM LED** will illuminate.

FAILED TO SYNCHRONISE, if the module cannot synchronise within the time allowed by the Synchronising timer a warning is initiated. The LCD will indicate '**FAILED TO SYNC**' and the **COMMON ALARM LED** will illuminate.

AUXILIARY INPUTS, if an auxiliary input has been configured as a warning the appropriate LCD message will be displayed and the **COMMON ALARM LED** will illuminate.

MAINS FAILED TO CLOSE, if the mains breaker fails to close, a warning is initiated. The LCD will indicate '**MAINS FAILED TO CLOSE**' and the **COMMON ALARM LED** will illuminate.

MAINS FAILED TO OPEN, if the mains breaker fails to open, a warning is initiated. The LCD will indicate '**MAINS FAILED TO OPEN**' and the **COMMON ALARM LED** will illuminate.

INSUFFICIENT CAPACITY, if the generators reach full load when they are in parallel with the mains (utility). The LCD will indicate '**INSUFFICIENT CAPACITY**' and the **COMMON ALARM LED** will illuminate.

MINIMUM SETS NOT REACHED, if the minimum number of sets on the generator has not been reached prior to closing the generator load switching device, the LCD will indicate '**MINIMUM SETS NOT REACHED**' and the **COMMON ALARM LED** will illuminate.

MSC DATA ERROR, if the data on the MSC link is corrupt, then the LCD will indicate '**MSC DATA ERROR**' and the **COMMON ALARM LED** will illuminate.

MSC ID ERROR, if more than one 7520 module is connected to the same MSC link, the LCD will indicate '**MSC ID ERROR**' and the **COMMON ALARM LED** will illuminate.

MSC FAILURE, if the link breaks, the LCD will indicate '**MSC FAILURE**' and the **COMMON ALARM LED** will illuminate.

BUS FAILED TO CLOSE, if the generator breaker fails to close, the LCD will indicate '**BUS FAILED TO CLOSE**' and the **COMMON ALARM LED** will flash.

BUS FAILED TO OPEN, if the generator breaker fails to open, the LCD will indicate '**BUS FAILED TO OPEN**' and the **COMMON ALARM LED** will flash.

MAINS REVERSE POWER, if the 7520 detects that the generator is exporting more than the configured limit, the LCD will indicate '**MAINS REVERSE POWER**' and the **COMMON ALARM LED** will flash.

MSC TOO FEW SETS, if the number of modules on the MSC link falls below the **Minimum modules on Multiset comms link**, the LCD will indicate '**MSC TOO FEW SETS**' and the **COMMON ALARM LED** will illuminate.

MSC ALARMS INHIBITED, if an input has been configured as 'MSC ALARMS INHIBIT' and is active, the LCD will indicate '**MSC ALARMS INHIBIT**' and the **COMMON ALARM LED** will illuminate.

7.2 ELECTRICAL TRIPS

Electrical trips are latching, and open the generator breaker. The alarm must be accepted and cleared, and the fault removed to reset the module.

MAINS REVERSE POWER, if the module detects a mains reverse power in excess of the pre-set trip level and time delay, an electrical trip is initiated. The LCD will indicate '**MAINS REVERSE POWER**' and the **COMMON ALARM LED** will flash.

AUXILIARY INPUTS, if an auxiliary input has been configured as an Electrical Trip the appropriate LCD message will be displayed and the **COMMON ALARM LED** will flash.

MINIMUM SETS NOT REACHED, if the minimum number of sets are not synchronised on to the bus, prior to the common generator breaker closing, an electrical trip is initiated. The LCD will indicate '**MIN. SETS NOT REACHED**' and the **COMMON ALARM LED** will flash.

BUS FAILED TO CLOSE, if the generator breaker fails to close, an electrical trip is initiated. The LCD will indicate '**BUS FAILED TO CLOSE**' and the **COMMON ALARM LED** will flash.

BUS FAILED TO OPEN, if the generator breaker fails to open, an electrical trip is initiated. The LCD will indicate '**BUS FAILED TO OPEN**' and the **COMMON ALARM LED** will flash.

INSUFFICIENT CAPACITY, if the module is configured for Mains CT and the load levels are so high that the generator is unable to supply enough load to maintain the configured mains level, insufficient capacity will be displayed and the **COMMON ALARM LED** will flash. The generator will provide 100% of its capacity and the loading on the mains will increase.

MAINS REVERSE POWER, if the module is configured for Mains CT and the amount of power being exported to the mains supply is above the setting for the 'export power level alarm' then mains reverse power is displayed and the **COMMON ALARM LED** will flash.

OLD UNITS ON BUS, if the module detects that there is one or more 7520 controllers connected to the MSC link that are not compatible with the module (for example earlier versions not supporting multiple mains supplies), Old units on generator is displayed and the **COMMON ALARM LED** will flash.

FAILED TO SYNCHRONISE, if the module cannot synchronise within the time allowed by the Synchronising timer a warning is initiated. The LCD will indicate '**FAILED TO SYNC**' and the **COMMON ALARM LED** will illuminate.

MSC TOO FEW SETS, if the 7520 detects that the number of generator sets connected module cannot synchronise within the time allowed by the Synchronising timer a warning is initiated. The LCD will indicate '**FAILED TO SYNC**' and the **COMMON ALARM LED** will illuminate.


PRIORITY SELECTION ERROR, if the 7520 detects that two or more 7520 controllers share the same priority number, an electrical trip is initiated. The LCD will indicate '**PRIORITY SELECTION ERROR**' and the **COMMON ALARM LED** will illuminate.

BUS PHASE SEQUENCE WRONG, if the module detects a generator phase rotation error, an electrical trip is initiated. The LCD will indicate '**BUS PHASE SEQ WRONG**' and the **COMMON ALARM LED** will illuminate.




MAINS PHASE SEQUENCE WRONG, if the module detects a mains phase rotation error, an electrical trip is initiated. The LCD will indicate '**MAINS PHASE SEQ WRONG**' and the **COMMON ALARM LED** will illuminate.

7.3 ROCOF / VECTOR SHIFT

When configured to run in parallel with the mains (utility) supply, the module monitors for ROCOF / Vector shift trips according to the module's configuration settings. This is included within the module and will detect failure of the mains supply during parallel operation with the generator.

 **NOTE:- This protection operates only when in parallel with the mains supply and is disabled at all other times.**

Should either of these alarms operate, the module will perform either a controlled shutdown (electrical trip) of the generator or will instigate the mains failure function. This operation must be manually reset :

- 1) Press  button. The engine will stop if it is still running and the alarm is cleared.
- 2) Activate digital input configured to "Clear ROCOF/Vector shift" if this has been provided.
- 3) Press  and  button together and hold for 5 seconds. The ROCOF/Vector shift instrument is displayed and all 'peak hold' values are reset, clearing the ROCOF/Vector shift alarm.

For details on activating and configuring the ROCOF/Vector shift protection you are referred to the 75xx for Windows configuration software manual.

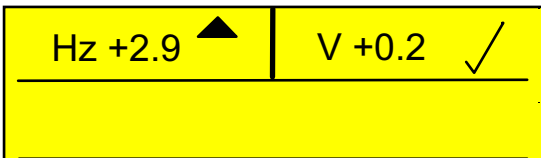
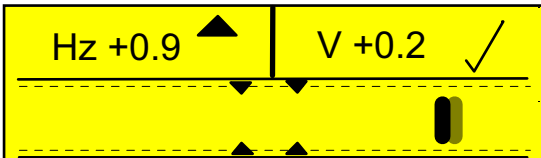
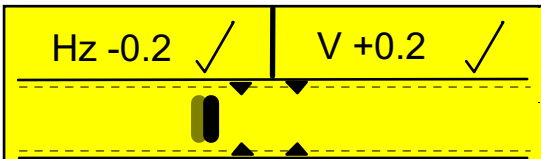
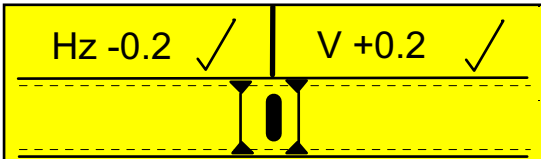
7.3.1 MAINS DECOUPLING TEST MODE

To aid the testing of the mains decoupling features in the controller, a special test mode is included. This is activated by placing the module into STOP mode and enabling the 'test mode' in the module's front panel 'running editor', described elsewhere in this document.

This allows a 'one shot' test of the mains decoupling protection, enabling the Test Engineer to inject the necessary test signals into the DSE control and timing the reaction from application of the signal to activation of a DSE output configured to 'combined mains decoupling'.

The actual testing of mains decoupling must be left to experienced engineers and is outside the scope of DSE support.

7.3.2 SYNCHROSCOPE OPERATION

	<p>Initial stage of Synchronising display will only show the difference between the Mains Supply and the Generator Output. Here the display is showing a frequency mismatch of +2.9Hz - The genset frequency is too high (indicated by the arrow) and should be reduced. The voltage is +0.2 volts high, but is within the limits set for synchronising.</p>
	<p>Once the difference between the Mains and the Generator frequency has been reduced, the 'Synchroscope' display will become active. The moving bar will roll from one side to the other showing the phase of the two supplies. The area in the centre of the scope indicates the set limits for synchronising to occur.</p>
	<p>Synchronising will only occur when both the Frequency and the voltage differences are within acceptable limits - Indicated by 'Tick' marks on the top of the display. Then the moving bar display will show the phase difference. The engine speed will be automatically adjusted, altering the phase, until the moving bar enters the centre of the scope.</p>
	<p>Once the Mains and generator supplies are synchronised, the module will initiate a breaker close signal to load the generator onto the Mains. Should synchronism be broken the moving bar will pass out of the synchronising window.</p>

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

7.4 COMPLETE INSTRUMENTATION LIST

7.4.1 BASIC INSTRUMENTATION

Bus volts (L1-N, L2-N, L3-N)

Bus volts (L1-L2, L2-L3, L3-L1)

Bus Hz

Bus kW

Bus kVAr



These values are calculated by reading the information from the modules via the MultiSet Communications (MSC) link

Bus phase sequence

Load Amps, pf

Load kW, kVA, kVAr

Mains Volts (L1-N, L2-N, L3-N)

Mains Volts (L1-L2, L2-L3, L3-L1)

Mains Hz

Mains Amps

Mains kW

Mains kVA

Mains pf

Mains kVAr

Mains kWh

Mains kVAh

Mains kVArh

Mains phase sequence









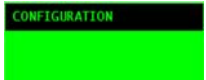
ROCOF / Vector shift

Synchroscope




7.5 THE FRONT PANEL CONFIGURATION EDITOR

This configuration mode allows the operator limited customising of the way the module operates.

7.5.1 ACCESSING THE FRONT PANEL CONFIGURATION EDITOR.

- Press the Stop/Reset  and Info  buttons simultaneously.
- If a module security PIN has been set, the PIN number request is then shown : 
- Press  (up) or  (down) to adjust it to the correct value.
- Press  (right) when the first digit is correctly entered. The digit you have just entered will now show '#' for security.
- Repeat this process for the other digits of the PIN number. You can press  (left) if you need to move back to adjust one of the previous digits.
- When  is pressed after editing the final PIN digit, the PIN is checked for validity. If the number is not correct, you must re-enter the PIN.
- If the PIN has been successfully entered (or the module PIN has not been enabled), the editor is displayed : 

EDITING A PARAMETER


- Enter the editor as described above.
- Press the left or right buttons to cycle to the section you wish to view/change.
- To edit the parameter, press  to enter edit mode. The parameter begins to flash to indicate that you are editing the value.
- Press the up or down buttons to change the parameter to the required value.
- Press  to save the value. The parameter ceases flashing to indicate that it has been saved.
- To exit the editor at any time, press the  button.


- ▲ NOTE:** When the editor is visible, it is automatically exited after 5 minutes of inactivity to ensure security.
- ▲ NOTE:** The PIN number is automatically reset when the editor is exited (manually or automatically) to ensure security.
- ▲ NOTE:** More comprehensive module configuration is possible using the 75xx series PC configuration software. Please contact us for further details
- ▲ NOTE:** The contents of the tables overleaf may differ depending on the actual module configuration.

7.5.2 LIST OF ADJUSTABLE PARAMETERS IN 'MAIN CONFIGURATION EDITOR'

Front Panel Configuration Editor (Factory default settings are shown in bold italicised text)


Section	Parameter as shown on	Values
Timers	Mains Transient Delay	0 -10s (2s)
	Start Delay	0– 60m (5s)
	Transfer Delay	0– 10s (0.7s)
	Return Delay	0– 60m (30sa0)
	Low battery Delay	0– 10m (1m)
	High battery Delay	0– 10m (1m)`
Mains	Mains Under voltage Alarm	50V–360V ph-N (184v)
	Mains Over voltage Alarm	50V–360V ph-N (276v)
	Mains Under Frequency	0Hz–75Hz (45Hz)
	Mains Over Frequency	0Hz–75Hz (55Hz)
System	Plant Battery Under Volt Alarm	0–40v (10v)
	Plant Battery Over Alarm	0–40v (30v)
Misc	Language	English, other
	Alternative Frequency	Enable Disable
	Alternative voltage	Enable Disable
	AC System	3 phase 4 wire Single phase 2 wire 3 phase 3 wire 2 phase 3 wire L1 & L2 3 phase 4 wire ED 2 phase 3 wire L1 & L3
	Contrast	<input type="checkbox"/> <input checked="" type="checkbox"/>
	Date and Time	dd mmm yyyy hh:mm
	Auto Scroll Time	0–10s (2s)
	Mains CT Primary Rating	5A– 6000A (600A)
	Mains CT Secondary Rating	1A, 5A (5A)
	Load Ramp Rate	0.1%–100% (2.0%) (% per sec)

 **NOTE:-** More comprehensive module configuration is possible using the 75xx series PC configuration software in conjunction with the P810 PC interface. Please contact us for further details.

 **NOTE:-** Languages are subject to change as the modules are updated. Please contact us for the list of latest supported languages.



7.6 RUNNING EDITOR



7.6.1 ACCESSING THE 'RUNNING' CONFIGURATION EDITOR


- The 'running' editor can be entered while the engine is running. All protections remain active if the engine is running while the running editor is entered.
- Press and hold the  button to enter the running editor.


EDITING A PARAMETER

- Enter the editor as described above.

- Press the left  or right  buttons to cycle to the section you wish to view/change.



- Press the up  or down  buttons to change the parameter to the required value.

- To save parameters scroll to 'save changes and exit' followed by the down  button

- To cancel changes scroll to 'Abandon changes and exit' followed by the down  button

ADJUSTABLE PARAMETERS (Running editor)

Running Editor

Section	Parameter as shown on display	Factory Settings
DISPLAY	Contrast	 
	Language	English
	Load power factor	%
	Load parallel power	%
	Enable commissioning screens	No
	Voltage adjust (manual mode only engine running generator breaker open)	Raise Steady Lower
	Frequency adjust (manual mode only engine running generator breaker open)	Raise Steady Lower
	Enable mains decoupling	No
	Abandon changes and exit	
	Save changes and exit	

8 COMMISSIONING

8.1 COMMISSIONING SCREENS

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

8.1.1 SCREEN 1

L-N	0V	kW	0	Average L-N Voltage and total kW
Sets load	0A	KVAr	0	Load on the set(s) and total kVAr
Ramp	0.0%	kW	0.0%	Ramp level and % of full load kW
		kVAr	0.0%	% of full load kVAr

8.1.2 SCREEN 2

B kW	0.0%	kVAr	0.0%	Bus load levels (kW / kVAr)
B Tgt	0.0%	kW	0.0%	Target and actual % of full load buskW
B Tgt	0.0%	kVAr	5.0%	Target and actual % of full load generator kVAr
Sets load	0			Load on the set(s)

8.1.3 SCREEN 3


M Tgt	0%	kW	0%	Target and actual % of full load mains kW
M Tgt	0%	kVAr	0%	Target and actual % of full load mains kVAr
Pf	0.00	Sets load	0	Mains power factor Load on the set(s)
L-N	0V	Amps	0A	Mains average voltage and maximum amps



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

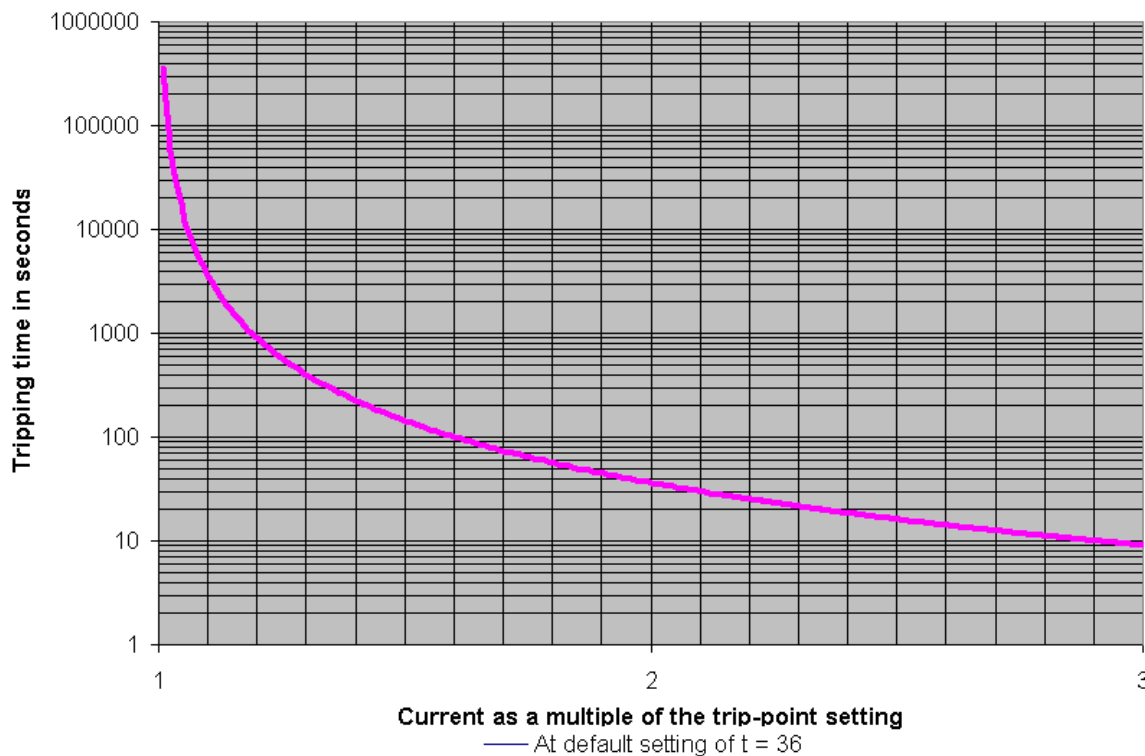
9 FAULT FINDING

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 when the module is operating. Run the system through a complete test and check the voltage remains within these limits consistently. Check the operating temperature is not above 70°C. Check the DC fuse.
Warning fault operates	Check relevant switch and wiring of fault indicated on LCD display. Check configuration of input.
Continuous starting of generators when in AUTO	Check that there is no signal present on the "Remote Start" input. Check configured polarity is correct. Check that the mains supply is within limits and load level on the mains is not above the configured level for mains "import/export".

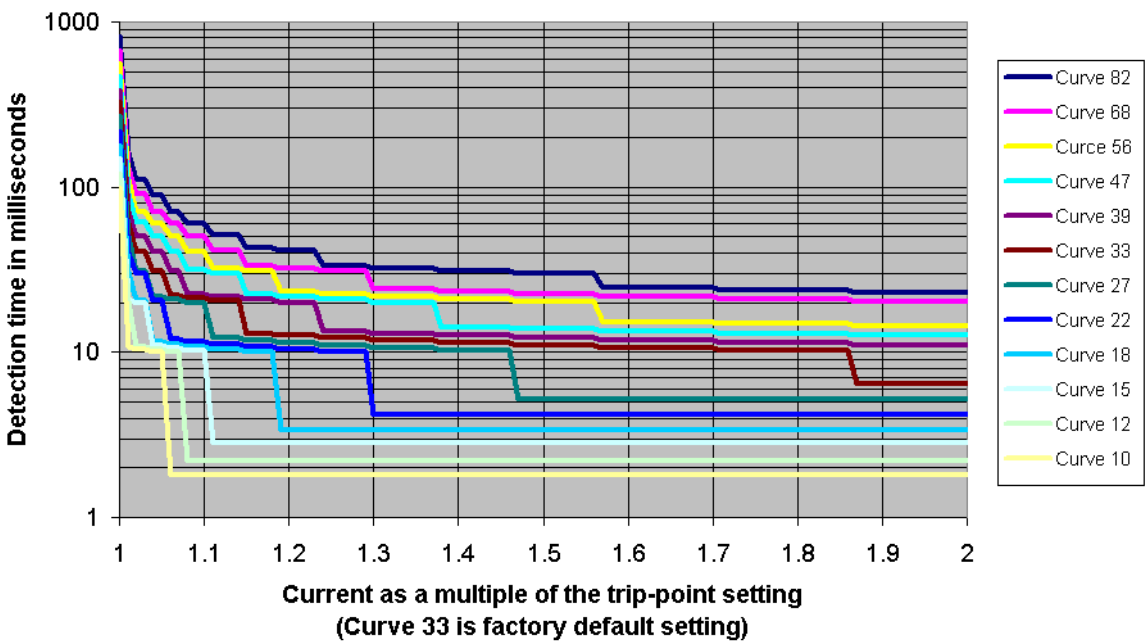
 **NOTE:** - The above fault finding is provided as a guide check-list only. As it is possible for the module to be configured to provide a wide range of different features always, refer to the source of your module configuration if in doubt.

10 APPENDIX

10.1 7520MK1 IDMT TRIPPING CURVES (TYPICAL)



10.2 7520MK1 SHORT CIRCUIT TRIPPING CURVES (TYPICAL)



10.3 ACCESSORIES

10.3.1 OUTPUT EXPANSION

There are several methods of output expansion available for the 75xxMK1 range of modules: -

RELAY OUTPUT EXPANSION (157)

An expansion module is available, which connects to the configuration socket, and enables the 75xxMK1 to use eight additional relays, providing Volt-free contacts for customer connection. A maximum of two of these units can be used give 16 independent volt-free contacts.

The 157's need to be identified as module 'A' and module 'B'

Refer to technical data sheet on the 157 relay module for further details.

LED OUTPUT EXPANSION (548)

An expansion module is available, which connects to the configuration socket, and enables the 75xxMK1 to use the eight additional LED's on the 548 module, providing remote LED's indication. A maximum of two of these units can be used give 16 independent remote LED's.

The 548's need to be identified as module 'A' and module 'B'

Refer to technical data sheet on the 548 LED modules for further details.

It is possible to use a mix of 157 and 548 modules to give both relay and LED expansion if required.

10.3.2 INPUT EXPANSION (P130/P540/P541)

It is possible to increase the number of monitored inputs available by utilising either:

- DSE P130 input expansion.
- 540 / 541 Protection Expansion/Annunciator.

Please refer to the relevant product documentation for further details.

10.4 COMMUNICATIONS OPTION

10.4.1 DESCRIPTION

The 75xx series configuration software allows the 7520MK1 controller to communicate with a PC. The computer can be connected to the module either directly, via a modem (RS232) or via an RS485 link.

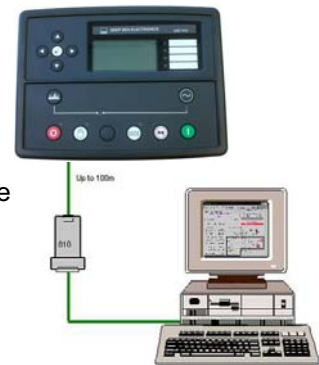
The operator is then able to remotely control the module, starting or stopping the generator, selecting operating modes, etc. The various operating parameters (such as output volts, oil pressure, etc.) on the remote generator can also be viewed.

The information contained in this manual should be read in conjunction with the appropriate module documentation. This manual only details the operation of the communications software and how it should be used. The operation of the module is detailed in its own relevant manual.

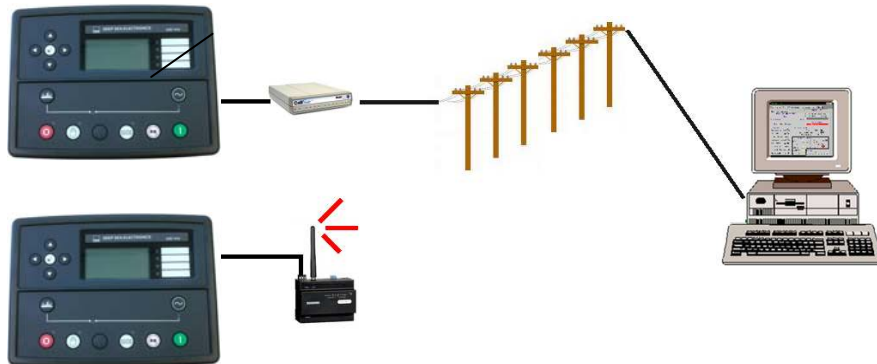
10.4.2 CONTROLLER TO PC (DIRECT) CONNECTION

To connect a 7520MK1 to a modem the following items are required: -

- Any 7520MK1 Module
- 75xx series configuration software (Supplied on DSE software CD).
- P810 interface (USB or RS232 as required)



10.4.3 CONTROLLER TO MODEM CONNECTION



To connect a 7520MK1 to a modem the following items are required: -

- 7520MK1 Module with RS232 Communications Interface enabled
- Compatible RS232 Modem (PSTN or GSM)
- Suitable connection leads
- Power supply for the modem
- 5xxx series configuration software (Supplied on DSE software CD).
- Access to a PSTN Line or GSM network.

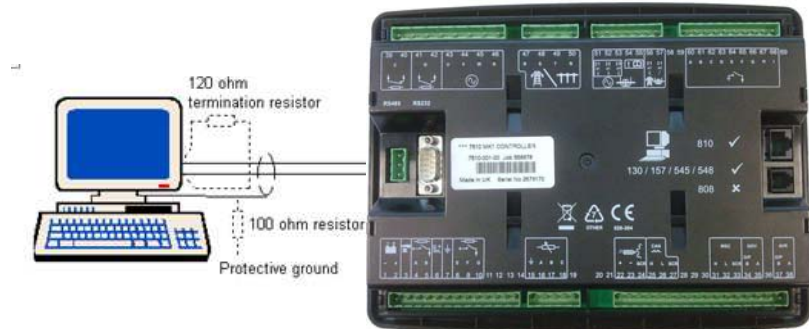
CAUTION! - The modem must be powered from a suitably stabilised supply, preferably supplied with the modem. Failure to ensure continuity of supply will result in communication difficulties at such times as Mains failure or during cranking. An uninterruptible power supply arrangement is recommended (AC or DC depending on modem power requirement).

10.4.4 RS485 LINK TO CONTROLLER

The RS485 enabled 7520MK1 modules are able to communicate with a PC or other RS485 enabled device over a standard RS485 connection. Typical uses of RS485 are:

- Direct connection to a remote PC running the Link5000 software. RS485 is capable of communication over a distance of 1.2km where suitable 120Ω RS485 cable is installed.
- Connection to a building management to allow mains, generator and engine parameters/alarm conditions to be displayed along with information from other devices (air conditioning, fire alarm system etc).

Typical connections of RS485 PC system (master) to RS485 DSE controller (slave)

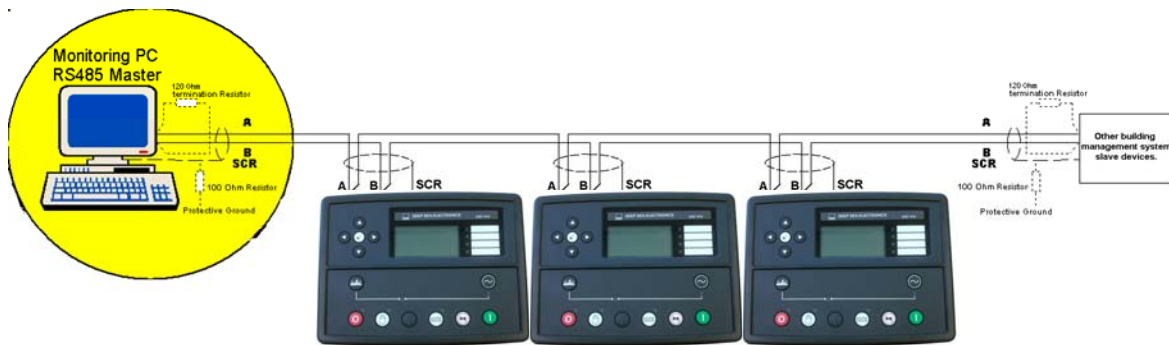


NOTE: - The RS485 system will comprise of one MODBUS master (typically a PC) and up to 31 MODBUS slaves. The 7510MK1 modules are always MODBUS slave devices. To ensure correct operation a suitable 120Ω terminal resistor must be fitted to each end of the RS485 connection bus.

Caution! - The A and B lines of the 485 network should be terminated at each end with a 120Ω resistor.

Some RS485 devices (PC cards in particular) are already fitted with a terminating resistor. However if they are not installed as an 'end of line' device then such terminating resistors must be removed. Other RS485 devices may be fitted with a 'switchable' resistor, again this must be switched out if the device is not installed as an 'end of line' device.

TYPICAL BUILDING MANAGEMENT SCHEME USING RS485 MONITORING



! CAUTION! -. RS485 cabling must be 120Ω impedance cable, specified for use with RS485. 120Ω terminating resistors must be fitted to the first and last devices on the bus. Some PC RS485 cards are already fitted with this resistor, and in this case should not be fitted externally. If in doubt, consult the supplier of your PC RS485 card. If the 7520MK1 controller is the 'last' device on the bus, then it's RS485 connection must be suitably terminated with a 120Ω resistor as detailed in the specification laid out in the RS485 standard.

Recommended cable BELDEN 9841 120Ω RS485 cable.
DSE part number 016-030.

NOTE: - The RS485 output uses 'MODBUS' protocol. It is possible to use third party software to monitor and control the 7520MK1 module via this protocol. Please refer to Deep Sea Electronics Plc for details.

10.4.5 MODBUS

The RS485 output uses Modbus communications protocol. This uses a master-slave technique to communicate. Only the Master can initiate a packet transaction, called a 'query'. When appropriate the slave (7520MK1 Module) responds to the query and provides the information requested by the master.

All supported data can be read and written as specified in the register table (documentation is available from Deep Sea Electronics Plc.).

When the 7520MK1 Module receives a query it will respond by either supplying the requested register data or performing the requested action. A slave device (the 7520MK1 module) will never initiate communications on the Modbus™ link. The 7520MK1 can only be configured as a slave device. The Master can only query individual slaves. Refer to the Modbus™ protocol document for more details.

Refer to the Link7000plus Manual for further details on communications expansion.


10.5 ENCLOSURE CLASSIFICATIONS

IP CLASSIFICATIONS

BS EN 60529 Degrees of protection provided by enclosures

First Digit	Second digit
Protection against contact and ingress of solid objects	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 interfere 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).

NEMA CLASSIFICATIONS

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

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

10.6 IEEE C37.2 STANDARD ELECTRICAL POWER SYSTEM DEVICE FUNCTION NUMBERS

The DSE 7520MK1 contains many protection devices and functions, which are listed in detail in the following sections.

Functions and protections provided corresponding to IEEE C37.2 (1996) system device numbers are listed below.

Overall the 7520MK1 is designated as *11 - Multifunction device* and includes the following protections and functions:

Device	Description
2 time delay starting or closing relay	A device that functions to give a desired amount of time delay before or after any point of operation in a switching sequence or protective relay system, except as specifically provided by device functions 48, 62, 79, and 82.
3 checking or interlocking relay	A device that operates in response to the position of one or more other devices or predetermined conditions in a piece of equipment or circuit, to allow an operating sequence to proceed, or to stop, or to provide a check of the position of these devices or conditions for any purpose.
5 stopping device	A control device used primarily to shut down equipment and hold it out of operation. (This device may be manually or electrically actuated, but it excludes the function of electrical lockout [see device function 86] on abnormal conditions.)
12 overspeed device	A device, usually direct connected, that operates on machine overspeed.
14 underspeed device	A device that functions when the speed of a machine falls below a predetermined value.
15 speed or frequency matching device	A device that functions to match and hold the speed or frequency of a machine or a system equal to, or approximately equal to, that of another machine, source, or system.
18 accelerating or decelerating device	A device that is used to close or cause the closing of circuits that are used to increase or decrease the speed of a machine.
25 synchronizing or synchronism-check relay	A synchronizing device produces an output that causes closure at zero-phase angle difference between two circuits. It may or may not include voltage and speed control. A synchronism-check relay permits the paralleling of two circuits that are within prescribed limits of voltage magnitude, phase angle, and frequency.
27 undervoltage relay	A device that operates when its input voltage is less than a predetermined value.
30 annunciator relay	A non-automatically reset device that gives a number of separate visual indications upon the functioning of protective devices and that may also be arranged to perform a lockout function.
31 separate excitation device	A device that connects a circuit, such as the shunt field of a synchronous converter, to a source of separate excitation during the starting sequence.
32 directional power relay	A device that operates on a predetermined value of power flow in a given direction such as reverse power flow resulting from the motoring of a generator upon loss of its prime mover.
46 reverse-phase or phase-balance current relay	A device in a polyphase circuit that operates when the polyphase currents are of reverse-phase sequence or when the polyphase currents are unbalanced or when the negative phase-sequence current exceeds a preset value.
48 incomplete sequence relay	A device that generally returns the equipment to the normal or off position and locks it out if the normal starting, operating, or stopping sequence is not properly completed within a predetermined time.
50 instantaneous overcurrent relay	A device that operates with no intentional time delay when the current exceeds a preset value.
51 ac time overcurrent relay	A device that functions when the ac input current exceeds a predetermined value, and in which the input current and operating time are inversely related through a substantial portion of the performance range.

Device	Description
52 ac circuit breaker	A device that is used to close and interrupt an ac power circuit under normal conditions or to interrupt this circuit under fault or emergency conditions.
54 turning gear engaging device	A device electrically operated, controlled, or monitored that functions to cause the turning gear to engage (or disengage) the machine shaft.
55 power factor relay	A device that operates when the power factor in an ac circuit rises above or falls below a predetermined value.
59 overvoltage relay	A device that operates when its input voltage exceeds a predetermined value.
62 time-delay stopping or opening relay	A device that imposes a time delay in conjunction with the device that initiates the shutdown, stopping, or opening operation in an automatic sequence or protective relay system.
63 pressure switch	A device that operates at a given pressure value or at a given rate of change of pressure.
69 permissive control device	A device with two-positions that in one position permits the closing of a circuit breaker, or the placing of a piece of equipment into operation, and in the other position, prevents the circuit breaker or the equipment from being operated.
71 level switch	A device that operates at a given level value, or on a given rate of change of level.
74 alarm relay	A device other than an annunciator, as covered under device function 30, that is used to operate, or that operates in connection with, a visual or audible alarm.
78 phase-angle measuring relay	A device that functions at a predetermined phase angle between two voltages, between two currents, or between voltage and current.
81 frequency relay	A device that responds to the frequency of an electrical quantity, operating when the frequency or rate of change of frequency exceeds or is less than a predetermined value.
83 automatic selective control or transfer relay	A device that operates to select automatically between certain sources or conditions in equipment or that performs a transfer operation automatically.
86 lockout relay	A device that trips and maintains the associated equipment or devices inoperative until it is reset by an operator, either locally or remotely.
90 regulating device	A device that functions to regulate a quantity or quantities, such as voltage, current, power, speed, frequency, temperature, and load, at a certain value or between certain (generally close) limits for machines, tie lines, or other apparatus.